China

Ex-Post Evaluation of Japanese ODA Loan Project

Zhejiang Sewage Treatment Project

External Evaluator: Yuko Kishino, IC Net Limited

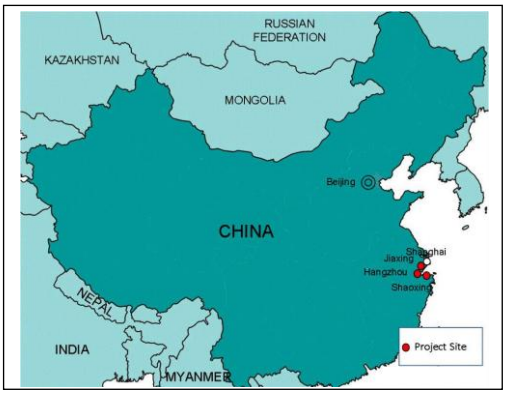
0. Summary

In order to achieve its environmental protection objectives, the Chinese government placed top priority on water contamination measures and urban environment measures and implemented various efforts to accomplish these measures. This project is part of these measures and was implemented in the cities of Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization and urbanization were progressing rapidly. Hangzhou and Jiaxing were designated as watershed cities of Lake Tai, where pollution is becoming increasingly serious. Shaoxing being a city of history culture was designated as a national priority tourist destination. Thus, all three cities had the highest need and priority for this project which aimed to improve the water quality in rivers by constructing a central sewage treatment facility.

The Hangzhou Sewage Treatment Plant as the wastewater treatment facility for the city's economic development zone, and the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant being the sole sewage treatment plants in their respective cities, all play a vital role in the sewage treatment of each city. Facility utilization for each is high and the treated water meets standards. The plants are contributing to the improvement of the water quality of the rivers in these cities as well as the living environments of nearby residents. Although there are some financial issues for the implementing agencies for each plant, they have no effect on the sustainability of the project effect.

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

1. Project Description



Project Locations

Shaoxing Sewage Treatment Plant

1.1 Background

The recent dramatic and increasing urbanization and improvements in lifestyles in China have led to a drastic increase in household sewage and industrial wastewater. However, construction of sewage and industrial wastewater treatment plants lagged behind and the sewer coverage ratio was only 26% (1997). In order to secure safe water sources, the Chinese government designated "Three Rivers and Three Lakes" (Hai River, Liao River, Huai River, Lake Tai, Lake Chao, and Dian Lake) and the Seven Great Rivers [1], where water pollution has become a serious issue, as priority regions, as well as designating the strengthening of industrial wastewater regulations and construction of sewers in urban areas, as top priorities.

The watershed for Lake Tai[2], one of the "Three Lakes", is the tributary region located at downstream from the south bank of the Yangtze River water system. The watershed area is 36,500 square kilometers including those of rivers flowing in and out of the Yangtze. Since the 1980s, eutrophication progressed due to the rapid development of industry, modernization of agriculture and the increase in population. Water pollution became prominent even in the Lake Tai water system as well. The Chinese government drew up a ""Lake Tai Watershed Pollution Prevention Ninth Five-Year Plan / 2010 Plan" and established pollution improvement objectives for 2000 in regions where sewage load may flow in and watershed cities related to the Lake Tai water environment. In Zhejiang Province[3], Huzhao City, Changxing County, Anji County, Deqing County, Yuhang City and Lin'an City were designated as Lake Tai Influence Zone. Hangzhou City and Jiaxing City were designated as Lake Tai watershed cities. Measures in order to regulate sewage discharge volume are to be implemented.

At the time of project appraisal, the sewage discharge volume for Zhejiang Province was in excess of 1.4 billion cubic meters per year while sewage treatment capacity was only 400 million cubic meters per year. In Hangzhou, Jiaxing and Shaoxing, the deterioration in the water quality of the rivers was serious. There was a need for immediate water quality measures to be taken from the environmental improvement perspective for Hangzhou, the capital of Zhejiang Province and Jiaxing, and the increasing seriousness of industrial wastewater pollution in Shaoxing.

