No.

Ex-Post Evaluation Report of Japanese ODA Loan Projects 2009 (China IV)

September 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

IC NET LIMITED

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Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2007. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

September 2010
Atsuro KURODA
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations, the English translation of the original Japanese version, shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

Ex-Post Evaluation of

Japanese ODA Loan Project 2009

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Ex-Post Evaluation of Japanese ODA Loan Project

Heilongjiang Songhuajiang River Basin Environmental Improvement Project

External evaluator: Kenji Momota, IC Net Limited

1. Project Description

Project Site

Mudanjiang Sewage Treatment Plant

1.1 Background

Since having adopted the reform and open-door policy in 1978, China has maintained steady economic growth. Meanwhile, however, a rapid progress in industrialization has brought about water pollution in rivers due to increased sewage and wastewater as well as air pollution due to the use of coal. Thus, it had been urgent to cope with these environmental problems.

At the time of appraisal (1998), there were many state-owned large-scale enterprises represented by petrochemical industries in the basin of Songhuajiang River (about 2,308 km in total) flowing from Jilin Province to Heilongjiang Province, and their businesses were thriving. While sewage and wastewater were on the rapid increase with their business expansion, plant equipment to treat them was remained unready, and water pollution became more and more serious. Against such background, reducing pollution sources and construction of sewage systems have become urgent issues in Heilongjiang Province.

1.2 Project Outline

The objective of this project is to improve water and air quality in the basin of Songhuajiang River, Heilongjiang Province, which suffers serious water and air pollution with rapid economic growth, by implementing environmental improvement projects, thereby contributing to the improvement of health and living environment of the local residents.

Approved amount/ Disbursed amount	10,541 million yen / 10,533 million yen

Exchange of Notes Date/ Loan Agreement Signing Date	December, 1998 / December, 1998
Terms and Conditions	Interest Rate: 0.75% Repayment period: 40 years (grace period: 10 years) Conditions for procurement: partially untied
Borrower/ Executing agencies	Guarantors: Government of People's Republic of China/ Government of Heilongjiang People's Government
Final Disbursement Date	July, 2006
Main Contractor	None
Main Consultant	None
Feasibility studies, etc. (if any)	F/S (China Municipal Government Engineering North-East Designing Research Institute), SAPROF (Kyowa Consultants/Technoconsultants)
Related projects (if any)	None

This project consists of group of subprojects, characterized by their objectives as follows:

1) Urban sewage treatment projects to control noncommercial wastewater;
2) Wastewater treatment projects to control large amounts of wastewater from factories;
3) Heat supply subprojects to control air pollution; and
4) Subprojects to cultivate the environmental monitoring ability of the Environmental Protection Department, Heilongjiang.

A report is made on the basis of this classification. The following is a list of the subprojects planned and the responsible parties concerned:

Type	Subproject	Implementing Agency
Type 1: Sewage Treatment Projects		
1-1	Sewage Treatment Project in Mudanjiang City	Mudanjiang Sewage Treatment Plant
1-2	Sewage Treatment Project in Yanshou County	Yanshou Sewage Treatment Plant
1-3	Sewage Treatment Project in Daqing City	Daqing Dongcheng Sewage Treatment Plant
Type 2: Factory Wastewater Treatment Projects		
2-1	Wastewater Treatment Project of Heilongjiang paper factory	Chenming Paper Manufacturing Co., Ltd.
2-2	Water Pollution Control Project by Tonghe Paper Factory	Heilongjiang Tonghe Paper Manufacturing Co., Ltd.

2-3	Wastewater Treatment Project for Harbin Pharmaceutical Factory	Harbin Pharmaceutical Factory
2-4	Wastewater Treatment Project of Daqing Petrochemical Complex	Daqing Petrochemical
2-5	Wastewater Treatment Project for Linyuan Oil Refining Factory	Linyuan Petrochemical
2-6	Wastewater Treatment Project for Xinsanxing Brewery Factory	Xinsanxing Brewery
Type 3: Anti-Air Pollution Projects		
3-1	Heat Supply and effective coal utilization project in Jidong Country	Jidong Thermal Power Station
3-2	Heat Supply Project in Yichun City	Yichung Thermal Power Station
3-3	Heat Supply Project in Mishan City	Mishan Thermal Power Station
Type 4: Monitoring Capacity Enhancement Project		
4-1	Heilongjiang Environmental Monitoring Network Project	Environmental Monitoring Station, Heilongjiang

The objective each of the subprojects is to improve water quality of sewage and wastewater released into Songhuajiang River and its tributary streams. The following map shows where the main streams are located in Heilongjiang, where water samples were collected (Liuyuan and Kulipao), and how far they are located from the project sites:

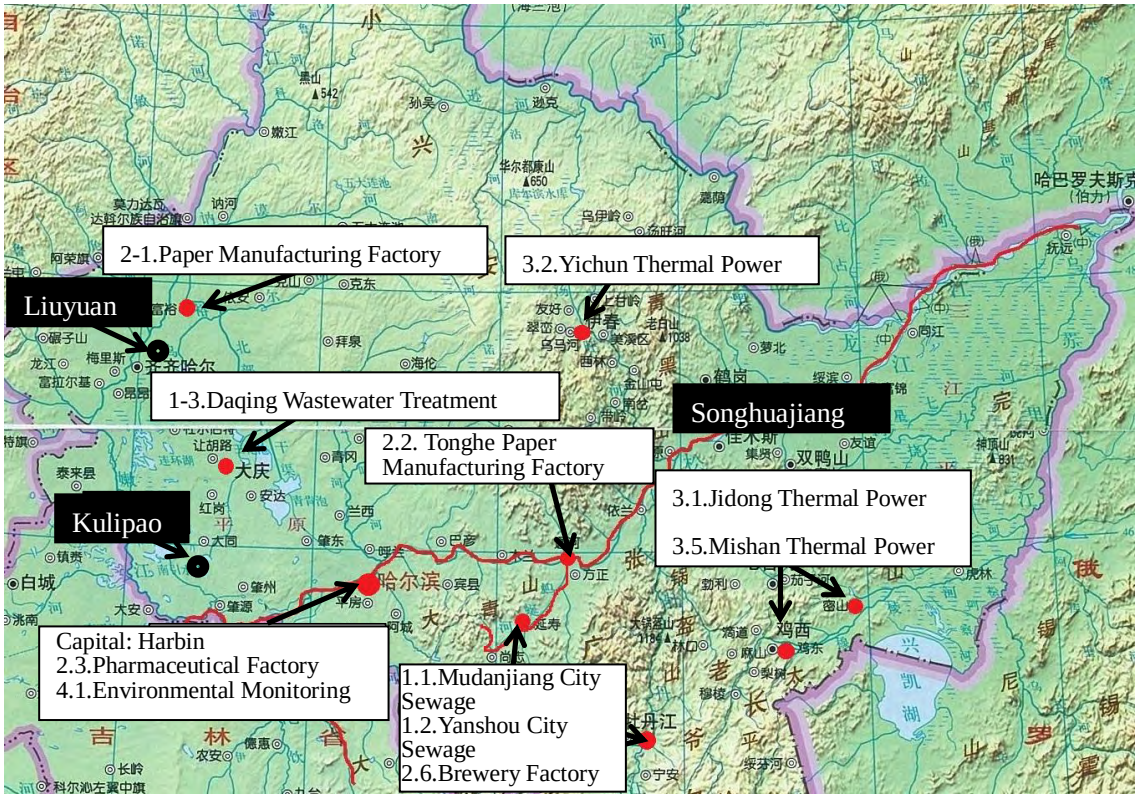


Figure 1 Project Distribution Map[1]

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

Duration of the Study: October, 2009 – October, 2010

Duration of the Field study: January 23 – 31, 2010 and April 4 – 30, 2010

2.3 Constraints during the Evaluation Study

The objectives of the subprojects were to improve the water quality of Songhuajiang River and its tributary streams. For the ex-post-evaluation, therefore, we tried to collect water quality data at the places where wastewater was released. However, detailed data (Monitoring data at city and municipal level) necessary to verify the direct effect of the subprojects was kept confidential by the decision of the Provincial Government.

For an analysis of the project effectiveness, therefore, data on the water quality collected at national

[1] The two subprojects, 2-4. Wastewater Treatment Project of Daqing Petrochemical Complex and 2.5. Wastewater Treatment Project for Linyuan Oil Refining Factory, were cancelled before the plan was carried out. Therefore, nothing is written on them in this report.

level[2] were used as an alternative. Since some of those monitoring spots are distant from the subproject sites, those data cannot clearly verify the effectiveness of the subproject. In addition, since the rivers and streams are so long and large, there are various factors which could give either positive and negative influences on the water quality (for instance, environmental improvement projects by governments as a favorable factor, and construction of new factories as a source of water pollution as an unfavorable factor). All in all, it was difficult to exactly grasp these factors. In this evaluation, therefore, we adopted the data that presumably have certain relevance with the project. Thus, the evaluation of the project effectiveness is based on certain assumptions. Concerning a few subprojects not currently in operation, available data were very limited.

3. Results of Evaluation (Overall Rating: B)

3.1 Relevance (Rating: a)

3.1.1 Relevance with the Development Plan of China

(1) Development Policy of China at the Time of Appraisal

Taking countermeasures against environmental problems arising in line with economic growth had been important theme in China. The most important tasks adopted in the 9th 5-year plan (1996-2000) were to control sources of water and air pollution and to improve urban environments. At that time, the reform of state-owned enterprises had been in progress, and projects to improve the environment needed to be carried out under better business management. Listed as important areas for water pollution control were three streams and three lakes as well as seven large rivers including Songhuajiang in this project. Measures planned for air pollution control were implementation of countermeasures in energy industries and other designated industries, closure of outdated factories and renewal of production processes.

Following this central government policy, Heilongjiang Government established the 9-5 environment protection plan (1996-2000) and a long-term plan beginning in 2010. The 9-5 plan targeted to reduce the total amount of pollutants to the level of 720,000 tons/year or less of COD[3], 530,000 tons/year or less of dust and 310,000 tons/year or less of sulfur dioxide. This project was carried out as part of the 9-5 plan, and the project was highly prioritized in Heilongjiang Province's environmental policy.

(2) Development Policy of China after Ex-Post-Evaluation

In the 11th 5-year plan of the central government (2006-2010), nine goals are listed up. Among them, environment-related goals are, "Strengthen sustainable growth" and "Improve people's living standard". As monitoring indicators for these goals, the plan addressed 10 percent reduction of

[2] Important spots in the main streams and basins in whole China opened to public by Data Center, Environmental Protection Department, People's Republic of China. Their locations are shown by the ● mark in Fig. 1.

[3] COD = Chemical Oxygen Demand
COD is a value to represent the degree of water pollution. It indicates the amount of oxygen consumed when organisms in water are oxidized with oxidants.

primary pollutants and improvement in the living environments of the local residents. With respect to water pollution, it addressed 10% reduction of COD and other primary pollutants from the level of 2005.

In Heilongjiang Province, goals set in "Songhuajiang River Basin Water Pollution Prevention Plan (2006-2010)" designed by Heilongjiang Government include "save energy," "reduce exhaustion of pollutants," "help ecological industries grow" and "protect ecosystem." Total investment in the environmental field during this period amounts to 21.224 billion yuan (about 300 billion yen).

This project, as one of a series of water and air pollution control projects in Songhuajiang river basin that is still under way, is very important.

3.1.2 Relevance with the Development Needs of China

3.1.2.1 Needs for Improvement of Water Quality in Songhuajiang

Water pollution in Songhuajiang was very serious at the time of appraisal. Out of six main monitoring spots, 62 percent were classified as National Ground Water Quality Standard Class IV and V, which are unfit to drink as the source of water supply. In the basins of Songhuajiang River in Heilongjiang in particular, more than 60 percent of the monitoring spots exceeded National Ground Water Quality Standard IV, that is unfit to drink, with 30 percent of them aggravated to Standard V. Such water pollution was attributable to an increase in industrial waste water and everyday sewage resultant from rapid industrialization and economic growth. Under these circumstances, quick measures were required to keep the source of water supply free from pollution.

3.1.2.2 Relevance of Project Objective and Selection of Subprojects

As discussed above, the project was of strong needs at both policy and project levels. Meanwhile, there were rooms for improvement in terms of: (1) relevance in the definition of project objectives, and (2) relevance in the selection of sub-projects.

(1) Relevance of project objectives definition

There was as a considerable divergence between the scale of the project and its stated objective "to improve water quality of Songhua Rivers, thereby contributing to improved standard of living of the local residents." A more focused project objectives definition would have been necessary.

The project can be understood as a structured "program" consisting of a number of subprojects. Accordingly, relevance of such a project should be evaluated by the criteria of "whether or not the overall objective of the project has been achieved." Documents in the early stages of the project state that the outcome of this project was "water quality improvement of Songhua River" and through its attainment the project sought to "improve the health and living environment of the local residents." If interpreted strictly, this wording means that the objective is "water quality improvement of Songhua River throughout its entire mainstream." This interpretation is

unrealistic, given the size of Songhua River (total length: 2,308km) and the scale of the project under evaluation. For the purpose of this ex-post evaluation, therefore, the true project objective that was intended at the time of project planning was “the improvement of water quality of water systems and rivers downstream of the sub-project locations out of the entire water systems of Songhua River”, and the project outcomes and project impact should consist of the following:

1. Direct effects measurable by the operation and effect indicators of sub-projects
2. Change in the water quality of nearby rivers and water systems to which the wastewater of the sub-project is discharged.

The above two points will be considered as project outcomes and the improvement of living and health environment of the local residents will be considered as the project impact.

Nevertheless, there is still a divergence in the project objectives definition even after the above mentioned restatement and re-definition. Even one of the many tributaries of Songhua River downstream of a sub-project location alone has a length of hundreds of kilometers. It is simply too vast an area to pass reasonable judgment on any effect of the project on the water quality. Little is mentioned in the appraisal documents with respect to specific locations for which the water quality improvement would be intended or the degree of improvement to be pursued.

During the setup of project objectives, greater attention should have been paid to the scale of the project and the numerous factors that have bearing on the water quality. More thought should have been given to define the objective more clearly by, for example, setting direct effects of sub-projects as objectives or designating a focused number of monitoring sections at which more direct effects are likely to emerge, and positioning water quality improvement of the rivers and water systems as an overarching project objective.

(2)Validity of Selection of Subprojects

In this project, a change affecting its achievement arose, as there was cancellation or shutdown of operation after completion in four subprojects. The details on them and the reasons are as follows:

• 1-2: Sewage Treatment Project in YanShou County

This subproject was completed in 2003, but it remained idle until 2006. Now in 2010, the operation is at a standstill again for reconstruction (see 3.3 Effectiveness on detail). The reason may be unsuitability of the technology in cold areas and financial problems.

• 2-2: Wastewater Treatment Project in Tonghe Paper Manufacturing Factory

This subproject was completed in 2003, but the operation was started in 2006. Due to decline in the paper industry business, however, the operation stopped in about two years, and is still at a

standstill now in 2010.

- 2-4: Wastewater Treatment Project in Daqing Petrochemical Plant
- 2-5: Wastewater Treatment Project in Linyuan Oil Refining Plant

These two subprojects were cancelled as Japanese ODA undertakings due to their initial postponement and reduction in scope, which followed a review of production quantity and production items in line with realignment of the industry. As a result, they were executed by domestic fund of the central government.

The main reasons for the unforeseen accidents in these four subprojects are ascribable to changes in economic and market conditions at that time. In China at that time, abrupt changes happened, as represented by privatization of state-owned enterprises. Under such unstable circumstances, however, it is questionable whether or not there was still a necessity for starting subprojects that have uncertain future prospect and are susceptible to market conditions. Before they were taken up as subprojects, more prudent verification should have been made in terms of the future sustainability as a stable business. With regard to 1-2. Sewage Treatment Project in YanShou County, no treatment sufficiently effective to satisfy the national standard could be made. The reason was that a technology of which treatment effect is not so good in cold areas, was adopted.

Although the lessons from above two points should be considered for future ODA projects of similar nature, they are not reflected in the rating of this evaluation because of the following reasons:

- When this project was planned (around 1998), there were no stringent institutional requirements to conduct ex-ante evaluation or to set out relevance indicators and target values.
- A project like this one which consists of a number of sub-projects could be interpreted as a sort of “sector loan.” In-depth appraisal of individual sub-projects was practically impossible.

3.1.3 Relevance with Japan’s ODA Policy

Air pollution abatement and other pollution control as well as natural environment conservation were priority sectors in the Japanese government’s “Country Assistance Policy --- China” that served as the guidelines for Japan’s cooperation programs for China at the time of appraisal of this project. Based on this policy, the environmental sector was positioned as one of the four priority sectors for assistance, and it was decided to promote assistance projects relating to energy efficiency, solid waste recycling, air pollution control such as soot treatment and desulfurization of exhaust and vent gases as well as sewage improvement and other water pollution control. The project under evaluation is thus highly relevant to Japan’s ODA policy.

As a whole, this project has been highly relevant with the country’s development plan, development needs, as well as Japan’s ODA policy, therefore, its relevance is high.

3.2 Efficiency (Rating: b)

3.2.1 Project Output

A number of subprojects are comprised in this project. In general, project outputs were mostly completed as planned, except for the cancelled two subprojects. With respect to Type 1: Urban Sewage Treatment Project and Type 3: Anti-Air Pollution Measure Project, many of the subprojects are expanding/upgrading the equipment to cope with the growing demand of wastewater treatment and heat supply, caused by the growth in the target cities. (See Attachment 1 on the details of the project outputs.)

Fig. 2 1-3. Daqing Wastewater Treatment Plant

Fig. 3 2-3. Harbin Pharmaceutical Factory

3.2.2 Project Inputs

3.2.2.1 Project Period

In consideration of the fact that a number of subprojects are comprised in this project[4], a period (months) required from commencement to completion for each subproject was added up in both of the plan and the achievement for comparative purposes. A ratio in each subproject was expressed as a score of sub-rating, and the entire average score was evaluated as the entire rating. (See Attachment 2 on the details.) Based on this calculation, the average rating point is 1.57 (projects' period is or higher than 50% and less than 80%) or slightly longer than planned.

The main reason for delays in some subprojects was due to procrastinated governmental procedures for approval and for procurement of local currency portion. About 2 subprojects (2-1 and 2-2) which are currently non-operational, we were not able to receive related information from the executing agencies, therefore performance of those subprojects are not reflected in the rating.

[4] In this project consisting of many subprojects, if the period from start to completion is taken as the standard for rating, a long delay in one single project affects the entire rating, possibly resulting in a rating far removed from reality.

3.2.2.2 Project Cost

The actual total project cost of 20,296 million yen (10,533 million yen as ODA loan) was slightly higher (103 percent) than the planned amount of 19,725 million yen (10,541 million yen as ODA loan). There were some subprojects in which the actual cost exceeded the planned cost. From among them, the excess was particularly large (165 percent higher than planned) in 2-1 (paper manufacturing factory) because reaction ponds and precipitation ponds had to be enlarged for a sudden growing demand of wastewater treatment at detailed design stage.

Both the project period and the project cost slightly exceeded the planned period and cost. Therefore, efficiency of the project is fair.

3.3 Effectiveness (Rating: b)

3.3.1 Quantitative Effects

As already described in "3.1 Relevance," an analysis on the effectiveness of this project was made in the following steps:

(1) Analysis of the operation and effect indicators in each of the subprojects;
(2) Analysis of changes in the rivers and streams neighboring the sites in each of the subprojects in the sewage treatment program (Type 1-2); and
(3) Analysis of air pollution conditions in the target cities and county in the anti-air pollution measure program (Type 3).

3.3.1.1 Results from Operation and Effect Indicators

(1) Planned and Actual Effect of the Entire Project

1) Type 1: Urban Sewage Treatment Subprojects/Type 2: Factory Wastewater Treatment Projects

The indicators used in analyzing working conditions of the sewage treatment project (Type 1-2) are the amount of treated wastewater and a population covered as operating indicators, and the reduction of pollutants and the rate of reduction as effectiveness indicators. Indicators collected in this study were, BOD[5], COD and SS[6] that are commonly used for analysis of water pollution. The following table shows a comparison of the sum of reduction of these three pollutants between the original plan and actual performance.

[5] BOD = Biochemical Oxygen Demand
BOD is used as an indicator of water pollution. It is one of the key pollutants of wastewater from factories that is restricted by regulations. It is expressed as the amount of oxygen consumed when microorganisms decompose organisms in water. The larger this value, the heavier the pollution.

[6] SS = Suspended solids
SS is insoluble particle-like substances that are suspended in water. They occur as fine particles deriving from clay minerals, animal and plant planktons and carcasses thereof, and precipitates of organisms and metals deriving from sewage and wastewater.

Table 1 Comparison of Original / Actual of primary indicators in Types 1 & 2

	Plan	Achievement	Achievement rate
Population (10,000 people)	77	76	99%
Amount treated (10,000 tons/day)	32	25	79%
COD (tons/year)	74,530	29,404	39%
BOD (tons/year)	23,760	8,834	37%
SS (tons/year)	21,339	17,971	84%

Note 1: Population can be applied to Type 1 only.

Note 2: 2-3. Pharmaceutical Factories were excluded, as no information was available on the amount of treatment and the amount of COD reduction.

The reduction of COD and BOD was less than 40 percent compared to the original plan. The reason of low achievement was mostly because operation was at a standstill in 1-2. Sewage Treatment Project in YanShou County and 2.2. Wastewater Treatment Project in Tonghe Paper Manufacturing Factory at this stage. Meanwhile, however, in the subprojects of Type 2, the cleaner production brought about good results of reducing the amount of wastewater and the quantity of pollutants released from the factories. Therefore, an exact evaluation cannot be made simply based on the comparison between the plan and the achievement. In fact, the rate of removed pollutants reached 80-90 percent in the subprojects under operation, and thus operation conditions are evaluated highly.

2) Type 3: Anti-Air Pollution Project

The indicators used in analyzing operational status of the subproject in this category (Type 3) are heat supply area and availability factor as operation indicators, and the amount and rate of elimination of pollutants as effectiveness indicators. Indicators collected in this evaluationn were SO_2[7] and TSP[8] that are commonly used for analysis of air pollution. The following table shows a comparison of the sum of reduction of these pollutants between the original plan and the actual achievements:

Table 2 Comparison of Original / Actual of primary indicators in Type 3

Indicators	Plan	Achievement	Achievement rate
Heat supply area (10,000 m^2)	325	442	136%
SO_2 (tons/year)	1,501	1,393	93%
Dusts (tons/year)	6,425	4,335	67%

[7] SO_2 = Sulfur dioxide
SO_2 is one of the main air pollutants that is generated by combustion of fuels such as coal and heavy oil containing sulfur. It causes acid rain.

[8] The word "total suspended particles" is a generic name of all particle-like substances.

Heat supply area was remarkably expanded, and SO_2 was reduced almost as planned. Therefore, this project can be evaluated highly. In each subproject, the demand for heat supply has shown remarkable growth with the city development, and they are expanding the facilities to catch up with the growing demand.

Based on the above results, the overall effectiveness of the project is high, due to the good performance of the operating subprojects. However, performance of subprojects is random, due to the existence of the standstill subprojects. Therefore, the operational status of subprojects as a whole can be evaluated "fair".

(2) Operation Conditions of Subprojects (See Attachment 3 for details)

1) Type 1: Urban Sewage Treatment Projects

Operation conditions are largely as planned in two out of the three subprojects. In 1-2 Sewage Treatment Project in YanShou County, however, operation is at a standstill due to reconstruction. The outline of these subprojects is as follows:

1-1. Sewage Treatment Project in Mudanjiang City

The amount of pollutants is reduced mostly as planned. The demand for the sewage treatment has increased up to 230,000 tons per day with the growth of Mudanjiang City. The present plant is now in full operation, and this city is planning to start the second construction within this year to cope with the increasing demand.

1-2. Sewage Treatment Project in YanShou County

Even after the project was completed, operation remained at a standstill, because sewers were not so widespread and the amount of sewage was not so large, and because operation and administration costs were not financed by the local government. Operation was started in 2006, but was halted again in October 2009, for the reason that the treatment effect did not satisfy the requirement of new national standard revised in 2002. The oxidization pond technology adopted at that time failed to produce expected treatment effects especially in winter, and turned out not to be good enough to satisfy the water quality standards regulated more strictly. At the present stage, reconstruction is in progress for changeover from the oxidization pond method to the CASS method, with the re-opening goal scheduled in October 2010.

1-3. Sewage Treatment Project in Daqing City

The second expansion construction has already been completed. The present total treatment capacity is 150,000 tons per day, and the average treatment amount is 80,000 tons per day. The operation rate of the subprojects covered by ODA loan (the first construction) has reached the

treatment level almost as designed. The rate of the elimination of pollutants is 80-90 percent. Therefore, this project is evaluated highly.

2) Type 2: Factory Wastewater Treatment Projects

Wastewater treatment in the four subprojects in Type 2 (excluding the two cancelled subprojects 2-4 and 2-5) exhibited almost the expected effects. However, 2-2 Wastewater Treatment Project in Tonghe Paper Manufacturing Factory is now at a standstill because the factory shut down the operation. Cleaner production was promoted commonly in all of the subprojects, and as a result the amount of wastewater released during operation became far smaller than originally planned. Accordingly, the treatment amount of wastewater in each plant was reduced. This outcome is a consequence of efforts for an improvement in the water quality, which can be evaluated highly. Excellent treatment effects were obtained to the extent that the rate of the elimination of pollutants in each of the factories reached 90 percent or so. Each of the subprojects is outlined as follows:

2-1.Wastewater Treatment Project in Heilongjiang Paper Manufacturing Factory

Both the amount of wastewater treatment and the amount of pollutants have decreased, as wastewater has been reduced by cleaner production. The amount of COD release in 2009 cleared 100 percent the national standard, and the operation conditions are good.

2-2.Wastewater Treatment Project in Tonghe Paper Manufacturing Factory

Two years after the operation was started, the factory shut down the operation due to unfavorable market conditions. The eliminating effect of pollutants was very good while in operation according to factory workers, but it is difficult to make an evaluation because no information has so far been available on any quantitative data.

2-3. Wastewater Treatment Project in Harbin Pharmaceutical Factory

As a result of having promoted cleaner production in the entire factory, the amount of wastewater was dramatically reduced by half or less, and the amount of pollutants was also dramatically reduced. The reduction rate of the main pollutants is maintained at a level of 90 percent or so, and this project can be evaluated highly.

2-4.Wastewater Treatment Project in Brewery Factory

As a result of having promoted cleaner production in the entire factory, the amount of wastewater was decreased from 8 tons/ton of beer down to 3.5 tons. Consequently, the treatment amount of wastewater was reduced. This project can be evaluated highly with good treatment effects obtained.

3) Type 3: Anti-Air Pollution Project

As described above, the heat supply area remarkably increased, and reduction of SO2 reached the

planned level, therefore overall performance is high. The executing agencies of subprojects are upgrading their equipments, to meet the growing demand of heat supply. Summary of operational status of subprojects are as follows.

3-1. Heat Supply and effective coal utilization project in Jidong Country

The availability factor of the equipment is kept in good condition. Noticeable effects were obtained with the installation of the system. As a result, 180 small boilers and 170 or more chimneys were scrapped, and the consumption of coal was saved by 160,000 tons per year. Equipment is further being reinforced with the growth of Jidong County. The heat supply area is to be expanded up to 2 million m^2 by the end of 2010.

3-2. Heat Supply Project in Yichun City

The availability factor of the equipment is kept in good condition. Noticeable effects were obtained with the installation of the system. As a result, 150 small boilers and 100 or more chimneys were scrapped, and the consumption of coal was saved by 54,500 tons per year. The demand for heat supply is on the increase with the growth of this city, and the current urban heat supply area covers 5 million m^2. There are two heat supply companies in the city. This project is managed by one of them located in the east area. The heat supply area is to be expanded up to 2.4 million m^2 by the end of 2010.

3-3. Heat Supply Project in Mishan City

The availability factor of the equipment is kept in good condition. Noticeable effects were obtained with the installation of the system. New equipment was installed at the end of 2008. The existing equipment is to be used for peak demand.

Fig. 4 3-2 Heat Supply Equipment in Yichun

Fig. 5 Heat Supply Equipment in Jidong

4) Type 4: Monitoring Capacity Enhancement Project

The Environmental Inspection Department, Heilongjiang Province as the executing agency is

responsible for the execution of the environmental regulations, observation of environments and treatment of environmental accidents, and dispatches inspectors to cover all Heilongjiang Province. The equipment was installed for the purpose of reinforcing the capacity of monitoring and inspections at both central and local office, and it displays the expected effect.

In particular, about monitoring of water quality, 70 percent of inspection procedures are done by using of the equipment installed by the project. Its contribution is noteworthy. The incidence of environmental accidents was reduced by 75 percent in 2009 as compared with the preceding year, and denounced enterprises are on the decrease.

Table 3 Activities of Environmental Inspection Department

	2005	2009
Gross number of dispatch	25,000	36,000
Number of on-site inspections	8,996	1,064
Number of denounced enterprises	1,214	904

Source: Environmental Inspection Dept., Heilongjiang

An interview with a staff member of Environmental Inspection Section revealed that awareness to abide by environmental regulations as well as an interest in environmental protection has been enhanced in enterprises and citizens as a result of education and dissemination by this section. In fact, although activities by this section are much more reinforced, the incidence of denounced cases is decreasing. This is considered to be one of the effects brought about by enhanced capacity of this section.

(3) Improvements in Water Quality in Neaby Rivers and Water system

The objective of this project is to improve the water quality of the nearby rivers and water systems through the implementation of the subprojects. The table below shows a list of the rivers and water systems, and monitoring locations presumably related to the subprojects.

In case of 2-2.Harbin Pharmaceutical Factory, however, the target river is Songhuajiang mainstream, and therefore, many other factors are involved in changing the water quality.
It is difficult to precisely identify the degree of the project contribution. Therefore, evaluation was made on a certain presumption. Also some of the subprojects were excluded from the evaluation as no information was provided by Environmental Protection Department.

Table 4 Subprojects and Neighboring Rivers and Streams

	Subprojects	In-flow Rivers and Streams	Name of Data on Samples Collected
1-1	Sewage Treatment Project in Mudanjiang City	Mudanjiang River	No detail confirmed
1-3	Sewage Treatment Project in Mudanjiang City	Kulipao River	Data on water quality of Kulipao
2-1	Wastewater Treatment Project of Heilongjiang paper factory	Songhuajiang main stream	Data on water quality of Liuyuan

1-1. Sewage Treatment Project in Mudan City

No detailed monitoring data on the water quality were available. According to a bulletin on environmental conditions issued by Heilongjiang, the water quality of Mudanjiang was seriously aggravated, with about 20 percent of the total length classified as Class V or less on the national standard in 1999. However, a bulletin in 2008 disclosed that it was improved mostly up to Class III. This subproject covers about 50 percent of the demand for sewage treatment in Mudan. Therefore, the contribution of this subproject to an improvement in the water quality can be evaluated highly.

1-3. Sewage Treatment Project in Daqing City

The water quality of Kulipao River having inflow of the sewage treated by Daqing Sewage Treatment Plant is as shown below. Water pollution remains serious with all the values in excess of the standards. The water quality in entire Daqing City is classified as the worst Class V on the national standard in 2008.

Table 5 Water Quality of Kulipao River (Unit: mg/l)

		COD	BOD
	National Standard (Class III)	15 or less	4 or less
2006	**Average**	25.01	3.87
	Excess rate %	87.5	0
2007	**Average**	102	1.6
	Excess rate %	100	0
2008	**Average**	97.6	16.8
	Excess rate %	100	100

Source: Bulletin on environmental conditions issued by Daqing

2-1. Wastewater Treatment Project of Heilongjiang paper factory

Data on the water quality of Liuyuan at the downstream area of this subproject is as shown below.

COD on this spot following the start of operation has shown a downward tendency, maintaining Class II on the national standard. While SS was unstable and fluctuated, the water quality was somewhat improved as a whole.

Table 6 Water Quality of Monitoring Samples in Liuyuan (Unit: mg/l)

Indicators	1999	2007	2008	2009
COD_{Cr}		6.44	4.04	5.52
BOD_5	1.21	1.00	1.00	1.00
SS	57	71	24.78	351.75

Source: Bulletin on environmental conditions issued by Harbin

As seen from the above, there is a wide difference among the subprojects in the water quality of the nearby rivers and water systems. The reason of this discrepancy could be explained from the following aspects:

1) Among nearby rivers, some of them are over-100km-rivers. The subprojects do not cover the entire wastewater which flows into the river. Therefore, no direct effect of subproject can be traced.

2) The table below shows a chronological change in the amounts of sewage and wastewater in Heilongjiang Province. For the past few years, there has been no significant change, almost at a level of about 1.1 billion tons per year. The achievement rate for the national water quality standard rather shows a declining tendency. For instance, the amount of wastewater treated in compliance with the national standard was about 87 percent in 2008 as against about 93 percent in 2001.

Table 7 Change in Amounts of Sewage and Wastewater in Heilongjiang Province

(Unit: 100 million ton)

	Wastewater	Sewage	Total
2001	4.94	6.97	11.91
2006	4.48	7.09	11.57
2007	3.84	7.06	10.9
2008	3.89	7.20	11.09

Source: Almanac on Environmental Statistics in Heilongjiang, 2008

Under the circumstances where the amounts of sewage and treated wastewater remained unchanged in the entire stream, an effect of this subproject should be evaluated not in terms of improvement in the water quality but from the viewpoint of "mitigating aggravation of the water quality." In this subproject, there are a number of external factors that affect an evaluation on account of a gap between the project scale and an improvement in the water quality in the target rivers, and therefore, it is difficult to make precise evaluation. In the meantime, operation of the

subproject is in good condition, and the water quality has been found to be improved, mostly as planned. In other words, should this subproject not have been carried out, water pollution in the rivers would have been more serious. If this subproject is evaluated in terms of mitigating aggravation of water pollution in the rivers, it can be mentioned that certain effects have been obtained.

(4) Urban Air Pollution Conditions

In case of Type 3: Anti-Air Pollution Measure Projects, the objective is to improve air pollution in the target cities and counties.

Table 8 Urban Air Pollutants (2007-2009)

(Unit: mg/m^3)

	Mishan City		Jidong County		Yichun City		National Air Environmental Standard
	Before project	Current	Before project	Current	Before project	Current	
SO2	0.041	0.012	0.059	0.012	0.015	0.011	0.060
NOx	0.033	0.027	n.a	n.a	n.a	0.027	0.050
TSP	0.179	0.148	0.464	0.148	0.270	0.040	0.200

Source: Bulletin on Environmental Conditions in Each City

Note: In Yichun City, as part of data in 2008-2009 was not available, data in 2007 were used.

After the operation was started, an upward tendency was noted in urban areas. Especially in Jidong County, a remarkable improvement was brought about to the extent that the main pollutants were reduced by 70-80 percent as compared with the time of appraisal. The days when the national standard was cleared amounted to 300 days in a year, and this indicates that atmospheric environments in the target urban areas were improved significantly. The subprojects aimed at developing regional heat supply system in urban areas, and this effect must have turned out favorable in the atmospheric environment.

3.3.1.2 Results of Calculations of Internal Rates of Return

Calculations of financial internal rates of return on this project were made for the profit-oriented subprojects, i.e. Type 1: Urban Sewage Treatment Projects and Type 3: Anti-Air Pollution Projects. As to the heat supply subprojects, charges are fixed at a low rate for public benefit and the operation is carried out on the non-profit basis. Therefore, there is almost no significance in figuring out the profit rate by FIRR. Calculations were made for reference purposes to help the executing agency or the government to take necessary steps for further improvement of the project's sustainability and proper tariff standard enough to cover operation and maintenance cost and repayment of ODA loan. The results of calculations are as follows:

Table 9 Calculations of Financial Internal Rate of Return (FIRR)

(1) Financial internal rate of return (FIRR) Mudanjiang Sewage Treatment Plant 6.97% at appraisal Heat Supply and effective coal utilization project in Jidong Country 20.89% at appraisal	Mudanjiang Sewage Treatment Plant 5.247% at ex-post evaluation Heat Supply and effective coal utilization project in Jidong Country 5.12% at ex-post evaluation
(2)Financial benefit Charge for sewage treatment or heat supply tariff	(3)Financial cost 1) Initial investment 2) Expenses for maintenance and administration

Mudanjiang Sewage Treatment Plant has always been in full operation. Although the internal rate of return has become smaller now than at appraisal, a small benefit is kept. Meanwhile, however, in Jidong Heat Supply Project, the internal rate of return has sharply been reduced from the level at appraisal. The reason is that while the cost per unit was 10 yuan at appraisal, the actual cost exceeded 20 yuan due to a rise in the cost of coal.

3.3.2 Qualitative Effects

Details are described in "3.4 Impacts"

Overall, this project has somewhat achieved its objectives, and therefore its effectiveness is fair.

