People's Republic of China

FY2017 Ex-post Evaluation of Japanese ODA Loan

"Sichuan Water Environmental Improvement Project"

External Evaluator: Kenji Momota, IC Net Limited

0. Summary

This project was implemented in five cities in the upper river basin of the Chang Jiang River in Sichuan Province to reduce the discharge of water pollutants into the rivers in each city and facilitate stable and safe supply of water through the construction of sewage and water supply facilities, thereby contributing to improvement of the living environment for the residents in the area.

The project is consistent with China's development policy and needs at the national and municipal levels between the time of the appraisal and the time of the ex-post evaluation; therefore, the project as a whole is highly relevant. Although the outputs were significantly modified from the time of project planning, as this was a flexible response to the urban planning of each city, it is fair to say that these changes were appropriate in achieving the purpose of the project. The efficiency is fair because the project period took much longer than planned despite the project cost was a little lower than planned. The constructed water supply/sewage facilities are operating smoothly and, except for some cities where urban development was delayed, the volume of treated sewage, coverage, and the reduction of the water pollutants have all achieved their targets as planned. By the improvement of sewage treatment rate, the volume of polluted water discharged into the river has been reduced, contributing to the improvement in water quality of major rivers in each city; therefore, the effectiveness and the impact of this project is high. With regard to the sustainability of this project, institutional capacity and technical aspects developed without any problem; however, financial information of some cities has not been confirmed, therefore its financial sustainability is fair. Main facilities are in good condition and overall sustainability is high. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project location

Sewage treatment plant in Panzhihua city

1.1 Background

Although China has achieved rapid economic growth, environmental pollution has become more serious since the 1980s because of industrialization and population growth, and the pollution level of the river was significantly worse than the national standard. During *China's 10th Five-Year Plan (2001–2005)*, the Chinese government concentrated its efforts on water environment protection through measures like designation of major protection areas and setup of quantitative target on the reduction of water pollutants. However, with the constant economic growth, they failed to achieve the targeted reduction of the water pollutants as they were not able to control the growing discharge of domestic and industrial sewage. In urban area of Sichuan Province, the amount of sewage increased because of economic development while the construction of sewage facilities lagged behind. For that reason, untreated domestic and industrial sewage was discharged directly into the upper river basin of Chang Jiang River, which is also important as a source of drinking water. There are water systems whose quality index reaches below Class V[1] during the drought season, which indicates severe water pollution, and it is essential to improve the water environment without delay. In addition, contamination of sources of drinking water has made it difficult for some cities to use existing water sources. It is therefore necessary to develop new water sources.

1.2 Project Outline

The objective of this project is to reduce the amount of polluted water discharged into the river in five cities (Yibin city, Suining city, Mianyang city, Panzhihua city and Ziyang city) located in the upper river basin of Chang Jiang River in Sichuan Province and realize a stable supply of safe water by improving sewage facilities and water supply/sewage facilities in each city, thereby contributing to improvement of the living environment of residents in this area.

Loan Approved Amount/ Distributed Amount	6,300 million yen/6,065 million yen
Exchange of Notes Date / Loan Agreement Signing Date	March 2007/March 2007
Terms and Conditions	Interest rate 0.75%/1.75%, Repayment 30/40 years (Grace period: 10 years) General Untied
Borrower/Executing Agency	Government of the People's Republic of

[1] River water quality in China is classified into Classes I to V according to the Environmental Quality Standards for Surface Water (GB3838-2002). Class-I water is mainly water at the source of a river in a national natural protection area. Class-II water is used mainly for drinking and exists in a first-class protection area, an area for rare kinds of fish, or a place for fish or shrimp spawning. Class-III water is used mainly for drinking and exists in a second-class protection area, an area for protection of general fish, or a swimming area. Class-IV water is used mainly as general industrial water and exists in a general industrial water area or a water area for entertainment where people cannot directly touch the water. Class-V water is mainly used for agriculture and exists in an agricultural water area. It is also used for securing the general landscape.

	China/Sichuan Provincial People's Government
Project Completion	April 2017
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Related Studies (Feasibility Study, etc.)	Prepared by the Southwestern China Municipal Engineering Design & Research Institute in December 2006
Related Projects	1. World Bank: Sichuan Urban Environment Project (1999) 2. World Bank: Sichuan Urban Environment Project (2006)

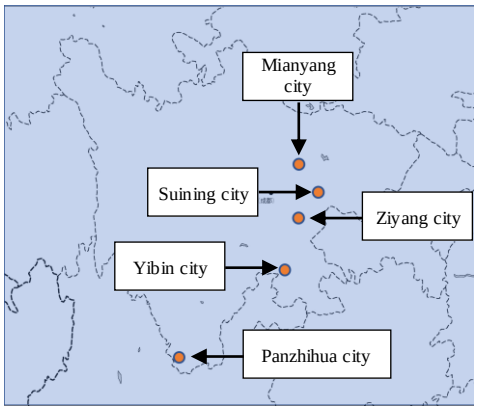


Figure 1: Five cities subject to this project

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of Evaluation Study

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

Duration of the Study: July 2017–March 2019

Duration of the Field Study: November 2–20, 2017, March 29 – April 5, 2018

2.3 Constraints during the Evaluation Study

In this project, the project scope was partially changed because of the Sichuan Earthquake. With regard to changes in project expenses and scope due to these changes, details of changed plans, etc., were not confirmed sufficiently at the site, and the evaluation of efficiency was constrained in part. In addition, with regard to sustainability, financial statements of implementing organizations in each city contained much non-disclosure information. It was therefore difficult to analyze financial sustainability on the basis of detailed financial information.

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

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

3.1.1 Consistency with the Development Plan

(1) Consistency with the development plan at the time of the appraisal

During China's *10th Five-Year Plan (2001–2005)*, the Chinese Government started working on the improvement of urban environments, such as improvement of sewage system and industrial pollution. In the subsequent *11th Five-Year Plan (2006–2010)* and *Notice on Distribution of the Comprehensive Work Plan for Energy Saving and Emissions Reduction by the State Council (June 2007)*, the government reinforced efforts to improve the environment and set a goal to reduce the total amount of discharge of major pollutants by 10% compared with 2005. With regard to sewage system, a goal was set to achieve a sewage treatment rate of 70% in urban areas (80% in major provincial cities) and Class II level of water quality through environmental improvement measures in the upper river basin of Chang Jiang River. River basins relevant to major protection were specified in *China's 11th Five-Year Plan for Environmental Protection (2006–2010)* for the improvement of river water quality, and a goal was set to achieve a certain standard of water quality through the prevention of water pollution in river basins that are important as sources of drinking water as well as measures like conversion of water sources.

In response to these plans, Sichuan Province defined environmental pollution and ecological destruction in the upper river basin of Chang Jiang River through construction of sewage treatment plants and conversion of water sources as major issues in *Sichuan's 11th Five-Year Plan for Economic and Social Development (2006–2010)*.

Improvement of urban water supply infrastructure was identified as an important issue in regard to water supply after China's *9th Five-Year Plan (1996–2000)*. The securing of water sources in urban cities with severe water shortages was also specified as an important issue in China's *11th Five-Year Plan (2006–2010)*. This included reinforcement of water supply capacity by newly establishing and updating waterworks, securing safe drinking water and saving water sources by reducing leakage rates, etc. In order to resolve the shortage of funds, it also addressed reforming the water supply cost structure (introduction of a gradual increase system, combination of flat rate and commodity charge, etc.), securing of facility investment by reinforcement of water charge collection, promotion of water conservation and reinforcement of pollution countermeasures.