[1] Songhua River, Liao River, Hai River, Yellow River, Huai River, Yangtze River, Pearl River
[2] A lake located on the border between the southern Jiangsu Province and northern Zhejiang Province.
[3] 33% of the Lake Tai watershed area accounts for 24% of the watershed population.

1.2 Project Outline

The objective of this project is to improve water quality in the rivers of the cities, Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization had progressed rapidly, and Lake Tai by constructing sewage treatment plants in each city, thereby contributing to the improvement of the living environments of the residents.

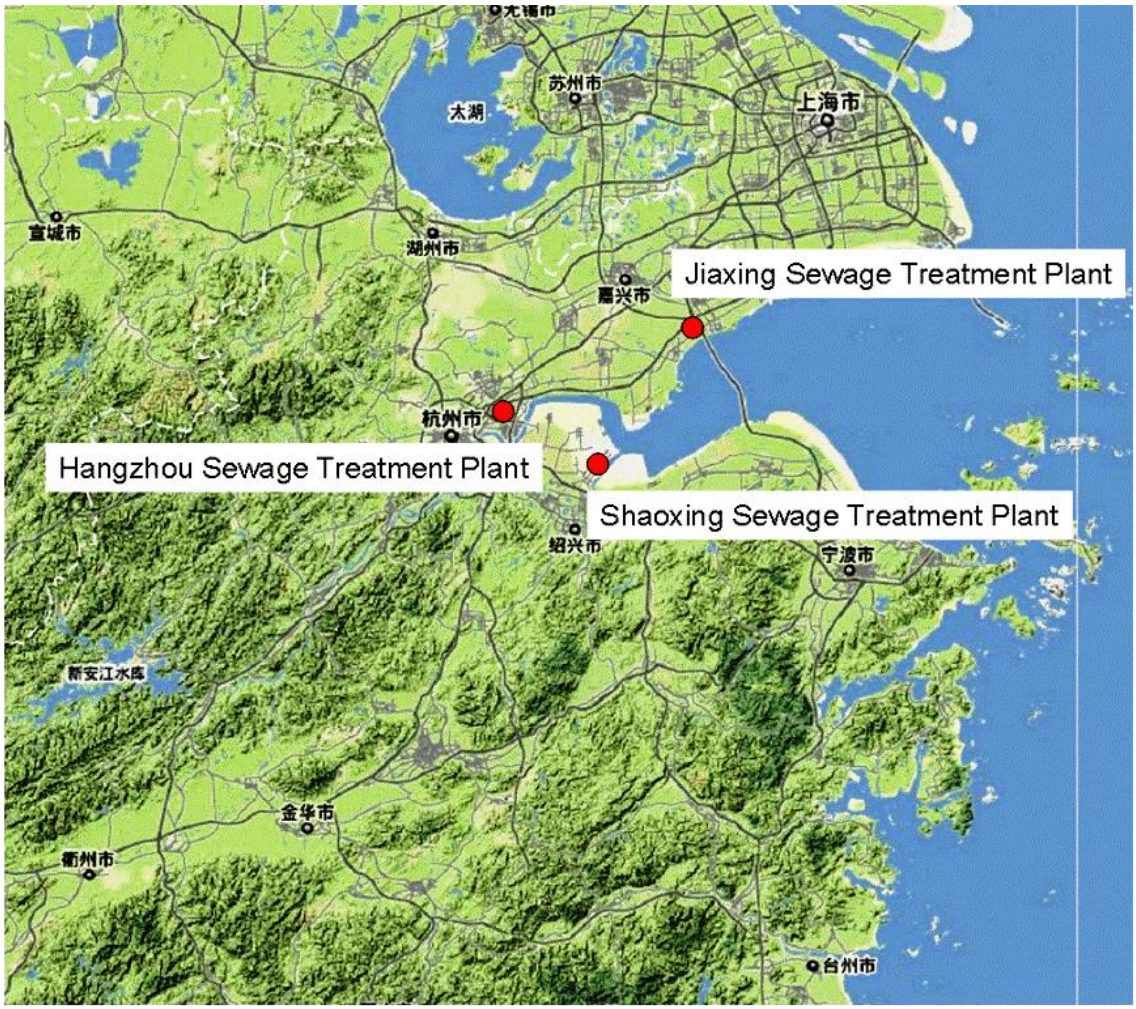


Figure 1 Subproject Location Map

Loan Approved Amount/ Disbursed Amount	11,256 million yen/ 11,204 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000 / March 2000
Terms and Conditions	Interest Rate: 0.75% Repayment Period: 40 years (Grace Period: 10 years) Bilateral Tied
Borrower / Executing Agency Implementing agencies	The Government of the People's Republic of China / Zhejiang Provincial People's Government Hangzhou Capital Water Company Limited Jiaxing United Sewage Treatment Co., Ltd. Shaoxing Water Treatment Development Co., Ltd.
Final Disbursement Date	July 2007
Main Contractor	China Anneng Construction Corporation / China Construction Eighth Engineering Division, China Jiangsu Machinery & Equipment I/E Corp. (J/V) (Above are all from the People's Republic of China)
Main Consultant	None
Feasibility Studies, etc.	Feasibility Studies Hangzhou City: Shanghai Municipal Engineering Design Institute, 1999 Jiaxing City: China Northwest Municipal Engineering Design Institute / Beijing Biaoqi Environment Group, 1999 Shaoxing City: Design Institute of Jilin Chemical Industry Company, 1999
Related Projects	Development Survey "Study on Integrated Management Master Plan for Tai Lake Basin Water Management" Grant Aid "The Japan-China Friendship Environmental Protection Center Construction Project", Other[4]

[4] World Bank Loan "Zhejiang Urban Environment Project", German government grant aid "Hangzhou Sewage Treatment Plant Expansion Construction"

2. Outline of the Evaluation Study

2.1 External Evaluator

Yuko Kishino, IC Net Limited

2.2 Duration of Evaluation Study