3.4 Impacts

3.4.1 Intended Impacts (Improvement in Health, Welfare and Living Environments)

(1) Improvement in Health, Welfare and Living Environments of Local Residents

The ultimate objective of this project is to improve the health, welfare and living environments of the local residents by means of improving the water quality of the rivers and streams as their water source and improving atmospheric environments over them. It is difficult to set up quantitative indicators in evaluating how the health, welfare and living environments were improved, and it is also difficult to evaluate these items in distinct relevance with an improvement in the water quality and atmospheric environments. In this study, therefore, an interview was made with some local residents as beneficiaries in an attempt to gauge impacts. In a face-to-face question and answer style, a survey was made mainly on how they evaluate change in the water quality in the neighboring rivers and in the air environments and whether or not there was an improvement in their living environment comprising smell and so on. In conducting this survey, a single sampling group was taken from Type 1 and Type 3, respectively, totaling up to 117 people.

Subprojects		Sampling Number
1-1	Sewage Treatment Project in Mudanjiang City	67
3-1	Heat Supply Project in Jidong County	50
	Total	117

1) Sewage Treatment Project (1-1 Sewage Treatment Project in Mudanjiang City)

56 percent of the respondents evaluate that the water quality of Mudanjiang has somewhat been improved as compared with 10 years ago. As noticeable opinions, some of them pointed out that the administration of wastewater from factories has been made better and that sewage treatment plants have been well equipped. As described in "3.3 Effectiveness," the water quality of Mudanjiang has been improved, and such beneficiaries' impression is in conformity with the data. In connection with the fact that the sewage treatment plant is not an attractive existence, there were few opinions appreciating its contribution. In view of the present status that this plant treats about 50 percent of sewage, however, it is considered that their evaluation for the contribution of this project is high.

2) Anti-Air Pollution Measure Project (3-1 Heat Supply Project in Jidong County)

About 60 percent of the respondents answered that the air environment has been aggravated as compared with the 1990's. Noticeable answers were that exhaust smokes from factories and exhaust fumes from automobiles are the main factors. An overall impression is that the air environment has become worse with the economic growth of Jidong County. About 60 percent of the respondents answered that the manifestation of symptoms of pains in eyes, coughing and respiratory diseases has become more frequent than before. As described in 3.3 Effectiveness, air environment has been statistically improved in quality. The present status is actually in for an upward tendency, but such unfavorable answers might be ascribed to their impressions against exhaust fumes from automobiles and their bodily insensitivity to atmospheric change. As the effectiveness of the subprojects could be ascertained, a favorable evaluation could be made from the standpoint of "control of aggravation" of the air environment.

Based on the result above, impacts of the project are evaluated as follows:

1. About 60 percent of the respondents answered that the water quality has become better than before.
2. About 50 percent of the above respondents recognize that the wastewater treatment plants have contributed to an improvement in the water quality. This means that the effectiveness of this project is evaluated favorably by the beneficiaries.
3. Farmers and fishermen notice no dramatic improvement in the relation between the water

quality and their working environments, but evaluate the change somewhat favorably.

4. Although the air environment is statistically in for an upward tendency, many of the respondents do not have favorable feelings. This means that such an improvement has not yet reached the level where people can have bodily sensation.

With the economic growth of Heilongjiang, more and more factories are being constructed, and more and more people are living in this province, and as a result there is increasing demand for the treatment of sewer and wastewater. Under these circumstances, some opinions were expressed to recognize that the water quality has been somewhat improved. This suggests that an effort to improve the water quality made by Heilongjiang Government and by this project has exhibited a certain effect.

3.4.2 Other Impacts

About negative impact which the project might cause, such as noise, odor and sludge, no particular concerns and problems were found during field survey. About sludge produced in the process of wastewater treatment, each project take proper treatment by drying sludge and transporting to disposal plant. About noise and odor, since most of the subprojects are located distant away from living quarters and urban areas, it can be reasonably assumed that no particular concern exists. In the process of carrying out this project, acquisition of the land for construction of the wastewater treatment plants was executed. It was confirmed that such acquisition was made legitimately on the basis of land regulations and urban design regulations, and no particular problem was noted.

It is difficult to precisely evaluate what effect this project has brought about in the living environment as well as the health and welfare of the local people. Meanwhile, numerous opinions evaluated favorably improvement in the water quality in the rivers and the contribution of the wastewater treatment plants. It is considered, therefore, that this project contributed somewhat to mitigating aggravation of the living environment of the local people through improvement in the water quality in Heilongjiang where water pollution is on the increase amidst economic growth and industrialization.

3.5 Sustainability (Rating: a)[9]

Unlike common ODA loan projects, this project consist of group of subprojects, carried out by Heilongjiang Province Environmental Protection Department as the supervisor of the entire project and by the group of executing agencies of respective subprojects.

To meet this nature of the project, we adopted the following approach for the evaluation of sustainability. As the first step, an individual evaluation was conducted on every stakeholder,

[9] Refer to the Attachment 4 on the standard and results of individual rating.

including Environmental Protection Department and each of the executing agencies, and by consolidating individual evaluation, overall evaluation was conducted[10].

With respect to Type 1-2, no particular problems were observed in the operation and maintenance system except for a few subprojects currently standstill, and their sustainability is high. With respect to Type 3 (Anti-Air Pollution Projects), there are some financial problems, but no serious problems that might affect their business were found. Overall, the sustainability of this project can be kept high in the near foreseeable future.

3.5.1 Structural Aspects of Operation and Maintenance

(1) Environmental Protection Department, Heilongjiang (Supervisor)

At the time of ex-post evaluation, it was found that this department is efficiently carrying on the project in good cooperation with the other executing agencies, and that it has the right authorized power and the right personnel in the right places. It has an internal Environment Inspection Section that assumes supervising, executing and inspecting activities based on the environmental protection regulations. The headquarters have 30 staff members, and total 1,400 supervisors are stationed in cities and counties under their command in whole province. The wastewater treatment subprojects are monitored by this department via online monitoring network. All-time automatic monitoring is done at the outlet of each plant.

(2) Subprojects Executing Agencies

Type 1: Urban Sewage Treatment Projects

All three sewage treatment plants are operated by government-owned enterprises under almost common organization structures and under the administration of each municipal sewage treatment company as their parent company. There is no plan for making these subprojects privatize, and no concern about the operation system.

Type 2: Factory Wastewater Treatment Projects

All four subprojects were carried out by private enterprises. Apart from 2-2 Tonghe Paper Manufacturing Factory, the three other subprojects are operated by group companies on the nationwide scale under the well-organized regime. Each of them has an environmental affairs office in its factory, and is ready to operate these subprojects in compliance with environmental regulations

Type 3: Anti-Air Pollution Subprojects

All three subprojects are operated by state-owned enterprises. There is no plan of privatization, and no concern about the operation system. The operation of 3.3 Intensive Heat Supply Subprojects

[10] As there are a number of organizations to be evaluated, the procedure for an evaluation was more simplified than a common ex-post evaluation. Therefore, a survey was conducted on the basis of key focused items only.

in Mishan is entrusted Mishan Dongan Electric Power Co., Ltd. on the basis of five-year contract.

3.5.2 Technical Aspects of Operation and Maintenance

An evaluation was made mainly on the basis of visual check of the equipment, interviews with staff members and confirmation of mechanical inspection records.

(1) Environmental Protection Department, Heilongjiang (Supervisor)

It was confirmed that the personnel having practical ability in carrying out the supervision are placed at the level of the central provincial government. According to the interview to the officer of the Department, however, staff members at the low-end county level, were in shortage, and there were differences in their skill. Thus, a proposal to improve this status was put forward. There was an answer that Environmental Protection Department is making an endeavor to raise its level by dispatching about 350 persons a year for technical training. The Environmental Inspection Section has many opportunities for doing on-the-spot inspections or performing its duties based on the regulations. Therefore, troubles with companies sometimes happen in that inspections are not welcomed or they are rejected. This is one of the tasks to settle for better operation.

(2) Subprojects Executing agencies

For the purpose of evaluation of technical aspects of this project, Chinese experts of environmental protection and improvements joined this evaluation and field survey. An overall evaluation added with their analysis revealed that there is no problem in the equipment used and the skill of the engineers engaged in the subprojects, and that the technical level of operation is high. In interviews conducted at each of the sewage and wastewater treatment plants, the monitoring record of the water quality was found to be under appropriate administration, and the explanation by the respondents was appropriate in terms of the treatment flow and daily routine works. In every sewage and wastewater treatment plant, common unification is worked out in the skills and the technical levels required for operation. Thus, no problem was found. Each of the subprojects is outlined below:

1)Type 1: Urban Sewage Treatment Subprojects

In general, there is no problem. In the 1-2 Yanshou subprojects, however, another different treatment method (CASS) is planned to be adopted. The CASS method itself is already in common use, and the engineers are ready to undergo the technical training. In this sense, there is no concern, but it is necessary to do monitoring at a certain interval for confirmation of operation by the CASS method.

2)Type 2: Factory Wastewater Treatment Subprojects

A positive attitude was seen in a technical improvement at all of the factories with private companies as their parent companies. After operation was started, an effort for further improvement

in wastewater treatment has been continued by each factory.

3)Type 3: Anti-Air Pollution Measure Subprojects

The heat supply equipment is technically fulfilled. The staff engineers are well skilled, and the operation manuals are well equipped. Therefore, there must be no problem in operation.

Fig. 6 3-2. Central Control Office of Mishan Heat Supply

Fig. 7 2-3. Water quality monitoring spot in Harbin Pharmaceutical Factory

3.5.3 Financial Aspects of Operation and Maintenance

(1) Heilongjiang Province Environmental Protection Department (Supervising Agency)

Heilongjiang Province Environmental Protection Department is a supervisor that is not directly involved in the financial sustainability of the subprojects, and therefore it is excluded from evaluation.

(2) Subprojects Implementing Agencies

1) Urban Sewage Treatment Projects

Some of the sewage treatment plants cannot survive only on the charges for sewage treatment, so they are subsidized by the government. All of them answer that the financial budget including the subsidy is reasonable, with their importance as public infrastructures recognized, and in this respect, there is no problem. Regarding the 1-2. Yanshou subproject, no information was available, as the operation is now at a standstill. At the time of starting the subproject, it took long time to acquire the financial support from the local government. It is necessary, therefore, to make sure whether or not this subproject is reasonably backed up by it

2) Factory Wastewater Treatment Subprojects

The subprojects now in operation are administered by the executors which are nationwide large-scale group companies. No detailed financial statements were available, but an answer was

returned to the effect that there was no problem in the financial budget for environmental protection including the subprojects. According to some factory respondents, it is essential for management to have the right personnel placed and to properly use the budget, and such manner leads to stable acquisition of necessary budget.

3) Anti-Air Pollution Measure Subprojects

A problem common to all the subprojects is that operation is made with financial backup of each local government due to gap between price-rising coal and the fixed charge for heat supply. According to the responsible persons in each of the subprojects, the charge is fixed at such a low rate and the cost of coal fluctuates so often that a system of absorbing fluctuations in the cost of coal is required.

3.5.4 Current Status of Operation and Maintenance

(1) The subprojects now in operation can be evaluated favorably in terms of equipment conditions and repair for accidents. Corrosion of equipment occurs in the equipment of some wastewater treatment plants, but since maintenance work is carried out at regular intervals, no particular problem affecting the operation has so far happened.

(2) No problem has been found at this stage in the two subprojects at a standstill, but for prevention of deterioration of the equipment while not in operation, incessant monitoring or guidance by the executing agency is considered necessary. In 2-2 Tonghe Paper Manufacturing Factory, a small number of staff members are kept on duty, and the other workers are required to stand ready at home while not in operation. According to the factory manager interviewed, no particular steps are taken for the maintenance of the equipment.

In general, no major problems have been observed in the operation and maintenance setup from the systematic, technical and financial aspects, therefore sustainability of the project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the project is to improve the water quality and the air environment by constructing sewage and wastewater treatment plants and heat supply system in Heilongjiang seriously affected by water and air pollution. Its importance is very high in this province under the current circumstances where the pollution is becoming more and more serious. It is considered, in the meantime, it is possible there was a better way to set up the project objective and to select subprojects.While a few subprojects are not in operation, the effects as planned were almost accomplished from an overall viewpoint. No particular problem was observed in both of operation and maintenance, and it is expected that proper operation is conducted hereafter.

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

4.2 Recommendations

4.2.1 Recommendations to Executing Agencies

(1) Data and documents on the water quality at the monitoring spots in the neighboring rivers and streams are important in evaluating this project, but they are not available in an orderly way and are not openly disclosed. They are not only necessary for evaluating this project but also useful to the central and local governments in China as well as the donors that support environmental protection projects, as they can be commonly used by them for promotion of environmental improvements. The executing agencies are required to make data and documents complete and open to the public.

(2) No operation is under way in 1-. Sewage Treatment Project in YanShou County and 2-2 Water Pollution Control Project by Tonghe Paper Factory. They showed their intention to reopen the operation, but no distinct schedule has yet been laid out at this stage of the on-the-spot survey. It is considered, therefore, that continued monitoring is required. There is a possibility that the operation of Tonghe Paper Manufacturing Factory is obliged to be at a standstill for the time being, since the paper industry is likely to be influenced by market conditions. The Environmental Protection Department is required to monitor its equipment at certain intervals for maintenance purposes.

(3) The Type 3 subproject (Anti-Air Pollution Measure by Heat Supply) is operated on the basis of the financial backup by each local government on account of price-rising-coal as the raw material and the fixed charge for the heat supply. Unlike sewage and wastewater treatment, raw material cost is incurred by use of coal for the heat supply business. It is desirable for self-support operation to adopt a changeable charge system to absorb the raw cost.

4.2.2 Recommendations to JICA

Nothing in particular.

4.3 Lessons Learned

This project sets up the very big objective of improving the water quality in the basins of Songhuajiang River, Heilongjiang. This objective is too excessive for the real project scale. In appraisal, it is necessary to set targets in a manner that make relevance with the project clear and to make achievements ascertainable. Otherwise, it is difficult to properly grasp the development outcome and to make an adequate evaluation. By the same token, in selecting subprojects, it is necessary to establish criteria focused on relevance to targets and to appraise and examine their adequacy on the basis of the criteria.

Concluded

Comparison of Achievement against Plan

Items	Original	Actual
(1) Outputs Type 1: Urban sewage treatment projects Type 2: Factory wastewater treatment projects Type 3: Anti-air pollution measure Projects Type 4: Project to cultivate monitoring ability	As detailed in Attachment 1.	As detailed in Attachment 1
(2) Period	December, 1998- June, 2001 (31 months)	December,1998- December, 2005 (73 months)
(3) Project cost Foreign currency Local currency Total Japanese ODA loan portion Exchange rate	 10,541 million yen 9,184 million yen (574 million yuan) 19,725 million yen 10,541 million yen 1 yuan = 16.2 yen (As in December, 1998)	 10,533 million yen 9.763 million yen (691 million yuan) 20,296 million yen 10,533 million yen 1 yuan = 14.12 yen (Average for the period of January, 1999 –December, 2003)

Attachment 1 3.2.1 Details on Outputs

Type 1: Urban Sewage Treatment Project Outputs Plan/Achievement

Subprojects		Original	Actual
1-1	Sewage Treatment Project in Mudanjiang City Treatment amount of sewage	100,000 m^3/day	As planned.
1-2	Sewage Treatment Project in Yanshou 1. Treatment amount of sewage 2. Drain	20,000 m^3/day 45km	As planned. 60.8km
1-3	Sewage Treatment Project in Daqing 1. Treatment amount of sewage 2. Drain 3. Pump houses	50,000 m^3/day 19.57km One house newly built. 10 houses for small pumps. 10 houses reformed.	As planned.

Type 2: Factory Wastewater Treatment Project Outputs Plan/Achievement

Subprojects		Original	Actual
2-1	Wastewater Treatment Project of Heilongjiang paper factory Drainage treatment & washing equipment / daily treatment amount	40,000 m^3/day	As planned.
2-2	Water Pollution Control Project by Tonghe Paper Factory Alkaline recovery & drainage treatment / daily treatment amount	20,000 m^3/day	As planned, but now not in operation.
2-3	Wastewater Treatment Project for Harbin Pharmaceutical		

	Factory 1. Improvement in the process of alkaline recovery 2. Improvement in the process of bleaching 3. Drainage treatment equipment	 Equipment to recover green mud established, and the existing cleaner converted. Equipment newly constructed to manufacture chlorine dioxide 25,000m^3/day	As planned.
2-4	Wastewater Treatment Project of Daqing Petrochemical Complex Drainage treatment equipment	 8 places	Cancelled.
2-5	Wastewater Treatment Project for Linyuan Oil Refinary Factory Drainage treatment equipment	 One newly constructed. One improved	Cancelled.
2-6	Drainage treatment plant for brewery factory Drainage treatment equipment Designed treatment amount	 12,500m^3/day	 8,000m^3/day

Type 3: Anti-Air Pollution Measure Subprojects

Subprojects		Original	Actual
3-1	Heat Supply Project in Jidong City 1. Flowing-floor boiler 2. Area covered by heat supply	 3 boilers 713,000 ㎡	 As planned.
3-2	Heat Supply Project in Yichun 1. Flowing-floor boiler 2. Area covered by heat supply	 3 boilers 1,434,000 ㎡	 As planned.

3-3	Heat Supply Project in Mishan 1. Flowing-floor boiler 2. Area covered by heat supply	 2 boilers 1,100,000 ㎡	As planned.

Type 4: Subproject to Cultivate Monitoring Ability

Subproject		Original	Actual
4-1	Heilongjiang Environmental Monitoring Network Project 1. Equipment enlarged in Environmental Science Research Laboratories 2. Equipment enlarged in Environmental Supervisory Station	 Monitors, data processors & cars On-the-spot monitors, recorders, telecommunication kits, data processors, protection tools, etc.	As planned.

Attachment 2 3.2.2.1 Detailed Rating on Project Period (months)

Subprojects		Original	Actual	Difference	Score
Type 1: Urban Sewage Treatment	1-1. Sewage Treatment Project in Mudanjiang City	36	57	158%	1
	1-2. Sewage Treatment Project in Yanshou	27	45	167%	1
	1-3. Sewage Treatment Project in Daqing	18	30	167%	1
Type 2: Factory Wastewater Treatment	2-1. Wastewater Treatment for Heilongjiang Paper Manufacturing Factory	18	Not ascertained.		
	2-2. Wastewater Treatment for Tonghe Paper Manufacturing Factory	15	Not ascertained.		
	2-3. Wastewater Treatment for Harbin Pharmaceutical Factory	27	36	133%	2
	2-6. Wastewater Treatment for Brewery Factory	27	45	167%	1
Type 3: Anti-Air Pollution Measure	3-1. Heat Supply in Jidong	28	38	136%	2
	3-2. Heat Supply in Yichu	36	49	136%	2
	3-3. Heat Supply in Mishan	19	18	95%	3
Type 4: Cultivate Monitoring Ability	4-1. Heilongjiang Environmental Monitoring Network	24	36	150%	1
	Total	275	354	**129%**	**14**
				Average score	**1.57**

<Method of Rating>

1. A comparison is made between the plan and achievements in each subproject to figure out a sub-rating (the subprojects cancelled or not ascertained are excluded).
2. The average of the total sub-ratings thus obtained is made as an overall rating.
3. Scores below a decimal point are taken up on the following basis:
   a: Not less than 80% (not less than 2.4)
   b: Not less than 50% to less than 80% (not less than 1.5 to less than 2.4)
   c: Less than 50% (less than 1.5)

The average was calculated as 1.57 in this project. So, the overall rating was b, being not less than 80 percent.

Attachment 3 3.3.1 Quantitative Effects Individual Operation Indicators on Subprojects Plan/Achievement

(1) Type 1: Main Operation and Effect Indicators on Urban Sewage Treatment Subprojects Plan/Achievement

Subprojects	Original (1998)	Actual (2010)
1-1. Sewage Treatment Project in Mudanjiang City	Treatment amount: 100,000 tons/day Population covered: 280,000 people COD: 10,950 tons/year BOD: 5,840 tons/year SS: 6,570 tons/year	Treatment amount: 100,000 tons/day Population covered: 280,000 people COD: 10,950 tons/year BOD: 5,840 tons/year SS: 6,570 tons/year
1-2. Sewage Treatment in Yanshou	Treatment amount: 20,000 tons/day Population covered: 51,000 people COD: 1,792 tons/year BOD: 960 tons/year SS: 1,088 tons/year	Treatment amount: 6-8,000 tons/day Population covered: 75,000 people Not in operation now. While in operation, no improvement in the water quality was observed to the extent of satisfying the new national standard.
1-3. Sewage Treatment in Daqing	Treatment amount: 50,000 tons/day Population covered: 275,000 people COD: 4,380 tons/year BOD: 2,373 tons/year SS: 3,286 tons/year	Equipment purchased by ODA Treatment amount: 48,000 tons/day Population covered: 400,000 people COD: 5,011 tons/year BOD: 2,592 tons/year SS: 3,110 tons/year

(2) Type 2: Main Operation and Effect Indicators on Factory Wastewater Treatment Subprojects Plan/Achievement

Subprojects	Original (1998)	Actual (2010)
2-1. Wastewater Treatment for Heilongjiang Paper Manufacturing Factory	Wastewater treatment: 40,000 tons/day COD: 15,471 tons/year SS: 6,576 tons/year	Wastewater treatment: 20,000 tons/day COD: 5,531 tons/year BOD: 3,359 tons/year SS* 3,951 tons/year

2-2. Wastewater Treatment for Tonghe Paper Manufacturing Factory	Wastewater treatment: 22,000 tons/day COD: 36,417 tons/year BOD: 11,687 tons/year SS: 1,840 tons/day	Not ascertained, as in no operation.
2-3. Wastewater Treatment for Harbin Pharmaceutical Factory	Wastewater treatment: 25,000 tons/day Reutilization: 10,000 tons/day COD: 16,740 tons/day BOD: 5,947 tons/day SS: 7,972 tons/day	Wastewater treatment: 10,000 tons/day Reutilization: unknown Reduction rate of pollutants: COD: about 92-94% BOD: about 99% SS: about 94-97%
2-6. Wastewater Treatment for Brewery Factory	Wastewater treatment: 12,000 tons/day Circulation efficiency: COD: 5,250 tons/year BOD: 2,900 tons/year SS: 1,980 tons/year	Wastewater treatment amount unknown, but reduced to about 40% as compared with the level at the planning time. Wastewater treatment: 8,000 tons/day Circulation efficiency: COD: 7,912 tons/year BOD: 402 tons/year SS: 4,340 tons/year

(3) Type 3: Anti-Air Pollution Measure Subprojects

Subprojects	Original (1998)	Actual (2010)
3-1.Heat Supply in Jidong	Heat supply area: 713,000 m^2 Population covered: no information available SO_2:1,095 tons/year reduced Particles of soot: 2,079 tons/year reduced	Heat supply area: 1,420,000 m^2 (Achievement rate: 199%) Population covered: 36,000 people SO_2:1,069 tons/year reduced Particles of soot: 2,079 tons/year reduced Soot collecting efficiency: 99.5%

3-2. Heat Supply in Yichun	Heat supply area: 1,434,000 m^2 SO_2: 360 tons/year reduced NOx:: no data available. Particles of soot: n.a Flying ash: n.a	Heat supply area: 1,700,000 m^2 Population covered: 55,000 people SO_2: 149.6 tons/year NOx:: no data available. Particles of soot: 864.9 tons/year Flying ash: 968 tons/year Soot collecting efficiency: 98.2%
3-3Heat Supply in Mishan	Heat supply area: 1,100,000 m^2 SO_2: 141 tons/year reduced NOx:: no data available. Particles of soot: 3,482 tons/year reduced Flying ash: 1,940 tons/year reduced	Heat supply area: 1,300,000 m^2 (Achievement rate: 118%) Population covered: 48,000 families (about 140,000 people) SO_2: 174 tons/year NOx: 118 tons Particles of soot: 1,392 tons/year reduced Flying ash: no data available. Sulfur eliminating efficiency: 63.2% Soot collecting efficiency: 96.7%

Attachment 4 3.5 Sustainability-Rating Results by Subprojects

(1) Criteria for Rating

Supervisory Organization	Criteria
Regime	- Is the regime well-organized and are the personnel well-placed for supervising the subprojects? - Is the supervisory organization in good relationship with the subproject executing organizations for incessant close communication? - Is the monitoring system well-established on the basis of environmental regulations?
Skill	- Are the personnel of Environment Protection Department well-placed and is their skill upgraded to the level to properly supervise the subprojects?
Finance	- Are the above activities financially backed up to a sufficient extent?
Subprojects	Criteria
Regime	- Is the regime well-organized for operation and administration (for decision-making)? - Is there a possibility of being privatized? If so, is there a possibility that the sustainability of the subprojects is affected?
Skill	- Are the personnel kept at an appropriate level for maintenance and operation? - Are the competent personnel having the technical skill for operating equipment well-placed? - Is a technical training system fulfilled for operation and administration? Is any training actually put in practice? - Is the operation manual available? And is it actually utilized? - Are the results of the inspections properly recorded and kept in good conditions?
Finance	- Are the profit and loss well-balanced? - Is the system to collect charges established in the manner to recover the cost? -In case the project is in deficit operation, is any governmental subsidy given, and is there no problem in carrying on operation from financial aspects?
Maintenance & administration	- Is the equipment ready to display its performance? - Is there no problem in maintenance activities, for instance, on the procurement of spare parts? -Is there no problem in having maintenance at regular intervals? - Has there been no problem in troubleshooting?

(2) Rating Results

		Evaluation	Institutional	Technical	Financial
Supervisor: Environmental Protection Department, Heilongjiang		3	3	3	Out of scope
Urban Sewage Treatment	Mudanjiang	2	3	3	2
	Daqing	3	3	3	3
	Yanshou	2	3	3	2
Factory Wastewater Treatment	Paper Manufacturing Factory	3	3	3	3
	Tonghe Paper	1	1	1	1
	Pharmaceutical Factory	3	3	3	3
	Xuehua Brewery	3	3	3	3
Heat Supply	Yichun	2	3	3	2
	Jidong	2	3	3	2
	Mishan	2	3	3	2
Others	Environmental Monitoring Network	3	3	3	Out of scope
Total		**2.4**			

<Method of Rating>

1. A comparison is made between the plan and achievements in each subproject to figure out a sub-rating (the subprojects cancelled or not ascertained are excluded).
2. The average of the total sub-ratings thus obtained is made as an overall rating.
3. Scores below a decimal point are taken up on the following basis:
   a: Not less than 80% (not less than 2.4)
   b: Not less than 50% to less than 80% (not less than 1.5 to less than 2.4)
   c: Less than 50% (less than 1.5)

China

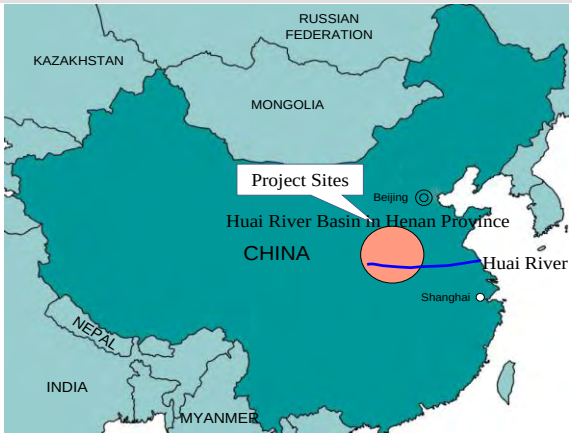
Ex-Post Evaluation of Japanese ODA Loan Project

Huai River Henan Water Pollution Control Project

Huai River Henan Water Pollution Control Project (II)

External Evaluator: Yuko Kishino, IC Net Limited

1. Project Description



Project Site

Louhe Pulp and Paper Making Factory

1.1 Background

Located midway between the Yellow River and the Yangtze River, the Huai River in the People's Republic of China is one of the Seven Great Rivers[1] of the country. The river has a drainage area of 269,000 square kilometers, and a total length of 1,000 kilometers, with its aquatic resources amounting to 79 billion 400 million cubic meters[2] in total. The Huai River consists of the Huai Main Water System and the Gijyutsushi Water System. The former water system flows eastward from its source in Mt. Tongboguan, Henan Province, and via Anhui Province, enters Lake Hongze in Jiangsu Province. From there the river turns southward and finally meets the Yangtze River. Meanwhile, the latter water system originates from the southern part of Shandong Province, and partly flows into the Yellow Sea via the northern part of Jiangsu Province. The Huai River Basin is inhabited by 45% of the 315 million populations of the four provinces, with major agricultural and industrial zones of the country stretching out around it.

At the time of the appraisal of this Japanese ODA Loan Project (1997-1998), these regions were experiencing rapid economic development, which resulted in a sudden increase in industrial/domestic wastewater. On the other hand, due to the lack of maintenance in sewage treatment facilities, most of the untreated wastewater was being discharged into the tributaries of the Huai River, thus aggravating water pollution.

Amid such circumstances, the Chinese Government enacted and enforced the "Provisional Act

[1] Songhua, Liao, Hai, Yellow River, Huai, Yangtze, Pearl River

[2] Huai Basin Water Resources Committee, "Evaluation of Water Resources in the Huai River Basin" (2004)

Against Water Pollution in the Huai River Basin" in 1996, and the Central Government and four provincial governments in the basin region orchestrated the "Huai River Basin Water Pollution Control Project and the 9th 5-year Project" (1996-2000), thereby initiating efforts toward the improvement of water quality.

1.2 Project Outline

The objective of this project is to improve the water quality of the Huai River Basin in Henan Province by constructing sewage treatment facilities and sewage networks in major cities located in the area, as well as installing effluent treatment equipment in factories that are discharging contaminants above the standard level into water systems in the said basin, thereby contributing to the improvement of the living environment of the local residents. The contractual details of this project are as follows:

Approved Amount/ Disbursed Amount	(I) 4,945 million yen / 3,956 million yen (II) 7,230 million yen /6,654 million yen[3] Total 12,175 million yen / 10,610 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	(I) September, 1997 (II) December, 1998 / (I) September, 1997 (II)December, 1998
Terms and Conditions	Interest Rate (I) 2.1% (II) 0.75% Repayment Period (I) 30 years (Grace Period 10 years) (II) 40 years (Grace Period 10 years) General Untied Loan
Borrower / Executing Agencies	Guarantor: Government of People's Republic of China / Henan Provincial People's Government
Final Disbursement Date	(I) April, 2003 (II) July, 2004
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	Feasibility Studies of Respective Subprojects
Related Projects (if any)	World Bank, "Huai River Pollution Control Project"

As shown in Table 1 and Table 2 below, this project consists of 4 subprojects selected at the appraisal in 1997 and 7 subprojects selected at the appraisal in 1998, classified as the "Huai River

[3] The amount deducted 575 million yen (data provided by JICA) from the disbursed amount (II). That amount was advance redemption, associated with cancellation of the subproject, "Wastewater Treatment Project for Feiyafei Paper Industry Company".

Henan Water Pollution Control Project" and the "Huai River Henan Water Pollution Control Project (II)," respectively.

In this ex-post evaluation of the project, the subprojects were divided into the following 2 types for analysis:

Type 1: Sewage treatment subprojects (mainly dealing with domestic wastewater in urban areas)

Type 2: Factory contaminant source treatment subprojects (dealing with factories discharging contaminants)

Table 1 List of subprojects at the time of evaluation in 1997 (I)

Number	Subproject Name	Type	Implementation Body
1)	Sewage Treatment System Construction Project in Zhengzhou City	1	Zhengzhou Wangxinzhuang Wastewater Treatment Plant
2)	Sewage Treatment System Construction Project in Pingdingshan City	1	Pingdingshan Sewage Purification Company
3)	Sewage Treatment System Construction Project in Xuchang City	1	Xhuchang Wastewater Treatment Plant
4)	Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	2	Kaifeng Chemical Fertilizer Plant

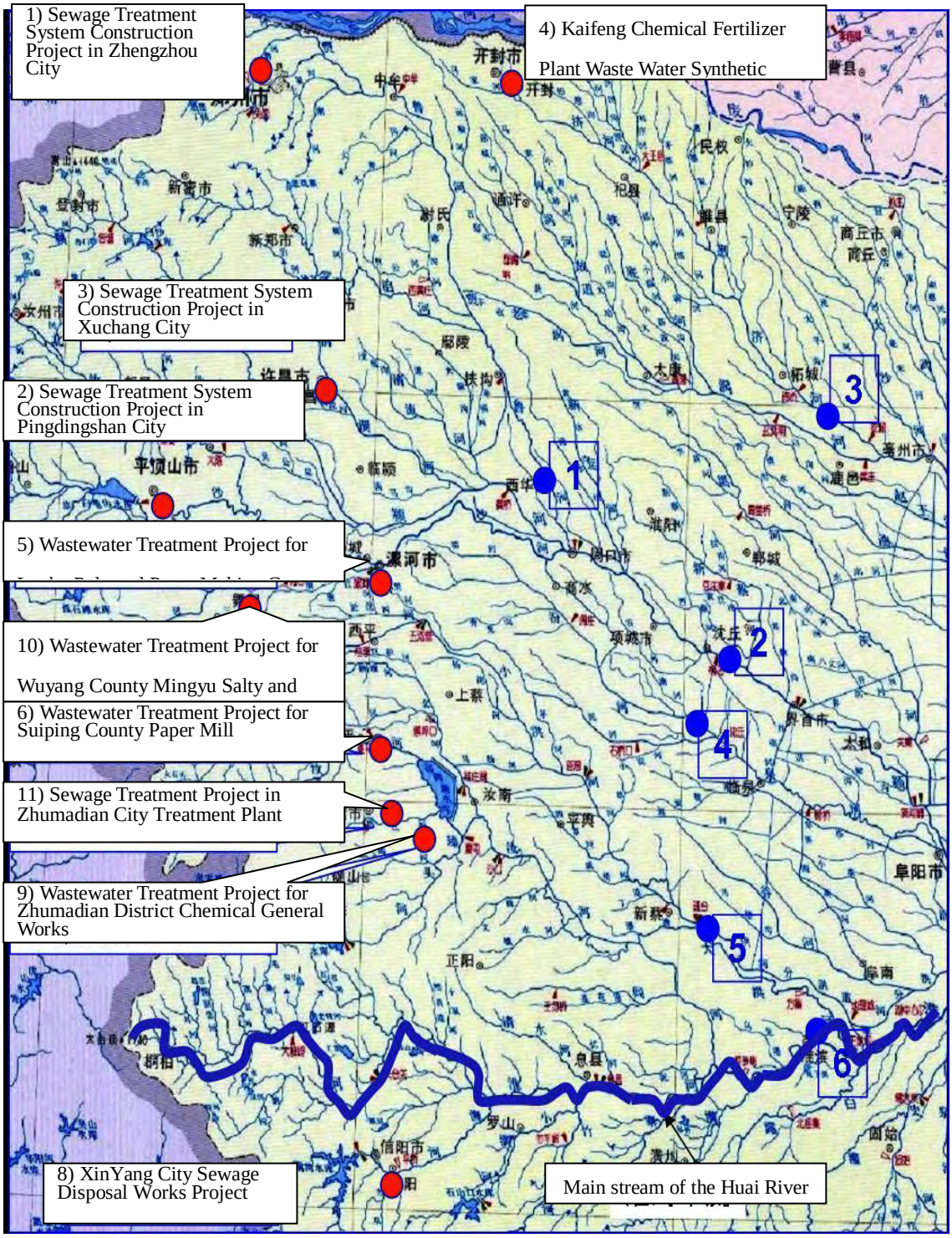
Table 2 List of Subprojects at the time of Evaluation in 1998 (II)

Number	Subproject Name	Type	Implementation Body
5)	Wastewater Treatment Project for Louhe Pulp and Paper Making Group	2	Louhe Yinge Paper Industry Company Limited
6)	Wastewater Treatment Project for Suiping County Paper Mill	2	Suiping country paper Making mill
7)	Wastewater Treatment Project for Feiyafei Paper Industry Company[4]	2	Feiyafei Paper Industry Company
8)	Wastewater Treatment Project for Zhoukou Paper Factory	2	Zhoukou country Papermaking mill
9)	Wastewater Treatment Project for Zhumadian District Chemical General Works	2	Zhumadian District Chemical factory

[4] In this evaluation report, the contractual name for yen loan "Wastewater Treatment Project for Feiyafei Paper Industry Company" is used instead of "Wastewater Treatment Project for Ruzhou Pulp Paper Industry Company" used in the assessment document.

10)	Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company	2	Wuyang County Mingyu Salty and Chemical Group Company Second Papermaking mill
11)	Sewage Treatment Project in Zhumadian City	1	Zhumadian city Wastewater Treatment Company Limited

Note: The numbers are in order listed in the assessment document.