[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[3] (3) High, (2) Fair, (1) Low

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

China's *12th Five-Year Plan (2011–2015)* established by the central government set a concrete goal to achieve an 85% sewage treatment rate in urban areas by promoting measures for water pollution in important river basins, protecting the river environment and reinforcing ecological management as important tasks. The *13th Five-Year Plan (2016–2020)* has set a goal to achieve a 95% sewage treatment rate in urban areas, along with the promotion of sewage treatment facilities and drainage construction in urban areas, which have made numerical goals stricter.

Both the 12th and 13th five-year plans consistently consider measures to prevent water quality pollution to be important. After the *11th Five-Year Plan*, the sewage treatment rate was specified as a national goal and has been raised gradually. The provincial level of the development plan continuously defined water supply/sewage sector as an important basic infrastructure; in particular, the sewage project has been defined as important from the perspective of reinforcing measures for the environment.

In *Sichuan's 13th Five-Year Plan for Economic and Social Development (2016–2020)*, measures for water pollution have been announced continuously as a part of environment conservation measures, and an action plan has been submitted to improve sewage treatment facilities and the piping network and tighten regulations on large-scale sources of pollution such as industrial estates. In particular, there have been calls to tighten the management of industrial estates and papermaking and the chemical industry, which includes rivers designated as important river basins in neighboring cities subject to this project, such as the Min Jiang and Tuo Jiang Rivers.

In light of the above, improvement of water quality and air pollutants have been defined as priority items in each development measure at the national and Sichuan Province level. Consistency with this project is high, which is implemented for the purpose of improving the river environment by improving sewage facilities. This position has been the same from the time of the appraisal to the time of the ex-post evaluation, and the national development plan promotes tightening of regulations to reduce the amount of water pollutants discharged. In Sichuan Province, five cities subject to this project has maintained the same position since the time of the appraisal, and this project has been highly relevant to the country's development policy. Therefore, its relevance is high.

3.1.2 Consistency with Development Needs

(1) Situation of each city from the time of project planning to the time of the ex-post evaluation

The amount of sewage has been increasing in each city of Sichuan Province because of economic growth; at the same time, there are delays in the construction of sewage treatment

facilities. Therefore, untreated domestic sewage and industrial sewage are discharged directly into the upper river basin of Chang Jiang River, which is a source of drinking water. There are water systems whose water quality index reaches below Class V during the drought season, which indicates severe water pollution, and it is essential to improve the water environment without delay.

In Sichuan Province at that time, water pollution due to delays in the construction of sewage treatment facilities had an influence on the water supply situation, and existing water sources could not be used in some cities. For that reason, it was necessary to improve the water supply infrastructure by development of new water sources.

With this background, five cities located in the river basin of Chang Jiang River were selected in this project. The specific selection process and project plan were promoted based on the *Water Pollution Prevention Plan for Sanxia Dam and its Upstream Area* issued in 2001. At that time, a national development project of Sanxia Dam was in progress. Measures to prevent pollution from occurring in water sources were a major issue, and major cities located in the river basin of Chang Jiang River in Sichuan Province were also greatly affected by water quality. Therefore, nearly 40 cities were selected and improvement of stable water supply capacity, sewage treatment facilities and measures for regulations, etc. of severely polluting industries, etc. were implemented. Five cities subject to this project were included in these cities and a Japanese ODA Loan project was implemented as part of these measures.

Still, improvement of water quality has been important in the five cities subject to this project. Economic development such as population increase and industrial estates, which can be a factor of pollution, has progressed in each city, and the quality of the river water in the province has deteriorated. For that reason, continuous implementation of measures for water quality pollution is sought, and the sewage project, a core infrastructure, continues to take higher priority.

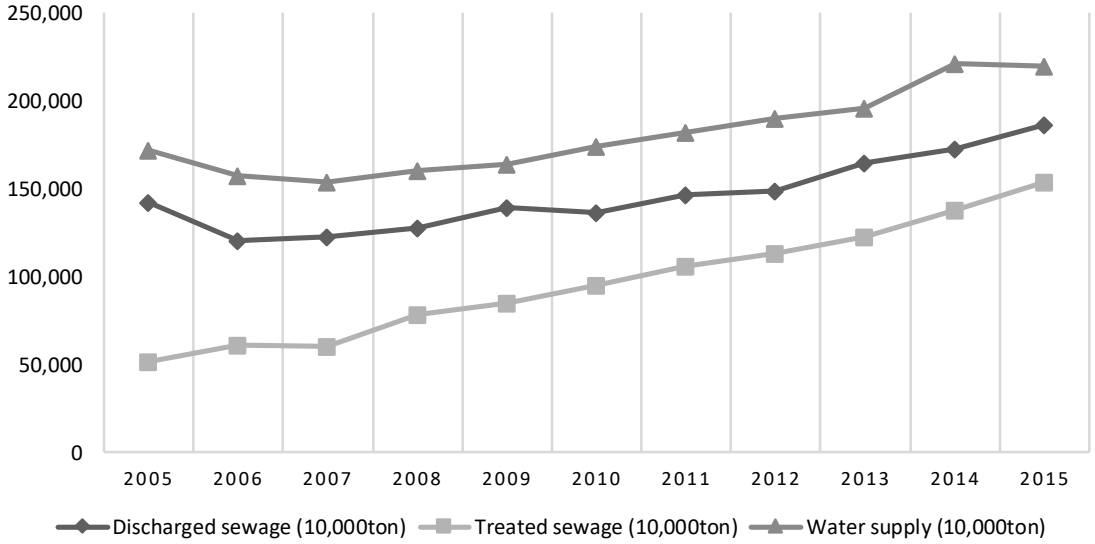


Figure 2: Aging data related to water supply/sewage systems in urban areas of Sichuan Province
Source: China Environment Statistics Yearbook, Sichuan Statistic Yearbook, and China Urban Construction Statistics Yearbook

(2) Appropriateness of the project plan and approach, etc.

The output of this project was planned and implemented to support and construct water supply/sewage systems in five cities subject to the project. The output of the Japanese ODA loan occupies a part of the entire water and sewage system in each city, but a main sewage line and a unique or main sewage treatment plant were implemented in each city, and these play an important role in the functioning of the water and sewage system of the entire city. Thus, it can be evaluated that its position was planned appropriately.

3.1.3 Consistency with Japan's ODA Policy

In the *Medium-Term Strategy for Overseas Economic Cooperation Operation* (2005 to the first half of 2008) of the Japan International Cooperation Agency (JICA), of all the priority sectors, such as support for poverty reduction, development of infrastructures for sustainable development, and support for measures to cope with global problems and peacebuilding, JICA clarified the importance of developing farming villages through the construction of sewage systems in poverty areas, the promotion of sustainable growth through the development of much-needed economic and social infrastructures, such as waterworks, sewage systems, and energy facilities, and measures against air and water pollution for the purpose of making the development compatible with the environment.

Moreover, in the *Country Assistance Strategy*, JICA has identified environmental problems resulting from rapid economic growth, and places importance on environmental conservation mainly in inland areas.

While economic development has progressed in each city since implementation of the project, comprehensive measures for water quality pollution are carried out to control water quality pollution, and improvement and diffusion of sewage treatment plants and tightening of regulations on pollutants continue to be carried out. In light of the above, this project has been highly relevant to the development policy and development needs of the Chinese Government, Sichuan Provincial government and municipal governments of five cities subject to this project, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: (2))

3.2.1 Project Outputs

The following table shows the planned and actual outputs in this project, indicating that there is no change in the structure of main facilities, but there are major changes in the amount and scale.