1- Jialuhe River Xihuaxian Dawangzhuang

2- Shayinghe River Shenqiuxian Zhidian

3- Huiji River Luyixian Dongsunying

4- Quan River Shenqiuxian Lifen

5- Hong River Xincaibantai

6- Huai River Huaibin Hydrologic Station

[Explanatory notes]

●: Subproject Sites

●: Downstream Monitoring Sections

Note: Excludes subprojects before replacement or those cancelled

Figure 1 Executed subprojects and map of monitoring sections in downstream basin

2. Outline of the Evaluation Study

2.1 External Evaluator

Yuko Kishino, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation was implemented as follows:

Duration of the Study: October, 2009 – October, 2010

Duration of the Field Study: January 17 – February 6, 2010; May 14 – May 20, 2010

2.3 Constraints during the Evaluation Study

In general, the analysis of differences between original and actual constitutes the basis of an ex-post evaluation. In this project, however, due to the obscurity of the planning (project objectives) and constraints of the investigation, evaluations of effectiveness could only be based, to a certain extent, on speculation.

Although an appraisal document by JICA cites "water quality improvement in the Huai basin, Henan Province" as a project objective, there is no mention of further specific goals. In the preliminary survey and Sino-Japanese Intergovernmental Conference, we interviewed the executing agency as to the objectives of this project for both nations. Judging from the interview results, scale of the project, and expected effects, we interpreted the goal of both nations as "water quality improvement in the subproject downstream basin," and thus decided to adopt the water quality data in the subproject downstream basin as the indicators of effectiveness.

The next problem was to clarify exactly where the subproject downstream basin was located. In order to verify the relationship between the subprojects and improvement of water quality, it is necessary to obtain water quality data from the monitoring sections in the vicinity of treated wastewater discharge points. For this reason, we attempted to obtain the water quality data from the monitoring sections in the vicinity, but the city/provincial environmental agencies did not have successive data from the time of appraisal to ex-post evaluation since it was only a couple of years ago that they had started collecting such data. Consequently, we decided to adopt the available water quality data from monitoring sections under the direct jurisdiction of the Department of Environment Protection of the Henan Provincial Government[5].

To evaluate effectiveness, it is also necessary to analyze to what extent this project has contributed to water quality improvement. However, since the monitoring sections under the jurisdiction of the Department of Environment Protection are geographically distant from the subproject sites, water quality is subject to various types of influences along the way. In other words, even if water quality

[5] The monitoring sections are established and water quality data are controlled by respective organizations including the Ministry of Environmental Protection/Ministry of Water Resources, Huai Basin Water Resources Committee, Environmental Protection Agencies/Water Resources Agencies of provincial governments, and Environmental Protection Agencies/Water Resources Agencies of city/couty governments. Accordingly, more often than not, monitoring points and the number of sections may or may not be the same depending on the organization. The data from the Henan Environment Protection Agency that was directly involved in this project had the highest availability.

improvement is confirmed, validating the relationship with this project is impossible. With the time and budgetary constraints of this ex-post evaluation survey, it was difficult to carry out an investigation into numerous factors influencing the water quality of each river in vast expanses of the basin area.

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

3.1 Relevance (Rating: a)

3.1.1 Relevance with the Development Plan of China

(1) Development Policy at appraisal

The most important issues in China's environment protection policy in accordance with the Ninth Five-year National Plan (1996-2000) were measures against water/air-quality pollution and improvement of urban environments. The goal advocated in the "National Environment Protection Ninth Five-year Plan and 2010 Long-term Goal" was to "prevent environmental pollution and ecosystem deterioration, improve environments in some cities/districts, maintain model cities/districts for ecosystem development, economic protection and environmental conservation." The water pollution control project targeted the "Three Rivers and Three Lakes"[6] including the rivers targeted in this project, as well as the Seven Great Rivers.

The "Henan Province Huai Basin Water Pollution Control Project and the Ninth Five-year Plan" (1996-2000) stipulated that it be imperative to construct sewage treatment facilities in principal cities within the province such as Zhengzhou, Pingdingshan, Xuchang, and Zhumadian, and implement measures against water contaminants from major factories with high pollution loads. It was declared that the chemical oxygen demand (COD)[7] at all the 48 monitoring sections[8] in the Huai River Basin in Henan Province would be improved from Class V of the National Surface Water Quality Standard (25 mg/L or below) to either Class III (15 mg/L) or Class IV (20 mg/L or below)[9]. This project was implemented pursuant to this plan.

(2)Development Policy atex-post evaluation

In the Eleventh Five-year National Plan (2006-2010), a goal of reducing the total amount of discharged major contaminants by 10% is laid out with an eye on strengthening ecosystem conservation, environmental protection and resources management. The National Environmental Protection Eleventh Five-year Plan (2006-2010) proposes goals such as increasing the ratio of water systems exceeding Class III in the Seven Great Rivers to 40% or above, decreasing the COD and the total amount of ammonia nitrogen discharge by 5% and 3%, respectively, compared with 2005, as well

[6] Huai River, Hai River, Liao River, Taihu Lake, Dian Lake, and Chao Lake.

[7] A unit used to represent the degree of water pollution, signifying the amount of oxygen consumed when organic compounds in the water are oxidized by oxidizing agents.

[8] The number of sections in Henan Province under the jurisdiction of the Huai Basin Water Resources Committee.

[9] GB3838-1988, enforced by the Environmental Protection Agency (the current Environmental Protection Ministry) in 1988, classifies 30 indices pertaining to water quality, such as COD, into Class I to V. GB3838－2002, revised in 2002, eases the COD concentration standard compared to GB3838-1988: Class III-20 mg/L or below; Class IV-30 mg/L or below; and Class V-40 mg/L or below.

as increasing the ratio of urban wastewater treatment to 60% or above.

The "Henan Province Huai River Basin Water Pollution Prevention Project and the Eleventh Five-year Plan" (2006-2010) speculates that the COD and discharge targets for ammonia nitrogen be set at the 46 monitoring sections in the Huai River Basin in Henan Province, thereby improving the values to between Class III and V in each section. The 12 cities under the direct jurisdiction of the province[10] intend to propose strict COD reduction goals, improve the treated water quality from wastewater treatment plants, and increase reuse rates.

This project is aimed at water quality improvement in the Huai River Basin—a prioritized area in relation to national, basin, and provincial policies; therefore its relevance is high.

3.1.2 Relevance with the Development Needs of China

3.1.2.1 The need for Water Quality Improvement in the Huai River Basin in Henan Province

At the time of appraisal, water quality pollution in the Huai River Basin in Henan Province was becoming grave. According to the COD measurement results (1996), 83% of the Huai River Basin sections within Henan Province exceeded Class V levels of the National Surface Water Quality Standard—the most polluted classification. In some sections, even heavy metal contaminants such as arsenic and hexavalent chromium were observed to exceed Class V levels. With Henan Province situated in the most upstream reaches of the Huai River Basin, water quality pollution within the province was having a serious impact on the downstream provinces of Anhui, Jiangsu and Shandong, thus necessitating urgent antipollution measures. Since this project is aimed at installing wastewater treatment equipment in principal cities and companies focusing on antipollution measures, the necessity of its implementation was high both at the time of appraisal and ex-post evaluation.

Meanwhile, the treated water discharged from the wastewater treatment facilities inaugurated in this project falls short of the water quality standard required by the government. In order to fulfill the national standard of contaminant discharge at the time of appraisal, wastewater treatment plants were constructed by employing the methodology and scale for effluent processing commensurate with the present needs. However, between 2001 and 2008, the discharge standard for contaminants in domestic/industrial wastewater was strengthened, thus resulting in an inability to achieve the required levels solely with the facilities installed in this project. With the view of complying with the discharge standard, the implementation bodies initiated efforts to remodel the technology and add installations at their expense in all subprojects.

3.1.2.2 Relevance of the Project

(1) Relevance of Project Goal Setting

Since the evaluation system at the time of appraisal did not require setting a goal with strict objectives and indicators, the goals set in this project cannot be regarded as adequate by JICA's present evaluation standards. Although a project goal of "water quality improvement in the Huai River Basin

[10] Zhengzhou, Kaifeng, Pingdingshan, Xuchang, Luohe, Zhumadian, Xinyang, Shangqiu, Zhoukou, Nanyang, and Luoyang.

in Henan Province" was announced at planning, no concrete objective was set in detail, nor was there any clarification as to how the goal was to be achieved and why the subprojects were selected. In light of the considerable discrepancy between the objective and scope of the project, we believe that a more realistic goal should have been set.

As shown in Figure 1, the Huai River in Henan Province branches into multitudes of tributaries with a vast basin area. If the project goal was interpreted literally as water quality improvement in the entire basin, the number of selected subprojects would be too small. Moreover, considering the dispersion of project sites in each tributary, overall positive effects on water quality were unlikely.

Taking into account the various factors that influence water quality, it appears that there was a lack in perspective: To what extent and in which section of the river should water quality be improved? What is the adequate scale and location in order for subprojects to achieve the given objectives? Are they appropriate as targets of a Japanese ODA loan project? Thorough consideration should have been made on the logical structure of the project as well as other external factors such as strategic selection of subprojects in close collaboration with the other water quality improvement projects in the Huai River Basin executed by Henan Province, and project goal setting proportionate to the subproject scale.

(2) Relevance of Subproject Selection

Of the 11 subprojects selected at the time of appraisal, one was replaced, another cancelled, and the equipment was removed in another factory shortly after the start of operation. The implementation bodies of these subprojects were paper mills and a chemical fertilizer plant that were unable to adjust to large shifts in their environments, namely the reform of state-run enterprises, adjustment of industrial structure, and environmental policies. As a result, effects could only be seen in only the remaining 9 subprojects, thus affecting the achievement of the project goal.

Although further details will be provided in 3.2.1, the 4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project, in which the equipment was removed, was forced into production closure or suspension due to a business downturn 4 years after inauguration. Of the 4 treatment facilities that had been installed in this subproject, 1 was removed and the remaining 3 went out of service for approximately 1 year. The installation of some disposal equipment built more than 30 years ago that produce high concentration nitric acid or sulfuric acid might have contributed to the outcome where the equipment had to be removed on account of dilapidation merely 5 to 9 years after the start of operation. In spite of the concern about the financial conditions of the factories voiced at the time of appraisal, financial analysis and fact-finding investigations were insufficient. Financial sustainability had been confirmed through mid-term evaluation and management and Special Assistance for Project Implementation (SAPI) by JICA on the basis of the proposals made at the time of appraisal. However, in hindsight, the factories could not respond to the changes in domestic policies and markets. If more in-depth investigation had been implemented at the time of appraisal, it can not be denied that situations of this kind could have been averted.

In contrast, sewage treatment system construction subprojects, which are more public in nature, are

being implemented in a steady manner thanks in part to the sponsorship of the government. From an environmental pollution prevention standpoint, projects for large-scale factories that generate COD and sewage treatment system construction projects in principal cities are both highly necessary and urgent. However, from the viewpoint of Japanese ODA loan targets, it might have been preferable to focus on more public sewage treatment facilities rather than factories whose sustainability is greatly susceptible to policies and markets.

In conclusion, it is essential for appraisals to fully ascertain the relevance of the project in question through processes such as the clarification of project objectives, concrete goal setting, and strategic selection of subprojects. Furthermore, as in the case of this project, if a project consists of multiple subprojects which are to be determined by loan contracts, it is desirable to put in place structures and systems that can swiftly respond to replacement at the implementation stage. There should be more flexible project planning in which loan contracts do not determine subprojects, and can also be adjusted for achievement of the objectives. In such cases, it is essential that an attentive and flexible management structure for project operation be in place in order to carry out subprojects that are more pertinent to goal attainment.

3.1.3 Relevance with Japan's ODA Policy

In the Economic Assistance Program for China (2001), a country-specific assistance policy, it was declared that "emphasis should be put on areas that centre on environment and ecosystem conservation, livelihood improvement and social development in inland regions, human resources training, system establishment, and technology transfer." The program places "cooperation on dealing with global-scale problems such as environmental issues" as the highest priority issue in the strategic field of assistance; therefore, the relevance between this project and the Japan's ODA policy is high.

In conclusion, this project has been highly relevant with the China's development plan, development needs, as well as Japan's ODA policy; therefore its relevance is high[11].

3.2 Efficiency (Rating: b)

3.2.1 Project Outputs

(1) Changes in Subprojects

After the appraisal, the loan contract was changed twice, ultimately leaving 10 subprojects to be implemented.

[11] Assessment on the "relevance of the project" was not reflected in the relevance rating for the following reasons: (1) The evaluation system at the time (1997-1998) did not require planning subject to assessment or strict and definite indicators for goal setting as today. (2) JICA interprets projects consisting of multiple subprojects such as this one as a sort of sector loan, and thus regards rigorous evaluation on each individual project as being practically difficult.

Table 3 List of changed subprojects

Projects at the time of appraisal	Actual
7) Wastewater Treatment Project for Feiyafei Paper Industry Company	Cancelled
8) Wastewater Treatment Project for Zhoukou Paper Factory	8) XinYang City Sewage Disposal Works Project (Replaced)

In the loan contract change in 2002, the "Wastewater Treatment Project for Zhoukou Paper Factory" was replaced with the "XinYang City Sewage Disposal Works Project." At the time of appraisal, the Zhoukou Paper Factory was producing 17,000 tons of pulp annually, and was planning to expand the production to 25,000 tons per year by installing a new manufacturing line. However, owing to the structural adjustment of the pulp and paper industry initiated since 2002 in Henan Province, manufacturing lines with an annual production capacity of 17,000 tons or less, including the Zhoukou Paper Factory, were closed down by 2003.

On account of the cancellation of the "Wastewater Treatment Project for Feiyafei Paper Industry Company" subproject, the loan contract was modified in 2006. This outcome stems from the concurrence of a number of adverse conditions. Although the possibility of replacing it with another subproject was explored, the plan never materialized on the grounds of the time required for its execution and the length of the loan period. In retrospect, had the decision for replacement been made earlier, the impact on the project goal accomplishment might have been minimized. The following are the circumstances leading up to the cancellation.

The plan at the time of appraisal was that wastewater disposal facilities and recycled pulp mills would be constructed within the premises of the factories in Ruzhou, a city under the jurisdiction of Pingdingshan, whereupon the treated water would be discharged into the Beiru River. However, in 2002, regulations on COD discharge into the Beiru River were tightened, thereby rendering it impossible to construct new factories in the city. This caused the project site to be relocated to Pingdingshan. In 2006, the Henan Provincial Government drastically strengthened the discharge standard of water pollutants from paper factories, thus forcing the subproject to review the wastewater disposal plan as a whole. Furthermore, the land acquisition cost and corporation tax, which the subproject was supposed to be exempt from, were no longer subject to exemption in accordance with a decision by Pingdingshan, with the resulting burden further aggravating the financial standing of the factory. Under such circumstances, the merger and reorganization of enterprises was encouraged as part of a structural adjustment policy of the paper industry. That being the case, the municipal government recommended that the Feiyafei Paper Industry Company merge with a state-owned money-losing enterprise as a condition for the execution of the Japanese ODA loan project. However, since the paper company refused to acquiesce to this condition, the subproject was discontinued after the loan contract was modified in accordance with a conference between the Chinese government and JICA.

(2) Subproject Outputs (See Attachment 1)

In 3 subprojects, modifications were made to the original plan. We consider this decision to be appropriate as these modifications were made to correspond to the changes in the environment surrounding these subprojects at the implementation stage. They had no significant influence on either the project period as a whole or the costs of the project.

Of the Type 1 subprojects, modifications were made to the 3) Sewage Treatment System Construction Project in Xuchang City. The construction of advanced water treatment equipment was temporarily suspended as the expected demand by the recipients of the water supply disappeared for the time being. Construction resumed in a self-funded manner after water supply destinations were secured. Meanwhile, foreign currencies were funneled into the construction of the sewer culverts, which had been scheduled to be built using domestic currency, due to the difficulties in financing by the local governments. This change resulted in an extension of the project period by 6 years and an increase in subproject costs by 1.6 times the original amount. By contrast, the water catchment area in Xuchang was expanded, with the operational rate of the facilities increasing from 30% to 90% or above.

Of the 5 Type 2 subprojects, changes were made in the 6) Wastewater Treatment Project for Suiping County Paper Mill and 10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company. As a result of the aforementioned industrial structural adjustment policy in 2002, small-scale paper mills were either shut down or suspended, substantially decreasing the demand for pulp in the market. Faced with the necessity to equip themselves with production lines of their own that encompassed the entire process from pulp making to paper manufacturing in order to continue production, the Suiping County Paper Mill and the Wuyang County Mingyu Salty and Chemical Group Company added printing paper manufacturing equipment and cardboard manufacturing equipment, respectively.

In 2 other subprojects, equipment was either scaled back or removed after the completion of the subprojects as scheduled. One is the 1) Sewage Treatment System Construction Project in Zhengzhou City, with the capacity of the wastewater treatment facility curtailed to 240 thousand tons daily from the originally planned 400 thousand tons daily 3 years after the start of operation in 2006. This is due to 2002's tightening of the discharge standards for contaminants in treated urban wastewater, which urged the addition of new equipment for removing ammonia nitrogen, E. coli and phosphorous. In 2006, 3 internal circumfluence system pumps were added to the reaction tank for the purpose of eliminating ammonia and nitrogen, and at the same time, the mode of treatment was changed. Since system capacity was limited, the implementation body scaled back the facilities maintained by the Japanese ODA loan and installed new equipment capable of treating 160 thousand tons per day using private funds.

The other subproject where equipment was scaled back or removed was the 4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project mentioned in the "relevance section". In April 2003, a business downturn stemming from market factors forced the Kaifeng Chemical Fertilizer

Plant (name at the time of appraisal)[12] to suspend all of its operations producing arsenic, cyanogen, high concentration nitric acid, and sulfuric acid[13]. At this stage, the production of arsenic was discontinued and the treatment equipment for arsenic wastewater was removed. Although the production of cyanogen and high concentration nitric acid was succeeded and resumed by the "Kaifeng Jinkai Chemical Limited Liability Company" founded thereafter in May 2004, the company was unable to conform to the industry standard for environmental protection technology for nitrogenous fertilizers set by the Department of Environment Protection in Henan Province; therefore in September 2005, the treatment equipment for cyanic wastewater was removed. Meanwhile, the treatment equipment for concentrated nitric acid discharge installed in the production equipment for concentrated nitric acid introduced in the 1960s was removed along with the production equipment in 2004 due to dilapidation. Although the Kaifeng Chemical Fertilizer Plant (name at the time of appraisal) resumed the production of nitric acid in 2004, its 2 production systems, having been made in the 1960s and 80s and poorly maintained, were both in a state of severe disrepair. Consequently, on the basis of safety inspection results in 2008, the treatment facility for nitric acid discharge was removed along with the production equipment.

Fig. 2 Reaction Tank in a Sewage Treatment Facility in Zhengzhou

Fig.3 After Equipment Removal, Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project

3.2.2 Project Inputs

3.2.2.1 Project Period

The project periods were (I) September 1997 – December 2006 (112 months) and (II) December 1998 – June 2008 (115 months) as opposed to the schedules of (I) September 1997 – December 2000 (40 months) and (II) December 1998 - December 2001 (49 months), resulting in ratios of 280% and 235%. With the exception of the 4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic

[12] The name was changed to the Kaifeng Chemical Collective Company Limited in 1998, but the name at the time of appraisl is used here.

[13] Of arsenic, cyanogen, high concentration nitric acid, and nitric acid,, the production of cyanogen, high concentration nitric acid, and nitric acid was suspended only temporarily before the resumption in 2004.

Treatment Project at a ratio of 65%, the period of each subproject was significantly longer than planned at a ratio of 150% (See Attachment 2). This is partly attributable to the considerable amount of time squandered in the cumbersome procedures from the official launch to the approval of completion inspection and measures to prohibit business trips due to severe acute respiratory syndrome (SARS).

The reasons for the delay in the 5 subprojects where the project ratios exceeded 200% were as follows:

Government policy had a great influence on the 5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group and 10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company. As the structural adjustment of the paper industry carried out between 2002 and 2005 changed the market, the companies were compelled to either discontinue or modify their production lines, production scale, and investment plans in waste water treatment facilities, etc. Furthermore, due to the alteration in the stock structure as a result of the reform of state-owned enterprises, the Suiping County Paper Mill needed significant time before deciding its management policy. Meanwhile, the Wuyang County Mingyu Salty and Chemical Group Company, having been affected by the structural adjustment, went bankrupt after falling into distress. It took some time for a new company to be established and operations to be resumed. The delay in the 3) Sewage Treatment System Construction Project in Xuchang City and 6) Wastewater Treatment Project for Suiping County Paper Mill derived from the fact that fund-raising by the local governments lagged behind schedule. The delay in the 9) Wastewater Treatment Project for Zhumadian District Chemical General Works was caused by a suspension of construction due to personnel changes in the company's executive board, as well as a review of shopping and bidding lists.

3.2.2.2 Project Cost

The total project costs combining (I) and (II) were 29.95 billion yen (including 10.61 billion yen in foreign currency) in actuality as opposed to the initial estimate of 32.176 billion yen (including 12.175 billion yen in foreign currency), thus lower than planned. That is 97.5% of the planned total project costs of 30.729 billion yen (including 11.432 billion yen in foreign currency) excluded cancelled subproject.

In conclusion, although the project cost was mostly as planned, the project period was significantly longer than planned; therefore the efficiency of the project is fair.

3.3 Effectiveness (Rating: b)

3.3.1 Quantitative Effects (Water Quality Improvement in the Subproject Downstream Basin)

With the project objective regarded as "Water Quality Improvement in the Subproject Downstream Basin" as described above, analysis will be conducted on the following 2 levels:

(1) Results from Operation and Effect Indicators (Effects of the Project as a Whole and Individual Subprojects)

(2) Water Quality in the Monitoring Section of the Subproject Downstream Basin (COD)

3.3.1.1 Results from Operation and Effect Indicators

(1) Effects of the Project as a Whole

Judging from the project design, the COD elimination quantity was estimated to be 243,165 tons at the time of appraisal. In response to the cancellation of the 7) Wastewater Treatment Project for Feiyafei Paper Industry Company, the planned COD elimination quantity was revised downward to 197,610 tons annually. The 2009 gross COD elimination quantity of the 9 subprojects in operation at the time of ex-post evaluation was 140,457 tons, i.e. 71% compared to the plan.

Table 4 COD Elimination Quantity

(Unit: Tons)

	Original	Actual	Ratio
Type 1: Sewage Treatment Subprojects	98,740	115,097	117%
Type 2: Factory Contaminant Source Treatment Subproje	98,870	25,360	26%
Total	197,610	140,457	71%

As opposed to the planned ratio of 117% in Type 1, the ratio for Type 2 was lower, at 26%. In parallel with the expansion of the piping construction area and annual increase in the drainage volume, the COD elimination quantity is also in an increasing trend in sewage treatment plants. Nevertheless, the fact that the drainage volume decreased in the plants compared with the figure at the time of planning as a result of efforts to save production water and enhance the cyclic utilization ratio through the introduction of cleaner production made a difference. In addition, it was also significant that in reaction to the tightening of wastewater discharge standards for the paper industry by both the National and Henan Provincial Governments, the COD discharge per production unit was reduced by adding/installing new deep-layer aeration apparatus and anaerobic treatment equipment using private funds. As shown in Figure 4, the water and COD discharge volumes in the paper mills decreased 64-72% and 81-94%, respectively. Although the water discharge volume did not change in the 9) Zhumadian District Chemical General Works as it had been planned that at least 95% of the treated water would be reused as gas washing water in the factory, the COD discharge volume per production unit was curtailed by 32%. In terms of water quality improvement, these positive factors warrant favourable assessment.

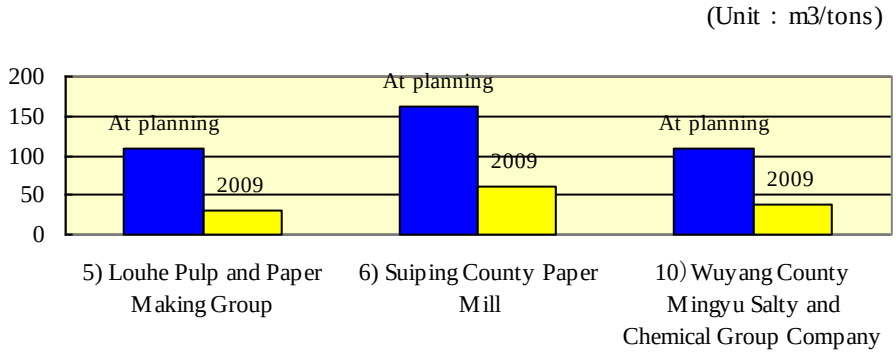


Figure 4 Change in Water Discharge Volumes per Production Unit

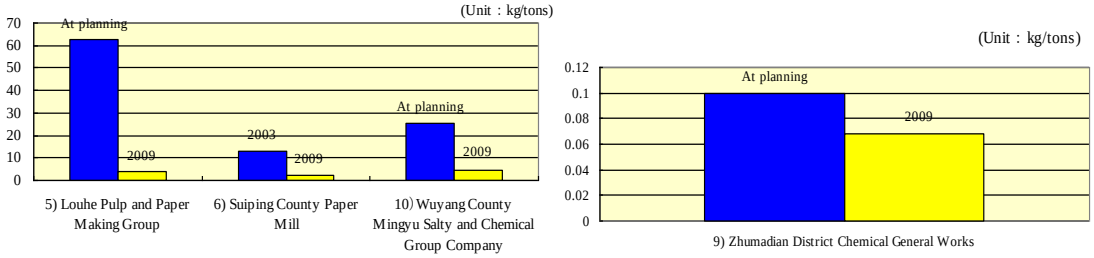


Figure 5 Change in COD Discharge Volumes per Production Unit

As shown in Table 5, all the achievement rates in Type 1 were at least 80%. The elimination rates of COD, biochemical oxygen demand (BOD)[14], and suspended solids (SS)[15] were also high, with at least 92% in Type 2 as well. Therefore, this project can be considered sufficiently effective.

[14] A water pollution indicator especially important as one of the regulation items for industrial wastewater, etc. Represented as an oxygen volume consumed when microorganisms decompose organic substances in the water, the larger the value is, the higher the degree of water pollution.

[15] Refers to insoluble particulate substances suspended in the water. Includes zoo/phytoplankton and their remains, organic substances deriving from sewage/industrial wastewater, metal precipitates, etc.

Table 5 Plan/Achievement Ratios of Major Indicators

Type 1

	Original (1997	Actual (2009)	Ratio
Sewage Treatment Population (10 thousand people)	311	274	88%
Sewage Treatment Volume (10 thousand cubic meters/day)	83	84	101%
COD elimination volume (tons/year)	98,740	115,097	117%
COD elimination ratio (%)	78	89	114%
BOD elimination volume (tons/year)	45,825	50,793	111%
BOD elimination ratio (%)	86	91	106%
SS elimination volume (tons/year)	67,215	84,739	126%
SS elimination ratio (%)	87	93	107%

Sources: Original-appraisal documents; Actual-individual subprojects

Note 1: The elimination rates are the comparisons between the water quality at the time of wastewater inflow and that of treated water, and are the mean values of each subproject.
Note 2: The actual values include the effects of the equipment constructed additionally using private funds.

Type 2

	Original	Actual	Ratio
Sewage Treatment Volume (10 thousand cubic meters/day)	11	7	61%
COD elimination volume (tons/year)	78	83	106%
COD elimination ratio (%)	N/A	92	N/A
BOD elimination volume (tons/year)	27,968	6,827	24%
BOD elimination ratio (%)	N/A	95	N/A
SS elimination volume (tons/year)	34,885	13,919	40%
SS elimination ratio (%)	N/A	96	N/A

Source: Individual subprojects

Note 1: The elimination rates are the comparisons of the water quality at the time of wastewater inflow and that of treated water, and are the mean values of each subproject.
Note 2: The actual values include the effects of the equipment constructed additionally using private funds.
Note 3: The above figures apply only to the subprojects in operation at the time of ex-post evaluation.
Note 4: The above figures do not include the BOD and SS values of 9) Zhumadian District Chemical General Works as they were not available.

(1) Effects of Individual Subprojects

1) Type 1: Wastewater Treatment Subprojects (See Attachment 3)

The amount of wastewater treated[16] and the rate of facility utilization[17] are indicators to determine whether or not the sewage treatment facilities have been fully operated and utilized. In Type 1, the amount of wastewater treated and rate of facility utilization in 2009 were all at least 80%; thus, the equipment was being operated/utilized efficiently at the time of ex-post evaluation. Nevertheless, there were sewage treatment facilities that had a low facility utilization rate for a few years since their inauguration. These are the cases in which the piping branch lines in the disposal areas were constructed after the completion of the facilities: in the 3) Sewage Treatment System Construction Project in Xuchang City, the rate of facility utilization was of the order of 30% for 2 years after the start of operation; and in the 11) Wastewater Treatment Project for Zhumadian District Chemical General Works, it was 50% for 1-2 years. In the 8) XinYang City Sewage Disposal Works Project, there are still areas where piping has yet to be laid down at present; thus the rate has not reached 100%.

An issue in relation to water quality is that part of the untreated sewage is discharged directly into

[16] Volume acceptable by a sewage disposal facility.
[17] Average daily disposal volume/equipment capacity.

rivers in ten-odd days during the summer when there are heavy downpours, thereby contributing to water quality pollution. This kind of situation occurs when the sewage volume exceeds the amount assumed for sunny days at once by a certain percentage because with the exception of the 3) Xhuchang Wastewater Treatment Plant, a combined drainage system, which drains out rainwater and sewage in the same piping, is utilized. Although the government recommends that this system be converted to a separate drainage system, problems such as construction expenses are hindering the conversion in old towns.

Thanks partly to the addition of privately funded equipment, the quality of the treated water in all the subprojects satisfies the Grade Pre-1 Discharge Standard for Urban Wastewater Treatment Facilities (Grade A or Grade B)[18].

2) Type 2: Factory Contaminant Source Treatment Subprojects (See Attachment 4)

Although the rate of facility utilization of the 6) Wastewater Treatment Project for Suiping County Paper Mill and 9) Wastewater Treatment Project for Zhumadian District Chemical General Works were satisfactory, those of the 5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group and 10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company were 48% and 44%, respectively, indicating an insufficient utilization of the facility's capacity. In the Louhe Pulp and Paper Making Group, the fact that the drainage volume had decreased by a large margin due to measures such as water saving and reuse of wastewater had an impact. In the Wuyang County Mingyu Salty and Chemical Group Company, of the 5 plants that had been targeted at the time of appraisal, only 1 remained as a target after the other small-scale plants were shut down on account of the structural adjustment of the industry. Furthermore, the government's policy prescribed that the manufacturing process be modified so that 70% of the industrial water would be reused in the production lines for recycled pulp. This also contributed to the reduction of wastewater.

As in Type 1, with the addition of wastewater disposal equipment through private funds, the COD concentration in the treated water conforms to the discharge standard of water pollutants for the paper industry[19] and the discharge standard of water-quality pollutants for synthetic ammonia plants[20].

[18] The contaminant concentrations prescribed in GB18918-2002 are as follows: COD-50mg/l (Class A), 60mg/l (Class B); BOD-10 mg/l (Class A), 20 mg/l (Class B); SS-10 mg/l (Class A), 20 mg/l (Class B)

[19] The contaminant concentrations prescribed in GB3544-2008 are as follows: COD-120 mg/l (recycled pulp), COD-150 mg/l (other pulp products).

[20] The contaminant concentration prescribed in GB13458 -2002 is COD-150 mg/l.

Fig.6 Wuyang County Mingyu Salty and Chemical Group Company

Fig. 7 Treated Water in Zhumadian District Chemical General Works

3.3.1.2 Water Quality in the Subproject Downstream Basin (COD Concentrations)

The monitoring sections of the subproject downstream basin under the jurisdiction of the Department of Environmental Protection of Henan Province are as follows. With the exception of No. 1, the other 5 locations are monitoring sections situated on the border between Henan Province and Anhui Province. With these sections being geologically distant from the subproject sites, the water quality at these locations is subject to the influence of domestic/industrial wastewater from numerous locations outside the coverage of the subprojects, as well as that of other water quality improvement projects. Consequently, as stated in the constraints during the evaluation study in segment 2.3, it is impossible to corroborate the correlation between the subprojects and changes in water quality in the monitoring sections, much less evaluate the effectiveness of this project in an accurate manner. In this segment, therefore, we intend to ascertain how the COD concentrations in the downstream monitoring sections of the subprojects fluctuated, and whether or not the COD concentration objectives set by the Chinese government at the time of appraisal were achieved.

Table 6 Monitoring Sections in Subproject Downstream Basin

No.	Name of Downstream Monitoring Section	Subproject	Rivers/water systems into which treated water flows
1	Jialuhe River Xihuaxian Dawangzhuang	1) Sewage Treatment System Construction Project in Zhengzhou City	Jialu river /Shaying river
2	Shayinghe River Shenqiuxian Zhidian	2) Sewage Treatment System Construction Project in Pingdingshan City	Zhan river/Sha river, Ying river, Shaying river

		3) Sewage Treatment System Construction Project in Xuchang City	Qingyi river/Qingni river, Shaying river
3	Huiji River Luyixian Dongsunying	4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	Wohe river/Huiji river
4	Quan River Shenqiuxian Lifen	5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group	South magou river/Hei river, Ni river, Quan river
5	Hong River Xincaibantai	6) Wastewater Treatment Project for Suiping County Paper Mill	Liwang river/Beiru river, Ru river, Hong river
		9) Wastewater Treatment Project for Zhumadian District Chemical General Works	Huangyou river/Suya lake, Hong river
		10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company	Hong river
		11) Sewage Treatment Project in Zhumadian City	Lianjiang river/Suya lake, Hong river
6	Huai River Huaibin Hydrologic Station	8) XinYang City Sewage Disposal Works Project	Shi river/ Main stream of the Huai River

(Unit: mg/l)

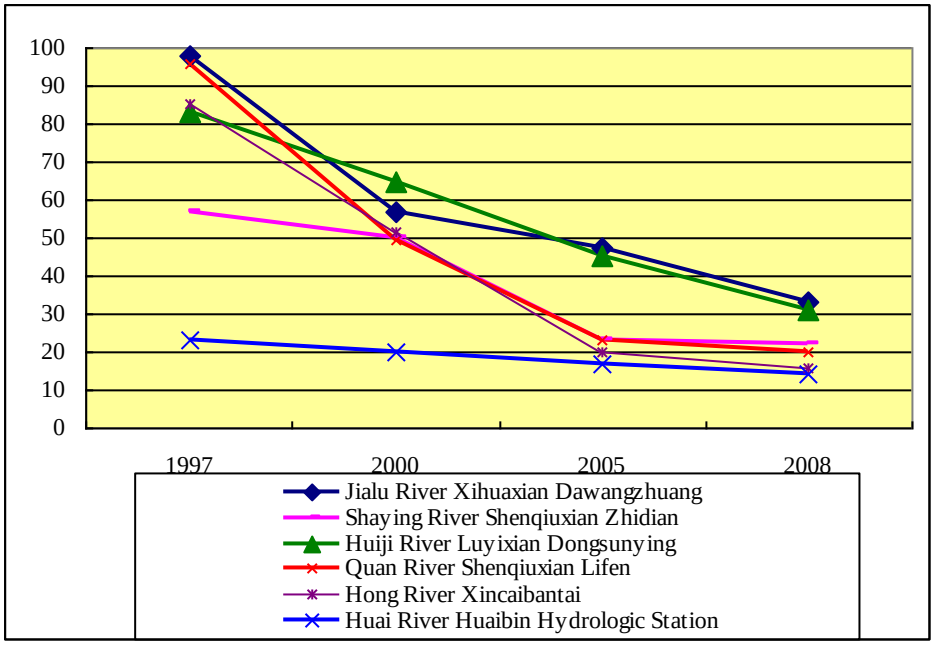


Figure 8 COD Concentrations in the Monitoring Sections in Subproject Downstream Basin

As shown in Figure 8, COD was improved in all 6 monitoring sections. The water quality at the Huai River Huaibin Hydrologic Station situated in the main stream of the Huai River improved to the extent where it is now potable. This can be regarded as the effects of not only this project but also the projects and policies for water quality improvement in the Huai River under the auspices of the Central and Henan Provincial Governments, as well as environmental measures taken by enterprises discharging pollutants[21, 22].

On the other hand, as shown in Table 7, the Hong River Xincaibantai and Huai River Huaibin Hydrologic Station where the only 2 locations that achieved the target values proposed by the Chinese government at the time of appraisal[23]. In spite of an attainment rate of 30%, if factors that adversely affect water quality such as population growth and economic development are taken into account, the fact that COD improved to 2008 levels is praiseworthy. In fact, in the cities and counties where the subprojects are located, their populations increased by approximately 6% between 1997 and 2009,

[21] Presidential Decree No.22 in the Environmental Protection Law of the People's Republic of China (December 26, 1989) stipulates that companies discharging contaminants should strive to prevent pollution by their own factories through technical innovations. If their contaminant discharge exceeds the standard prescribed by the government, they are required to pay discharge expenses pursuant to the regulations.

[22] The gross investment planned in the 9th~11th 5-year program (1996-2010) in the "Henan Huai Basin Water Quality Pollution Control Project" amounted to 22.1 billion yuan (403 projects).

[23] Since no specific numerical targets were set at the time of evaluation, it was decided that the COD values in the national surface water quality standard proposed in the "Henan Province Huai Basin Water Pollution Control Project and the 9th 5-year Plan" (1996-2000) were to be regarded as the target values. In 2002, the COD values in the national surface water quality standard were eased in China. Therefore, in the ""Henan Province Huai Basin Water Pollution Control Project and the 11th 5-year Plan" (2006-2010), downwardly-revised figures from target values at the time of evaluation are listed as the targets for the year 2010.

with the local and industrial gross products soaring by 3 times and 4 times, respectively[24] resulting in an increased strain on the environment.

Table 7 COD Concentrations in the Monitoring Sections in Subproject Downstream Basin

(Unit: mg/l)

No.	Downstream Section	1997	2000	2005	2008	Target concentration for 2000 at the time of appraisal
1	Jialu River Xihuaxian Dawangzhuang	98	56.6	47.6	33.3	20 or below
2	Shaying River Shenqiuxian Zhidian	57.1	49.9	22.9	22.1	20 or below
3	Huiji River Luyixian Dongsunying	83.2	64.8	45.5	31.3	25 or below
4	Quan River Shenqiuxian Lifen	95.9	49.5	23.4	20.2	20 or below
5	Hong River Xincaibantai	85.1	51.7	19.8	15.6	20 or below
6	Huai River Huaibin Hydrologic Station	23.3	20	17.1	14.2	15 or below

Source: Department of Environmental Protection of Henan Province

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

At the time of appraisal, the financial internal rates of return of the 1) Sewage Treatment System Construction Project in Zhengzhou City, 2) Sewage Treatment System Construction Project in Pingdingshan City, and 3) Sewage Treatment System Construction Project in Xuchang City were calculated, with the revenues from sewage disposal and water recycling as profits, and expenses for construction, sewage treatment, maintenance, and taxes, as expenditures. As a result, the rates of return were -2.45~3.03% (project life 30 years), 2.17% (23 years), and 2.1% (22 years), respectively. Of these, negative figures were obtained from the recalculation of the FIRR of both the 1) Sewage Treatment System Construction Project in Zhengzhou City and 3) Sewage Treatment System Construction Project in Xuchang City. This is attributable to the fact that maintenance and management expenses ended up being 1.17 times and 2.35 times more than the initial estimates, respectively. In the 3) Sewage Treatment System Construction Project in Xuchang City, construction expenses and taxes surpassed the initial estimates by a significant margin.

3.3.2 Qualitative Effects

See 3.4.1

In conclusion, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

[24] According to the city/county governments that have jurisdiction over each subproject.

3.4 Impact

3.4.1 Intended Impact (Enhancement of Living Conditions of the Local Residents in the Subproject Downstream Basin)

In this ex-post evaluation survey, we conducted a questionnaire survey among the beneficiaries with the aim being to ascertain how the farmers and residents in the subproject downstream basin recognize the changes in water quality, and how the improvement of water quality changed their living conditions. The subjects of the survey were 125 persons in total: 32 farmers and 28 residents living in the downstream basin of the Heihe River, a confluent of the Nanmagou River into which treated wastewater from the Louhe Pulp and Paper Making Group is discharged, and 33 farmers and 32 residents living in the downstream basin of the Ru River, into which the treated wastewater from the Suiping County Paper Mill is discharged.

(1) Changes in Water Quality

Of the farmers living in the downstream basin of the Heihe River, 97% responded that "water quality improved" from before the implementation of the project, and recognized that the color of the river changed from black to yellowish green. As opposed to the 60% who had merely regarded the river water as useless sewage before project implementation, 69% are now considering use of river water as agricultural water after the project. In the downstream basin of the Ru River, the 88% of the farmers replied that "the water quality improved" from before the implementation of the project, and recognized that the color of the river changed from either black or red to green. Those who answered that they could use the river water after the project for scenic purposes in addition to agricultural water reached 46%. These results indicate that the farmers living in both basins were aware of the improvement in water quality, thereby leading to further utilization of the rivers.

Fig.9 South magou River

Fig.10 Heihe River

(2) Changes in the Agricultural Environment

The main agricultural product of the survey area is wheat, followed by corn and soybeans. Agricultural water is drawn either from groundwater or rivers. In the downstream basin of the Heihe River, 90% responded that the water quality affects the quality/yield of the produce either "to a certain

extent" or "significantly," and 88% said that the yield increased either "somewhat" or "greatly" after the project. The ratios were 64% and 97%, respectively, in the downstream basin of the Ru River. Consequently, a large number of farmers evaluated that the changes in river water quality had a relatively favorable impact on their agricultural earnings.

(3) Changes in Living Conditions

In the downstream basin of the Heihe River, 86% of the residents responded that the changes in the water quality either "brought some advantages" or "brought tremendous advantages" to their life, and 50% noticed an "improvement in the scenery." In the downstream basin of the Ru River, the ratios were 88% and 53%, respectively. Before the implementation of the project, only 40% (Heihe River) and 41% (Ru River) visited the respective rivers for some purposes, whereas the ratios increased to 93% (Heihe River) and 97% (Ru River) after the project. The purposes of their visits also varied, including swimming, walking, fishing, and so forth. In the downstream basin of the Ru River, 50% of the residents responded that the "foul odor has disappeared." This is believed to be because the black fluid discharged from the Suiping County Paper Mill has stopped after the project.

Fig.11 Beneficiary Survey

Fig.12 Ru River

In light of the paucity of the sample number and mixed levels of knowledge and interest in the rivers, the results of this beneficiary survey do not necessarily represent the beneficiaries as a whole. Nevertheless, it is apparent that many of the beneficiaries in the subproject areas recognize an improvement in their agricultural environment and living conditions on account of the improvement in water quality.

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

The environmental measures planned in Type 1 were measures against foul odors, noise, and disposal of sludge, a by-product in the sewage treatment process. With regard to foul odors and noise, measures such as an installation of separation spaces including green belts, a ban on housing construction within a radius of 200m from the disposal facilities, and installation of noise/vibration

abatement systems were taken. Initially, the polluted sludge had been scheduled to be used as compost after being dried. However, it was only implemented in the 3) Sewage Treatment System Construction Project in Xuchang City, with the rest being buried in waste disposal sites without being dried or burned. The implementation bodies of each subproject have not indicated any problems pertaining to the current treatment method.

With regard to Type 2, JICA's appraisal document did not specify any environmental mitigation measures. On the basis of planning by the Chinese side, appropriate measures such as measures against foul odors, noise, air pollution, and disposal of solid waste were taken, and no environmental problems have occurred. The activated sludge generated during the sewage treatment process has been reconverted to resources as fertilizers and additives for brick and packing paper, which were either given away for free or sold.

3.4.2.2 Land Acquisition and Resettlement

At the time of appraisal in 1997 and 1998, the resettlement of residents was not planned. With a change in the loan contract in 2002, 8 residents from 2 households became resettlement targets in the 8) XinYang City Sewage Disposal Works Project. According to the implementation body of the subproject, resettlement procedures were processed without incident, and the residents' livelihood was improved after the resettlement. With the exception of the 4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project and 9) Wastewater Treatment Project for Zhumadian District Chemical General Works, land for project sites measuring a total area of 2551 ha, worth 92.66 million yuan in total, were acquired in 8 subprojects.

Considering the nature of the project, improvement of water quality, impact can only be confirmed in the vicinity of the subproject sites and water discharge locations, and the further one moves away from the discharge locations, the less the impact can be felt. Therefore, since the results of the beneficiary survey substantiated that this project contributed to the improvement of living conditions of the local residents, albeit in a limited area, and there were no other negative impacts, we can conclude that the project has been effective to a certain extent.

3.5 Sustainability (Rating: a) (See Attachment 5)

3.5.1 Structural Aspects of Operation and Maintenance

(1) Executing Agency

At the time of appraisal (1997), the Henan Provincial Government established a liaison office as a management office of Japanese Loan for Environmental Protection Project within which the Planning Committee, Department of Environment Protection, and Foreign Trade and Economy Committee of the province participated. It was decided that the subprojects would be carried out by each implementation body under the supervision of the said liaison office. At the time of ex-post evaluation,

the Foreign Trade and Economy Department of the Development and Reform Committee[25] of the province, functioning as the said liaison office, supervised the operation status of the subprojects. The environmental supervisory organization is the Department of Environment Protection of the province comprising of the Law and Regulation Department, Planning Finance Department, Public Relations and Education Department, and Discipline Inspection Office. It is responsible for the formulation of environmental protection plans, environmental observation and administration. Both organizations are regularly inspect and direct the subprojects, and thus have no systematic problems as the supervisory institutions.

(2) Implementation Bodies of the Subprojects

In many cases, the implementation bodies and organization names have changed since the time of appraisal (See Attachment 6).

At the time of ex-post evaluation, state-owned enterprises, where the state was responsible for 100% of the funds invested, are limited to the 1) Zhongyuan Environment Protection Company Limited, 2) Pingdingshan Sewage Purification Company, and 8) XinYang City Sewage Disposal Limited Liability Company. The majority were reorganized into publicly traded corporations between 2003 and 2008 as an extension of the reform of state-owned companies that had started in the 1990s. The 3) Xhuchang Ruibeiqia Purification Water Business Limited Company and 11) Zhumadian City Sewage Disposal Limited Liability Company were privatized in 2006, thereby constructing a new mechanism for corporate management. The Ruibeiqia Group Corporation, a stockholder of the 3) Xhuchang Ruibeiqia Purification Water Business Limited Company, is a listed enterprise and owns 6 subsidiaries engaged in real estate, mining, waterworks, expressways, hotels, and so forth. One hundred percent of the investment in the 8) Zhumadian City Sewage Disposal Limited Liability Company is from the Zhumadian City Country Business Waterworks Group Corporation, which engages in businesses such as water supply projects and mineral water production. According to the executing agency, both companies are supervised pursuant to the corporation law, and thus have no systematic problems. Incidentally, the 4) Kaifeng Jinkai Chemical Limited Liability Company went bankrupt in December 2009.

3.5.2 Technical Aspects of Operation and Maintenance

(1) Executing Agency

The Department of Environment Protection, an environment supervisory organization, regularly conducts inspections of the operation status of the subproject sites and contaminant discharge volume. The drainage outlets of each subproject are installed with automated 24-hour online monitoring devices belonging to the Environment Agency. Furthermore, the department, along with the province, 9 provincial cities, and environment monitoring stations positioned in all counties, carries out

[25] The name was changed from the Planning Committee after the duties of the Economy and Trade Committee were integrated in 2003.

monitoring, water quality inspection, direction, and supervision every month.

(2) Implementation Bodies of the Subprojects

In all of the implementation bodies whose information was obtained, technical assessment criteria for operation and maintenance have been established, and personnel who fulfill those criteria are stationed. With established training systems for technical improvement, there appears to be no problem with respect to the maintaining of technical levels and acquisition of new skills. According to the executing agency, technical standards in relation to operation and maintenance are high, and management discipline is appropriate. Judging from the operation status to date, it is safe to say that technical abilities are at the proper levels.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Executing Agency

They were not subjected to assessment at this time as they were not directly related to the financial sustainability of the subprojects.

(2) Implementation Bodies of the Subprojects

With regard to the finances in Type 1, it was indicated at the time of appraisal (1997) that the operation and maintenance structure should be reviewed and the fee structure revised since the fee rates for sewage disposal were low, and thus the maintenance and operation cost per unit could not be afforded. The sewage disposal fees[26] in Henan Province were revised in 2004 to the current 0.65 yuan for general households, 1 yuan for commercial establishments, and 0.8 yuan for industrial plants—25~333% higher than at the time of appraisal. The actual operation and maintenance fees per square meter vary from 0.31 to 2.21 yuan depending on the sewage disposal facility and fiscal year, but the periods when the sewage disposal fees fell below the unit price of operation and maintenance were limited to those when the facility operation rate was low. Consequently, as long as equipment is fully operated and 100% of the sewage disposal fees are collected, the current standard poses no problem.

On the other hand, from the perspective of efficient operation management, the administrative structure of the current sewage disposal fees still has some room for improvement. Due to their highly public nature, sewage disposal projects require long-term and stable guarantees by the government. On the basis of this understanding, sewage disposal fees are collected by other proxy organizations and paid to the government, which then allocates from the budget necessary maintenance and operation expenses annually to the sewage disposal facilities. Therefore, the incentive for operation improvement in the sewage disposal facilities tends to be suppressed. In the future, the government is

[26] After the provincial government holds a public hearing participated in by local residents, the city/county governments determine the sewage disposal fees on the basis of the base amounts that set the directed prices; where after the provincial government gives its approval to the pricing.

expected to improve the administrative structure of sewage disposal fees so that the implementation bodies can further advance the streamlining of operation and maintenance tasks, as well as reducing costs. It is also desirable that the implementation bodies make management efforts to diversify its revenues through methods such as cost reduction, sale of recycled water, conversion of sludge into resources and so forth.

Of the 2006-2008 financial indicators (See Attachment 7) of implementation bodies in Type 2, the current ratio is low, suggesting low short-term solvency, but the rest are generally favorable. In the 10) Wuyang yinghe paper Company Limited, the profit ratio of total capital and the net profit to sales ratio were negative in 2008. This is probably due to accruing financial expenses in 2008, when sales fell slightly below 2007 levels that were 112% higher than 2006. Although a questionnaire survey with the said company did not refer to financial problems, thus implying no major financial problems, the executing agency is required to monitor its financial status hereafter as well.

3.5.4 Current Status of Operation and Maintenance

It was confirmed that operation and maintenance is conducted in conformity with the regulations in all operating subprojects. In Type 1 subprojects, backup facilities were installed to ensure that sewage disposal is not affected in case of a breakdown. As mentioned above, measures against sewage during heavy rains in the summer is an issue for disposal facilities adopting the combined sewer system and so feasible remedial plans should be considered.

In Type 2 subprojects, conversion into cleaner production is in progress. At the 5) Henan Yinge Industrial Investment Company Limited, an oxidation ditch and anaerobic equipment were added to the effluent treatment facility, whereby the alkali collection rate exceeded 89%. Moreover, in collaboration with a Japanese corporation, the production of special paper is being attempted using water and energy-saving methodology. The 6) Zhumadian District Baiyun Paper Limited Company passed a cleaner production test carried out by the Department of Environment Protection of Henan Province in 2004, and in 2009, was approved as an energy-saving science technology innovation model enterprise and a water-saving enterprise. The 9) Henan Junhua Development Stock Limited Company acquired the ISO9001 International Quality Management Standard and ISO14001 International Environment Management Standard in succession.

In conclusion, no major problems have been observed in the operation and maintenance system; therefore sustainability of the project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the Huai River Basin Water Quality Improvement Policy, a priority issue for the government, the necessity of the project is particularly high in the Huai River Basin in Henan Province located in the most upstream section of the river. This project aims to contribute to the improvement of water quality by installing wastewater treatment equipment in principal cities and factories, i.e. pollution sources.

Therefore, the relevance with the policy is high. On the other hand, there have been indications that the planning, including the setting of goals and selection of subprojects as a Japanese ODA loan project left something to be desired. Despite the satisfactory achievements of each operating subproject, on account of the inappropriateness of project planning itself (e.g. the loftiness of set goals) the effectiveness of the project as a whole remained fair. Since the operating facilities are being managed and maintained in a proper manner without any structural, technical and financial difficulties, the future sustainability of the project is believed to be secured.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Since most of the subprojects utilize the combined sewer system in which rainwater and sewage are drained out in the same piping, the sewage volume during heavy rains exceeds the disposal capacity of the treatment facilities. This results in the effluence of untreated wastewater into the rivers. In order to prevent water quality pollution because of this, the government is expected to put further efforts in constructing separate pipe systems to encourage a shift from the combined sewer system to a separate piping system so that sewage disposal facilities can function to the fullest of their capabilities.

(2) In order to facilitate the efficient operation and management of the sewage treatment facilities themselves, the implementation bodies should make efforts to improve the administrative structure of the sewage disposal fees by the government. At the same time, maintenance management of each facility should be streamlined while reducing expenses. In addition, they should strive to diversify their revenue sources in order to increase potential for independence by selling recycled water, converting sludge into resources and other measures.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

(1) In this project, despite excellent operation management and manifestation of effects even at the subproject level, since the project objective was proposed to be “water quality improvement in the Huai River Basin in Henan Province,” which was a national-level, long-term and expansive goal, the project fell short of achieving the objective, albeit contributing to the improvement of the water quality to a certain extent. As in this case, when implementing a project comprising of multiple subprojects or one that supports an entire sector, it is important to establish a clear project objective that is appropriate and feasible, with the scope of executable subprojects as a given condition. Since it is impossible to hope for the attainment of the goal without relevant planning, it is requisite to further clarify a path to achieve the goal, and fully consider the expected effects and influence of external

factors. In cases where a loan contract identifies a subproject, structures and mechanisms that can swiftly respond to any replacements at the implementation stage should be in place. Meanwhile, in cases where flexible project planning in which a loan contract does not identify a subproject is required, it is desirable to conduct prudent and flexible operation management that allows adequate adjustment of the subproject at the implementation stage.

(2) This ex-post evaluation failed to clarify the grounds for subproject selection at the time of appraisal. Granted that there were external factors involved such as policies and the market, it cannot be denied that the selection of subprojects was somewhat problematic as proven by the fact that a drainage facility was removed less than 10 years after completion. At appraisal, it is important to select subprojects while taking into full account their relevance, strategy and sustainability as Japanese ODA loan projects. As targets of Japanese ODA loan environmental projects, it is presumed to be more suitable to select subprojects related to infrastructure development that are higher in public nature such as sewage treatment projects, rather than ones that are susceptible to policies and the market.

(3) In these sewage treatment subprojects, construction by yen loans were limited to disposal facilities and sewage trunk lines, whereas the majority of branch line constructions were executed by the local governments. Due to the delay in financing by local governments, the construction of sewage branch lines lagged behind the schedule in some of the subprojects, thus suppressing the rate of facility utilization after their completion. It is expected that combining piping and sewage treatment facilities as an aggregate target of Japanese ODA loans will enhance the facility utilization rate, thereby improving efficiency of the project. This point should be noted in formulating project plans.

Concluded

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	See Attachment 1	See Attachment 1
2. Project Period	(I)September 1997~December 2000 (40 months) (II) December 1998~December 2001 (49 months)	(I)September 1997~December 2006 (112 months) (II) December 1998~June 2008 (115 months)
3. Project Cost (I) Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate Project Cost (II) Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate **Project Cost (1)＋(2)** Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion	(I) 4.945 billion yen 10.881 billion yen (800 million yuan) 15.826 billion yen 4.945 billion yen 1 yuan=13.6 yen (As of February 1997) (II) 7.230 billion yen 9.120 billion yen (570 million yuan) 16.350 billion yen 7.230 billion yen 1 yuan=16 yen (As of May 1998) 12.175 billion yen 20.001 billion yen (1.370 billion yuan) 32.176 billion yen 12.175 billion yen	(I) 3.956 billion yen 10.645 billion yen (763 million yuan) 14.601 billion yen 3.956 billion yen 1 yuan=13.9479 yen (Average of 1999~2004) (II) 6.654 billion yen 8.695 billion yen (623.39 million yuan) 15.349 billion yen 6.654 billion yen 1 yuan=13.9479 yen (Average of 1999~2004) 10.610 billion yen 19.340 billion yen (1.386.58 billion yuan) 29.950 billion yen 10.610 billion yen

Attachment 1 Subproject Outputs

Type 1: Sewage Treatment Subprojects

Subproject Name	Original	Actual
1) Sewage Treatment System Construction Project in Zhengzhou City	(1) Inflow of 400 thousand tons/day (2) 38.9km of sewer culvert laid	Completed almost as scheduled. Later downsized. (1) Inflow 400 of thousand tons/day (2) Sewer culvert: 38.9km
2) Sewage Treatment System Construction Project in Pingdingshan City	(1) Inflow of 150 thousand tons/day (2)52km of sewer culvert laid	Almost as scheduled (1) Inflow of 150 thousand tons/day (2) Sewer culvert: 52km
3) Sewage Treatment System Construction Project in Xuchang City*	(1) Inflow of 80 thousand tons/day (2) Advanced recycled waterprocessing: 20 thousand cubic meters (3) Sewer culvert: 12.15km	(1) Inflow of 80 thousand tons/day(As planned) (2) Advanced recycled waterprocessing: 20 thousand cubic meters (Cancelled) (3) Sewer culvert: 68.33km (Added)
8) XinYang City Sewage Disposal Works Project	(2002 Plan) (1) Inflow of 100 thousand tons/day (2) Relay pumps: 1 location (3) 63km of sewer culvert laid	Almost as planned (1) Inflow 100 thousand tons/day (3) Sewer culvert: 63km
11) Wastewater Treatment Project for Zhumadian District Chemical General Works	(1) Inflow of 100 thousand tons/day (2) Expansion of existing sewer networks. Water intake area: 70% → 75%	Almost as planned (1) Inflow of 100 thousand tons/day (2) Sewer culvert: 8.71km

Type 2: Factory Contaminant Source Treatment Subprojects

Subproject Name	Original	Actual
4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	(1) Arsenic drainage treatment (2) Cyanogen drainage treatment (3) High concentration nitric acid drainage treatment (4) Sulfuric acid drainage treatment	Completed almost as planned. Later removed. (1) Arsenic drainage treatment, removed in 2003 (2) Cyanogen drainage treatment, removed in 2004 (3) High concentration nitric acid drainage treatment, removed in 2004 (4) Sulfuric acid drainage treatment, removed in 2008
5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group	(1) Pulp production equipment (34 thousand tons/year) (2) Equipment for environmental measures etc. (Alkali collection, drainage treatment equipment: 25 thousand tons/year)	Almost as planned (1) Pulp production equipment (34 thousand tons/year) (2) Equipment for environmental measures etc. (Alkali collection 36,000 cubic meters/year, drainage treatment equipment: 25 thousand tons/year)

6) Wastewater Treatment Project for Suiping County Paper Mill*	(1) Pulp production equipment: 20 thousand tons/year (2) Equipment for environmental measures etc. (Alkali collection, drainage treatment equipment: 30 thousand tons/day)	(1) Pulp production equipment 34 thousand tons/year (Expanded) (2) Print paper manufacturing equipment: 50 thousand tons/year (Added) (3) Environmental measure equipment (Almost as planned)
9) Wastewater Treatment Project for Zhumadian District Chemical General Works	(1) Ammonia collection equipment: 2100 cubic meters/year (2) Cooling water recycling equipment etc: 8000 cubic meters/hour (3) Drainage treatment equipment:1000 cubic meters/hour	Almost as planned (1) Ammonia collection equipment: 2100 cubic meters/year (2) Cooling water recycling equipment etc: 8000 cubic meters/hour (3) Drainage treatment equipment: 1000 cubic meters/hour
10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company*	(1) Recycled paper treatment equipment: 36 thousand tons/year (2) Drainage treatment equipment: 30 thousand tons/day (3) White fluid treatment equipment: 6600 tons/day	(1) Recycled paper treatment equipment: 34 thousand tons/year (Almost as planned) (2) Drainage treatment equipment:30 thousand tons/day (Almost as planned) (3) White fluid treatment equipment (Cancelled) (4) Cardboard production equipment: 60 thousand tons/year (Added)

Source: Implementation bodies for individual subprojects.
Note: * subprojects with changes in outputs.

Attachment 2 Subproject Periods

Subproject Name	Original	Actual	Ratio	Evaluation
(I)	September 1997~December 2000 (40 months)	September 1997~December 2006 (112 months)	280%	c
1) Sewage Treatment System Construction Project in Zhengzhou City	September 1997~December 2000 (40 months)	September 1997~December 2003 (76 months)	190%	c
2) Sewage Treatment System Construction Project in Pingdingshan City	September 1997~December 2000 (40 months)	September 1997~June 2003 (70 months)	175%	c
3) Sewage Treatment System Construction Project in Xuchang City	September 1997~December 2000 (40 months)	September 1997~December 2006 (112 months)	280%	c
4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	September 1997~December 2000 (40 months)	September 1997~October 1999 (26 months)	65%	a
(II)	December 1998~December 2001 (49 months)	December 1998~June 2008 (115 months)	235%	c
5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group	December 1998~June 2001 (31 months)	December 1998~November 2006 (96 months)	310%	c
6) Wastewater Treatment Project for Suiping County Paper Mill	December 1998 ~June 2001 (31 months)	December 1998~July 2004 (68 months)	219%	c
8) XinYang City Sewage Disposal Works Project	March 2002~December 2003 (22 months)	March 2002~April 2005 (38 months)	173%	c
9) Wastewater Treatment Project for Zhumadian District Chemical General Works	December 1998~December 2000 (25 months)	December 1998~June 2008 (102 months)	408%	c
10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company	December 1998~October 2000 (23 months)	December 1998~October 2005 (83 months)	361%	c
11) Wastewater Treatment Project for Zhumadian District Chemical General Works	December 1998~December 2001 (37 months)	December 1998~August 2004 (69 months)	186%	c

Source: Implementation bodies for individual subprojects.
Note: The plan for the XinYang City Sewage Disposal Works Project is that at the time of L/A in 2002.
Note: Definition of completion - Approval of completion inspection.

Attachment 3 Main operation and effect indicators of subprojects (Type 1)

Type 1: Sewage Treatment Subprojects

Subproject	Indicators/Original	Actual (2009)
1)Sewage Treatment System Construction Project in Zhengzhou City	Sewage treatment volume: 400 thousand tons/day Treatment population: 1.6 million people COD: 36,000 tons/year BOD: 19,217 tons/year SS: 28,087 tons/year	Sewage treatment volume: 396 thousand tons/day (99%) Treatment population: 1 million people (63%) Facility utilization rate: 99% COD: 57,233 tons/year (159%) BOD: 26,820 tons/year (140%) SS: 43,430 tons/year (155%)
2)Sewage Treatment System Construction Project in Pingdingshan City	Sewage treatment volume: 150 thousand tons/day Treatment population: 650 thousand people COD: 11,500 tons/year BOD: 4,754 tons/year SS: 12,848 tons/year	Sewage treatment volume: 150 thousand tons/day (100%) Treatment population: 720 thousand people (111%) Facility utilization rate: 100% COD: 22,858 tons/year (199%) BOD: 7,068 tons/year (149%) SS: 22,699 tons/year (177%)
3) Sewage Treatment System Construction Project in Xuchang City	Sewage treatment volume: 80 thousand tons/day Treatment population: 387 thousand people COD: 10,000 tons/year BOD: 10,129 tons/year SS: 12,045 tons/year	Sewage treatment volume: 120 thousand tons/day (150%) Treatment population: 490 thousand people (127%) Facility utilization rate: 99.5% COD: 15,768 tons/year (157%) BOD: 8,332 tons/year (82%) SS: 8,322 tons/year (69%)
8) XinYang City Sewage Disposal Works Project	Sewage treatment volume: 100 thousand tons/day Treatment population: 300 thousand people COD: 29,560 tons/year BOD: 5,475 tons/year SS: 6,250 tons/year	Sewage treatment volume: 9.537 thousand tons/day (95%) Treatment population: 28.7 thousand people (96%) Facility utilization rate: 95.37% COD: 8,038 tons/year (27%) BOD: 3,843 tons/year (70%) SS: 4,188 tons/year (67%)
11) Wastewater Treatment Project for Zhumadian District Chemical General Works	Sewage treatment volume: 100 thousand tons/day Treatment population: 17.12 thousand people COD: 11,680 tons/year BOD: 6,250 tons/year SS: 8,030 tons/year	Sewage treatment volume: 80 thousand tons/day (80%) Treatment population: 240 thousand people (140%) Facility utilization rate: 80% COD: 11,200 tons/year (96%) BOD: 4,730 tons/year (76%) SS: 6,100 tons/year (78%)

Source: Implementation bodies for individual subprojects.
Note: Annual elimination quantities for COD, BOD and SS.
Note: Figures in brackets are plan ratios.

Attachment 4 Main operation and effect indicators of subprojects (Type 2)

Type 2: Factory Contaminant Source Treatment Subprojects

Subproject	Indicators/Original	Actual (2009)
4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	Arsenic (discharge amount): 1 ton/year Cyanogen(discharge amount): 2.1 tons/year	(2000~2003 only) Arsenic: 18.73 tons/year Cyanogen: 79 tons/year COD: 946.9 tons/year Sulfuric acid: 291.6 tons/year Nitric acid: 525.2 tons/year
5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group	Sewage treatment volume: 30 thousand tons/day COD: 19,831 tons/year BOD: 6,026 tons/year SS: 12,736 tons/year Production-per-unit COD discharge amount: 62.7kg/ton	Sewage treatment volume: 1.21 thousand tons/day (40%) Facility utilization rate: 48.4% COD: 7,217 tons/year (36%) BOD: 1,803 tons/year (30%) SS: 3,698 tons/year (29%) Production-per-unit COD discharge amount: 4.03kg/ton
6) Wastewater Treatment Project for Suiping County Paper Mill	Sewage treatment volume: 30 thousand tons/day COD: 17,690 tons/year BOD: 5,670 tons/year SS: 14,561 tons/year	Sewage treatment volume: 1.8 thousand tons/day (60%) Facility utilization rate: 72% COD: 12,877 tons/year (73%) BOD: 4,087 tons/year (72%) SS: 8,344 tons/year (57%) Production-per-unit COD discharge amount: 60kg/ton (2003) 12.5kg/ton (2009)
7) Wastewater Treatment Project for Feiyafei Paper Industry Company	COD: 45,555 tons/year BOD: 10,900 tons/year SS: 13,527 tons/year	Cancelled
9) Wastewater Treatment Project for Zhumadian District Chemical General Works	Sewage treatment volume: 2.4 thousand tons/day COD: 1,106 tons/year Ammonia nitrogen: 2,289 tons/year SS: 590 tons/year Cyanogen: 3 tons/year Production-per-unit COD discharge amount: 0.1kg/ton	Sewage treatment volume: 2.6 thousand tons/day (108%) Facility utilization rate: 100% COD: 2,452 tons/year (222%) Arsenic (discharge amount): 7.4 tons/year Cyanogen (discharge amount): 0.03 tons/year Production-per-unit COD discharge amount: 0.068kg/t
10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company	Sewage treatment volume: 30 thousand tons/day COD: 60,243 tons/year BOD: 16,272 tons/year SS: 7,588 tons/year	Sewage treatment volume: 1.320 thousand tons/day (44%) Facility utilization rate: 44% COD: 2,814 tons/year (4.7%) BOD: 937 tons/year (58%) SS: 1,877 tons/year (25%) Production-per-unit COD discharge amount: 25.38kg/ton (2005) 4.76kg/ton (2009)

Source: Implementation bodies for individual subprojects.
Note: Annual elimination quantities for COD, BOD and SS.
Note: Figures in brackets are plan ratios.

Attachment 5 Evaluation of Sustainability

(1) Criteria for Rating

Executing Agency	Criteria
Structural	-Is the regime well-organized and are the personnel well-placed for supervising the subprojects? -Is the executing agency in good relationship with the subproject implementation bodies for incessant close communication? -Is the monitoring system well-established on the basis of environmental regulations?
Technical	-Are the personnel of Environment Protection Department well-placed and is their skill upgraded to the level to properly supervise the subprojects?
Financial	-Are the above activities financially backed up to a sufficient extent?

Subprojects	Criteria
Structural	-Is the regime well-organized for operation and maintenance (for decision-making)? -Is there a possibility of being privatized? If so, is there a possibility that the sustainability of the subprojects is affected?
Technical	-Are the personnel kept at an appropriate level for operation and maintenance? -Are the competent personnel having the technical skill for operating equipment well-placed? -Is a technical training system fulfilled for operation and maintenance? Is any training actually put in practice? -Is the operation manual available? And is it actually utilized? -Are the results of the inspections properly record and kept in good conditions?
Financial	-Are the profit and loss well-balanced? -Is the system to collect charges established in the manner to recover the cost? -In case the project is in deficit operation, is any governmental subsidy given, and is there no problem in carrying on operation from financial aspects?
Maintenance & management	-Is the equipment ready to display its performance? -Is there no problem in maintenance activities, for instance, on the procurement of spare parts? -Is there no problem in having maintenance at regular intervals? -Has there been no problem in troubleshooting?

(2) Rating Results

Supervisory institution and subprojects	Evaluation items				Results	
	Structure	Technique	Finance	Maintenance	Rating	Score
Supervisory institution（EA）：Henan Provincial Governm	a	a	-	-	a	3
1) Sewage Treatment System Construction Project in Zhengzhou City	a	a	a	a	a	3
2) Sewage Treatment System Construction Project in Pingdingshan City	a	a	a	a	a	3
3) Sewage Treatment System Construction Project in Xuchang City	a	a	a	a	a	3
4) Kaifeng Chemical Fertilizer Plant Waste Water Synthetic Treatment Project	Bankruptcy				c	1
5) Wastewater Treatment Project for Louhe Pulp and Paper Making Group	a	a	a	a	a	3
6) Wastewater Treatment Project for Suiping County Paper Mill	a	a	a	a	a	3
8) XinYang City Sewage Disposal Works Project	a	a	a	a	a	3
9) Wastewater Treatment Project for Zhumadian District Chemical General Works	a	a	a	a	a	3
10) Wastewater Treatment Project for Wuyang County Mingyu Salty and Chemical Group Company	a	a	b	a	b	2
11) Wastewater Treatment Project for Zhumadian District Chemical General Works		a	a	a	a	3

Average: 2.7
Overall rating: a

<Method of Rating>
1. A comparison is made between the original and actual in each subproject to figure out a sub-rating (the subproject cancelled is excluded).
2. The average of the total sub-ratings thus obtained is made as an overall rating.
3. Scores below a decimal point are taken up on the following basis:
   a: Not less than 80% (not less than 2.4)
   b: Not less than 50% to less than 80% (not less than 1.5 to less than 2.4)
   c: Less than 50% (less than 1.5)

Attachment 6 Subproject Implementation Bodies

No.	At the time of appraisal	At the time of ex-post evaluation
1)	Zhengzhou City's Wangxinzhuang Wastewater Treatment Plant	Zhongyuan Environmental Protection Company Limited
2)	Pingdingshan Sewage Purification Company	No change
3)	Xhuchang Wastewater Treatment Plant	Xuchang Rebecca Water Industry Company Limited
4)	Kaifeng Chemical Fertilizer Plant	Kaifeng Jinkai Chemical Company Limited
5)	Luo River Yinghe Paper Company Limited	Henan Yinge Industrial Investment Company Limited*
6)	Suiping Country PaperMaking Mill	Zhumadian City Baiyun Paper Company Limited *
8)	Xinyang City Sewage Treatment Company Limited	No change
9)	Zhumadian District Chemical Factory	Henan Junhua Development Company Limited
10)	Wuyang Mingyu Salt Chemical Group Corp Second Papermaking Mill	Wuyang Yinghe Paper Company Limited
11)	Zhumadian City Sewage Treatment Company Limited	Zhumadian City Sewage Treatment Company Limited

* Only the organization name was changed.