Table 1: List of outputs

	Plan	Actual
Sewage system	Length of sewage pipe Total 297 km Yibin city 62 km Suining city 27 km Mianyang city 140 km Panzhihua city 21 km Ziyang city 47 km	Length of sewage pipe Total 192.03km (65%) Yibin city 33.3 km (54%) Suining city 18.5 km (69%) Mianyang city 94.75 km (68%) Panzhihua city 7.4 km (35%) Ziyang city 39.41 km (83%)
	Pump station 20 locations Mianyang city 14 locations Yibin city 6 locations	Pump station 8 locations (-12 locations) Mianyang city 2 locations (-12 location) Yibin city As planned (6 locations)
	Sewage treatment plant 4 locations Capacity 99,000 m^3/day Suining city 1 location 60,000 m^3/day (Expanded) Panzhihua city 3 locations 39,000 m^3/day (Newly established)	Treatment plant 6 locations (+2 locations) 112,000 m^3/day (113%) Suining city 1 location 60,000 m^3/day (Newly established) Panzhihua city 2 locations (-1 location) 39,000 m^3/day (Newly established) Mianyang city 3 locations (+3 locations) 13,000 m^3/day (Newly established)
Water supply system	Length of water supply pipe Panzhihua city 9 km	Length of water supply pipe Panzhihua city 10.8 km (120%)
Training	Training on management staffs, training on sewage treatment technology	Cancelled

Source: The planned outputs are based on materials provided by JICA, while the actual outputs are based on the implementing organizations' responses to questionnaires.

(1) Main changes in outputs

Background to main changes in the outputs are as follows:

1) Changes in the entire plan due to detailed design: Detailed site investigations were conducted at the stage of detailed design and the plan was reviewed after confirming the

existing sewage pipe and the necessity of pump stations, etc. The total length of sewage pipe was therefore reduced in all five cities.

2) Efficiency of laying plan: With regard to sewage pipe, the diameter of the pipe to be laid was changed to a larger diameter in the detailed design. Pipe was planned to be laid running parallel to both sides of the road, but was laid on one side of the road only and the total length was shortened. There are other cases where sewage pipe was found to be already laid when the road was constructed in site investigations.
3) Review because of earthquake disaster: In Mianyang city, the plan was revised again due to the Sichuan Earthquake in 2008. At that time, a document issued by the Sichuan Provincial People's Government Development Reform Committee (dated December 10, 2008) mentioned that there were plans to construct new sewage treatment plants at three locations and pump stations at three locations. Later, a site investigation was conducted for the first time at the final design, and the number of pump stations was changed from three to two because it was confirmed in the site investigation that there was an existing pump station and a new pump station did not need to be constructed.

Pump station in Yibin city

Songya Treatment Plant in Mianyang city

In light of the above, the output was changed in a major way. From the discussion with each city, although there were changes on the project components of the Japanese ODA loan project, the entire development of water supply and sewage treatment system progressed as planned. And the current operational status of system, which will be described in 3.3 Effectiveness, implies that function and capacity were generally developed as planned. The outputs of Japanese ODA were organized and changed to meet the entire development plan of each city. In light of the above, it was observed as appropriate changes in line with the entire plan of system.

(2) Training program

Because of the great earthquake in Sichuan Province and further tightening of the overseas training system in China, the training program was not implemented. When it was confirmed whether the training program instead of visiting Japan for training was implemented in each city, it was not implemented as a part of this project, but company or organizations responsible for operation of respective facilities conducted regular human resource development program such as sending their personnel in training and visit to other sewage treatment facilities. Sewage treatment technique was already established in China and it was evaluated that cancellation of the training program did not have a major influence on achieving the project goal.

3.2.2 Project Inputs

3.2.2.1 Project Cost

Although the total project cost was initially estimated to be 10,709 million yen (including a Japanese ODA loan of 6,300 million yen), in reality it was 9,460 million yen (including a Japanese ODA loan of 6,065 million yen), 88% of the estimate. The total project cost was within the plan, but the actual project cost is different according to each city. The total project cost was as planned mainly because sewage pipe was effectively laid in the detailed design. However, the project scope was changed many times since it was planned. With regard to the implementation status of the project cost compared with the changed scope, it was not possible to examine the details of output structure of the revised scope. Therefore, it is difficult to analyze suitability of project cost expenditure because of change in scope.[4]

3.2.2.2 Project Period

Although the initially planned period was between March 2007 and December 2012 (70 months), the actual period was considerably prolonged, between March 2007 and April 2017 (122 months, 174% of the initial plan.) The main reasons for the difference between the actual period and planned period according to each city are as follows.

[4] There are several documents containing a variety of information concerning the output in Mianyang city and it is difficult to verify the matter exactly by comparing to the plan. Therefore, it is also difficult to verify the validity of project cost associated with the change in project scope. However, a survey conducted at the project implementation organization in each city showed that the project cost exceeded the planned cost in Mianyang city only, and that the cost increased mostly because of the increase in amount in local currency. It seems that there will be no influence on the rating itself.

Table 2: Reasons for the difference between the actual period and planned period in each city

City name	Actual ( ) compared to planned	Reason
Yibin city	Oct. 2008 to Dec. 2012 51 months (75%)	A sewage treatment plant was not included in the output. In addition, when the sewage pipe was developed, the city reduced the time for internal coordination by making frequent communication and coordination with government organizations, and created an environment to execute the project as planned.
Suining city	Jul. 2009 to Dec. 2014 66 months (97%)	There was a delay in the improvement of the sewage piping network due to the revision of the development of industrial estate which had been developed together. However, the entire period was almost as planned.
Mianyang city	Jan. 2010 to Apr. 2017 45 months (125%)	The plan was changed several times in and after 2008 because of the Sichuan Earthquake, and it took time to approve the details of applications every time.
Panzhihua city	May 2008 to Jul. 2011 39 months (57%)	The entire city regarded the sewage project as high priority. In addition, the quality of the detailed design was advanced and construction management was thoroughly conducted.
Ziyang city	Jul. 2008 to May 2015 83 months (118%)	The sewage piping network was changed in one section because of changes in urban planning. Moreover, roads and railroads had already started to be constructed in some sections, which required changes in the method of laying the pipe.

Reference: The plans are based on materials provided by JICA and the implementing organizations' responses to questionnaires.

Note: Among packages implemented in each city, the actual period of the relevant city started when the project first entered into the process and ended at the end time when the package that was completed ultimately ended.

Here are the reasons why the period was different especially from the plan in each city.

1) The project period was shortened in Yibin city and Panzhihua city. In addition to the changes on the project scope such as reduction of total length of the pipeline, this was largely because of smooth progress of internal coordination and approval process of the government such as procurement contract due to the smooth coordination with the people's government and executing agencies. In Panzhihua city in particular, the people's government understood this project well, which made the project work smoothly.
2) There were long delays in the project compared to the plan in Ziyang city because areas where sewage pipe was planned to be laid crossed the jurisdiction of railway department. In this case, the Railroad Service did not regard this project as important, which resulted in significant delays.

3) In Mianyang city, the commencement of the project delayed due to the review of the plan by the consultation with the concerned organizations upon the happening of the Sichuan Earthquake. In addition, there was a further delay of the project due to the delay in the procurement.

In consultation with the provincial government, procurement methods, construction and implementation management were put in the hands of each city, and project executing agencies and a framework and functions related to united construction management were not introduced. For that reason, understanding and response to this project vary according to the people's government of each city, which may affect the efficiency of implementation in each city.