Attachment 7 Financial Indicators in Type 2

5) Henan Yinge Industrial Investment Company Limited

	2006	2007	2008
Profit ratio of total capital (%)	6.1%	5.0%	6.2%
Percentage of gross profit on sales (%)	16.9%	17.6%	15.4%
Net income to sales (%)	10.5%	7.4%	8.8%
Tota asset turnover (times)	0.6	0.7	0.7
Current ratio (%)	80.0%	77.8%	98.6%
Equity ratio (%)	31.8%	32.4%	46.8%

Source: Henan Yinge Industrial Investment Company Limited

6) Zhumadian City Baiyun Paper Company Limited

	2006	2007	2008
Profit ratio of total capital (%)	2.4%	2.6%	2.0%
Percentage of gross profit on sales (%)	13.4%	11.2%	9.6%
Net income to sales (%)	3.3%	3.1%	2.9%
Tota asset turnover (times)	0.7	0.8	0.7
Current ratio (%)	67.7%	95.3%	96.3%
Equity ratio (%)	24.1%	25.9%	20.3%

Source: Zhumadian City Baiyun Paper Company Limited

9) Henan junhua development Company Limited

	2006	2007	2008
Profit ratio of total capital (%)	6.1%	7.4%	3.1%
Percentage of gross profit on sales (%)	15.8%	20.6%	10.8%
Net income to sales (%)	7.2%	10.2%	4.8%
Tota asset turnover (times)	0.8	0.7	0.6
Current ratio (%)	51.9%	42.8%	57.0%
Equity ratio (%)	19.6%	36.9%	31.6%

Source: Henan junhua development Company Limited

10) Wuyang yinghe paper Company Limited

	2006	2007	2008
Profit ratio of total capital (%)	1.8%	5.0%	-1.2%
Percentage of gross profit on sales (%)	9.0%	6.4%	9.0%
Net income to sales (%)	3.8%	5.1%	-1.6%
Tota asset turnover (times)	0.5	1.0	0.8
Current ratio (%)	78.6%	153.3%	117.7%
Equity ratio (%)	45.4%	71.5%	56.8%

Source: Wuyang yinghe paper Company Limited

China

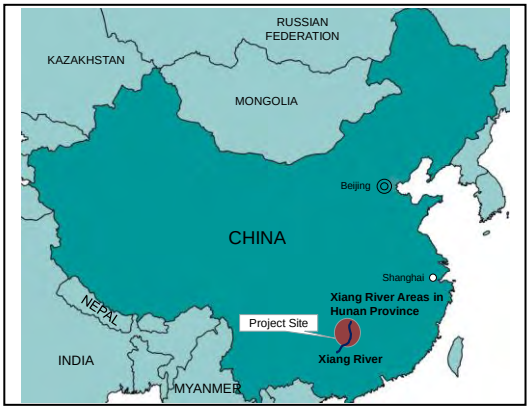
Ex-Post Evaluation of Japanese ODA Loan Project

Xiang River Basin Hunan Environmental Improvement Project

Xiang River Basin Hunan Environmental Improvement Project (II)

External Evaluator: Kaori Honda, IC Net Limited

1. Project Description



Project Site

Expansion Project of Changsha No.1 Sewage Treatment Plant: Final Settling Tank

1.1 Background

The basin of Xiang River (length: 865 kilometers) that runs into Chang River, the longest river in China, is home to China's major non-ferrous, construction materials and other industries. Because of its rapid economic growth in the last ten-strong years, Xiang River Basin has been designated as one of the highest priority development areas of Hunan Province. The economic growth brought with it increases in the amounts of industrial and household waste water in the area, resulting in a serious problem of water quality deterioration in the basin. Being the source of potable water for the urban population in the basin, the Xiang river system was required to meet Grade II or III under China's national water quality standard.[1]

At the time of project appraisal (1997), pollution of water and air was a serious problem in Xiang River Basin; the quality of Xiang River water was below the standard at nearly all of the monitoring sections.[2] The pollutants identified included not only organics but also lead, cadmium, mercury and other heavy metals, giving rise to concerns about human health risks. Additionally, the increased standards of living and rapid rise of urban population resulting from economic growth generated increasingly greater amounts of household and other solid waste,

[1] The surface water quality standard was promulgated by the Ministry of Environmental Protection on April 5, 1998, going into effect on June 1 that year. The standard sets out COD and 29 other water quality parameters with classification into Grades 1 through IV. Potable water sources must satisfy Grade II or III standard. Source: JICA literature

[2] Monitoring sections refer to the monitoring stations that are set up to monitor river water quality on a periodical basis. For the project appraisal, the figures quoted in the Hunan Province Environmental Protection Master Plan were referenced.

making it difficult for capacities of waste treatment facilities to cope with. Some of such collected waste was left open-air on the banks of River Xiang in heaps, causing contamination of soil, groundwater and the river. The problem of air pollution in the region was also grave: acid rain fell on major cities frequently, suggesting the need for conversion from coal to city gas, regulations on industrial emissions, introduction of cleaner production[3] technologies and other measures.

Against this background, the project in question was implemented for the purpose of improving the environment of Xiang River Basin through improved sewage and waste water treatment, air pollution measures and solid waste management.

1.2 Project Outline

The objective of this project is to prevent aggravation of water quality deterioration, acid rain and other environmental pollutions by implementing projects relating to sewage and waste water treatment, air pollution abatements and solid waste treatment along Xiang River in Hunan Province, a region faced with serious water, air pollution, and unsound solid waste management problems as a result of rapid economic growth, thereby contributing to an improved natural environment in the basin as well as an improved standard of living for the local residents.

Approved Amount/ Disbursed Amount	(I) 5,678million yen, (II) 6,175million yen; Total 11,853million yen / (I) 5,675 million yen, (II) 6,174 million yen; Total 11,849 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	(I) September 1997, (II) December 1998 / (I) September 1997, (II) December 1998
Terms and Conditions	(I) Interest Rate: 2.1％ Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General untied (II) Interest Rate: 0.75％ Repayment Period: 40 years (Grace Period: 10 years) Conditions for Procurement: Partial untied
Borrower / Executing Agency(ies)	Government of People's Republic of China / Hunan Provincial People's Government (Hunan Province Management Office of Japanese Loan for

[3] Methods of production and processing that are designed to minimize generation of hazardous substances and waste and incorporate reaction processes for removal of hazardous substances. See http://dictionary.goo.ne.jp/leaf/jn/217673/m0u/%E3%81%8F%E3%82%8A/

	Environmental Protection Project)
Final Disbursement Date	(I) April 2003 / (II) July 2004
Main Contractor (Over 1 billion yen)	Not applicable
Main Consultant (Over 100 million yen)	Not applicable
Feasibility Studies, etc.	OECF SAPROF (Special Assistance for Project Formation) " Xiang River Basin Hunan Environmental Improvement Project" OECF, 1998
Related Projects (if any)	Not applicable

The project is divided into 22 sub-projects, which can be grouped into five categories: Category 1 – City sewage treatment projects for sewage of the entire city with a focus on household sewage, Category 2 – Industrial waste water treatment projects for industrial plants and other facilities that discharge large quantities of waste water, Category 3 – Air pollution abatement projects through provision of coal-substituting energies, Category 4 – Waste treatment projects for solid waste management, and Category 5 – Project for improved environmental monitoring capacity of the Bureau of Environmental Protection of Hunan Province. In fiscal 1997, 13 of these sub-projects were taken up as the Japanese ODA loan project under the title of "Xiang River Basin Hunan Environmental Improvement Project," and in fiscal 1998 nine other sub-projects were taken up as Phase II project under the title of "Xiang River Basin Hunan Environmental Improvement Project (II)." For the purpose of distinction of the two phases of the project, terms "Project (I)" and "Project (II)" are used herein, as required. The following is a list of the sub-projects that were planned for implementation at the project planning stage:

Category 1 City sewage treatment projects

1-1) Sewage Treatment System Construction Project in Yongzhou City
1-2) Sewage Treatment System Construction Project in Yueyang City
1-3) Sewage Treatment System Construction Project in Changde City
1-4) Sewage Treatment Project in Zhuzhou City
1-5) Sewage Treatment Project in Linxiang City
1-6) Sewage Treatment Project in Xingsha Development Area of Changsha
1-7) Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City

Category 2 Industrial waste water treatment projects

2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory
2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory
2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory
2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project
2-5) Wastewater Treatment Project for Xiangtan Paper Mill Factory
2-6) Mining Water Pollution Control Project in Shuikoushan
2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co.
2-8) Water Pollution Control Project by Liuyang Paper Plant
2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factory

Category 3 Air pollution abatement projects

3-1) Expansion Project of Gas Supply Network in Shaoyang City
3-2) Expansion Project of Gas Production Plant in Zhuzhou City
3-3) LPG Supply Project in Changsha City

Category 4 Waste treatment projects

4-1) Garbage Filling Yard Construction Project in Hengyang City
4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City

Category 5 Other project

5-1) The Environmental Monitoring and Management Center of Hunan Province

The map below illustrates the water system of Xiang River and the locations of sub-projects.

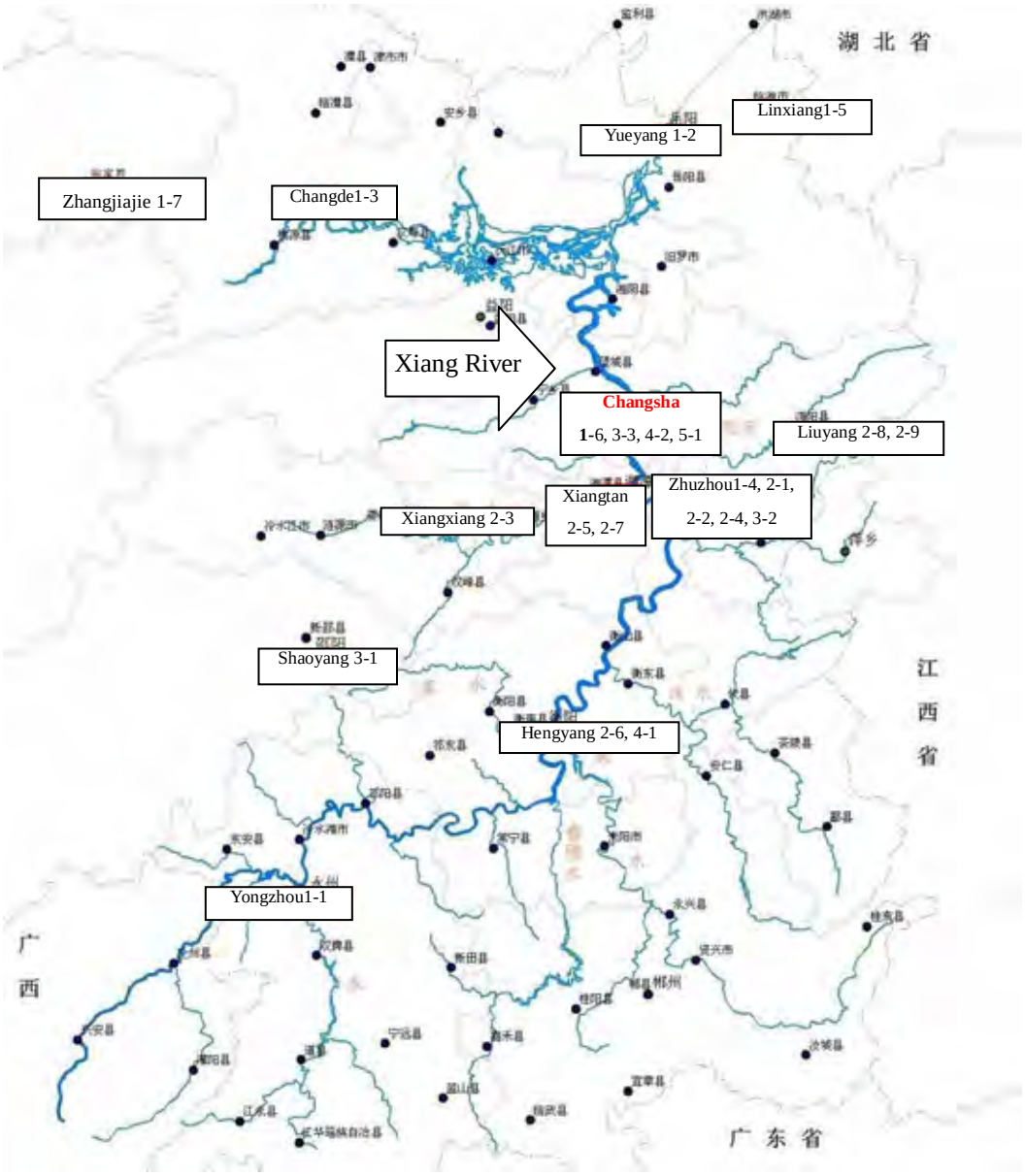


Figure 1 Location of Sub-projects

Source: Prepared from various reference materials

Note: Changsha is the capital of Hunan Province.

2. Outline of the Evaluation Study

2.1 External Evaluator

Kaori Honda, IC Net Limited

2.2 Duration of Evaluation Study

For the purpose of the ex-post evaluation, a study was conducted over the following period of

time:

Duration of the Study: October 2009 –October 2010

Duration of the Field Study: January 7 – 29, 2010 and April 13 – 21, 2010.

2.3 Constraints during the Evaluation Study

At the time of project planning, improvement of Xiang River water quality was cited as one of the goals of the project. Realization of such a broadly-defined goal, however, was unrealistic, given the size and scope of the project. Xiang River is a very long river that extends 865 kilometers in total. Added to this was the presence of a number of external factors[4] that affect the water quality of Xiang River. It was not possible to substantiate any correlations between the effective reduction of pollutants through the sub-projects and the water quality of Xiang River.

For the purpose of this ex-post evaluation, accordingly, the objective of the project was re-interpreted as "the improvement of rivers and water systems of Xiang River adjacent to the sub-project sites" and data and information on the water quality at monitoring sections closest to the sub-project sites were collected. Some of such monitoring sections, it should be added, are at some distance (3 – 28 kilometers) from the sub-project sites concerned and are undeniably affected, both positively and negatively, by the numerous external factors of such a long and wide river. Because of this difficulty of establishing definitive correlations between the water quality at monitoring sections and project impact, certain assumptions were added in the evaluation.

In some sub-projects, the operation had been discontinued or the operating enterprise had gone bankrupt. Verifiable information is extremely limited for these sub-projects, though a survey visit was accepted in some cases.

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

3.1 Relevance (Rating: a)

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

(1) Development policy at the time of project appraisal

Addressing environmental problems that have been aggravated in conjunction with rapid economic growth is a major challenge in China. The Ninth 5-year Plan (1996 – 2000) cites measures against water and air polluting sources and improvement of urban environment as top priority issues. Xiang River, being one of the tributaries of Chang River, has been designated as a priority region as a part of the Seven Major River Basin Program that flows into Chang River. The impending challenge at the time was to implement environmental improvement plans that would serve the dual purposes of restructuring ailing state companies and combating environmental pollution.

[4]Examples of such external factors include: decreased number of polluting sources resulting from closure of small- and medium-sized factories through the government's industrial structure adjustment policy, increased emission/discharge of pollutants and contaminants resulting from industrialization and urbanization.

In line with this national government policy, the Basic Policy on Xiang River Basin Comprehensive Environmental Improvement Plans (1998) calls for conformance of all industrial effluents in the Province with all applicable discharge standards, both national and provincial. The Report on Overall Environmental Impact of the Japanese ODA Loan Project for Xiang River Basin Hunan Environmental Improvement, which served as the environmental impact assessment report of Hunan Province Environmental Protection Master Plan, recommended that emission/discharge standards of industrial waste water, industrial gases and solid waste to be set in accordance with the national requirements of "containing total emissions/discharge of major pollutants in the year 2000 not higher than the levels of year 1995." The project was implemented based on this policy.

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

Increase of environmental pollution abatement capacities and protection of ecology and environment are given major challenge status in China's National Development Plans, in both the Tenth 5-year (2001 - 2005) and the Eleventh 5-year (2006 - 2010) Plans. More specifically, the Plans call for sound management of environmental problems that would otherwise adversely affect sustainable development of the society, by prioritizing prevention and abatement of pollution and by improving the quality of potable water in both urban and rural areas. The stated goals include: improvement of water environment through reduction of COD[5] in the effluent, mitigation of air pollution through reduction of sulfur dioxide emissions, and promotion of recycling and safe treatment of solid waste. In both The Tenth and Eleventh 5-year National Environmental Protection Plans, standards for the levels of pollutants that must not be exceeded are set out.

The Eleventh 5-year Plan for Prevention of Xiang River Basin Water Quality Pollution (2006 – 2010) states that Xiang River is one of the seven major rivers that runs into Chang River, and that Xiang River basin requires intensive efforts such as improved city sewage treatment, heavy metal effluent treatment and sound management of municipal solid waste.

The project has as its objectives reduction of water pollution, air pollution and solid waste, which have been identified as focus areas in both the national and provincial development plans. Thus, its relevance to development policies is high, at the time of project appraisal as well as of ex-post evaluation.

3.1.2 Relevance with the Development Needs

3.1.2.1 The need to improve water and air in Xiang River basin

Water pollution of Xiang River at the time of project planning was serious; the standards were exceeded at several monitoring stations in terms of not only COD and BOD[6] but also of

[5] COD, standing for Chemical Oxygen Demand, is an indicator of the degree of water contamination. It is the amount of oxygen that is consumed for oxidization of organics in the water by an oxidizing agent.

[6] BOD stands for Biochemical Oxygen Demand. It is an indicator of the degree of water contamination. It is especially important as a regulatory parameter for industrial effluent. It is expressed in terms of oxygen consumed by microorganisms for decomposition of organic components in the water. The higher is the BOD value, the higher is the degree of water

lead, cadmium and other heavy metal concentrations. BOD was 6 – 34% in excess of the standard at six major water quality monitoring sections, and mercury concentration in Xiangtan, an industrial city near Changsha, was approximately 60% above the standards. Air pollution in the region was no less serious; Frequencies of acid rain were 100% in Changsha, 99% in Xiangtan and 57% in Zhuzhou. Additionally, the generation of household waste and other solid waste was on the increase. Lack of waste treatment facilities was causing serious problems of foul odor and contamination of soil and nearby water streams.

The project was intended to address the serious environmental pollution in the region as described above, and its objective of pursuing improvement of water pollution, air pollution and solid waste management was relevant to the development needs of the region. The holistic approach of addressing multiple development needs by a single project was quite appropriate because the sources of pollution in Xiang River basin were diversified and geographically dispersed.

3.1.2.2 Relevance of project objectives definition and sub-projects selection

Meanwhile, there was room for improvement in terms of (1) relevance in the definition of project objectives, and (2) relevance in the selection of sub-projects.

(1) Relevance of project objectives definition

The project had a stated objective of "preventing aggravation of environmental pollutions by implementing projects relating to sewage and waste water treatment, air pollution abatement, and solid waste treatment, thereby contributing to an improved natural environment in the basin as well as improved standard of living for the local residents." Strictly interpreted, these wordings mean "quality improvement of the water in Xiang River as a whole."

This interpretation, however, is unrealistic, given the vastness of Xiang River and the input that was to be made by the project. Major rivers such as Xiang are exposed to numerous external factors, and it is next to impossible to make a rational assessment of the project impact on the overall water quality improvement of Xiang River.[7] For this reason, the objective of the project was restated as "the improvement of rivers and water systems of Xiang River adjacent to the sub-project sites" and the water quality at monitoring sections closest to the sub-project sites was chosen as indicator of effectiveness evaluation. The improvement of living standard of the local residents was chosen as the measuring stick for evaluation of project impact, the overall goal.

Also included in the project objectives was alleviation of air pollution and acid rain damages through introduction of a city gas service to reduce emissions of sulfur dioxide and other

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contamination.

[7] If all the sub-projects of the project were to demonstrate their designed performances in full, 75,821 tons of COD were to be reduced each year. The COD discharge in 1997 of eight cities in the Xiang River basin was 438,108 tons in total, which means the project impact would have accounted for 17%. It should be noted, however, that the actual benefit would be smaller because COD from sources other than the eight cities is not accounted for.

polluting substances. Even though reduction of sulfur dioxide gas emissions at the sub-project level is possible ("output"), it is not clear how such reduction would contribute to "improvement of life environment through waste gas reduction" that is stated as a qualitative effect ("outcome") of the project. For the purpose of the present ex-post evaluation, effectiveness is rated on the basis of sulfur dioxide emissions reduction that is set out as a quantitative effect of the project, and the "improvement of life environment through waste gas reduction" is used as a basis for rating of project impact. Since the input of only one project in one city is unlike to produce any noticeable results on the entire population and there are numerous external factors, the effect of waste gas reduction on the life of local residents was not measurable. Accordingly, evolution of acid rain frequency was reviewed only as data for reference.

(2) Relevance of sub-projects selection

There were substitutions in the sub-projects prior to the project implementation; three of the initially-contemplated nine industrial waste water treatment projects of Category 2 were replaced by different sub-projects. The reasons for the changes are as follows:

- 2-4) Wastewater Treatment Project for Xiangtan Paper Mill Factory: The company had financial problems and went bankrupt in 1999.
- 2-8) Water Pollution Control Project by Liuyang Paper Plant: The plant operation was discontinued as a result of government industrial structure adjustment policy, because of its small production capacity and heavy environmental load.
- 2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factory: The production process was streamlined and the financing was made from domestic sources, thus avoiding the need for a Japanese ODA loan.

In exchange, the following three sub-projects were implemented:

- 2-10) Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project
- 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant
- 1-9) Sewage Treatment System Construction Project in Liuyang City

The project has built up flexible management system among the Borrower, the Executing Agency and JICA, by adequately replacing the suspended sub-projects with difficulties before implementation. These new substitute sub-projects are highly relevant with the project objective and match the needs and beneficial effects. The replacement itself has no influence over the entire project; however, it should be remembered that closer examination of the financial conditions and project implementation organization at the appraisal stage might have avoided such substitution. All of the replaced sub-projects related to private enterprises and the substitution became necessary due to financial difficulties, insufficient business scale and other reasons. It was found, for instance, financial conditions were not reviewed sufficiently at the

time of appraisal for Sub-projects 2-4) Wastewater Treatment Project for Xiangtan Paper Mill Factory and 2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factory.

Meanwhile, it should be recognized that ex-ante evaluation was not commonly performed as strictly at the time of appraisal of this project (1997 – 1998) as it is today, and clear rules or procedures had not been established for selection of sub-projects. The appraisal was carried out in a more simplified way in comparison with that of other ODA Loan projects, and the brevity of the appraisal was understandable in view of the large number of sub-projects involved. These shortcomings in the relevance of project objective definition and of sub-projects selection are not reflected in the rating because of the absence of stringent ex-ante evaluation at the time, the practical inability of performing detailed appraisal of individual sub-projects, and counterpart's major lead in selection process.

3.1.3 Relevance with Japan's ODA Policy

The Economic Cooperation Plan for China, a country assistance program policy statement formulated in 2001, cites responses to environmental pollution associated with economic growth as one of the long-term challenges in China's development strategy. The policy statement list "cooperation in the effort to address the environment and other global challenges" as the number one issue among priority areas for Japan's assistance; hence, the project under evaluation is highly relevant with Japan's ODA policy.

In conclusion, this project has been highly relevant with China's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Efficiency (Rating: b)

3.2.1 Project Outputs

The sub-projects, which are grouped into categories described below, were generally implemented as planned. Category 1 "City sewage treatment projects" were implemented as planned in general. Category 2 "Industrial waste water treatment projects" were implemented as planned in general, except for the two sub-projects that were replaced. Category 3 "Air pollution abatement projects" were implemented as planned in general, but two of the three sub-projects are not in operation and limited information was available. Category 4 "Waste treatment projects" and Category 5 "Other project" were also implemented as planned in general. (See Attachment 1)

(1) Category 1: City sewage treatment projects

Category 1 "City sewage treatment projects" were generally implemented as planned. For the purpose of sub-project substitution, sub-projects 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant and 1-9) Sewage Treatment System Construction Project in Liuyang

City were newly included. City sewage treatment projects form a part of the urban basic infrastructure and are mostly implemented and operated by local governments. It is believed that these sub-projects were less resilient to market economy influences, suffering little occasions of work interruptions or design alterations. The design treatment capacity of Sub-project 1-7) "Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City" was lowered. This was due to the cancellation of a tourist facilities construction that had been initially planned outside the scope of the project, as well as a reduced discharged water that reflected the designation of Shuirao Si Gate, a zone initially considered to be served by the project, as a natural reserve.

(2) Category 2: Industrial waste water treatment projects

Category 2 "Industrial waste water treatment projects" were implemented as planned in general, except for the two sub-projects that were replaced. Sub-project 2-10) Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project, as hereinafter described in detail, encountered financial difficulties and went bankrupt, partly influenced by the industrial structure adjustment policy of the government.

(3) Category 3: Air pollution abatement projects

Category 3 "Air pollution abatement projects" were implemented as planned in general, but two of the three sub-projects are not in operation and little information was available. The facilities under sub-project 3-2) Expansion Project of Gas Production Plant in Zhuzhou City were constructed as planned and were in operation until 2008. However, the change of government policy on city gas services from coke-based to natural gas-based forced the facilities to discontinue operation, except the distribution pipeline. Similarly, the facilities under sub-project 3-3) LPG Supply Project in Changsha City were constructed as planned and were in operation for about two years, but the change of government policy on city gas services (from LPG-based to natural gas-based)[8] forced the facilities to discontinue operation. As of this writing, the pipeline facilities have been transferred to Changsha XinAo Gas Company and are in service.

(4) Category 4: Waste treatment projects

Category 4 "Waste treatment projects" were implemented as planned in general.

(5) Category 5: Other project

Category 5 "Other project" was implemented as planned in general.

[8] The West-East Gas Pipeline Project advocated in the Tenth 5-year Plan was motivated by the government policy to diversify energy sources and reduce coal consumption by increased use of natural gas.

3.2.2 Project Inputs

3.2.2.1 Project Period

Though the planned project period at the time of appraisal was 36 months from September 1997 through August 2000 for Project (1), the actual implementation took 96 months (267% of the planned period) from January 1998[9] through December 2005. The implementation of Project (II) was planned for the 49 months from December 1998 through December 2002, but in practice it took 81 months (165% of the planned period) from April 1998 through December 2004.

There were considerable differences among the sub-projects in terms of project period divergence. The individual divergences of sub-projects were rated, and the rating average was used for the overall rating. (See Attachment 2). Based on this calculation, the average rating point is 1.55 (average of subprojects' period exceeded 50% or higher and less than 80%) or slightly longer than planed.

Overall, the actual project period was longer than planned, but the length of delay varies from one sub-project to another. In 7 of the 22 sub-projects, the construction was completed and completion inspection was conducted within 150% of the planned period. Thirteen others suffered project delays between 150% and 250%. Project delays of over 250% were observed for 1-3) Sewage Treatment System Construction Project in Changde City and 2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project. Sub-project 1-3) Sewage Treatment System Construction Project in Changde City took as long as two years for the completion inspection following the construction completion. Sub-project 2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project experienced suspension of the entire business activities of the implementing agency because of financial difficulty. The implementing agency was initially a state company but a difficulty in financing forced it to be merged with a private entity. The operation was thus suspended for about two years. Sub-project 2-10) Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project and 3-2) Expansion Project of Gas Production Plant in Zhuzhou City are not counted for the purpose of rating, owing to unavailability of required information because the former sub-project has been cancelled after implementation and the latter underwent operation discontinuation.

3.2.2.2 Project Cost

The total project cost of Projects (I) and (II) combined was 26,593 million yen against the plan of 25,008 million yen (106%), thus resulting in a minor overrun. The foreign currency was expended almost as planned, while the domestic currency expenditures exceeded the planned sum slightly. The major reason was the additional input for roads and pipelines that became necessary as a result of location change of some sewage treatment plants. Sub-project 1-1)

[9] The month in which the pertinent executing agency or corporation actually started the project implementation is deemed as the project initiation month.

Sewage Treatment System Construction Project in Yongzhou City, in particular, was over 150% in excess of the planned project cost; domestic funds had to be included additionally for the improvement of pipeline networks and other purposes.

In summary, both project period and project cost were slightly higher than planned, therefore efficiency of the project is fair.

3.3 Effectiveness (Rating: b)

For the purpose of this ex-post evaluation, effects on water pollution, air pollution and solid waste management will be evaluated in a comprehensive manner. However, central themes of the description and the weight in rating will relate to water quality improvement because it is the focus of project inputs. The indicators for project effectiveness and impact for the evaluation are defined as follows:

- Level 1: Operation and effect indicators of sub-projects
  Quantitative effects: reductions in COD, mercury, arsenic, cadmium, lead, sulfur dioxide, household waste and chrome slag [Effectiveness]
- Level 2: Water quality of rivers and water systems adjacent to the sub-project sites
  Water quality of rivers and water systems adjacent to the sub-project sites along Xiang River at the monitoring sections [Effectiveness]
- Level 3: Improvement of health conditions of local residents
  Qualitative effects: (a) improvement in the living standard of local residents and preservation of water resources through improved quality of rivers and water systems in the Xiang River basin, and (b) improvement in the living standard of local residents through reduction of gas emissions and solid waste [Impact]

As was mentioned in 3.1.2.2 (1) "Relevance of project objectives definition," the objective of the project was restated as "the improvement of rivers and water systems of Xiang River adjacent to the sub-project sites." As indicators of effectiveness evaluation for water pollution improvement, the operation and effect indicators (Level 1) and the water quality at monitoring sections closest to the sub-project sites (Level 2) were chosen.

No detailed data or information was available with regard to air pollution abatement projects because two of the three sub-projects were no longer operational. Accordingly, effectiveness was evaluated in terms of achieved reductions of pollutants by the sub-projects (Level 1) and the frequency and pH value of acid rain (Level 3) were used only as reference data in the project impact evaluation.

The effectiveness of solid waste treatment project was evaluated in terms of the amount of household waste treated (Level 1). Because no water quality data (Level 2) was available with respect to the rivers and water systems adjacent to the sub-project sites, this portion is not reflected in the rating.

3.3.1 Quantitative Effects

Effectiveness measuring the degree of achievement of project objectives is evaluated on the basis of: (1) operation and effect indicators of the sub-projects, (2) evolution of water quality of the rivers and water systems at monitoring sections closest to the sub-project sites, and (3) results of calculations of internal rates of return (IRR).

3.3.1.1 Results from Operation and Effect Indicators

Annual reductions in COD, mercury, arsenic, cadmium, lead, sulfur dioxide, chrome slag and household waste were to be used as effect indicators of the project. Please refer to Attachment 3, "A Summary of Operation and Effect Indicators for Sub-Projects," for a comparison of target and actual values. For a quick review of project effectiveness, the status of operation and effect are summarized by sub-project category as follows:

Table 1 Status of Operation and Effect by Sub-project Category

Category	Status of operation	Effect
Category 1: City sewage treatment projects	Nine out of nine are operational.	Objectives generally achieved
Category 2: Industrial waste water treatment projects	Six out of seven are operational; one has been discontinued.	Objectives generally achieved
Category 3: Air pollution abatement projects	One out of three is operational; two have been discontinued.	Substantially below the plan
Category 4: Waste treatment projects	Two out of two are operational.	Plan exceeded
Category 5: Other project	One out of one is operational.	Objectives generally achieved

The effectiveness of sub-project in operation is generally good. With respect to Category 1 "City sewage treatment projects," the COD reduction and other indicators are below the target values that were set at the time of project planning. This, however, is due to reduced emissions of pollutants itself, reflecting the withdrawal from the market of small- and medium-sized companies through industrial structure adjustment. In most of the sub-projects, the quality of post-treatment discharged water is superior to what was envisioned in the project plan. With respect to Category 2 "Industrial waste water treatment projects," the target reduction values of hazardous substances in the plant effluents have been met in most of the sub-projects. Operation of one sub-project has been discontinued because of the company's financial difficulties. The effectiveness of Category 3 "Air pollution abatement projects" has been limited, because the operation of two of the three sub-projects has been discontinued. With respect to Category 4 "Waste treatment projects," the covered population became larger than planned, and the amount of solid waste treated far exceeds the target value. The water quality, however, has not met the target values. Specific amounts of annual reduction are reviewed for each category as below.

(1) Water pollution improvement projects

Category 1: City sewage treatment projects (9 sub-projects implemented)

Reduction item	Target value	Actual reduction	Achievement ratio (%)
COD	75,821 t/yr	42,439t/yr	56
BOD	37,782 t/yr	16,447t/yr	44
SS[10]	177,185 t/yr	142,662t/yr	81
Sewage treated	850,000 t/day	630,000 t/day	74

Note: The reductions in this table include those from sub-projects of other categories for the purpose of reviewing the overall effectiveness of the entire loan project.

The effect indicators chosen for city sewage treatment projects were reductions in COD, BOD and SS as well as the amount of sewage treated. Reduction in COD, BOD and SS varied between 44% and 81% of the plan. This was affected by the less than anticipated generation of pollutants, reflecting the withdrawal from the market of small- and medium-sized enterprises through industrial structure adjustment. It is worth noting that the water quality achieved by most of the sub-projects is better than the planned quality. Altogether, the effectiveness of pollutants reductions can be considered good.

Fig. 2 Sub-project 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha: wide-mesh screen

Fig. 3 Sub-project 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant: oxidation ditch process-based treatment facility

Category 2: Industrial waste water treatment projects (7 sub-projects implemented, of which 1 has been closed)

Reduction item	Target value	Actual reduction	Achievement ratio (%)
Mercury	2 t/yr	3 t/yr	150
Arsenic	127 t/yr	117 t/yr	92
Cadmium	22 t/yr	22 t/yr	100
Lead	99 t/yr	130 t/yr	131
Chrome slag treated	2.1 t/yr	1.2 t/yr	57

The effect indicators chosen for industrial waste water treatment projects were mercury,

[10] SS, standing for "Suspended Solid", refers to insoluble particle matters that are suspended in water. It includes: micro particles of clay minerals, zoo- and phyto-planktons and their shells, organic matters and metal sediments from sewage or industrial effluents, etc.

arsenic, cadmium, lead and chrome slag treatment. The achievement ratio varied between 57% and 150%; those for mercury, cadmium and lead exceeded 100%. Approximately 95% of the chrome slag has been treated already and within one year there will be no more slag to be treated. Reductions of hazardous substances in industrial waste water have met the target values in most of the sub-projects in operation.

It should be noted, however, that sub-project 2-10) Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project suffered closure after project implementation. After the facilities were completed, the plant had an accident and the operation was discontinued entirely. Subsequently, the company faced financial difficulties and eventually went bankrupt, adversely affected also by the government's industrial structure adjustment policy.

Sub-project 2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory is no longer producing chrome product.

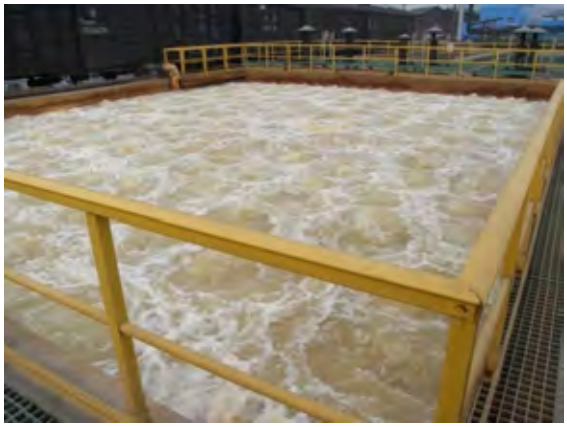

Fig. 4 Sub-project 2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory: Compressed air is injected for sulfuric acid washing.

Fig. 5 Sub-project 2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory: Treated water is of quality fit for direct discharge to Xiang River.

(2) Air pollution abatement projects

Category 3: Air pollution abatement projects (3 Sub-projects implemented, of which 2 have been closed)

Reduction item	Target value	Actual reduction	Achievement ratio (%)
Sulfur dioxide	10,692 t/yr	1,184 t/yr	11
Coal	25,713 t/yr	1.46t/yr	0
TSP[11]	5,521 t/yr	712t/yr	13

In Category 3 "Air pollution abatement projects," two out of the three sub-projects, namely, 3-2) Expansion Project of Gas Production Plant in Zhuzhou City and 3-3) LPG Supply Project in Changsha City, had to discontinue operation after implementation. The change in national policy that took place after the project implementation promoted use of natural gas and reduced

[11] Total Suspended Particulate; represents the total amount of suspended particulates in the air

the demand for coke gas and LPG that these sub-projects were producing, substantially diminishing their business base.[12] Thus, the operation discontinuation was a consequence of change in national policy on industrial structure adjustment and gas supply, which was unforeseeable at the time of project appraisal.[13] Accordingly, relevance of the sub-projects selection remains valid.

The effect indicators chosen for air pollution abatement projects were reductions of sulfur dioxide, coal and TSP. Sub-project 3-3) LPG Supply Project in Changsha City supplied 6.87 million cubic meters of LPG to 30,000 households with a total population of 100,000 in the third year of its operation (2003). Subsequently, however, the operation had to be discontinued as a result of change in national policy; there is little prospect that any further effect would be demonstrated. As for the two sub-projects that suffered operation discontinuation, no relevant data was provided by the implementing agencies of the sub-projects on any project effect while they were in operation. Despite the lack of substantiating data, that fact of operation discontinuation of two of the three sub-projects by itself leads to the view that the effect of air pollution abatement projects was limited.

Fig. 6 Sub-project 3-2) Expansion Project of Gas Production Plant in Zhuzhou City: Added coke furnace (no longer in operation)

Fig. 7 Sub-project 3-2) Expansion Project of Gas Production Plant in Zhuzhou City: Added coal gas purification equipment (no longer in operation)

(3) Solid waste treatment projects

Category 4: Waste treatment projects (2 sub-projects implemented)

Reduction item	Target value	Actual reduction	Achievement ratio (%)
Household waste treated	116 t/yr	131t/yr	113

The quantity of household waste treated is chosen for effect indicator of solid waste treatment

[12] Sub-project 3-1) Expansion Project of Gas Supply Network in Shaoyang City is in operation because the city is not served by natural gas.