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

(1) Financial Internal Rate of Return (FIRR)

At the time of the appraisal, the financial internal rate of return (FIRR) of the sewage project was 4.1%, which was calculated under the following conditions: project life should be 30 years; the benefit should be the revenue from the sewage rate charge; and the cost should be the project cost, operation and maintenance cost. Generally, it was calculated again at the time of the ex-post evaluation in the same way, and the following results were confirmed. Net budget as the project showed a loss in many facilities.[5]

Table 3: Recalculated result of Financial Internal Rate of Return (FIRR)

Project	Financial Internal Rate of Return (FIRR)	
Panzhihua city 1. Panzhihua city (Large) Sewage treatment plant 2. Panzhihua city (Small) Sewage treatment plant	At the time of the appraisal (entire city) 4.88%	Actual (entire city) Minus 1. 0.72% 2. Minus
3. Yibin city Pump station	At the time of the appraisal 5.11%	Actual 10.30%
4. Suining city Sewage treatment plant	At the time of the appraisal 4.04%	Actual Minus
Mianyang city 5. Mianyang city (Luxi-Huayuan) Sewage treatment plant 6. Mianyang city (Chenkang) Sewage treatment plant	At the time of the appraisal (entire city) 3.21%	Actual (Entire city) 10.74% 5. 14.45% 6. Minus 7. Minus

[5] Prerequisite is generally the same as the one at the time of the appraisal. The benefit should be the sewage treatment rate; the cost should be initial construction investment and maintenance cost. However, the output of Ziyang city, which was not relevant to recalculate, is excluded because it is sewage piping network only and difficult to extract the laying location of this project only and calculate the cost. In addition, regarding Yibin city, data related to the pump station management are acquired, so FIRR related to the cost of the pump station was recalculated. IRR for water supply was not calculated.

7. Mianyang city (Songya) Sewage treatment plant		

Source: Implementing organizations' responses to questionnaires and survey at local site
Note: Recalculation of entire city was calculated by adding expenses of each sewage treatment plant.

With regard to the recalculated results in each city, the main reasons why the result was different from the one at the appraisal are as follows.

1) Method of calculating sewage rate charge revenue: Likewise, at the time of the appraisal, the sewage rate charge revenue was set as the benefit. However, the flow of actual revenue from many treatment facilities adopts a system to receive an amount that adds a slight profit to the sewage treatment cost from the municipal government. [6]These revenues are set on the basis of maintaining soundness with single year management of this project, and the internal rate of return including initial investment showed as negative.
2) Two treatment plants in Mianyang city and Xiaoshaba sewage treatment plant in Panzhihua city remain a 30 to 60% sewage treatment amount and as a result, it is estimated that the internal rate of return is low. On the other hand, management of Luxi-Huayuan sewage treatment plant was commissioned to private company by the form of PPP contract for 30 years since 2015. It is assumed that higher FIRR was calculated since the city government has been paying higher treatment charge to the plant based on this contract.
3) Still, when revenue shows a loss, it adopts a system whereby the municipal government supplements the loss. It is therefore not so worrying that there is a severe restriction on project management finance. (detailed description in 3.4.3 in "Sustainability") Upon recalculation, financial statements are not submitted, so the amount by which the loss is supplemented is not confirmed.

In summarizing the evaluation of overall efficiency, the structure of the output changes in a major way from the time of the appraisal. However, this is because this project was placed in the entire development plan of each city at that time. It was inevitable that the details of the project changed because of the progress of the plan. Details of the changes are mostly appropriate from the perspective of achieving the project goal.

[6] As the method of calculation at the time of the appraisal did not clarify the details of revenue setting and structure of financial supplementation, it was difficult to have an exact comparison. However, with the consultation at the local site and confirmation of the materials, there is high possibility that IRR calculates the actual revenue of the project estimating financial supplementation, which assumed that recalculation of the net budget base was low. Two sewage treatment plants in Suining city and Panzhihua city, whose sewage treatment amount reaches 90% of treatment capacity, are greatly influenced by the factor described above. In the case of recalculation including financial supplementation amount, IRR is considered to be higher.

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

3.3 Effectiveness and Impact (Rating: (3)[7])

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and effect indicators)

As this project was implemented to bear a part of the development plan in each city, structure varies according to the needs and situation of each city, such as comprehensive improvement from sewage treatment plant to sewage pipes, and partial improvement of sewage pipes. To consider the evaluation of effect from the viewpoint of the nature of this project, attention was paid to the development situation of the entire water supply and sewage system of each city, especially, to what extent the basic capacity of sewage treatment was improved. The following is a specific analysis of operation and effect indicators in each city.

(1) Sewage facilities

1) Operation status of sewage treatment system

Table 4: Operation and effect indicator in each city

		Population treated (10,000 people)	Treatment amount (10,000 m^3/day)	Treatment rate (%)
Total of five cities[8]	Plan	**131.36**	**29.41**	**80%**
	Actual	**100.26**	**24.47**	**88%**
	Compared with the plan	**76%**	**83%**	**110%**
Yibin city	Plan	45.27	7.49	64%
	Actual	-	5	75%
	Compared with the plan	-	67%	**117%**
Suining city	Plan	36.3	10	53%
	Actual	46.6	12	85%
	Compared with the plan	128%	120%	**160%**
Mianyang city	Plan	7.21	1.56	100%
	Actual	3.55	0.45	100%
	Compared with the plan	49%	29%	**100%**
Panzhihua city	Plan	14.58	3.41	100%
	Actual	14.11	2.54	-
	Compared with the plan	97%	74%	-
Ziyang city	Plan	28	6.95	81%
	Actual	36	4.48	90%
	Compared with the plan	129%	64%	**111%**

Source: Materials provided by JICA and the implementing organizations' responses to questionnaires

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

[8] Total number was calculated and evaluated by the data of 4 cities except Yibin City, since the respective data was not obtained from the executing agency.

With regard to the sewage project, which is the main part of this project, the result varies according to each city but overall, the population treated and treatment amount reach nearly 80% of the plan, which can be evaluated as satisfactory in general. The result was significantly lower than planned in Mianyang city and the background is as follows.

In Mianyang city, because of the Sichuan Earthquake in 2008, factories were not moved to scheduled economic development areas as main users and residents evacuated from some target area owing to the earthquake, which meant that the actual treatment amount dropped to approximately 53 to 70% of treatment capacity. According to local government personnel concerned, it is expected that the number of factories to be moved to the target area is secured, and it is planned to construct a new residential estate and to extend sewage pipe in the future. However, a specific plan was not confirmed at the time of the ex-post evaluation and the realization of the effect at the time of the ex-post evaluation is fair.

2) Effects in reducing pollutants in water

The following table compares water quality when main pollutants flow in and water quality when pollutants are treated in each city.

Table 5: Treatment effect of pollutants in water in the sewage treatment plant in each city subject to this project

	BOD (mg/L)			COD (mg/L)			SS (mg/L)		
	Input	Output	Reduction rate	Input	Output	Reduction rate	Input	Output	Reduction rate
Planned value		<10-20						n/a	
National standard		10			10			50	
Yibin city	123.3	15.2	88%		45.5		171.2	17.5	90%
Suining city	68.9	6.2	91%		24.9		75	6	92%
Mianyang city	70.4	8.7	88%	208.5	27.8	87%	100	9	91%
Panzhihua city	96.5	5.8	94%		15.1		180.3	5.5	97%
Ziyang city	132.92	13.2	90%	188.55	15.0	92%	132.9	13.2	90%

Source: Materials provided by JICA and the implementing organizations' responses to questionnaires

It is confirmed that discharged water from the sewage treatment plant which was constructed as an output of this project almost satisfied major pollutants such as BOD and COD among the National Class I Standard A, which is the strictest standard, and achieves the planned level of reduction. With regard to the reduction capacity of pollutants in the sewage treatment system in each city, it maintains the level as planned. With the future increase in demand, a higher effect will be expected.

Facilities improved through this project constitute the main part of a sewage system such as a main treatment plant and main line in the sewage system in each city, and considered to be the foundation of each city's own project lasting up the present. In that sense, it can be

evaluated that the facilities make an important contribution to the development of sewage infrastructure in each city. The following table summarizes details of the output contribution in each city.