[13] The project had a strong characteristic of "sector assistance"; as such it does not seem to have required stringent perusal processes for sub-projects selection. The project preparation study that was made at the time of project preparation makes no references as to sub-projects selection processes or aptitude of individual executing entities.

projects. The indicator very well exceeded the target value because the served population became larger than initially contemplated. It should be remembered however that the discharged water from the treatment facilities is of quality not meeting the target value, and it is running into the river close to the sub-project locations. Possible future adverse effects should be watched with caution.

Sub-project 4-1) Garbage Filling Yard Construction Project in Hengyang City is overloaded already and its closure is scheduled by the end of 2010. In the case of this sub-project, the annual treatment quantity is about 1.8 times the planned quantity because of the 1.7 times increase in the covered population from 600,000 to one million. Since the facility was commissioned in 1999, the project life will be eleven years. Initially, a project life of 14 years was envisioned, but it will have been shortened because of the higher-than-expected capacity utilization.

Fig. 8 Sub-project 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City: Equipment (a backhoe excavator)

Fig. 9 Sub-project 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City: Filling yard side ditch

(4) Other project

Category 5: Other project (1 sub-project implemented)

Sub-project	Target	Actual
5-1) The Environmental Monitoring and Management Center of Hunan Province	Improvement of environmental monitoring, upgrading of data management and capacity building of technicians	Some 20 items were added to the 29 environmental monitoring items. Accuracy of mercury, arsenic and other heavy metal analysis has improved.

Under sub-project 5-1) The Environmental Monitoring and Management Center of Hunan Province, equipment and apparatus required for environmental monitoring were supplied. While no effect indicators had been set, interviews with the concerned parties revealed that 25 pieces of equipment and apparatus are properly managed and put into use, and the project is producing generally good effect. Utilization of these equipment and apparatus has raised the accuracy of

pollutants analysis, helping prevent serious environmental contamination incidents. Measuring equipment and instruments have been distributed among the environmental monitoring stations of cities in the Xiang River basin, contributing to the improved monitoring frequency and analytical accuracy on their part.

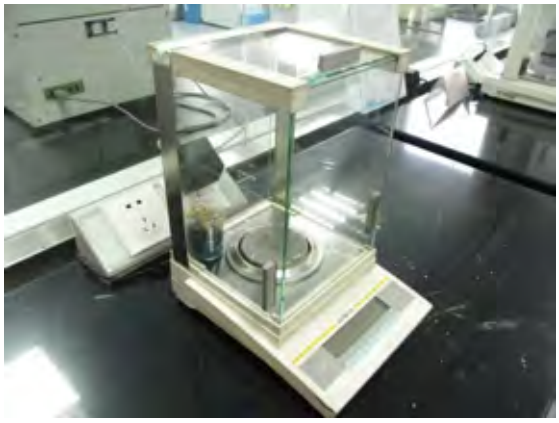

Fig. 10 Sub-project 5-1) The Environmental Monitoring and Management Center of Hunan Province: An electronic balance

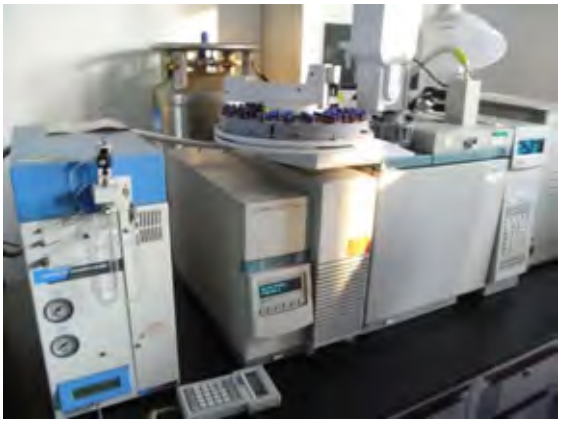

Fig. 11 Sub-project 5-1) The Environmental Monitoring and Management Center of Hunan Province: A headspace sampler (Shimadzu) [14]

3.3.1.2 Evolution of water quality of the rivers and water systems at monitoring sections closest to the sub-project sites

Table 2 shows the evolution of COD in the rivers and water systems measured at monitoring sections closest to the sub-project sites[15].

Table 2 Evolution of COD in the rivers and water systems measured at monitoring sections closest to the sub-project sites

Sub-project	Monitoring section	COD(Mg/L) as of 1997	COD(Mg/L) as of 2008
1-2) Sewage Treatment System Construction Project in Yueyang City	Chenglingji, Yueyang City: about 28 kilometer distance	3.16	2.06
2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory	Maijiahe, Zhuzhou City: about 6 kilometer distance	2.24	3.94
2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co.	Zhaoshan, Xiangtan City: about 19 kilometer distance	2.44	2.48
1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant	Sanzhenzhen, Changsha City: about 3 kilometer distance	2.58 (as of 1993)	14.6 (as of 2009)

[14] It separates and analyzes volatile components of a liquid or solid sample.

[15] The review was made on the basis of available data for four major cities, because of unavailability of data for all the rivers and water systems closest to the sub-project sites.

Sources: Bureau of Environmental Protection of Hunan Province, except for 1-8) which was furnished by Changsha No.1 Sewage Treatment Plant

The COD measured at the monitoring section closest to the site of Sub-project 1-2) Sewage Treatment System Construction Project in Yueyang City is on an improving trend in comparison with year 1997. The COD measured at the monitoring section closest to the site of Sub-project 2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory is on a deteriorating trend in comparison with year 1997. The COD after the implementation of Sub-project 2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co. deteriorated in year 2003 against year 1997 and since then has been on a moderate improving trend. However, there was little change over the year 1997. The COD after the implementation of sub-project 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant is on a deteriorating trend in comparison with year 1993. In comparison with the initial data at the time of project appraisal, COD is on deteriorating trends in the cities of Changsha and Zhuzhou and is on an improving trend in Yueyang City.

From a broader perspective, there have been substantial increases in the amounts of discharged industrial/household waste water and their COD in Hunan Province, as shown in Table 5 below.

Table 3 Evolution of Industrial/Household waste water discharge and its COD in Hunan Province (2000 – 2008)

Year	Waste water (100 million tons)			COD (10,000 tons)		
	Total	Industrial	Household	Total	Industrial	Household
2000	21.13	10.18	9.87	67.40		
2001	20.77	10.72	10.05	71.88	31.66	39.30
2002	22.02	11.18	10.84	74.12	30.93	43.19
2003	23.57	12.41	11.16	74.69	25.16	49.53
2004	25.00	12.31	12.69	84.99	27.60	57.39
2005	25.56	12.24	13.32	89.45	29.38	60.08
2006	24.41	10.00	14.41	92.25	29.21	63.04
2007	25.21	10.01	15.20	90.36	25.72	64.64
2008	25.03	9.23	15.80	88.46	23.73	64.74

Source: Hunan Province Environmental Statistical Yearbooks (2004 through 2008 editions)

By the year 2008, the amounts of waste water and COD discharge have increased to 118% and 131% of the year 2000, respectively. In the context of such an overall increase of waste water in the basin, the project served to reduce COD by 42,439 tons a year, corresponding to 4.8% of the total COD discharge of the basin in 2008. The aggregate total of waste water treated by the sewage treatment plants of this project is 630,000 tons per day, or by simple conversion, 230 million tons a year, which accounts for 9.2% of all waste water generated in the Hunan Province. Based on these figures, COD in the order of 40,000 tons and waste water in

the order of 200 million tons would have been discharged into the environment if it were not for the project under evaluation. The project may be said to have made a certain degree of positive contribution in the sense of preventing aggravation of environmental pollution.

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

Results of calculations of IRR: Financial Internal Rate of Return (FIRR)

The FIRR of sub-projects with financial benefits (those that charge fees in return for the service provision) was recalculated in order mainly to examine their financial sustainability. Of the four sewage treatment plants for which verifiable data were available, three produced negative results. This is due to the service fee that is artificially set at low levels because the implementing agencies are public entities and by nature are not expected to be financially self-standing. The sewage treatment service is supported by the city governments for necessary funds, and no realistic problem is in sight for sustained operation.

Sub-project	Results of FIRR calculation
1-1) Sewage Treatment System Construction Project in Yongzhou City	Negative result
1-3) Sewage Treatment System Construction Project in Changde City	3.76% (project life = 30 years)
1-5) Sewage Treatment Project in Linxiang City	Negative result
1-7) Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City	Negative result

- Costs: operation cost, maintenance cost (labor and other costs)
- Revenue: Sewage treatment fee (project life = 30 years; for Yongzhou City 20 years)

Sub-project 1-3) Sewage Treatment System Construction Project in Changde City produced a positive result, because the city charges a relatively high fee for the sewage service in comparison to cities of the other sub-projects. One factor for the difference may be the large population served by the sub-project (2.5 – 10 times as large).

3.3.2 Qualitative Effects

The qualitative effects of this project will be discussed in the section on "Impacts to Beneficiaries."

In sum, these sub-projects have generally achieved their respective objectives and helped prevent aggravation of water pollution in the nearby rivers. From this perspective, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

3.4 Impact

3.4.1 Intended Impacts (Improvement in Health, Welfare and Living Environments)

The qualitative effects of the project relate to water resource conservation, waste gas pollutants reduction and reduction of unsanitary solid waste disposal for improvement of the living environment of the residents in the basin. In order to analyze these aspects, the project impact was evaluated by the use of: (1) acid rain frequency data (to be regarded as reference only because two of the three sub-projects concerned are no longer operational), and (2) results of the beneficiaries survey.

(1) Acid rain frequency

The contribution of this project in reducing acid rain frequency and otherwise abating air pollution is rather limited, partly because two of the three sub-projects concerned suffered operation discontinuation. For reference purpose, let us take a look at the evolution of acid rain frequency and annual average pH values[16] in the cities of Shaoyang, Zhuzhou and Changsha. As of this writing, only sub-project 3-1) Expansion Project of Gas Supply Network in Shaoyang City is operational.

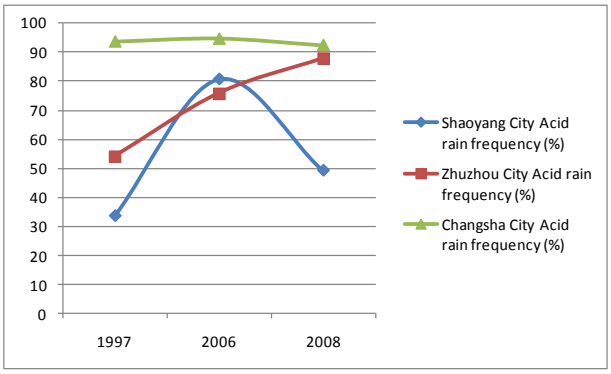

Figure 12 Acid Rain Frequency

Source: Hunan Provincial People's Government

Acid rain frequency continues to be high in Changsha City in comparison with the year 1997. In Zhuzhou City, it has increased more than 30 percentage points over the ten years. In Shaoyang City, the frequency went up in 2006 but has been on a declining trend since then. Sub-project 3-1) Expansion Project of Gas Supply Network in Shaoyang City started its operation in 2005 and has reduced between 660 and 1,184 tons of sulfur dioxide emissions every year. Even though no data or information was available that would establish definitive

[16] Acid rain refers to the phenomenon of acidic substances deriving from sulfur dioxide (SO_2), nitrogen oxides (NO_x) and other compounds emitted into atmosphere through fossil fuel incineration, metal smelting and other processes fall down back to the ground, entrenched in rain, snow, fog, etc. Hydrogen ion concentration (pH) is the indicator commonly used to express acidity/alkalinity of a substance. Lower pH values mean stronger acidities. In many parts of the world, rain with a pH value not greater than 5.6 is as an acid rain. Source: Japan Meteorological Agency website http://www.data.kishou.go.jp/obs-env/acidhp/knowledge_acid_rain.htm

relationship between the observed acid rain frequency decline and this sub-project, it appears likely that the project has indeed been making a certain degree of contribution to the turnaround that occurred in 2006.

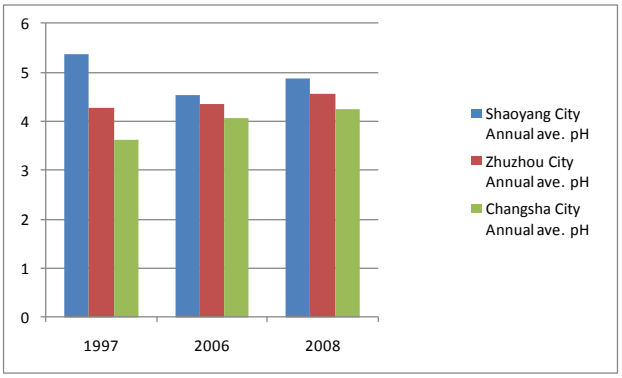

Figure 13 Annual Average pH Value

Source: Hunan Provincial People's Government

The annual average pH value of precipitation is showing an improving trend in the cities of Changsha and Zhuzhou, while it is on a deteriorating trend in Shaoyang City.

(2) Results of beneficiaries survey

A beneficiaries survey was made to local residents of Xiang River basin on the question of water pollution of the river (102 responses)[17]. While 25.5% of the respondents felt the pollution of Xiang River ten years ago was "very serious" or "relatively serious," 73.6% felt that way about today's situation. The survey revealed that many (72.2%) believed that major cause of the pollution was the industrial waste water and household waste water coming down from upstream, and a similarly large number of respondents (63%) cited above-standard discharge of urban sewage treatment plants as another major cause. Thus, the respondents were found to have a negative perception about the quality of Xiang River as a whole. This likely reflects influences of increases in the number of polluting sources, rising quantities of waste water discharge over the decade and other external factors that were brought about by the rapid economic growth and urbanization.

3.4.2 Other Impacts

3.4.2.1 Land Acquisition and Resettlement

No particular problems were observed with respect to the ODA loan project under evaluation.

[17] The beneficiaries survey was conducted by face-to-face interview, based on a structured interview format. The questions mainly related to change of Xiang River water quality over the decade, water usages with available quality, degree of satisfaction with the water quality, major sources of pollution, etc. The interviews were made to residents living close to Xiang River or the sub-project sites in five cities: Yongzhou, Hengyang, Zhuzhou, Xiangtan and Changsha.

A voice of dissatisfaction was raised by some on the question of compensation money relating to the resettlement that became necessary in connection with the facilities expansion under Sub-project 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City. There are ongoing negotiations about the compensation package between the government and the residents.

3.4.2.2 Economic benefits

On-site interviews and other information sources suggest that certain degrees of economic benefits have been realized in some sub-projects.

- Sub-project 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City: Some local residents responded that they were enjoying economic benefits by the construction of the 7 kilometer road and sale of farm products to the plant.
- Sub-project 2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project: The factory enjoys an economic benefit of RMB 35 million a year from the use of circulation water and the production of aerated concrete blocks from fly ash.

3.4.2.3 Negative impacts

Negative impact was expressed by local environmental experts and residents in the vicinity of garbage treatment sites. A follow-up is believed necessary.

- For Sub-project 4-1) Garbage Filling Yard Construction Project in Hengyang City, local experts pointed out incidents of unlawful discharge and noncompliance with the standards with respect to cover soil application and discharged water treatment.
- Some residents in the neighborhood of the site of Sub-project 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City complained about contamination of nearby rivers and streams, crop damage by the discharged water, cases of skin diseases, increased emergences of mosquito and flies, etc.
- Sludge from sewage and solid waste treatment sites was not recyclable for compost[18] and compiled by filling after treating. According to the officers at 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha, the current method of dehydration and filling would affect adversely to environment, so that they requested technical and financial support for low-cost and efficient sludge treatment.

It is virtually impossible to analyze accurately the extent to which the project may (or may not) have contributed to the improvement of living environment of the local residents. The perception that the quality of Xiang River water has deteriorated over the decade and that the

[18] According to the officers at 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha, Chinese government issued the national standard for sewage treatment called "Urban Area Sewage Treatment Sites Pollutant Discharge Standard" GB 18918-2002, and it states strict requirements for some indicators such as nitrogen, phosphorus, and Escherichia coli. The technology of currently adopted OD method cannot eliminate nitrogen or phosphorus completely, so that the advanced technology needs to be adopted to reduce the sludge with more capacity for eliminating above mentioned items.

pollution is serious is held by over 70% of the residents. While some residents stated that they were receiving economic benefits from the sub-project near them, some others point to the negative impact caused by the discharged water of solid waste facilities. With respect to air pollution abatement, the degree of contribution to acid rain frequency reduction and other concrete parameters is not clear and cannot be evaluated, partly because the sub-projects concerned suffered operation discontinuation. With all these observations put together, it seems fair to say that no project impact has surfaced onto the level of living environment of the residents. Evaluation of realized impact on the general populace appears to have its own limit in a case like this project that is characterized by the paucity of easily-visible impacts (positive, in particular) and by the difficulty of identifying the group of beneficiaries.

3.5 Sustainability (Rating: a)

This project is structured in a way that the Hunan Provincial People's Government monitors the sub-projects as the supervising organization and the respective implementation agencies/enterprises are responsible for the operation and maintenance of the individual sub-projects. Accordingly, the sustainability was rated by first evaluating the sustainability of Hunan Provincial People's Government and each of the implementation agencies individually and the computing the average value.[19] Sub-projects that are in operation at this writing are generally well operated and maintained. Sub-projects that have discontinued operation or are scheduled for closure in 2010 are evaluated to be not sustainable already at this time of ex-post evaluation.

3.5.1 Structural Aspects of Operation and Maintenance

(1) Executing agency: Hunan Provincial People's Government

The Hunan Provincial People's Government maintains an organization structure for constant supervision by continuing to keep in place the Hunan Province Management Office of Japanese Loan for Environmental Protection Project that is charged with the responsibilities of project monitoring and follow-up. The Bureau of Environmental Protection conducts an on-line monitoring of the urban sewage treatment sub-projects and some of the industrial waste water treatment sub-projects. While the project falls under the jurisdiction of four bodies --- Development and Reform Commission (5 officials), Local Finance and Securities Office (3 officials), Bureau of Environmental Protection (1 official) and Department of Construction (1 official), the Development and Reform Commission is responsible for coordination of follow-up activities. Shortcomings in project document management were pointed out in one of the self-evaluations of executing agencies, and should be corrected.

(2) Implementation Agencies of sub-projects

[19] The evaluation standards were based essentially on the sustainability standards applied to ordinary projects. Given the large number of entities involved, the simplified evaluation procedures were followed.

No problems were found with the organizational structures of those sub-projects that are in operation. The implementation agency of sub-project 2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project changed in 2003 from Xiangjian Nitrogen Fertilizer Factory, a state company, to privately-run Hunan Zhicheng Chemicals Co. Ltd. There are no management problems, either.

3.5.2 Technical Aspects of Operation and Maintenance

(1) Executing agency: Hunan Provincial People's Government (Bureau of Environmental Protection)

The Bureau of Environmental Protection performs monitoring, both scheduled and ad hoc, and is found to have the skill and competency necessary for proper supervision of the sub-projects. The Bureau of Environmental Protection makes responses to emergency situations of environmental incidents and extends routine support to city environmental monitoring stations in the Xiang River basin as well as to provincial centers through the supply of equipment, apparatus and technical assistance.

(2) Implementation Agencies of sub-projects

Generally no problems were found; most sub-projects are well-operated in terms of operation and maintenance personnel, size of technical staff and training/operation manuals. Some of the employees have participated in JICA's training programs in Japan, and the technical expertise and other knowledge acquired there are well reflected in the sub-project operation. Sub-project 1-1) Sewage Treatment System Construction Project in Yongzhou City was found to be suffering from insufficient inspection and maintenance equipment, which is a source of concern for sustained maintenance and repair activities.

3.5.3 Financial Aspects of Operation and Maintenance

(1) Executing agency: Hunan Provincial People's Government

No review was made on this particular aspect, because the Hunan Provincial People's Government is not an implementation agency of the sub-projects.

(2) Implementation Agencies of sub-projects

Most city sewage treatment enterprises are operated as public service with modest fees. Financial self-reliance is difficult or not intended at all. The government provides a constant flow of financial input and there are no financial problems that would hinder operation. With respect to sub-projects that are operated by private enterprises, no evaluation was possible because of the unavailability of financial statements.

3.5.4 Current Status of Operation and Maintenance

(1) Executing agency: Hunan Provincial People's Government

No review was made on this particular aspect, because the Hunan Provincial People's Government is not an implementation agency of the sub-projects.

(2) Implementation Agencies of sub-projects

As far as the facilities now in operation are concerned, the business environment to ensure stable operation, such as current status of operation, facilities management and spare parts replacement, was confirmed through visual inspection, examination of maintenance records and other means during the on-site evaluation study.

- With respect to sub-projects 1-2) Sewage Treatment System Construction Project in Yueyang City, 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha, 1-7) Environmental Countermeasures in Wulingyuan Scenic Zone World Natural Heritage, in Zhangjiajie City, 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant, 2-6) Mining Water Pollution Control Project in Shuikoushan, 4-1) Garbage Filling Yard Construction Project in Hengyang City and 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City, expansion or revamping of the facilities have been executed or are scheduled according to the need.
- Sub-project 2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory was found to possess no business sustainability, because the factory is no longer producing chrome on account of weakened demand.
- Among the several treatment facilities included in Sub-project 2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project, the waste water treatment facility in the urea production line was not in service. Since the urea production is planned to be resumed by the end of this year, further follow-up is considered necessary. A "b" rating was given because the production had not yet restarted.
- The facilities of Sub-project 4-1) Garbage Filling Yard Construction Project in Hengyang City are operated at overload already and their closure is scheduled by the end of 2010, as was mentioned in the "Effectiveness" section. Construction of a separate treatment facility is planned in the framework of an existing ODA loan project.

Among the sub-projects that are privately run or are vulnerable to market fluctuations, four sub-projects have seen their business scope reduced or have suspended or discontinued operation. They were found to have no sustainability. However, all the others that are in operation have no problems and their overall status of operation is found to be good. In summary, no major problems have been observed in the operation and maintenance system, therefore sustainability of the project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was planned and designed to address the grave environmental pollution of the

region. The intended approach of achieving comprehensive improvement of water quality, air quality and solid waste management was indeed relevant with the development need and the project relevance is high. With respect to the project planning process, however, there were rooms for improvement on the definition of project objectives and sub-projects selection. Under this project, three of the 22 sub-projects had to be substituted and after project implementation three had to discontinue operation. No planned effects were observed in the field of air pollution abatement. Influenced by the exiting of some small- and medium enterprises caused by the industrial structure adjustment policy, the reduction rates of COD and other water pollutants were adjudged "fair" but the quality of the treated water has indeed improved. Effects that have been realized in the fields of heavy metal concentration in industrial waste water and solid waste management exceeded initial expectation.

The evaluation study has revealed that the quality of rivers and water systems adjacent to the sub-project sites was on a deteriorating trend in the cities of Changsha and Zhuzhou and on an improving trend in Shaoyang City. Given the increases of waste water discharge and COD in recent years, the project can be said to have made a certain degree of positive contribution in preventing further deterioration of water quality.

Accordingly, a "b" rating was given to the overall effectiveness of the project. The sub-projects that are in operation are generally well operated and maintained.

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

4.2 Recommendations

4.2.1 Recommendations to the executing agencies

There were instances in which data required for evaluation were not available for reasons of change in personnel and others. Executing agencies should be fully advised of the importance of document management. Monitoring of pertinent data and information is very important for correct analysis of the effects and for sustained operation of the project. With respect to sub-projects at which the requested data were not available, in particular, it is hoped that the environmental monitoring center and/or the competent city environmental protection offices will make the necessary follow-up.

4.2.2 Recommendations to JICA

Nothing in particular.

4.3 Lessons Learned

(1) The project was implemented and is operated generally as planned, as far as its sewage treatment sub-projects are concerned, which are characterized by their strong public service nature. In contrast, the assistance extended to industrial waste water treatment and other sub-projects that were run by private enterprises ended up in outcomes such as project

cancellation and operation discontinuation, because of poor management or change in government policy. Particularly in extending assistance to private enterprises, it would have been desirable if the project had been designed to better respond to the dramatic changes in market conditions including rapid economic growth and policy changes. The use of a screening process that better responds to the most up-to-date situations would have been desirable by, for example, adopting the schemes that permit more flexible selection or changes of sub-projects from appraisal to implementation stages. It would then be possible for the project to adjust to immediate changes in policy, socio-economic situations, and company's financial status. It is also considered important from the viewpoint of fairness that private companies be given equal opportunities in response to the selection process led by the Government this time.

(2) As a lesson for future projects, it is felt very important to define project objectives more strictly. It is recommended that at the time of project planning the objectives be defined in such ways as: (1) the project objective should be narrowed down to reduction of pollutants at sub-project levels, (2) the target tributaries and monitoring sections should be specified, and the scope and scale of the assistance should be determined so that the water quality at such defined spots would be improved as intended, and (3) external factors (industrial structure adjustment, population trend, etc.) that have bearings on the achievement of the intended water and air quality improvement should be analyzed more fully in advance.

Concluded

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1.Project Outputs	Refer to Attachment 1 "Outputs by Sub-project Category"	
2.Project Period	(I) Overall: September 1997 – August 2000 (36 months) (II) Overall: December 1998 – December 2002 (49 months)	(I) Overall: January 1998 – December 2005 (96 months) (II) Overall: April 1998 – December 2004 (81 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion	(I) Total project cost: 12,097 million yen of which Japanese ODA loan portion: 5,678 million yen (of which foreign currency: 5,678 million yen and local currency: 472 million RMB) (II) Total project cost: 12,911million yen of which Japanese ODA loan portion: 6,175million yen (of which foreign currency: 6,175million yen and local currency: 421 million RMB) Grand total project cost ((I)+(II)): 25,008 million yen	(I) Total project cost: 13,513 million yen of which Japanese ODA loan portion: 5,648 million yen (of which foreign currency: 5,648 million yen and local currency: 557 million RMB) (II) Total project cost: 13,080million yen of which Japanese ODA loan portion: 6,175million yen (of which foreign currency: 6,175million yen and local currency: 489 million RMB) Grand total project cost ((I)+(II)): 26,593 million yen
Exchange rate	(I)RMB1 = 13.60 yen (as of September 1997) (II) RMB1 = 16.00 yen (as of December 1998)	RMB1 = 14.12 yen (average of 1998 - 2005)

Attachment 1. Outputs by Sub-project Category

Plan	Actual
Category 1 City sewage treatment projects 1-1) Sewage Treatment System Construction Project in Yongzhou City ・ Influx: 100,000 m3/day 1-2) Sewage Treatment System Construction Project in Yueyang City ・ Influx: 150,000 m3/day 1-3) Sewage Treatment System Construction Project in Changde City ・ Influx: 150,000 m3/day 1-4) Sewage Treatment Project in Zhuzhou City ・ Construction of a sewage treatment plant with 100,000 m3/day capacity ・ Installation of sewer culvert (18km) ・ Construction of a pump station 1-5) Sewage Treatment Project in Linxiang City ・ Construction of a sewage treatment plant with 60,000 m3/day capacity ・ Installation of sewer culvert (2km) 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha ・ Construction of a sewage treatment plant with 80,000 m3/day capacity ・ Installation of sewer culvert (12km) 1-7) Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City ・ Construction of three sewage treatment plants (6,000 m3, 16,000 m3, 2,000 m3) ・ Procurement of environmental monitoring equipment	**Category 1 City sewage treatment projects → generally as planned** 1-1) Sewage Treatment System Construction Project in Yongzhou City ・ As planned 1-2) Sewage Treatment System Construction Project in Yueyang City ・ As planned 1-3) Sewage Treatment System Construction Project in Changde City ・ As planned 1-4) Sewage Treatment Project in Zhuzhou City ・ As planned 1-5) Sewage Treatment Project in Linxiang City ・ As planned 1-6) Sewage Treatment Project in Xingsha Development Area of Changsha As planned, but sewer culvert length (ODA portion) was reduced to 1.3km because Chinese Government implemented sewer culvert installation 1-7) Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City Generally as planned, but sewage treatment plants were reduced from three to two. (1) Luoguta Plant with design treatment capacity of 3,000 m3/day, (2) Suoxiyu Plant with design treatment capacity of 4,000 m3/day, and (3) Pipeline connecting to Zhangjiajie City Plant of 20,000 m3/day capacity (1.6 m dia. x 9 km length). Machinery and equipment were procured generally as planned: screen, sand separator, surface aerator, etc. for Plant (1), and screen, sand separator, blower, etc. for Plant (2).
Sub-projects that were added as a result of substitution: 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant This sub-project replaced Sub-projects 2-8)	 1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant Generally as planned, but the sewer line

and 2-9) that were cancelled. ・ Sewage treatment plant upgrade (standard activated sludge process → AO process, 30,000 m3/day) ・ Construction of a new sewage treatment plant (OD process, 150,000 m3/day) ・ Sewer line (total length 24.4 km)	length (ODA portion) was reduced to 7.8 km, because the city government installed a portion of the sewer line.
1-9) Sewage Treatment System Construction Project in Liuyang City Surpluses from Sub-projects 1-4), 1-5), 1-6), 2-7) and 3-3) were directed to a new sub-project 1-9) Sewage Treatment System Construction Project in Liuyang City. ・ Construction of a new sewage treatment plant (A2O process, 80,000 m3/day) ・ Sewer line (12.1 km)	1-9) Sewage Treatment System Construction Project in Liuyang City As planned, but the construction is divided into two phases. Under Phase I, a 40,000-ton plant has been constructed. A 80,000-ton sewage treatment plant will be constructed under Phase II.
Category 2 Industrial waste water treatment projects	**Category 2 Industrial waste water treatment projects → Generally as planned, except for two cancelled subprojects and one that discontinued operation after implementation**
2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory ・ Treated wastewater: 1,200 t/hr (increment of 400 t/hr) ・ Treats wastewater from sulfuric acid washing, etc. ・ Recycled use of treated water	2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory As planned
2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory ・ Closed circuit washing of sulfuric acid ・ Mercury removal ・ Spent acid recovery ・ Treatment of wastewater from chemical fertilizer production process ・ Treatment of wastewater from vinyl chloride and other chemical processes ・ Treatment of high concentration organic wastewater ・ Recycled use of cooling water ・ Sludge treatment, etc.	2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory As planned
2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory ・ Production of chrome steel (6,000 t/y) from 21,000 t/y chrome slag	2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory As planned
2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project ・ Construction of new treatment facilities	2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project Generally as planned, but the urea production wastewater treatment facility

for wastewater from various processes ・ Recycled use of effluent ・ Construction a new facility for comprehensive utilization of fly-ash (200,000 t/y), etc. 2-5) Wastewater Treatment Project for Xiangtan Paper Mill Factory ・ Installation of paper mill wastewater treatment facility ・ Renovation of paper mill machinery ・ Installation of pulp dissolution equipment, etc.	has not been in service for one year because of weak urea demand. Restart is planned for February 2010. 2-5) Wastewater Treatment Project for Xiangtan Paper Mill Factory Cancelled because of financial difficulty and eventual bankruptcy. Substituted by Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project, but its executing agency, Hunan Lantian Enterprise Co., suffered a plant explosion and suspended its operation entirely. Because of financial difficulty, it went bankrupt, also affected by the government policy of industrial structure adjustment. The subproject was terminated.
2-6) Mining Water Pollution Control Project in Shuikoushan ・ Installation of wastewater facilities capable of reducing the lead, cadmium, arsenic, mercury and other substances contained in the wastewater to below the emission standards ・ Installation of recycling system for cooling water and treated effluent ・ Metals recovery from slag ・ Upgrading of sulfuric acid production unit, etc.	2-6) Mining Water Pollution Control Project in Shuikoushan Generally as planned
2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co. ・ Recycled use (95%) of wash water through installation of blast furnace gas washing water treatment facilities ・ Utilization of coal ash generated at the in-house power station through installation of brick production facilities ・ Installation of iron recovery facilities from blast furnace slag and converter furnace dust ・ Installation of wastewater treatment facilities in the rolling mill for the treatment of organic wastewater and recovery of oil components	2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co. Generally as planned
2-8) Water Pollution Control Project by Liuyang Paper Plant ・ Shutdown of small size pulp mills (6 mills) ・ Construction of a 17,000 t/y wood pulp mill with biochemical wastewater treatment facilities (capacity 6,000	2-8) Water Pollution Control Project by Liuyang Paper Plant The plant was closed and the sub-project was cancelled before implementation to be substituted by another sub-project.

t/day) 2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factor ・ Revamp of water gas methanation unit (40,000 m3/day) to supply water gas as city gas (20,000 households) ・ Introduce gas purification wash water to water treatment facility ・	2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factor Cancelled before implementation because the project was completed by local currency. Was substituted by another sub-project.
Category 3 Air pollution abatement projects	**Category 3 Air pollution abatement projects → Generally as planned, but two of the three sub-projects have ceased operation and little information was available.**
3-1) Expansion Project of Gas Supply Network in Shaoyang City • Increased gas supply to citizens of Shaoyang City: 60,000 m3/day → 110,000 m3/day • Installation of a coal gas purification unit • Expansion of gas holder: 50,000 m3 • Extension of gas pipeline (medium pressure 20.58 km, low pressure 23.51 km) • Addition of regulator stations, etc.	3-1) Expansion Project of Gas Supply Network in Shaoyang City As planned, but the regulator station has been transferred to the Technical Supervision Office, because the executing agency was not qualified to perform inspection measurements.
3-2) Expansion Project of Gas Production Plant in Zhuzhou City • Increased gas supply to citizens of Zhuzhou City: 60,000 m3/day → 120,000 m3/day • Expansion of coke gas furnace and purification unit: 60,000 m3/day • Expansion of gas holder: 54,000 m3 • Extension of gas pipeline (medium pressure 1.84 km, low pressure 8.09 km) • Addition of regulator stations, maintenance center, etc.	3-2) Expansion Project of Gas Production Plant in Zhuzhou City All the facilities were constructed and were put into use until 2008. But the government policy on city gas changed from coke gas to natural gas. Consequently, the project facilities are unused today, except for the pipeline for distribution.
3-3) LPG Supply Project in Changsha City • Reduction of SO_2 and TSP through construction of LPG gas supply facilities and network: 100,000 households to be newly served	3-3) LPG Supply Project in Changsha City All the facilities were constructed and were put into use for about two years. but the government policy on city gas changed from LPG to natural gas. The pipeline has been transferred to Changsha XinAo Gas Company and is in use.
Category 4 Waste treatment projects	**Category 4 Waste treatment projects → As planned**
4-1) Garbage Filling Yard Construction	4-1) Garbage Filling Yard Construction

Project in Hengyang City ・ Construction of filling yard for sanitary treatment of 250,000 t/y household solid waster ・ Leaching prevention measures and leachate collection system ・ Monitoring equipment for groundwater and air, etc. 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City ・ Construction of household solid waste filling yard (capacity 45 million m3) ・ Leachate treatment	Project in Hengyang City As planned 4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City As planned
Category 5 Other project 5-1) The Environmental Monitoring and Management Center of Hunan Province ・ Installation of equipment and apparatus for water quality analysis, measurements and experiments ・ Introduction of equipment for construction of monitoring data and information network, etc.	**Category 5 Other project** 5-1) The Environmental Monitoring and Management Center of Hunan Province Generally as planned, but some pieces of equipment have become obsolete and not fit for use.

Attachment 2 Computation Method of Project Period Rating for Sub-projects

	Unit: months											
Sub-project code	Plan	Actual	Plan	Actual	Variance	Rating	Points		Rating	Sub-projects	Points earned	Total points
1-1)	36	82	1997.9-2000.8	1998.1-2004.10	228%	c	1		a	4	3	12
1-2)	36	53	1997.9-2000.8	1998.6-2002.10	147%	b	2		b	3	2	6
1-3)	36	94	1997.9-2000.8	1998.1-2003.12	261%	c	1		c	13	1	13
1-4)	33	36	1998.10-2001.6	1998.10-2001.9	109%	b	2			20		31
1-5)	27	55	1998.10-2000.12	2000.4-2003.6	204%	c	1		**Rating**	**b**	**Average point**	**1.55**
1-6)	30	55	1998.10-2001.3	1998.4-2002.9	183%	c	1		Excludes two sub-projects that were cancelled or not verifiable			
1-7)	51	46	1998.10-2002.12	2001.10-2004.12	90%	a	3					
1-8)	28	45	2002.4-2004.7	1999.10-2003.6	161%	c	1					
1-9)	24	59	2002.4-2004.3	2001.10-2004.12	246%	c	1					
2-1)	36	18	1997.9-2000.8	1998.1-1999.6	50%	a	3					
2-2)	36	60	1997.9-2000.8	1998.1-2002.12	167%	c	1					
2-3)	36	69	1997.9-2000.8	1999.1-2004.9	192%	c	1					
2-4)	36	93	1997.9-2000.8	1998.4-2005.12	258%	c	1					
2-5)	36		1997.9-2000.8	Cancelled	0%	d						
2-6)	36	44	1997.9-2000.8	1998.1-2001.8	122%	b	2					
2-7)	27	51	1998.10-2000.12	2000.7-2004.9	189%	c	1					
3-1)	36	87	1997.9-2000.8	1998.10-2005.9	242%	c	1					
3-2)	36		1997.9-2000.8	Not verifiable	0%	d						
3-3)	39	39	1998.10-2001.12	1999.1-2001.9	100%	a	3					
4-1)	36	78	1997.9-2000.8	1998.1-2001.9	217%	c	1					
4-2)	30	49	1998.10-2001.3	1999.1-2002.9	163%	c	1					
5-1)	36	30	1997.9-2000.8	1998.1-2000.6	83%	a	3					
					Average point		**1.55**					

Note: The overall project period rating was obtained by rating the actual project periods of individual sub-projects and computing their average. The average value ratings were “a”: no less than 80% (2.4), “b”: no less than 50% and less than 80% (no less than1.5 and less than 2.4), and “c”: less than 50% (1.5).