Table 6: Position and contribution of this project in each city

City name	Position and contribution of this project
Yibin city	• Improvement of sewage pipes: Sewage pipe is laid to connect and carry waste to the existing sewage treatment plant, and a pump station was established, which helps to carry sewage in some urban areas to the sewage treatment plant located downstream. In addition, the improvement of sewage pipe in this project promoted conversion from a combined system to a separated system that is effective in increasing the treatment rate.
Suining city	• Sewage treatment plant: The sewage treatment plant of this project was constructed as a new sewage treatment plant that responds to the increased amount of sewage because it was impossible to expand the existing treatment plant, which was in a saturation state at that time. • Improvement of sewage pipe: The main pipe network was laid to carry sewage from industrial estates to the sewage treatment plant, which forms part of a sewage treatment system capable of treating an increasing amount of sewage discharge.
Mianyang city	• Sewage treatment plant: Contributed to improve the quality of the river and living environment in three town-level areas in the city where sewage treatment plants, which help to attract industrial estates and sewage treatment facilities, were established in areas where sewage was discharged directly into the river.
Panzhihua city	• Sewage treatment plant: Contributed to improve the river and living environment by establishing a sewage treatment plant in the area where sewage was discharged directly into the river.
Ziyang city	• Improvement of sewage pipe: Contributed to make the existing sewage pipe network complete as a cyclic structure in the urban area. Moreover, the sewage pipe network laid by this project made possible the conversion from a combined system to a separated system; at the same time, parks were maintained along the river in surrounding areas where pipe was laid, which helped to improve the living environment of residents.

Source: Implementing organizations' responses to questionnaires

(2) Water supply facilities

Panzhihua city is the only city where water supply is included in this project. Penetration of water supply at the time of ex-post evaluation is as follows.

Table 7: Coverage of water supply in Panzhihua city

	Standard	Plan	Actual	Compared to the plan
Diffusion of water supply (%)	95%	98%	n/a	n/a
Water supply population (10,000 people)	56	59	68.5	116%
Amount of water supply (10,000 m^3/day)	14	15	17.1	114%

Source: Implementing organizations' responses to questionnaires

It was unable to confirm an accurate diffusion rate but the water supply population and amount of water supply were significantly higher than planned, which proved that the expected effect is realized. This project is a limited output concerning the improvement of approximately 11 km of water supply pipe and system of the entire city. However, this section covers from the reservoir to filtration plant, which is an extremely important section

on water supply functionality. The contribution of this project to the entire functionality of the municipal water supply system is evaluated to be great.

In summary, the water supply project already achieves the goal and overall effect of the sewage project that is the main project of this project, reaching nearly 80%. It is therefore evaluated that the level of achievement of the entire effect is high.

3.3.2 Impacts

3.3.2.1 Intended Impacts

In this project, "Improvement of river water quality," and "Improvement of living environment of the residents in the target area" are positioned as impacts.

(1) Improvement of river water quality

1) Monitoring data of observation points

The following table compares the most recent water quality monitoring data of the major river systems at the time of the ex-post evaluation with data at the time of project planning.

Table 8: Water quality data at the downstream observation points of the relevant sewage treatment plants in each city involved in this project

City	Cross-section name	Test item	2007	2016
Yibin city[9]	Nanguan town	Water quality grade	—	III
		BOD (mg/L)	—	—
		COD	—	—
Suining city	Duiying river outlet	Water quality grade	III	III
		BOD (mg/L)	2.1	1.4
		COD	4.1	3.2
Mianyang city[10]	No data	Water quality grade		
		BOD (mg/L)		
		COD		
Panzhihua city	Jinsha Jiang river/ Jin Jiang cross-section	Water quality grade	I	II
		BOD (mg/L)	2.4	1.8
		COD	n/a	6
Ziyang city	Xingfu village	Water quality grade	III	IV
		BOD (mg/L)	2.2	2.8
		COD	16	16

Source: Materials provided by JICA and the implementing organizations' responses to questionnaires

[9] With regard to Yibin city, the external evaluator was unable to obtain satisfactory data from the Environmental Protection Bureau of Yibing Municipal Government.

[10] With regard to Mianyang city, the external evaluator was unable to obtain data to measure the impact of this project because no monitoring equipment for observation has been installed by the Environmental Protection Bureau at the tributary into which the sewage treatment plant discharges the sewage because the size of the river is too small.

The overall trend is that, although some indicators worsened, both the volume of pollutant loads and the river water quality (grade) are not showing much change. The Environmental Protection Bureaus of each city mentioned that the main reasons for this are (1) the fact that factors adversely impacting on water quality have been increasing with the progress of urbanization and industrialization by the economic development and (2) deterioration due to the industrial sewage from Chengdu (the capital of the province) in the upper river basin.

Recently, the Environmental Protection Bureaus have also been intensifying their restrictions on sources of pollution and taking such actions as improved monitoring systems and providing guidance by way of on-site inspections, so it seems that more pollutant reduction measures have progressively been installed.

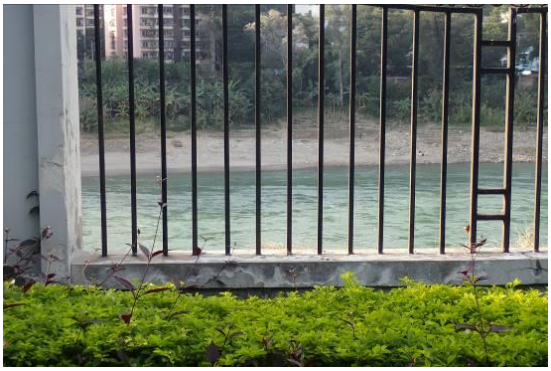
Although the external evaluator was able to confirm that measures including this project have been effective in controlling contamination of the water to a certain degree in "Effectiveness," it seems that, regarding long-term improvement of river water quality, continuous regulatory and control measures as well as monitoring are essential.

2) Improvement of living environment of the residents

In this project, it was expected that improvement of the living environment would be achieved by improving the sewage system. During the field survey period, the external evaluator conducted interviews with local residents and other stakeholders in each city and confirmed the following opinions:

- Mianyang city (local resident): Before the improvement of the sewage pipeline, sewage was flowing without any treatment, so there were many flies and mosquitoes, and parasitic worms as well. In addition, as untreated household sewage including cooking oil and detergent was discharged directly into the river, it was impossible to use the river water for agriculture. At that time, septic tanks were installed in each household, but as methane gas was generated from the wastewater stored in the septic tank, people's health was at risk. In particular, the odor coming from the septic tank was strong in summer. As these problems were all eliminated by improvement of the sewage system, everyday life became a lot more comfortable.
- Mianyang city (proprietor of a restaurant): Previously, the business of those stores that were located alongside the river was adversely affected by mosquitoes and flies, odor, etc. However, such problems have been eliminated now; the environment has improved and customers are coming back. In addition, response to hygiene issues has been improved because of stricter government control; for example, nowadays they are using waste disposal companies to dispose of their oil and food scraps.

- Panzhihua city (local resident / a resident who lives opposite the sewage treatment plant alongside the river): Before the improvement of the sewage treatment plant and sewage pipeline, untreated rainwater and sewage was discharged directly into the river during heavy rain, so the color of the river was exactly the same as the sewage. However, now the color of the river has changed to a “pure” color and the odor has gone as well. The water quality has been improved so much that we can use the river water for bonsai plants and house cleaning.



The Jinsha Jiang river, located in the upper river basin of the Chang Jiang River, into which sewage is discharged from Panzhihua city sewage treatment plants

A riverside park in Ziyang city

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

At the time of project planning, the impacts on the natural environment by this project were assessed as follows and the following mitigation measures were to be implemented:

1) The target areas of the project do not fall under the category of a susceptible area such as a national park or its vicinity; therefore, undesirable impact on natural environment should be minimal.
2) As the drainage from sewage treatment plants will be discharged into the river after it is treated so as to satisfy domestic sewage standards in China, no specific impact is anticipated in relation to the discharge of treated water.
3) The sludge generated at the sewage treatment plants should be properly disposed of at existing landfill disposal sites.

When the external evaluator checked the implementation status on the site, no serious problems that could not have been anticipated at the beginning in any cities was observed; therefore, it is fair to evaluate that, in general, appropriate measures have been taken.

With regard to treatment of sludge, all sewage treatment plants are treating their sludge by drying it in the plant to lower the moisture content to a certain level; then, they give it to those companies that make fertilizer from sludge, concrete companies, and other sludge

disposal companies. Regarding form of contract, some sewage treatment plants pay fees to dispose their sludge, while others sell their sludge. The following table shows environment-related measures at the time of construction and monitoring systems in five cities subject to this project.

Table 9: Measures and monitoring system to mitigate the environment impact on surrounding areas during construction in each city

City	Mitigation measures on environment impact	Monitoring system
Yibin city	Waste disposal: Building material waste was transported to designated disposal/repository sites. Dust: Sprinkling with water was implemented. Noise: Installation of noise insulation and absorption device.	—
Suining city	Waste disposal: Building material waste and gravel waste was transported to Chuangxin Industrial Park and disposed as banking material. Dust: Sprinkling with water was implemented. Noise: Elaborating construction plan and installation of noise insulation device.	At the time of construction, Environmental Protection Bureau of the Sichuan Provincial Government carried out an inspection and assessment. In January 2015, as a result of a post-construction environmental assessment meeting, this project received a Notification of Acceptance from the Environmental Protection Bureau of the Sichuan Provincial Government.
Mianyang city	Waste disposal: Intensive collection and transportation was carried out. Dust: Sprinkling with water was implemented. Noise: Installation of noise insulation and absorption device. Sewage: Sedimentation in a sedimentation pond was carried out.	Under the guidance of the Urban Construction Environmental Protection Bureau, the sub-contractor company carried out an on-site inspection once a month to check the status of dust and noise-related measures.
Panzhihua city	Waste disposal: Building material waste was transported to designated disposal sites. Dust: Sprinkling with water was implemented. Noise: Construction was carried out in compliance with specific national standards[11]. When some work is required at night in relation to concrete depositing, application was made to obtain night work permission.	It was implemented by respective implementing organizations under the guidance of the Environmental Protection Bureau of Panzhihua municipal government.
Ziyang city	Dust: Sprinkling with water was implemented Noise: Construction work was not carried out at night; and an insulation device was installed at the construction site.	The Environmental Protection Bureau of Ziyang municipal government, once a month, carried out inspection of water quality, soil, noise, vibration, and dust.

Source: Implementing organizations' responses to questionnaires

(2) Impacts on the social environment

At the time of planning, it was scheduled to obtain 13 ha of land. However, actually in almost all the cities, the government had already acquired the sites in advance. Therefore, most outputs were constructed on state-owned land. The only exception was the case in Panzhihua city where six small factories were relocated for the construction of Xiaoshaba sewage treatment plant. It was due to the unforeseen changes of the site during detailed design stage, and the compensation was paid to acquire a plot of 3.32 ha in accordance

[11] Regulatory standard: To be complied with GB3096-93, GB12348-90

with relevant legislation[12]. In addition, in case of Dadukou sewage treatment plant in Panzhihua city, as they cut down the trees on the site at the time of construction of the sewage treatment plant, they paid the cost of planting the same number of trees they had cut down to the town-level government.

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

3.4 Sustainability (Rating: (3))

3.4.1 Institutional Aspect of Operation and Maintenance

According to the plan, in this project, the Sichuan Provincial People's Government is the overall project implementing body to oversee each municipal government, and relevant implementing organizations in each city (relevant state-owned enterprises) are in charge of everything from construction to management. Such an implementing and managing framework has been implemented almost according to the plan, and the project was implemented with the Sichuan Provincial People's Government sitting on top of everything. Project offices were established inside each municipal government and actual implementation was carried out by investment companies and sewage treatment business operators in each city.

With regard to operation and maintenance, there has been no major change either and the business operators in each city are in charge of them. All of them are business corporations that manage all aspects of water and sewage operation in each city; therefore, responsibilities and the chain of command concerning the operation and maintenance of water supply and sewage system have all been clearly articulated.

The outline of each city including organizational framework and the number of staff are shown as follows:

Table 10: Operational Framework for Water supply/sewage System in Each City

City	Outline and analysis of name of organization, scale, and framework
Yibin city	1. Changes from the plan: **Yes (change of name)** 2. Detail: Yibin Qingyuan Water Affairs Limited Company (state-owned enterprise) is in charge of construction of the pumping station and sewage pipeline and maintenance and management of the pumping station after that. The management division of the pumping station consists of approximately 36 staff members. The sewage pipeline is under the jurisdiction of Bureau of Water Affairs.
Suining city	1. Changes from the plan: **Yes (elimination and consolidation of organization)** 2. Detail: Suining Water Affairs and Investment Limited Company (state-owned enterprise) is in charge of construction of a sewage treatment plant & sewage pipeline and management of the sewage treatment plant after that. The maintenance and management of the sewage pipeline is carried out by the Housing Construction Committee. In addition, the Suining Water Affairs and

[12] The following legislation was applied: *Panzhihua city urban housing control bylaw* and *People's Republic of China Land Act*

	Investment Limited Company is also checking the manholes at regular intervals. Approximately 24 staff members are in charge of operation including administrative staff.
Mianyang city	1. Changes from the plan: **Yes (change of management company)** 2. Detail: The companies which constructed respective outputs and the companies that operate respective sewage treatment plants and pumping stations are different. Summary of operating companies are as follows. • Luxi-Huayuan Sewage treatment plant: Mianyang Kaitian Environmental Protection Company (a PPP-style private limited company); This sewage treatment plant is operated by 14 staff members including management and administrative staff. • Songya Sewage treatment plant: Mianyang Jingkai Water Affairs Limited (state-owned enterprise); This sewage treatment plant is operated by around 10 staff including operations management and other technical staff. • Chenkang Sewage treatment plant: Mianyang Xiantong Environmental Protection Science & Technology Limited Company (state-owned enterprise); Operated by around 18 staff members including administrative staff.
Panzhihua city	1. Changes from the plan: **Yes (change of management company)** 2. Detail: All outputs have been transferred from those companies that were in charge of construction to those that are in charge of operation and maintenance of the water supply/sewage system. The Panzhihua Water Affairs (Group) Limited (state-owned enterprise) is in charge of water supply/sewage operation and no major organizational change is scheduled for the future. Operated by around 30 staff members including administrative staff.
Ziyang city	1. Changes from the plan: **Yes (change of management company)** 2. Detail: Currently, sewage pipelines are under jurisdiction of the Ziyang city Municipal Administration Bureau[13].

Source: Implementing organizations' responses to questionnaires

On the basis of interviews in these cities, it has been confirmed that, in regard to arrangement of the staff and operational framework, an appropriate number of staff members are allocated in proportion to the size of the respective sewage treatment plants and treatment system. Therefore, the operational framework of each city at the time of the ex-post evaluation does not have any problem for the purpose of operation and maintenance.

3.4.2 Technical Aspects of Operation and Maintenance

Compared with the time of the appraisal, operational technologies concerning sewage treatment have been well established in China as well, and project implementing organizations of each city has also accumulated sufficient experience. As they provide training to many employees every year concerning professional knowledge and technical knowhow, systems to maintain engineering skills have been generally established. In addition, with regard to the collaboration between these cities and mutual exchange, there has been almost no history of that as they are operating independently.

The following table shows an outline of each city's skill level and training system for skill development.