Attachment 3 Operational Effect Indicators of Sub-projects

Category 1 City sewage treatment projects	Pollutants (unit)	Plan (P)	Actual (A)	A/P (%)
1-1) Sewage Treatment System Construction Project in Yongzhou City	Average influx (10,000 m3/d)	10	5.1	51
	COD reduciton (t/y)	7,655	3,489	46
	BOD reduction (t/y)	3,650	1,155	32
	SS reduction (t/y)	1,500	2,710	181
1-2) Sewage Treatment System Construction Project in Yueyang City	Average influx (10,000 m3/d)	10	9.5	95
	COD reduciton (t/y)	7,300	6,472	89
	BOD reduction (t/y)	4,380	3,390	77
	SS reduction (t/y)	6,205	--	
1-3) Sewage Treatment System Construction Project in Changde City	Average influx (10,000 m3/d)	15	7.7	51
	COD reduciton (t/y)	3,285	1,670	51
	BOD reduction (t/y)	3,285	693	21
	SS reduction (t/y)	9,200	648	7
1-4) Sewage Treatment Project in Zhuzhou City	Average influx (10,000 m3/d)	10	7	73
	COD reduciton (t/y)	6,935	3,478	50
	BOD reduction (t/y)	4,015	1,459	36
	SS reduction (t/y)	5,475	3,716	68
1-5) Sewage Treatment Project in Linxiang City	Average influx (10,000 m3/d)	6	3.6	60
	COD reduciton (t/y)	5,256	920	18
	BOD reduction (t/y)	2,847	650	23
	SS reduction (t/y)	2,847	650	23
1-6) Sewage Treatment Project in Xingsha Development Area of Changsha	Average influx (10,000 m3/d)	8	8	100
	COD reduciton (t/y)	7,008	4,902	70
	BOD reduction (t/y)	3,796	1,909	50
	SS reduction (t/y)	6,716	2,399	36
1-7) Environmental Countermeasures in Wulingyuan Scenic Zone, one of the World Natural Heritage, in Zhangjiajie City	Average influx (m3/d)	24,000	8,080	34
	BOD reduction (t/y)	1,620	3	0
	SS reduction (t/y)	1,780	24	1
1-8) Expansion Project of Changsha No.1 Sewage Treatment Plant	Average influx (10,000 m3/d)	18	13.2	73
	COD reduciton (t/y)	16,425	8,266	50
	BOD reduction (t/y)	8,760	3,025	35
	SS reduction (t/y)	12,593	6,825	54
1-9) Sewage Treatment System Construction Project in Liuyang City	Average influx (10,000 m3/d)	7.6	8	105
	COD reduciton (t/y)	8,760	2,155	25
	BOD reduction (t/y)	4,672	997	21
	SS reduction (t/y)	6,716	1,538	23

Category 2 Industrial waste water treatment projects	Pollutants (unit)	Plan (P)	Actual (A)	A/P (%)
2-1) Expansion Project of Wastewater Treatment Plant for Zhuzhou Heavy Metal Factory	Wastewater treated (t/hr)	1,200	1,200	100
	Arsenic reduction (t/y)	117	117	100
	Cadmium reduction (t/y)	14	14	100
	Lead reduction (t/y)	32	32	100
2-2) Wastewater Treatment Project for Zhuzhou Chemical Factory	COD reduciton (t/y)	2,603	2,834	109
	Mercury reduction (t/y)	2	3	142
	Arsenic reduction (t/y)	46	47	103
	Fluorine reduction (t/y)	406	622	153
2-3) Chrome Slag Treatment Plant in Hunan Ferroalloy Factory	Comparable data unavailable			
2-4) Xiangjiang Nitrogen Fertilizer Factory Fly-ash and Wastewater Treatment Project	SS reduction (t/y)	12	12	100
2-5) Wastewater Treatment Project for Xiangtan Paper Mill	Cancelled			
2-6) Mining Water Pollution Control Project in Shuikoushan	Effluent reduction (million m3/y)	5.5	8.5	155
	Arsenic reduction (t/y)	9	13	138
	Cadmium reduction (t/y)	8	8	109
	Lead reduction (t/y)	67	96	143
	Mercury reduction (t/y)	67	0	0
2-7) Industrial Pollution Control Project by Xiangtan Iron & Steel Co.	COD reduciton (t/y)	1,434	1,550	108
	SS reduction (t/y)	4,742	4,838	102
	Cyanides reduction (t/y)	9	10	111
2-8) Water Pollution Control Project by Liuyang Paper Plant	Cancelled			
2-9) Gas Supply and Water Pollution Control Project by Liuyang Nitrogenous Fertilizer Factory	Cancelled			
2-10) Organophosphorus Pesticide Tech-transformation and Wastewater Treatment Project	Operation discontinued			

Category 3 Air pollution abatement projects	Pollutants (unit)	Plan (P)	Actual (A)	A/P (%)
3-1) Expansion Project of Gas Supply Network in Shaoyang City	Gas supply (10,000 m3/d)	11	8	73
	SO2 reduction (t/y)	1,324	1,184	89
3-2) Expansion Project of Gas Production Plant in Zhuzhou City	Operation discontinued			
3-3) LPG Supply Project in Changsha City	Operation discontinued			

Category 4 Waste treatment projects	Pollutants (unit)	Plan (P)	Actual (A)	A/P (%)
4-1) Garbage Filling Yard Construction Project in Hengyang City	Solid waste treated (10,000 t/y)	18	33	183
4-2) Garbage Sanitary Filling Yard Construction Project in Changsha City	Comparable data unavailable			

Category 5 Other project	Pollutants (unit)	Plan (P)	Actual (A)	A/P (%)
5-1) The Environmental Monitoring and Management Center of Hunan Province	Comparable data unavailable			

Attachment 4 Computation Method of Sustainability Rating for Sub-projects

(1) Criteria for Rating

Supervisory Organization	Criteria
Regime	- Is the regime well-organized and are the personnel well-placed for supervising the subprojects? - Is the supervisory organization in good relationship with the subproject executing organizations for incessant close communication? - Is the monitoring system well-established on the basis of environmental regulations?
Skill	- Are the personnel of Environment Protection Department well-placed and is their skill upgraded to the level to properly supervise the subprojects?
Finance	- Are the above activities financially backed up to a sufficient extent?
Subprojects	Criteria
Regime	- Is the regime well-organized for operation and administration (for decision-making)? - Is there a possibility of being privatized? If so, is there a possibility that the sustainability of the subprojects is affected?
Skill	- Are the personnel kept at an appropriate level for maintenance and operation? - Are the competent personnel having the technical skill for operating equipment well-placed? - Is a technical training system fulfilled for operation and administration? Is any training actually put in practice? - Is the operation manual available? And is it actually utilized? - Are the results of the inspections properly recorded and kept in good conditions?
Finance	- Are the profit and loss well-balanced? - Is the system to collect charges established in the manner to recover the cost? -In case the project is in deficit operation, is any governmental subsidy given, and is there no problem in carrying on operation from financial aspects?
Maintenance & administration	- Is the equipment ready to display its performance? - Is there no problem in maintenance activities, for instance, on the procurement of spare parts? -Is there no problem in having maintenance at regular intervals? - Has there been no problem in troubleshooting?

(2) Rating Result

	Evaluation		Structure	Technique	Finance	O&M
Supervised by Hunan Provincial People's Government	a		a	a		
1-1)	b	2	a	b	a	a
1-2)	a	3	a	a	a	a
1-3)	a	3	a	a	a	a
1-4)	a	3	a	a	a	a
1-5)	a	3	a	a	a	a
1-6)	a	3	a	a	a	a
1-7)	a	3	a	a	a	a
1-8)	a	3	a	a	a	a
1-9)	a	3	a	a	a	a
2-1)	a	3	a	a	a	a
2-2)	a	3	a	a	a	a
2-3)	c	1				c
2-4)	b	2	a	a	a	b
2-5)	a	3	a	a	a	a
2-6)	a	3	a	a	a	a
2-7)	a	3	a	a	a	a
3-1)	b	2	a	a	b	b
3-2)	c	1				c
3-3)	c	1				c
4-1)	c	1				c
4-2)	a	3	a	a	a	a
5-1)	a	3	a	a	a	a
Total	**a**	2.50				

	Rating	Number	Points	Total
	a	15	3	45
	b	3	2	6
	c	4	1	4
		22		55
	Rating	**a**	**Average**	**2.50**

<Method of Rating>

1. A comparison is made between the plan and achievements in each subproject to figure out a sub-rating (the subprojects cancelled or not ascertained are excluded).
2. The average of the total sub-ratings thus obtained is made as an overall rating.
3. Scores below a decimal point are taken up on the following basis:
   a: Not less than 80% (not less than 2.4)
   b: Not less than 50% to less than 80% (not less than 1.5 to less than 2.4)
   c: Less than 50% (less than 1.5)

China

Ex-Post Evaluation of Japanese ODA Loan Project

Jilin Song Liao River Basin Environmental Improvement Project

External Evaluator: Kenji Momota, IC Net Limited

1. Project Description

Project Site

Sewage Treatment Plant in Jilin City

1.1 Background

Since the 1978 adoption of the Economic Reform Policy, the Chinese economy has been making steady growth, and the country's development in economic aspects has been phenomenal. In parallel, however, the advancement of industrialization has brought about an impending challenge: solving environmental problems including deteriorating quality of river water caused by increased household and industrial wastewater, and air pollution caused by increased use of coal.

At the time of appraisal of the project in question (1998), the basin of Songhua River (total length: ca. 2,308 km) that runs through Jilin and Heilongjiang Provinces and Liao River (total length: ca. 1,390 km) that runs from Hebei Province/Inner Mongolia, through Jilin Province to Liaoning Province is home to a large number of state-owned petrochemical and other companies and has achieved solid economic growth. The economic prosperity, however, brought with it aggravation of water environment deterioration, because the increases in household sewage and industrial wastewater generation far exceeded the available capacity of sewage and wastewater treatment facilities. Against this background, the Province of Jilin was faced with the urgent need to implement control-at-source measures and improve the sewer system.

1.2 Project Outline

The objective of this project is to improve water quality by implementing environmental

pollution control projects in Songhua/Liao River Basin, a region faced with serious problems of water and air pollution as a result of rapid economic growth, thereby contributing to improved standard of living and health of the local residents.

Approved Amount/ Disbursed Amount	12,800 million yen / 12,638 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	December 1998 / December 1998
Terms and Conditions	Interest rate: 0.75% Repayment period: 40 years (Grace Period: 10 years) Conditions for Procurement: Partial untied
Borrower / Executing Agency(ies)	People's Republic of China / People's Government of Jilin Province
Final Disbursement Date	July, 2005
Main Contractor (Over 1 billion yen)	Tianjin Machinery & Electric Equipment Imp./Exp. Co., Ltd Sinosteel Equipment & Engineering Company (Both Chinese)
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	F/S : Northeast Academy of the China Civil Engineering Institute) SAPROF: Kyowa Engineering Consultants Co., Ltd. / Techno Consultants Co., Ltd.
Related Projects (if any)	None

The project consists of sub-projects, grouped into the following categories. "Category 1: Sewage Treatment Projects" for household sewage and all other wastewater of the city, "Category 2: Industrial Wastewater Treatment Projects" for the large amounts of wastewater discharged by plants and other facilities, and "Category 3: Monitoring Capacity Enhancement Project" for the Environmental Protection Agency of Jilin Province. This grouping will be used throughout the report. The table below summarizes the names of planned sub-projects determined at the time of project planning and their respective executing agencies.

Category	Sub-project name	Sub-project implementing agency
Category 1. Sewage Treatment Projects		
1-1	Sewage Treatment Project in Jilin City	Jilin City Sewage Treatment Inc.
1-2	Sewage Treatment Project in Songyuan City	Songyuan City Jiangnan Sewage Treatment Plant
1-3	West Suburb Sewage Treatment Project in Changchun City	Changchun City Sewage Inc.
1-4	Sewage Treatment Project in Shuangyang District	Changchun City Shuangyang District Municipal Facilities Management Office
1-5	Sewage Treatment Project in Liaoyuan City	Liaoyuan City Sewage Treatment Plant
Category 2: Wastewater Treatment Projects		
2-1	Wastewater Treatment Project for Jilin Ferroalloy Factory	Jilin Ferroalloy Group Co., Ltd.
2-2	Wastewater Treatment Project for Nickel Factory	Jilin Nickel Co., Ltd.
2-3	Wastewater Treatment Project for Jilin Paper Factory	Jilin Paper Co., Ltd.
Category 3: Monitoring Capacity Enhancement Project		
3-1	Songhua River Environmental Monitoring Project	Jilin City Environmental Protection Bureau

The objective of sub-projects is to improve the quality of wastewater discharged to the Songhua River, Liao River or their tributaries. The map below illustrates the major water system in Jilin Province, sampling points of water quality measurement and the locations of sub-projects.

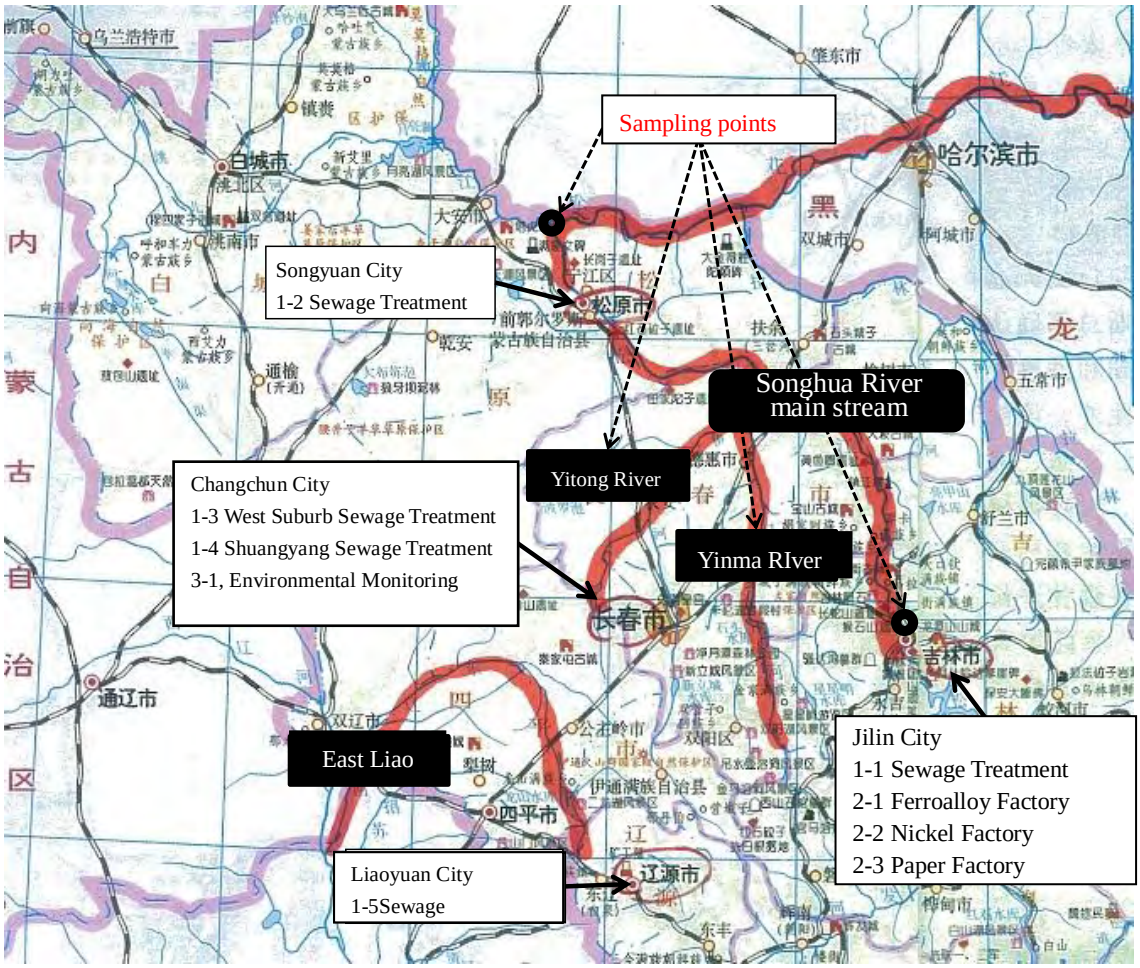

Figure 1 Location of Sub-projects

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

Duration of the Study: October 2009 – October 2010

Duration of the Field Study: January 7 – 31, 2010 and April 4 – 30, 2010.

2.3 Constraints during the Evaluation Study

The sub-projects in this project were implemented with the aim of improving the quality of water of Songhua and Liao River and their tributaries. In this ex-post evaluation, therefore, attempts were made to collect water quality data at or near the discharge points of post-treatment effluents of the sub-project facilities. However, the decision was made by the provincial government not to disclose municipality- and county-level detailed data that would

allow verification of any clear relationship with the sub-projects. Accordingly, the effectiveness analysis of this evaluation relies, as the second best choice, mainly on the water quality data available at the national level[1] for the rivers and water systems concerned. Some of the data is from monitoring stations that are some distances away from the pertinent sub-project locations, and in no way represent the exact impact of the sub-project on river water quality. Furthermore, the river system in question is so vast that it is vulnerable to a variety of factors that affect its water quality, both positively and negatively (for example, positive factors such as other environmental improvement projects by the government, as well as negative factors such as construction of new industrial facilities that will become a new source of pollution). It was not possible to make an in-depth analysis of such factors in a given condition with this ex-post evaluation activity. As a consequence, the present evaluation was made based on those of the aforementioned water quality data that are reasonably deemed to suggest a certain degree of relations with the project with attention to the size and scope of the respective sub-projects. The effectiveness analysis of this report is thus contingent upon certain assumptions.

In addition, one of the sub-projects has seen the facilities dismantled and another has had its executing agency go bankrupt. It was not possible to visit either of these sub-project locations during the on-site study, and the verifiable information is extremely limited.

3. Results of the Evaluation (Overall Rating: C)

3.1 Relevance (Rating: a)

3.1.1 Relevance with the Development Plan of China

(1) Development policy at the time of project appraisal

Addressing environmental problems that have been aggravated in conjunction with rapid economic growth is a major challenge in China. The Ninth 5-year Plan (1996 – 2000) cites measures against water and air polluting sources and improvement of the urban environment as top priority issues. At the same time, the government was promoting reform of state-owned companies; the impending challenge was to develop and implement environmental improvement plans that would serve the dual purposes of restructuring ailing state companies and combating environmental pollution. As top priority regions for water quality improvement measures, the two rivers to be covered by the project in question were designated under the programs of the Three Rivers/Three Lakes (that include Liao River) and the Seven Major Rivers (that include Songhua River).

[1] National Major River Basin Focused Monitoring Sections for which the Data Center of Ministry of Environmental Protection of People's Republic of China publishes data. Refer to Fig. 1 for location of monitoring sections involved.

In line with this national government policy, the provincial government of Jilin formulated the Ninth 5-year Plan for Environmental Protection (1996 – 2000) and the Long-term Plan toward 2010. The former Plan called for a total amount control target for COD[2] in Jilin Province of no greater than 581,600 tons per year by the year 2000. It also set the goals of improving the water quality of Songhua River at the Jilin – Heilongjiang provincial borders up to Level III under the national surface water quality standard and the water quality of Liao River to Level II for human consumption. The project under the present evaluation was implemented as a part of this Ninth 5-year Plan and had a pivotal importance in the environmental policy of Jilin Province.

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

The Eleventh 5-year Plan of the central government (2006 – 2010) has set out nine major objectives. Among these, "Advancement of Sustainable Growth" and "Improvement of People's Standard of Living" relate to the environment sector. More specifically, the Plan calls for 10% reduction in the discharge of major pollutants and other numerical goals for improved health and environment of people's lives. With respect to water quality, the goal is to achieve 10% reduction in the discharge of COD and other pollutants from the 2005 level by the year 2010.

At the provincial level, the objectives set out in the Eleventh 5-year Plan for Environmental Protection in Jilin Province (2006 – 2010) include: protection of water environment, city sewage treatment, water recycling, enhancement of environmental monitoring, preservation of drinking water sources, industrial pollution abatement, improvement of selected rivers and emergency responses to environmental incidents.

The project has as its objective reduction of water pollution, which has been identified as a focus area in both the national and provincial development plans. Thus, its relevance to development policies is high, at the time of project appraisal as well as of ex-post evaluation.

3.1.2 Relevance with the Development Needs in China

3.1.2.1 The need to improve water quality of Songhua River

Water pollution of Songhua River at the time of project planning was serious; among the six major water quality monitoring sections, 62% ranked Levels IV and V under the National Surface Water Quality Standards, meaning "not fit for human consumption." The same was true for Liao River; 87% of the eight major monitoring stations ranked Levels IV and V under the National Surface Water Quality Standards, meaning "not fit for human consumption."

[2] COD, standing for Chemical Oxygen Demand, is an indicator of the degree of water contamination. It is the amount of oxygen that is consumed for oxidization of organics in the water by an oxidizing agent.

Such serious water pollution was due to the increase of industrial wastewater discharge from rapid industrialization and to the dramatic increase of household sewage resulting from fast economic growth. Immediate actions for pollution control at the source were definitely needed.

3.1.2.2 Relevance of project objective and sub-projects selection

As discussed above, the project was of strong needs at both policy and project levels. Meanwhile, there were rooms for improvement in terms of: (1) relevance in the definition of project objectives, and (2) relevance in the selection of sub-projects.

(1) Relevance of project objectives definition

There was as a considerable divergence between the scale of the project and its stated objective "to improve water quality of Songhua/Liao Rivers, thereby contributing to improved standard of living of the local residents." A more focused project objectives definition would have been necessary.

The project can be understood as a structured "program" consisting of a number of subprojects. Accordingly, relevance of such a project should be evaluated by the criteria of "whether or not the overall objective of the project has been achieved." Documents in the early stages of the project state that the outcome of this project was "water quality improvement of Songhua River" and through its attainment the project sought to "Improve the health and living environment of the local residents." If interpreted strictly, this wording means that the objective is "water quality improvement of Songhua River throughout its entire mainstream." This interpretation is unrealistic, given the size of Songhua River (total length: 2,308km) and Liao River (total length: 1,390km) and the scale of the project under evaluation.[3] For the purpose of this ex-post evaluation, therefore, the true project objective that was intended at the time of project planning was "the improvement of water quality of water systems and rivers downstream of the sub-project locations out of the entire water systems of Songhua River and Liao River", and the project outcomes and project impact should consist of the following:

1. Direct effects measurable by the operation and effect indicators of sub-projects
2. Change in the water quality of nearby rivers and water systems to which the wastewater of the sub-project is discharged.

The above two points will be considered as project outcomes and the improvement of living and health environment of the local residents will be considered as the project impact.

[3] If the project were to demonstrate its designed performance in full, the amount of wastewater treated by the project would have been over 20 percent of the wastewater generated in the province, and the COD reduction would have been no greater than a mere 9%.

Nevertheless, there is still a divergence in the project objectives definition even after the above mentioned restatement and re-definition. Even one of the many tributaries of Songhua River downstream of a sub-project location alone has a length of hundreds of kilometers. It is simply too vast an area to pass reasonable judgment on any effect of the project on the water quality. Little is mentioned in the appraisal documents with respect to specific locations for which the water quality improvement would be intended or the degree of improvement to be pursued.

During the setup of project objectives, greater attention should have been paid to the scale of the project and the numerous factors that have bearing on the water quality. More thought should have been given to define the objective more clearly by, for example, setting direct effects of sub-projects as objectives or designating a focused number of monitoring sections at which more direct effects are likely to emerge, and positioning water quality improvement of the rivers and water systems as an overarching project objective.

(2) Relevance of sub-projects selection

Three of the sub-projects of this project underwent major changes of project cancelling, facility removal and operation discontinuation after project implementation, affecting the accomplishment of intended project objectives. The altered sub-projects and the reasons for the alteration are as follows:

• Sub-project 2-1: Wastewater Treatment Project for Jilin Ferroalloy Factory

The facilities were eliminated after four years of operation. The factory expanded the production scale and had to construct a larger-capacity wastewater treatment plant.

• Sub-project 2-2: Wastewater Treatment Project for Nickel Factory

Implementation as an ODA loan project was cancelled. The facilities were subsequently constructed by financing from Chinese government.

• Sub-project 2-3: Wastewater Treatment Project for Jilin Paper Factory

After the completion of plant construction, the plant had to suspend operation. Shortly after the plant completion, the executing agency, Jilin Paper Co., Ltd., suffered virtual bankruptcy. The plant is not in operation, even at the time of evaluation. Accordingly, no information was available on the latest situation.

The above changes are believed to be largely due to the changes that took place in the economic climate and market situations at the time. Such dramatic changes in the business climate were likely to occur, because privatization of state-owned companies and other radical policies were being implemented. In hindsight, questions remain on the selection of sub-projects that were significantly vulnerable to likely changes in market circumstances and were operated

by unstable executing agencies. Somewhat more in-depth examination might have been in order as to the relevance of sub-projects selection; for example, some steps should have been taken to help strengthen and ensure the business continuity in advance if such sub-projects were to be included.

Although the lessons from above two points should be considered for future ODA projects of similar nature, they are not reflected in the rating of this evaluation because of the following reasons:

- When this project was planned (around 1998), there were no stringent institutional requirements to conduct ex-ante evaluation or to set out relevance indicators and target values.
- A project like this one which consists of a number of sub-projects could be interpreted as a sort of "sector loan." In-depth appraisal of individual sub-projects was practically impossible.

3.1.3 Relevance with Japan's ODA Policy

Air pollution abatement and other pollution control as well as natural environment conservation were priority sectors in the Japanese government's "Country Assistance Policy --- China" that served as the guidelines for Japan's cooperation programs for China at the time of appraisal of this project. Based on this policy, the environmental sector was positioned as one of the four priority sectors for assistance, and it was decided to promote assistance projects relating to energy efficiency, solid waste recycling, air pollution control such as soot treatment and desulfurization of exhaust and vent gases as well as sewage improvement and other water pollution control. The project under evaluation is thus highly relevant to Japan's ODA policy.

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

3.2 Efficiency (Rating: b)

3.2.1 Project Outputs

This project consists of multiple sub-projects. An overall observation shows that good project output was confirmed with respect to Category 1. Sewage Treatment Projects that are characterized by high degrees of public service elements in their business, while some of the subprojects of the Category 2. Wastewater Treatment Projects, as was described in the section "Relevance" above, no longer exists, due to its vulnerability to the stability of the executing agencies. (Please refer to Attachment 1 for detailed review of sub-project outputs.)

(1) Category 1: Sewage Treatment Projects

The sewage treatment sub-projects of this project were constructed in selected major cities of Jilin Province for the purpose of treating household sewage previously untreated.

The sub-projects are of similar design in scope, consisting of water treatment facilities, sludge treatment facilities, culvert and pump stations. The facilities have been constructed as planned in general, and no changes have taken place that would significantly affect the attainment of the project objectives.

Sub-project 1-3: West Suburb Sewage Treatment Project in Changchun City saw changes in the total length of the pipeline and cancelling of pump station installation. Those changes became necessary because the contemplated treatment of sewage from the adjacent high-tech industrial zone was excluded from the project scope on account of the construction of a wastewater treatment plant of its own by the industrial zone. Consequently, the pipeline connecting the industrial zone and the accompanying pump station became unnecessary.

Fig.2 Sewage treatment plant in Songyuan City

Fig.3 West suburb sewage treatment plant in Changchun City

(2) Category 2: Wastewater Treatment Projects

The sub-projects under this category relate mostly to installation of treatment facilities of wastewater mainly generated from the production processes of steel and paper as well as facilities for collection of alkali. With respect to project output, one sub-project was cancelled, another saw the facilities dismantled after project implementation, and a third suffered from operation discontinuation as a result of bankruptcy of the executing agency enterprise. Thus, none of the sub-projects have facilities working at the time of this ex-post evaluation.

1. Sub-project 2-1: Wastewater Treatment Project for Jilin Ferroalloy Factory saw its gas-washing water treatment facilities dismantled. This was because the expansion of the

production facilities of the factory progressed at a pace faster than initially anticipated and the treatment facilities constructed by the ODA loan arrangement became incapable of coping with the increased treatment requirement. As of this date, the wastewater treatment facilities constructed by the executing agency on their own financing are in operation. Among the facilities and equipment installed by the project, only the wastewater treatment facilities for circulation-type electric furnace are existent.

2. Sub-project 2-2: Wastewater Treatment Project for Nickel Factory was implemented by the private financing of the Chinese side before the project was started.
3. Sub-project 2-3: Wastewater Treatment Project for Jilin Paper Factory suffered virtual bankruptcy of the executing agency in 2007, and no on-site study was possible during the ex-post evaluation. The Environmental Protection Agency of Jilin Province provided a response that the facilities were installed and constructed generally as planned, but there was no way to confirm the present state of the facilities and their ownership.

The operation of the plants and facilities of this category is by nature more susceptible to market fluctuations and business climate, and this is considered to be a major reason for the incidents of operation discontinuation and facility removal.

(3) Category 3: Other

The sub-project of this category has the purpose of enhancing the monitoring capacity of the Environmental Protection Agency of Jilin Province, and consists of an automatic water quality monitoring system that connects a control center to be located in Changchun City with terminal stations to be located in Jilin City, Songyuan City and other cities. Each terminal station is equipped with an automatic water quality sampling device and data communication equipment. The central control station collects and analyzes tat data.
It should be noted that increased responsibilities of the Environmental Protection Agency made it necessary to procure air and ecological environment monitoring equipment in addition to the initially planned water quality monitoring equipment. Additional procurement was made accordingly.

Fig. 4 Gas chromatograph

Fig.5 Portable monitoring equipment

3.2.2 Project Inputs

3.2.2.1 Project Period

Because the project under evaluation consists of multiple sub-projects[4], the overall rating with respect to project period was made based on the average of points that represent the actual- plan ratios of individual sub-projects with respect to their periods (months) from project commencement to completion. (See Attachment 2 for details.) Based on this calculation, the average rating point is 1.57 (projects' period is or higher than 50% and less than 80%) or slightly longer than planned.

The reasons for major delays in sub-projects are as follows:

- Sub-project 1-1: Sewage Treatment Project in Jilin City

The biggest reason was the outbreak of SARS in 2003/2004 that forced suspension of construction work and delay in procurement of local currency.

Sub-project 1-2: Sewage Treatment Project in Songyuan City

The reasons for the delay of this sub-project included: the outbreak of SARS in 2003/2004 that forced suspension of construction work and delay in procurement of local currency, the change of pipeline locations, and the flood of Songhua River near Songyuan City that forced suspension of construction work.

- Sub-project 2-1: Wastewater Treatment Project for Jilin Ferroalloy Factory

The major reason was that a delay in the appraisal and approval process on the part of the Chinese government did not allow the civil construction work to start until late 2002.

- Sub-project 3-1: Songhua River Environmental Monitoring Project

The reasons included: delay in the procurement of local currency, and the two-step procurement

[4] This project consists of a number of sub-projects. If the standard method of rating for project period counting from the start to completion is applied, an extraordinary delay of one particular sub-project would affect the overall project period, resulting in divergence from the true evaluation of the project period.

of the machinery and equipment that became necessary as a result of alterations and delays in the feasibility study and preliminary design and engineering.

3.2.2.2 Project Cost

The total project cost was 25,031 million yen (the Japanese ODA portion; 12,368 million yen), lower than planned 28,176 million yen (the Japanese ODA portion; 12,800 million yen). Major reasons are the cancellation of Sub-project 2-2: Wastewater Treatment Project for Nickel Factory and the inability to collect and include data on the local currency portion of Sub-project 2-3: Wastewater Treatment Project for Jilin Paper Factory on account of the bankruptcy of its executing agency.[5] All other sub-projects were implemented generally as planned, showing deviations in the neighborhood of 5%. Sub-project 3-1: Songhua River Environmental Monitoring Project showed an overrun of approximately 20% but this was due to the increased procurement of machinery and equipment owing to the expanded scope of project outputs mentioned above.

In conclusion, although the project cost was within the plan, the project period was slightly longer than planned, therefore efficiency of the project is fair.

3.3 Effectiveness (Rating: b)

3.3.1 Quantitative Effects

As was discussed in the section on "Relevance", the effectiveness of this project is evaluated in the following steps:

(1) Analysis of operation and effect indicators of individual sub-projects
(2) Change in the water quality of nearby rivers and water systems to which the wastewater of the sub-project is discharged.

3.3.1.1 Results from Operation and Effect Indicators

(1) Plan and actual effects of overall project

Operative indicators to measure the effectiveness of sewage treatment projects include the amount of sewage treated and the population served. Effect indicators include the amount of pollutants removed and their removal rate. For the purpose of this evaluation, BOD[6], COD and SS[7] data that are commonly used for evaluation of water quality were collected as effect

[5] As was mentioned above, the sub-project that suffered from bankruptcy of the executing agency is excluded from both the plan and actual for the purpose of rating, because fact-finding was not possible.

[6] BOD stands for Biochemical Oxygen Demand. It is an indicator of the degree of water contamination. It is especially important as a regulatory parameter for industrial effluent. It is expressed in terms of oxygen consumed by microorganisms for decomposition of organic components in the water. The higher the BOD value, the higher the degree of water contamination.

[7] SS, standing for "Suspended Solid", refers to insoluble particle matters that are suspended in water. It includes:

indicators. Table 1 is a comparative summary of the planned and actual aggregate totals of pollutants reduction effects of the six sub-projects of Categories 1 and 2.

Table 1 Comparison of Major Indicators

	Total		
	Plan	Actual	A/P
Sewage treated (x 10,000 t/d)	63	38	61%
Reference: population served (x 10,000)	198	242	122%
COD removed (t/y)	61,605	43,119	70%
COD removal rate (%)	64%	86%	136%
BOD removal (t/y)	39,374	24,281	62%
BOD removal rate (%)	86%	91%	106%
SS removed (t/y)	59,614	25,736	43%
SS removal rate (%)	88%	94%	107%

Note 1: Removal rate is calculated by comparing the quality of incoming sewage and that of outgoing effluent at each treatment plant. The figures shown here are compiled from the average rate of each treatment plant.
Note 2: No verifiable data were available on the removal rates of COD, BOD and SS for Category 2: Wastewater Treatment Projects. The evaluation is based only on the data for Category 1: Sewage Treatment Projects.

There is a stark contrast in the effects of the two categories. Category 1: Sewage Treatment Projects have shown good performance in removing pollutants; both the COD and BOD removal rates (comparison of incoming sewage and outgoing effluent) are better than the planned targets, even though the amount of sewage treated is 60% of the planned amount. The amount of sewage treated can vary significantly, depending on demand, economic situation, city planning, etc. While the amount of sewage treated is only 60% of the planned amount to this date, the function of removing pollutants is well demonstrated. Seen at the sub-project level, the operative effectiveness of this project category is adjudged generally high.

Category 2: Wastewater Treatment Projects, meanwhile, cannot be considered to have produced effective results. Neither of the two sub-projects that were implemented is currently in operation since the operation was discontinued only a few years after they were implemented. (See Attachment 3 for specific data for each project category.)

Project categories 1 and 2 together, the evaluation of the overall operational situation can be said to be “fair.” Category 1: Sewage Treatment Projects that have a major share in the entire

micro particles of clay minerals, zoo- and phyto-planktons and their shells, organic matter and metal sediments from sewage or industrial effluents, etc.

project have shown generally good performance in the removal of pollutants even though the amount of sewage treated is 60% of the planned amount. However, the sub-projects of Category 2 are no longer in service.

(2) Operational situation of sub-projects (more details in Attachment 3)

1) Category 1: Sewage Treatment Projects

Three of the five sewage treatment plants have reached no more than 50% of the planned amounts of sewage treated. The situations of these low-performing plants are as follows:

1. Sub-project 1-3: West Suburb Sewage Treatment Project in Changchun City

The plant is located near the major site of FAW Group Corporation, China's biggest automobile manufacturer, and the treatment demand for household sewage of a population of half a million in the district is high. The average treatment amount is 74,000 tons, as a consequence of the subsequent construction of the South Suburb Sewage Treatment Plant (150,000 tons) that handles the sewage from the industrial zone originally included in the panning of the sub-project. The maximum daily treatment amount is 90,000 tons, most of which comes from the automotive zone.

2. Sub-project 1-4: Sewage Treatment Project in Shuangyang District

The current amount of treatment is 11,000-12,000 tons, about half of the planned amount of 25,000 tons. This is due to the lower-than-expected demand caused by the change in city planning that gave lower priority for the development of the area concerned. Because there is little prospect for significant demand increase, the plant is expected to operate more or less at the current level. It should be remembered, however, that this is the only sewage treatment plant in the area and the need for sewage treatment is very high.

3. Sub-project 1-5: Sewage Treatment Project in Liaoyuan City

In the case of this treatment plant, the area's sewage generation is relatively low because the sewer system is not yet available in some parts and, moreover, there is a constant shortage of service water. It should be noted, however, that the demand for sewage treatment is currently 65,000 tons per day and it is expected to increase to 100,000 tons per day in the future. When the construction now underway of the Yangmu Dam is completed, the amount of city service water will increase. In addition, improvement/extension of the sewer culvert system is planned under the Twelfth 5-year plan of the province. Accordingly, increases in the amount of sewage treated by the plant are expected.

2) Category 2: Wastewater Treatment Projects

As reviewed in the section "Efficiency", no plants in this project category are in service any longer. The wastewater treatment plant of Sub-project 2-1: Wastewater Treatment Project for Jilin Ferroalloy Factory did operate for approximately four years generally demonstrating the planned performance, according to sources representing the plant. Currently, successor wastewater treatment facilities installed in response to the increased production scale are in service with satisfactory performances.[8]

3) Category 3: Environmental Monitoring Capacity Enhancement Project

The nature of the project makes it difficult to set quantitative indicators. In an interview with a representative of the monitoring center, it was stated that the project produced positive effects including: launch of on-line monitoring of sewage plants, increased accuracy of water quality monitoring results helped by the installation of the monitoring system,[9] increased frequency and accuracy of on-site inspections at pollution sources through the introduction of the portable equipment, and increased technical capability of the officials through the use of state-of-the-art equipment and apparatus.

(3) Situation of water quality improvement in nearby rivers and water systems

The objective of this project was to improve the water quality of the nearby rivers through implementation of the sub-projects. Table 2 below provides an overview of the nearby rivers and monitoring sections located on them from which the data was collected. These environmental monitoring sections were chosen under the assumption that they would offer data that is relevant with the sub-project even to some extent. However, it should be noted that, for example, the monitoring section used for the evaluation of Sub-project 1-1: Sewage Treatment Project in Jilin City is on the main stream of Songhua River and its water quality is of course dependent on many factors other than the performance of the sub-project. Given the vastness of the rivers, no precise quantification of the effect of the project was possible, and the present evaluation had to rely on certain assumptions. On one sub-project, no data was available from the Environmental Protection Agency of Jilin Province, hence its exclusion for the purpose of project evaluation.

[8] Jilin City's Official Environmental Report for 2007 says the annual COD discharge of Jilin Ferroalloy Group Co., Ltd. was 49 mg/l, which conforms to the standard.

[9] All the sewage treatment plants of Category 1 are linked on-line to the Environmental Protection Agency, and the water quality changes are periodically measured and transmitted. Inspection visits are made by the Agency, based on these data records. The on-site study for this evaluation confirmed that these data and documents were kept in good order and conditions.

Table 2 Overview of Category 1 Sub-projects and Nearby Rivers

	Sub-project	Effluent outlet	Data of monitoring section at:
1-1	Sewage Treatment Project in Jilin City	Songhua River mainstream	Songhuajiancun, Changchun, Jilin
1-2	Sewage Treatment Project in Songyuan City	Songhua River mainstream	Baishatan, Baichen, Jilin
1-3	West Suburb Sewage Treatment Project in Changchun City	Songhua River tributaries: Yitong, Xinkai	Yitong river water quality data
1-4	Sewage Treatment Project in Shuangyang District	Songhua River tributary: Yinma	Yinma river water quality data
1-5	Sewage Treatment Project in Liaoyuan City	Liao River tributary: Dongliao	No corresponding data available

Fig. 6 Songhua River close to the sewage treatment plant in Jilin

Fig. 7 Outlet of a sewage treatment plant

Table 3 below shows the evolution of water quality measured at two Songhua River monitoring sections that pertain to Sub-projects 1-1 and 1-2. While the values vary from one year to another, there are neither major changes nor clear tendencies of improvement. No quantitative statistical data were available with respect to the water quality in Changchun City (Yitong and Yinma Rivers) that pertain to Sub-projects 1-3 and1-4. An Official Environmental Report of Changchun City reports that the water quality of Yitong and Yinma Rivers (with the exception of upper stream segments) in 2007 was still at Levels IV – V under the national standards, and no improvement was observed in 2008.

Table 3 Water Quality of Nearby River of Sub-projects 1-1 and 1-2

		2006	2007	2008	2009	2010
1. Songhuajiancun, Changchun, Jilin	COD (mg/l)	4.4	4.2	3.6	2.9	4.0
	DO[10] (mg/l)	6.9	7.4	6.9	7.3	7.2
	National standard level[11]	III	III	IV	II	III
		2006	2007	2008	2009	2010
2. Baishatan, Baichen, Jilin	COD (mg/l)	3.8	5.5	4.1	3.4	6.7
	DO (mg/l)	10.1	9.6	11.3	11.0	8.5
	National standard level	V	III	V	III	IV

Source: Environmental Protection Agency of Jilin Province

As this table shows, no clear trend can be seen in terms of the "improvement of water quality of nearby rivers" which is the stated objective of the project. Reasons behind this may include the following:

1) Even though they are termed "nearby rivers," some are more than 100 kilometers long. Because the sub-projects are originally not intended to treat the entirety of sewage and wastewater generated in the basin, the impact of other such sewage and wastewater prevent measurement of proper effects of the project.
2) Table 4 below is a comparison of wastewater generation and treatment in the entire city of Changchun between years 2007 and 2008. Wastewater generation increased rather considerably during the short period of two years.

Table 4 Evolution of Wastewater Generation in Changchun City

(Unit:100 thousand ton)

	Industrial wastewater		Household sewage		Total	
Year	Discharge	Compliance*	Discharge	Compliance*	Discharge	Compliance*
2007	4,223	4,015	10,211	8,182	14,434	12,197
2008	5,377	5,126	11,523	10,461	16,901	15,587
Change (%)	127%	128%	113%	128%	117%	128%

[10] DO, standing for dissolved oxygen (O_2), means the amount of oxygen dissolved into water out of the atmosphere. The greater the value is, the cleaner the water is. It affects the activity of aerobic microorganisms in water. Generally, DO of minimum 2 mg/liter is required to prevent foul odor, and of minimum 3 mg/liter for fish to live in. (Source: Environment Creation Bureau website of Yokohama City)

[11] By the 2002 revision of the national standards, COD concentration and other thresholds were lowered from those applied at the time of project planning. Simple comparison is thus irrelevant. The stated project objective was to improve the water quality up to Level III under the National Surface Water Quality Standards. Level III (no higher than 15 mg/liter) under the old standards corresponds to Level II under the new standards now in practice.

Source: The 2008 Official Environmental Report of Changchun City
Note: "Compliance" represents the amount of effluent treated in treatment plants and conforming to the applicable national standards for discharge of pollutants to the environment.

Since the wastewater generation in the entire basin increased in such a manner, it is believed more appropriate to evaluate this project not from the viewpoint of improvement of water quality, but rather from the viewpoint of "mitigating further deterioration of water quality."

In the case of this project with its limited scale, there are so many external factors affecting the water quality that no exact evaluation of is possible. Nonetheless, those sub-projects that are operating --- granted, there are some project facilities of which operation has been halted --- play an important role as the sewage treatment plants in their respective communities, and their pollutant removal function is performed generally as planned. As far as the project objective of "removal of pollutants out of the targeted water systems and mitigation of further deterioration of water quality" is concerned, there have been good results and the water quality has been improved generally as planned. Had it not been for this project, the quality deterioration of the rivers would have aggravated further, and the project can be considered to have demonstrated a certain degree of effects from the perspective of preventing deterioration of river water quality.

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

Recalculation of the financial internal rate of return (FIRR) was made with regard only to the sub-projects that had the highest and the lowest rates of return at the time of project planning. Evaluating the project profitability by FIRR is of relatively low relevance here because the city sewage treatment service is provided as a public service and hence provided for relatively low fees. The operation is not necessarily profit-oriented. The results of recalculations should be used in the consideration of sub-project sustainability, review of the level of fees and maintenance expenses that would ensure uninterrupted repayment of the loan, study on the part of the executing agency for operation improvement, and any policy considerations on the part of the government. The recalculations were made with regard to Sub-projects 1-1: Sewage Treatment Project in Jilin City and 1-2: Sewage Treatment Project in Songyuan City. The results are shown in Table 5 below. The IRRs were negative (not calculable) and decreased, respectively. These results are believed to be due to the uncommonly higher level of sewage service fee assumed by the executing agency at the time of project appraisal than the actual level,[12] and to the low level of capacity utilization (60% of planned) in some of the treatment plants translating into high treatment cost per ton of sewage.

[12] For instance, the treatment fee was assumed to be 1.32 yuan while the actual is in the range of 0.4 – 0.8 yuan.

Table 5 Results of FIRR Recalculation

(1) FIRR: Sewage Treatment Project in Songyuan City: 6.4% at the time of appraisal Sewage Treatment Project in Jilin City: 4.72% at the time of appraisal	Sewage Treatment Project in Songyuan City: 1.35% by ex-post evaluation Sewage Treatment Project in Jilin City: not calculable
(2) Financial benefit: sewage treatment fee	(3) Financial costs: 1) Initial capital investment 2) Maintenance and operation costs

3.3.2 Qualitative Effects

The qualitative effects of this project will be discussed in the section on "Impacts."

Considering above, this project has somewhat achieved its objectives, therefore, its effectiveness is fair.

3.4 Impact

3.4.1 Intended Impacts (Improvement of living and health environment)

(1) Improvement of living and health environment of the residents in the basin

The project has the objective of improving the water quality of the rivers in order to improve the living and health environment of the residents around the basin who depend on the rivers as source of needed water. Improvement of living and health environment cannot be easily measured by any quantitative indicators, and establishing any clear relations with water quality improvement is also difficult. Accordingly, the project impacts were investigated in this evaluation study through beneficiary survey. The survey was conducted in the form of face-to-face interviews, and the major questions included: how the local residents view any changes in the water quality of nearby rivers, and whether they see any improvements in foul odor and other nuisances in their living environment.

The following three locations near selected sub-project sites were sampled out and the interview was made with a total of 100 respondents.

Sub-project		Respondents
1-3	West Suburb Sewage Treatment Project in Changchun City	22 (including 14 farmers)
1-1	Sewage Treatment Project in Jilin City	48 (including 31 farmers and fishermen)

1-5	Sewage Treatment Project in Liaoyuan City	30 (including 16 farmers)
	Total	100

1) Perception of water quality change

Many of the respondents in Jilin City and Liaoyuan City (60 – 80%) gave positive answers saying that the water quality had improved. Approximately 50% of the respondents cited the construction of the sewage plant as the reason for improvement, a result which indicated that there was a certain level of appreciation of the sewage treatment plant construction. This suggests that the project and its effects are positively perceived by the local residents, at least to a certain extent. In Changchun City, only 40% of the respondents said they saw an improvement in the water quality. This response is believed to reflect the continued increase of industrial wastewater in the area which is home to the largest automobile manufacturer in Northeast China.[13]

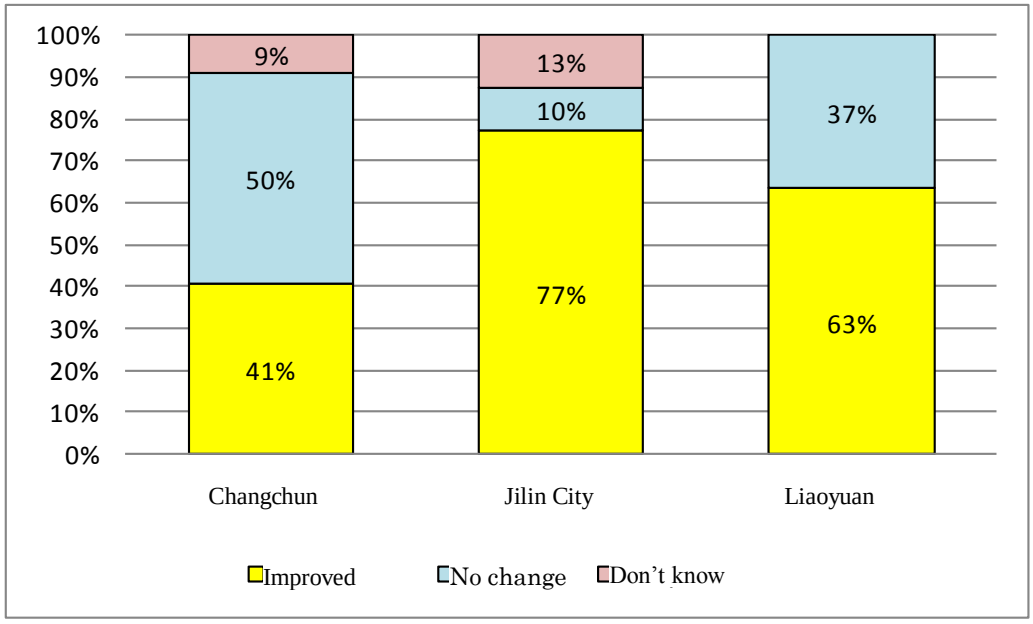

Figure 8 Responses of Beneficiaries about Water Quality Improvement

2) Changes in living environment

Farmers were asked if changes in the water quality had any influence on farming conditions, and fishermen were asked if changes in the water quality had any impact on their catch. The responses may be summarized as follows:

1. Fishermen and farmers in Jilin City appreciated that the water quality had indeed improved

[13] Some respondents pointed out that wastewater from washing of automobile parts drifted on the river surface and was causing foul odor and surface conditions.

and pointed out that their intake water for farming had increased.

2. Respondents in Liaoyuan City answered that even though the water quality had improved, they continue to avoid the use of river water for farming purposes. They pointed out that the paddy rice in the area suffers from low productivity because of the poor water quality.
3. An environment and sanitation official of Jilin City said the color and clarity of the river had apparently improved from five years ago.

Fig.9 Beneficiary interview

Fig. 10 Downtown Liaoyuan City

Based on the above, the impacts of the project are described as follows:

1. On average, approximately 60% of the respondents answered that the water quality was better than before.
2. Approximately 50% of these respondents perceived that the sewage treatment plants contributed to the improvement. Thus, the project is well received to an extent, even at the end beneficiary level.
3. Farmers and fishermen had seen no dramatic changes from the past with respect to impact of water quality on their agricultural/fishery activities, but they recognized a certain degree of improvement.

As the entire province continues to achieve economic development, there is an increasing need for treating sewage and wastewater that continue to be generated through construction of new industrial plants and the increased household use of water. The fact that a good percentage of the respondents recognized a certain degree of water quality improvement despite the increased level of wastewater/sewage generation suggests that the provincial government efforts toward water quality improvement, including this project, have been rewarded by some positive impact.

3.4.2 Other Impacts

In the course of this project implementation, land lots were acquired for the construction of sewage

treatment plants, and particularly in the case of Sewage Treatment Project in Jilin City, 75 households had to be relocated. The land acquisitions are confirmed to have been duly performed in compliance with applicable land and urban planning laws without any particular problems.

Most of the sub-projects, especially the sewage treatment plants, are located at long distances from the residential zones of the city, and no problems of noise, foul odor, etc. associated with the plant operation are believed to be existent.

It is impossible to pass accurate judgment as to how much effect, if any, this project has brought about on the living environment of the local residents, however more than a few residents expressed their views that the river water quality had improved and that the sewage treatment plants played a certain role in the improvement. It is believed therefore that through improvement of water quality, this project has made a certain contribution to the prevention of further worsening of the living environment of the residents in the province of Jilin, an area where the process of economic development and industrialization is continuing.

3.5 Sustainability (Rating: b)

Unlike an ordinary ODA loan project, the executing agency in the project is defined as the totality of the Environmental Protection Agency of Jilin Province that oversees and supervises the entire project and the executing agencies of individual sub-projects. Sustainability was evaluated first by separately evaluating the sustainability of the Environmental Protection Agency and the individual sub-project executing agencies, and then integrating the findings to reach the overall sustainability evaluation.[14]

The category 2 sub-project "Wastewater Treatment Project" did produce outputs at one point in time, but as was described in the section "Efficiency," no sub-projects are in operation any longer. For this reason, no sustainability is recognized on this category.

3.5.1 Structural Aspects of Operation and Maintenance

(1) Environmental Protection Agency of Jilin Province (executing agency)

The Environmental Protection Agency of Jilin Province has built up good relations with the sub-projects to mobilize their cooperation whenever needed. The sewage treatment plants are equipped with an automatic water quality monitoring unit installed at the outlet of treated effluent. The monitoring data is automatically transmitted and compiled at the water quality control center of the Environmental Protection Agency. The Agency is legally empowered to

[14] Given the large number of entities involved, simplified evaluation procedures were followed, whereby only points of major influence on sustainability were investigated.

make inspection visits without prior notice, which it in fact makes from time to time. Thus, the Agency is adequately structured to act as a supervising agency.

(2) Implementing agencies of sub-projects

All the sewage treatment plants concerned are operated by state-owned enterprises which have similar organizational structures. Each enterprise operates the sewage treatment plant under the control of its parent company, the Sewage Treatment Corporation of the City. There is no prospect of these enterprises privatized; their attributes as public entities would remain, at least in the foreseeable future.

3.5.2 Technical Aspects of Operation and Maintenance

(1) Environmental Protection Agency of Jilin Province (executing agency)

The Agency is generally adequately staffed as the supervising agency of the sub-projects. The Monitoring Bureau which is responsible for the actual monitoring activities has 86 staffs, including some 40 technicians. The Monitoring Bureau has been accredited by the China National Accreditation Service for Conformity Assessment and is considered to have the necessary capacity for supervision. It should be added, however, that a representative of the Monitoring Bureau during the interview alluded to the perceived lack of personnel, especially for the monitoring at and inspection visits to remote locations in the province.

(2) Implementing agencies of sub-projects

In the opinion of the expert on environmental improvement projects in China who accompanied the present external evaluator in his on-site study, the degree of familiarization and mastery of the installed machinery and equipment as well as the transferred technology is adequately high, and the technical level of plant operation is high. The adequately high technical level is also justified by the operation records of the plants to this date. The interviews made at the sewage plants confirmed that water quality monitoring data was properly documented, and the presentations on the treatment process flows and daily operations were good, suggesting that things are in good hands. There were ongoing efforts to standardize technical and operational procedures as well as targets among the sewage treatment plants, and no problems appeared to exist.

Fig.11 Central control room of Songyuan sewage treatment plant

Fig. 12 Sewage treated at Changchun West Suburb sewage treatment plant

3.5.3 Financial Aspects of Operation and Maintenance

(1) Environmental Protection Agency of Jilin Province (Executing agency)

Environmental Protection Agency of Jilin Province is a supervising agency that does not deal directly with the financial sustainability of the sub-projects. Accordingly, it is excluded from the scope of evaluation on this aspect.

(2) Implementing agencies of sub-projects

The sewage treatment plants are operated by 100% state-owned companies, and the financing required for operation is made entirely from the funds of the provincial government. Interviews with the representatives of the sub-project executing agencies confirmed that government expenditures in the amounts necessary for operation were secured and that there were generally no problems.

In the case of Sub-project 2-1: Sewage Treatment Project in Jilin City, the treatment fee is set at a rather low level and, if judged as a self-standing business, the revenue/cost balance is not satisfactorily high. Nonetheless, the financial structure of the company does not require balancing between revenue and costs, and this point is not considered to be a major financial problem.

3.5.4 Current Status of Operation and Maintenance

The sewage treatment plants are mostly in good conditions. Although the following problems were mentioned in the facilities of some sub-projects, they are not of a serious nature that would hamper the sewage treatment operations:

(1) In Sub-project 1-5: Sewage Treatment Project in Liaoyuan City, the pump for settling tank suffers from constant clogging. This is imported equipment and no proper actions have been

taken after the guarantee period expired. The representative of the sub-project executing agency added that the treatment function had not been affected per se. The local expert who accompanied the present external evaluator agreed with this view, and the operation records confirmed that this was not a problem for continued operation.

(2) No responses have been received with respect to the location and ownership of the facilities of Sub-project 2-3: Wastewater Treatment Project for Jilin Paper Factory. It is therefore not possible to grasp the current status. The paper factory is in the state of virtual bankruptcy and the facilities have been at a halt for years. There is little prospect that the facilities would be utilized again in the future.

In summary, some problems have been observed in terms of the structure of some sub-projects; therefore sustainability of the project is fairly satisfactory.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project had the objective of constructing sewage/wastewater treatment facilities to improve the quality of water in the Province of Jilin, where water pollution had been a serious problem. Its importance remains great in the face of the continued aggravation of pollution in the province. It is, however, true that there was room for improvement in terms of project objective definition and sub-project selection.

The sewage treatment facilities that were made available by this project play a pivotal role in the sewage treatment services of the cities concerned and display the intended functions and performances. Meanwhile, some of the industrial wastewater treatment sub-projects failed to demonstrate the expected effects as a result of facility removal and bankruptcy-related operation discontinuation. As far as the city sewage treatment facilities are concerned, they are in operation and no problems were observed in terms of operation or organization. It is expected that these facilities will continue to be managed and operated smoothly.

In light of the above, this project is evaluated to be (C) fairly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) In the course of the evaluation study, it was learned that the water quality data for the monitoring sections nearest to the sub-project sites and certain other data that is important for the evaluation were either unavailable or not to be disclosed. This data is not only of significant importance for this project evaluation, but also for broader purposes of promoting

environmental protection in general. It should therefore be commonly shared with a wider spectrum of stakeholders and the executing agency is encouraged to work more proactively toward improved data collection and disclosure.

(2) All of the sub-projects that are still in operation are the city sewage treatment plants. These sub-projects have high needs and they are operated in generally good conditions. There are no major concerns about their future sustainability, in view of their fundamental nature of being a public service for the basic infrastructure of treating sewage, as well as the solid support from the local governments and their low vulnerability to economic fluctuations. The necessity of continued periodical monitoring is believed to be small.

4.2.2 Recommendations to JICA

Nothing in particular.

4.3 Lessons Learned

(1) The sub-projects that suffered project cancelling and operation discontinuation were to be or were implemented by private companies. Their size and the markets they served made them vulnerable to the Chinese government policy of privatizing state-owned enterprises and other major changes in the business climate of the time. In the formation of program-type projects that consist of sub-projects, it is not extremely difficult to carry out detailed appraisal and study of all the candidate sub-projects and the surrounding business environment in advance. When executing agencies that are particularly susceptible to market situations are to be involved, as in the case of this project, it would be preferable to design the project in such as way as to permit rearrangement of sub-projects according to any situation changes during the project implementation, and to take a more flexible approach in the course of project implementation.

(2) This project originally had the immense objective of improving water quality in Songhua/Liao River Basin, but this objective setting was indeed too grandiose, given the size and scope of the project. To permit accurate analysis and evaluation of development outcomes, it is necessary to set objectives at the time of project appraisal that are more clearly relevant to the planned project and are more readily verifiable. With respect to sub-project selection, it is believed necessary to first set out selection criteria with stronger attention to the overall project objective, and then apply the criteria to the selection, appraisal and examination of sub-projects.

Concluded

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1.Project Outputs		
Category 1: Sewage Treatment Projects		
1-1 Sewage Treatment Project in Jilin City		
Sewage treated	300,000m^3/day	300,000 m^3/day
Sewer line	28.8km	28.8km
1-2 Sewage Treatment Project in Songyuan City		
Sewage treated	50,000 m^3/day	50,000 m^3/day
Sewer line	40km	40km
1-3 West Suburb Sewage Treatment Project in Changchun City		
Sewage treated	150,000 m^3/day	150,000 m^3/day
Sewer line	79km	22km
1-4 Sewage Treatment Project in Shuangyang District		
Sewage treated	25,000 m^3/day	25,000 m^3/day
Sewer line	26km	27km
1-5 Sewage Treatment Project in Liaoyuan City		
Sewage treated	100,000 m^3/day	100,000 m^3/day
Sewer line	26km	26km
Category 2: Wastewater Treatment Projects		
2-1 Wastewater Treatment Project for Jilin Ferroalloy Factory	Wastewater treatment facilities: 1 set	As planned, but have been dismantled by now
Factory gas washing water treatment	Slag wastewater treatment facilities: 1 set	
Water recycling inside battery limit		
Wastewater Treatment Project for Nickel Factory	Tailing wastewater treatment, concentration wastewater treatment, etc.: 4 sets	Cancelled
Treatment of wastewater from ore washing process		
2-2 Wastewater Treatment Project for Jilin Paper Factory		
Alkali recovery process renovation	Green mud recovery unit, etc.	Confirmation not possible because of executing agency's bankruptcy
Bleaching process renovation	Chlorine dioxide production unit	
Wastewater treatment facilities	50,000 m^3/day	
Category 3:		
3-1 Songhua River Environmental	Installed in Changchun City.	Generally as planned.

Monitoring Project Water pollution control center Terminal stations: Station No.1 Station No.2	Automatic water quality sampling unit, etc. Jilin City; 200 km downstream of Fengman Dam 20 km from Songyuan City	Additional procurement made for air and ecological monitoring units.
2.Project Period	December 1998 – June 2002 (43 months)	December 1998 – July 2007 (104months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 12,800million yen 15,376million yen (961 million yuan) 28,176million yen 12,800million yen 1yuan = 16 yen (as of December 1998)	 12,638million yen 12,393million yen (877 million yuan) 25,031million yen 12,638million yen 1yuan = 14.13 yen (weighted average January 1999 – December 2007)

Attachment 1 Detailed Project Outputs (see Section 3.2.1)

Category 1. Sewage Treatment Projects (Comparison of original and actual)

Sub-project		Original	Actual
1-1	Sewage Treatment Project in Jilin City		
	1. Sewage treated	300,000 m^3/day	300,000 m^3/day
	2. Sewer line	28.8km	28.8km
	3. Pump stations	5 locations	5 locations
1-2	Sewage Treatment Project in Songyuan City		
	1. Sewage treated	50,000 m^3/day	50,000 m^3/day
	2. Sewer line	40km	40km
	3. Pump stations	2 locations	1 location
1-3	West Suburb Sewage Treatment Project in Changchun City		
	1. Sewage treated	150,000 m^3/day	50,000 m^3/day
	2. Sewer line	79km	22km
	3. Pump station	1 location	Cancelled
1-4	Sewage Treatment Project in Shuangyang District		
	1. Sewage treated	25,000 m^3/day	25,000 m^3/day
	2. Sewer line	26km	27km
1-5	Sewage Treatment Project in Liaoyuan City		
	1. Sewage treated	100,000m^3/day	100,000m^3/day
	2. Sewer line	26km	26km
	3. Pump station	1 location	1 location

Category 2: Wastewater Treatment Projects (Comparison of original and actual)

Sub-project		Original	Actual
2-1	Wastewater Treatment Project for Jilin Ferroalloy Factory 1. Factory gas washing water treatment 2. Water recycling inside battery limit	Treatment facilities: 2 sets Slag wastewater treatment unit: 1 set	Implemented as planned, but have been dismantled by now.
2-2	Wastewater Treatment Project for Nickel Factory Treatment of wastewater from ore washing process	Tailing wastewater treatment, concentration wastewater treatment, etc.: 4 sets	Cancelled
2-3	Wastewater Treatment Project for Jilin Paper Factory 1. Alkali recovery process renovation 2. Bleaching process renovation 3. Wastewater treatment facilities	Install green mud recovery unit, convert existing purifier, etc. Install chlorine dioxide producing unit Maximum treatment capacity: 50,000m^3/day	Implemented as planned, the executing agency went bankrupt and details unverifiable

Category 3: Environmental Monitoring Capacity Enhancement Project (Comparison of original and actual)

Sub-project		Original	Actual
3-1	Songhua River Environmental Monitoring Project 1. Water pollution control center 2. Terminal stations: Station No.1	Install in Changchun City Jilin City; 200 km downstream of Fengman Dam	Generally as planned. Additional procurement made for air and ecological monitoring units.

	Station No.2	20 km from Songyuan City	

Attachment 2. Details of Project Period Rating (See Section 3.2.2.1; numbers in "Original" and "Actual" columns represent months)

	Sub-project	Original	Actual	Change	Rating
1-1	Sewage Treatment Project in Jilin City	43	104	242%	1
1-2	Sewage Treatment Project in Songyuan City	37	103	278%	1
1-3	West Suburb Sewage Treatment Project in Changchun City	35	45	129%	2
1-4	Sewage Treatment Project in Shuangyang District	37	37	100%	3
1-5	Sewage Treatment Project in Liaoyuan City	35	44	126%	2
2-1	Wastewater Treatment Project for Jilin Ferroalloy Factory	25	55	220%	1
2-2	Wastewater Treatment Project for Nickel Factory	25	0	0%	
2-3	Wastewater Treatment Project for Jilin Paper Factory	25	0	0%	
3-1	Songhua River Environmental Monitoring Project	25	81	324%	1
	Total	287	469	**163%**	**11**
				Ave.	**1.57**

Rating computation method:
1. First, each sub-project is rated on the basis of original/actual comparison. (Cancelled and unverifiable sub-projects are excluded.)
2. The average of the sub-project ratings is deemed the overall rating.
3. The decimals are treated according to the following rule:
   a: 80% (2.4) or higher; b: 50% or higher and less than 80% (1.5 or higher and less than 2.4); c: less than 50% (less than 1.5)

The average rating point of this project was 1.57, hence the overall rating of "b" (50% or higher and less than 80%).

Attachment 3 Original/Actual Comparison of Operation and Effect Indicators of Sub-projects

(See Section 3.3.1 Quantitative Effects)

Major operation and effect indicators of Category 1: Sewage Treatment Projects (percentages represent changes from the planned.)

Sub-project		Original indicators (1998)	Actual (2010)
1-1	Sewage Treatment Project in Jilin City	1. Sewage treated: 300,000t/d 2. population served: 870,000 3. Pollutants removal COD cr: 25,185t/y BOD: 16,425t/y SS: 24,090t/y	1. Sewage treated: 200,000t/d 2. population served: 1,085,000 3. Pollutants removal COD cr: 22,508t/y BOD: 14,966 t/y SS: 13,422 t/y
1-2	Sewage Treatment Project in Songyuan City	1. Sewage treated: 50,000t/d 2. population served: 160,000 3. Pollutants removal COD cr: 1,825t/y BOD5: 2,373t/y SS: 4,015t/y	1. Sewage treated: 46,800t/d 2. population served: 289,000 3. Pollutants removal COD cr: 4,422t/y (242%) BOD5: 2,479t/y (104%) SS: 1,985t/y (49%)
1-3	West Suburb Sewage Treatment Project in Changchun City	1. Sewage treated: 150,000 t/d 2. population served: 546,000 3. Pollutants removal COD cr: 12,045t/y BOD5: 8,760t/y SS: 11,498t/y	1. Sewage treated: 74,000 t/d (yearly average) 2. population served: 510,000 3. Pollutants removal COD cr: 10,030t/y (83%) BOD5: 3,943t/y (45%) SS: 5,874t/y (51%)
1-4	Sewage Treatment Project in Shuangyang District	1. Sewage treated: 25,000 t/d 2. population served 82,000 3. Pollutants removal COD: 2,738t/y BOD5: 1,551t/y SS: 1,734t/y	1. Sewage treated:12,000 t/d 2. population served 100,000 3. Pollutants removal COD: 1,445t/y (53%) BOD: 588t/y (38%) SS: 729t/y (42%)
1-5	Sewage Treatment Project in Liaoyuan City	1. Sewage treated: 100,000 t/d 2. population served: 320,000 3. Pollutants removal COD: 8,395t/y BOD: 6,205t/y SS: 8,213t/y	1. Sewage treated: 51,000 t/d 2. population served: 440,000 3. Pollutants removal COD: 4,714t/y (56%) BOD: 2,305t/y (37%) SS: 3,726t/y (45%)

Major operation and effect indicators of Category 2: Wastewater Treatment Projects

Sub-project		Original indicators (1998)	Actual (2010)
2-1	Wastewater Treatment Project for Jilin Ferroalloy Factory		The facilities built by the ODA loan have been dismantled with few exceptions. Below data are from when they were in use.
		1. Treatment volume: 240m3/hr (gas washing waster)	1. Treatment volume: 210 m^3/hr (gas washing waster)
		2. Treatment volume: 600-1,200 m^3/hr(slag wastewater)	2. Treatment volume: 600-1,200 m^3/hr(slag substitute facility)
		3. Water recycling ratio: 90%	3. Water recycling ratio: 91%
		4. SS: 7,000t/y	4. SS concentration: 94% reduction
		5. Sulfates: 5 t/y reduction	5. Discharge suspensions: 5,500 t/y reduction
2-2	Wastewater Treatment Project for Nickel Factory	1. Water use reduction: 700 m^3/d 2. Nickel: 1 t/y reduction 3. Ferrous: 1 t/y reduction 4. SS: 342 t/y reduction	Cancelled
2-3	Wastewater Treatment Project for Jilin Paper Factory	1. Treatment volume; 38,000 t/d 2. Pollutants reduction: COD cr: 11,417t/y BOD: 4,060t/y SS: 3,064t/y	Unverifiable because the operation has been discontinued.

Attachment 4 3.5 Sustainability-Rating Results by Subprojects

(1) Criteria for Rating

Supervisory Organization	Criteria
Structural	- Is the regime well-organized and are the personnel well-placed for supervising the subprojects? - Is the supervisory organization in good relationship with the subproject executing organizations for incessant close communication? - Is the monitoring system well-established on the basis of environmental regulations?
Technical	- Are the personnel of Environment Protection Department well-placed and is their skill upgraded to the level to properly supervise the subprojects?
Financial	- Are the above activities financially backed up to a sufficient extent?
Subprojects	Criteria
Structural	- Is the regime well-organized for operation and administration (for decision-making)? - Is there a possibility of being privatized? If so, is there a possibility that the sustainability of the subprojects is affected?
Technical	- Are the personnel kept at an appropriate level for maintenance and operation? - Are the competent personnel having the technical skill for operating equipment well-placed? - Is a technical training system fulfilled for operation and administration? Is any training actually put in practice? - Is the operation manual available? And is it actually utilized? - Are the results of the inspections properly recorded and kept in good conditions?
Financial	- Are the profit and loss well-balanced? - Is the system to collect charges established in the manner to recover the cost? -In case the project is in deficit operation, is any governmental subsidy given, and is there no problem in carrying on operation from financial aspects?
Maintenance & administration	- Is the equipment ready to display its performance? - Is there no problem in maintenance activities, for instance, on the procurement of spare parts? -Is there no problem in having maintenance at regular intervals? - Has there been no problem in troubleshooting?

(2) Rating Results

		Rating	Structural	Technical	Financial	O&M
Supervisor: Environmental Protection Agency of Jilin Province		3	3	3		
Sewage Treatment	1-1.Jilin City	2.75	3	3	2	3
	1-2.Songyuan City	3	3	3	3	3
	1-3.West Suburb Changchun City	3	3	3	3	3
	1-4.Shuangyang City	3	3	3	3	3
	1-5.Liaoyuan City	2.75	3	3	3	2
Wastewater Treatment	2-1.Jilin Ferroalloy Factory	0	0	0	0	0
	2-3.Jilin Paper Factory	0	0	0	0	0
Others	3-1.Environmental Monitoring	3	3	3	3	3
Overall rating		**2.28**				

<Method of Rating>

1. A comparison is made between the plan and achievements in each subproject to figure out a sub-rating (the subprojects cancelled or not ascertained are excluded).
2. The average of the total sub-ratings thus obtained is made as an overall rating.
3. Scores below a decimal point are taken up on the following basis:
   a: Not less than 80% (not less than 2.4)
   b: Not less than 50% to less than 80% (not less than 1.5 to less than 2.4)
   c: Less than 50% (less than 1.5)