[13] At the time of the first field survey, the external evaluator confirmed that, because of administrative reform, jurisdiction would be transferred from Ziyang city Water Affairs Bureau, which has been in charge of maintenance and management of sewage pipelines, to Municipal Administration Bureau, a separate organization. However, as the Municipal Administration Bureau was still in the transition period, the external evaluator confirmed the framework of the Water Affairs Bureau which was directly responsible for management. In addition, the external evaluator obtained an answer from the staff of the Water Affairs Bureau that the current framework in the Water Affairs Bureau would be maintained as it is.

Table 11: Skill level and training system for skill development in each city

City	Technical evaluation items and their overall condition
Yibin city	1) **Skill level:** A dedicated department has been established to manage the pumping station and engineers are posted exclusively for the pumping station. In addition, at the site, they post "Organize" and "Tidy up," a part of 5S, as their code of conduct. The staff on duty was able to tell me the details of inspection and response at the time of emergency. In addition, with regard to the record of routine inspection, the inspection record book of the applicable date was confirmed. 2) **Training system:** They implement training sessions 38 times a year, and they are keen to let their engineers participate in government-sponsored training and vocational school courses in addition to in-house training.
Suining city	1) **Skill level:** As they are also in charge of operation of No. 1 Sewage Plant, they exchange their engineers regularly so that engineers can share the experience at both sewage plants. Engineers, including the director of the plant and engineers for water quality inspection, were able to give a briefing concerning the details of inspection, response at the time of trouble, and so on without a problem. 2) **Training system:** In addition to sending their staff to different sewage plants in other cities for inspection as well as opportunity for studying, they implement training sessions three to four times a year including training on operation and management.
Mianyang city	1) **Skill level:** When the external evaluator checked, the details of verbal inspection and responses at the time of emergency with those engineers who were carrying out routine inspections at each sewage treatment plant at the time of the field survey, it was found that they were able to give explanations about the respective procedures without a problem. 2) **Training system:** At the respective sewage treatment plants, they conduct training sessions at least three times a year and up to nine times a year. Regarding the contents, they range from operation and management to safety measures and sewage plant technologies.
Panzhihua city	1) **Skill level:** Periodic exchange of engineers has been implemented among four sewage treatment plants operated by the managing company and lessons and knowhow are also shared. Engineers, including the director of the plant and engineers for water quality inspection, were able to give a briefing about the details of inspection, how to obtain parts at the time of breakdown, and response at the time of emergency in a positive manner. 2) **Training system:** They provide training on sewage treatment plants once or twice a year.
Ziyang city	1) **Skill level:** Because, at the time of the field survey, the external evaluator was only able to interview an engineer who could only open/close a manhole, the evaluator has not been able to confirm the procedures, etc. related to inspection of a manhole. According to the response to the questionnaire, they conduct inspection on sewage pipeline four times per month. 2) **Training system:** The Ziyang city Water Affairs Bureau,[14] which is responsible for the operation and maintenance of sewage pipeline, conducts a staff training session three to four times a year.

Source: Implementing organizations' responses to questionnaires

In evaluating the engineering skills of each city, the external evaluator prepared a checklist in cooperation with an expert on sewage system and had a session with local stakeholders along the lines of these listed items. As a result, it has been confirmed that, at each sewage treatment plant, the answers of engineers who carry out on-site inspections are appropriate and they have established a good system regarding things to do in inspection and response at the time of emergency. In addition, the external evaluator saw that all sewage treatment plants of the five cities which gave answers to the evaluator's questionnaire have appropriate management procedures and abilities to implement them; for example, they have a handling manual for emergency situations.

On the basis of the above, it is confirmed that there is no major problem in regard to technical aspects of operation and maintenance.

[14] As mentioned in the previous footnote, as the bureau in charge of operation and maintenance of sewage pipeline was in a transition period at the time of survey, the external evaluator confirmed this with the Bureau of Water Affairs which is the previous organization before the transition.

3.4.3 Financial Aspect of Operation and Maintenance

(1) Plan at the time of the appraisal and outlook for financial soundness

As it was planned that the cost of operation and maintenance should be covered by the water and sewage rate income, it was planned that the water affairs company consigned by the respective municipal government would collect sewage rates together with water service rates. As the level of sewage rates (0.1–0.35 yuan/m^3) was too low to cover the cost of operation and maintenance, it was considered that they should be increased gradually from 2006 to a level (0.8 yuan/m^3)[15] that was high enough to cover the cost of operation and maintenance by 2010.

(2) Actual financial management situation

As financial statements of each city were not allowed to be disclosed, the external evaluator was unable to analyze the financial situation in detail on the basis of financial statements. In the table below, the external evaluator carried out an overall analysis mainly on the basis of two standpoints, the total structure of the operation as public utility services (expenditure of subsidies, etc.) and the direct income and expenditure structure of the operation.

Table 12: Financial situation at each city

City	Profitability
Yibin city	Rate income: None Profitability of the service in itself: △ The government provides funding for the operation and maintenance in relation to the operation of pumping stations.
Suining city	Rate income: None Profitability of the service in itself: △ The government allocates some funding in proportion to the volume of sewage they treated at a unit price which is set in consideration of a certain level of profit. If the operation resulted in deficit, the deficit is compensated by the government.
Mianyang city	Rate income: None Profitability of the service in itself: △ The government allocates some funding in proportion to the volume of sewage they treated at a unit price which is set in consideration of a certain level of profit. If the operation resulted in deficit, the deficit is compensated by the government. In addition, with regard to PPP style, payment is made at a unit price which is approximately four times as much as the actual volume of sewage treated. However, it should be noted that, as the volume of sewage any of the sewage treatment plants is treating is up to 70% or so of the capacity at the moment, the unit cost per treatment volume becomes higher than the one for the sewage treatment plant that is operating at its maximum capacity.
Panzhihua city	Rate income: None Profitability of the service in itself: △

[15] The water supply/sewage service rate planned for 2010 was approximately 4.9% for Panzhihua city, where the average income rate per household was the highest, and the rate was considered within an affordable range for the users. As of July 2017, as the water supply/sewage service rate per household in Panzhihua city is 2.7 yuan/m^3, the current average income rate is approximately 5% which is almost unchanged compared with the time of planning. Although service rates in themselves have increased along with economic development and Consumer Price Index (CPI) increase, they are staying in an affordable range for the users.

	The government allocates some funding in proportion to the volume of sewage they treated at a unit price which is set in consideration of a certain level of profit. If the operation resulted in deficit, the deficit is compensated by the government.
Ziyang city	Details were not identified

Source: Implementing organizations' responses to questionnaires

In each city, the financial management of the treatment system is not self-sustained structure by the revenue of water charge, but it takes the form of the budget allocation by the municipal government, which covers the necessary cost for service operation. To work out such input, also applicable to the PPP-style company, a unit price consisting of sewage treatment cost by the government plus a certain margin of profit has been established, and if the operation ended up in deficit, the deficit is compensated by the municipal government. Therefore, it is a structure where the actual soundness of financial management depends on the financial situation of the respective government.

In addition, as the management and operation of sewage services are almost separate in each city except for a part of Mianyang city (Water Affairs Bureau, Finance Bureau, or a commissioned company are in charge of rates collection), the departments/organizations in charge of the sewage system in each city could not obtain all the details/data concerning actual rate income and collection status.

Although there is no major concern regarding financial matters and the service is being operated without a problem at this point of time, as the external evaluator has not been able to obtain detailed information concerning the financial status of each city, the project's financial sustainability is fair.

3.4.4 Status of Operation and Maintenance

With regard to the status of facilities management in each city, the external evaluator checked such matters as the actual condition of facilities, how spare parts are prepared, and how maintenance is being carried out by on-site inspections to see the actual facilities, interviews with relevant local agencies, and checking the inspection records, etc. The following table shows the summarized status in each city.

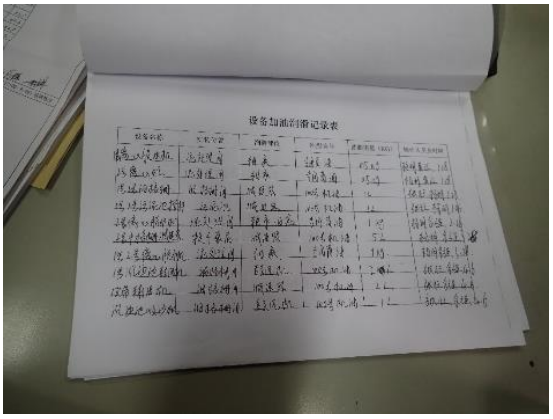
Table 13: Facilities maintenance and management status in each city

City	Condition of the facilities/Maintenance status
Yibin city	1. Facilities: Good 2. Maintenance status: The details and frequency of routine inspections have been established for sewage pipeline and pumping stations, and inspection records are kept in accordance with established procedures. In addition, they have engineers who have repairing skills. With regard to spare parts, they do not have any problem either as all spare parts are ones that can be procured domestically.
Suining city	1. Facilities: Good 2. Maintenance status: The details and frequency of routine inspections have been established for sewage pipeline and pumping stations, and inspection records are kept in accordance with established procedures. In addition, they have engineers who have repairing skills. With regard to spare parts, they do not have any problem either as all spare parts, although they are the parts

	of an overseas manufacturer, are ones which can be procured domestically.
Mianyang city	(Summary of 3 locations) 1. Facilities: Good 2. Maintenance status: The details and frequency of routine inspections have been established for sewage pipeline and pumping stations, and inspection records are kept in accordance with established procedures. In addition, they have engineers who have repairing skills. With regard to spare parts, they do not have any problem either as all spare parts, although they are the parts of an overseas manufacturer, are ones which can be procured domestically.
Panzhihua city	1. Facilities: The conditions of both sewage treatment plants and pipeline network (water supply/sewage) are good. 2. Maintenance status: Monthly inspection items and frequency have been established for all facilities and inspection is carried out by a team of two to five members. Manuals are issued for routine inspection and training; and, inspection records are kept. For example, the water service pipeline is set to be inspected for damages, etc. four to eight times a month.
Ziyang city	1. Facilities: Good (manholes in the city) 2. Maintenance status: The Water Affairs Bureau, by way of a team of two to four people, conducts routine inspections four times a month

Source: Implementing organizations' responses to questionnaires

Mianyang city
FY2017 safety check work plan table for the Songya Sewage treatment plant



Suining city
Record of sewage treatment plant maintenance

Main facilities have been maintained in good condition, partially because it has not been too long since completion, and there is no major concern at this time. Maintenance plans and access to after-sales services by the manufacturers are confirmed as adequate to maintain the condition. Spare parts, etc. are also in stock. It is fair to evaluate that they generally keep stable management.

Although it is difficult to make a precise evaluation on financial sustainability as detailed information was not confirmed, it is fair to say that the sustainability of this project, except for some cities, is high supported by fiscal funds from each municipal government[16]. On the basis of the above, no major problems have been observed in institutional, technical and financial

[16] According to the responses from the implementing organizations, collection rates for water supply/sewage system services of 2017 in each city are as follows: 100% in Yibin city, Suining city, and Panzhihua city; 90% in Ziyang city, and "no answer" for Mianyang city. These results cannot be used to directly evaluate what respective cities' financial conditions are, but they can be used as an index to ensure sustainability.

aspects, or the current status of the operation and maintenance system. Therefore, sustainability of the project effects is high.

4 Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented in five cities in the upper river basin of the Chang Jiang River in Sichuan Province to reduce the discharge of water pollutants into the rivers in each city and facilitate stable and safe supply of water through the construction of sewage facilities and water supply facilities, thereby contributing to improvement of the living environment for the residents in the said area.

The project is consistent with China's development policy and requirements at the national and municipal levels between the time of the appraisal and the time of the ex-post evaluation; therefore, the project as a whole is highly relevant. Although the outputs were significantly modified from the time of planning, as this was a flexible response to the urban planning of each city, it is fair to say that these changes were appropriate in achieving the purpose of the project. The efficiency is fair because although the project cost is a little lower than planned, the project period is far longer than planned. The constructed water supply/sewage facilities are operating smoothly and, except for some cities where urban development was delayed, the volume of sewage treated, coverage, and the effect of reducing the discharge of pollutants have all achieved their goals as planned. Thanks to the improvement of sewage treatment rate, the volume of polluted water discharged into the river has been reduced, contributing to the improvement in water quality of major rivers in each city; therefore, the level of achievement regarding effectiveness and impact of this project is high. With regard to the sustainability of this project, no significant problem is found in the institutional and technical aspects. The fiscal management of some cities are stable at this stage, since detailed financial information of some cities were not obtained, financial sustainability of the project is evaluated to be fair. Main facilities are in good condition and total sustainability is high. In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Improvement of effectiveness and efficiency by reinforcing coordination with the city development plan:

In this project, the implementation period deviated greatly from city to city resulting in extreme differences in the construction period, with the fastest construction period being within 60% of the plan and the slowest period more than double it. In successful cities like Panzhihua city, the importance of the project was clearly identified from the planning stage, municipal government took the initiative of prompt procurement and contract process, coordination with concerned sections. This promoted sectional coordination and smooth coordination with development projects implemented in parallel. When the project is significantly linked to the overall infrastructure development of the city and flexible modification or adjustment is required in relation to the overall plan, it would be effective to integrate the project into the development plan from the planning stage through the execution of the project, and authorize the executing agency to skip certain procedures required for design or scope change, or incorporate the framework similar to program loan by defining the assistance for the entire urban development plan. In addition, it would enhance the efficiency of implementation if each city shares their knowledge and experience through the monitoring of the provincial government.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1.Project Outputs		
1) Sewage pipeline	Sewage pipeline In total: 297 km Yibin city 62 km Suining city 27 km Mianyang city 140 km Panzhihua city 21 km Ziyang city 47 km	Sewage pipeline In total: 192 km Yibin city 33.3 km Suining city 18.5 km Mianyang city 93.4 km Panzhihua city 7.4 km Ziyang city 39.4 km
2) Pumping station	Total: 20 locations Mianyang city: 14 locations Yibin city: 6 locations	Total: 8 locations Mianyang city: 2 locations Yibin city: 6 locations
3) Sewage treatment plant (New construction: one location)	Total: 4 locations Treatment capacity: 99,000 m^3/day Suining city: 1 place; 60,000 m^3/day Panzhihua city: 3 locations; 39,000 m^3/day	Total: 6 locations Treatment capacity: 112,000 m^3/day Suining city: As planned Panzhihua city: 2 locations; 39,000 m^3/day Mianyang city: 3 locations; 13,000 m^3/day
4) Water supply	Water supply pipeline Panzhihua city 9 km	Water supply pipeline Panzhihua city 10.8 km
5) Training	Training on management staffs, training on sewage treatment technology	Cancelled
2 Project period	March 2007–December 2012 (70 months)	March 2007–June 2017 (124 months)
3 Project cost		
Amount Paid in Foreign Currency	6,815 million yen	6,116 million yen
Amount Paid in Local Currency	3,894 million yen (263.1 million yuan)	3,344 million yen (225.94 million yuan)
Total	10,709 million yen	9,460 million yen
ODA Loan Portion	6,300 million yen	6,065 million yen
Exchange rate	1 yuan = 14.8 yen (As of December 2006)	1 yuan = 15.08 yen (average exchange rate between 2007 and 2016)
4 Final Disbursement	September 2015	