The evaluation study for this ex-post evaluation was conducted as follows:

Duration of the Study: November 2010 – October 2011

Duration of the Field Study: February 21, 2011 – March 8, 2011 and May 30, 2011 – June 2, 2011

2.3 Constraints during the Evaluation Study

Because some evaluation indicators for the "Improvement of River Water Quality", the objective of this project, could not be obtained, qualitative evaluations were conducted based on a certain number of presumptions. For the evaluation of effectiveness, the original policy was to make a determination based on the operational status of the subprojects and the level of improvement in the water quality of the rivers in the city. However, we were unable to obtain water quality data for the targeted rivers in Hangzhou and Shaoxing. Because of this, a qualitative evaluation was conducted using disclosed data for Hangzhou City and questionnaire survey results by the implementing agencies in Shaoxing City under the following constraints:

- The disclosed data by Hangzhou City was averaged data for all monitoring sections of the target river and have been affected by household sewage and industrial wastewater from areas not targeted by the subprojects as well as being affected by other water quality improvement projects.
- The sample size for the beneficiary survey conducted in Shaoxing City was small, at only 100 people, and the statistical accuracy for the results obtained from the survey is low.

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Relevance with the Development Plan of China

(1) Development plan at the time of the appraisal

In its "National Environmental Protection Ninth Five-Year Plan and 2010 Long-term Goal", the Chinese government established water quality and atmospheric pollution measures and the improvement of urban environments as top priority issues and set an objective of "stopping environmental pollution and degradation of the ecological system, improving the environment of selected cities and regions, and establishing model cities and regions for economic development, environmental safety, ecosystem protection."

In the "Lake Tai Watershed Pollution Prevention Ninth Five-Year Plan / 2010 Plan", six priority pollution control areas, and numeric targets of pollutant emissions volume to be achieved by 2000 were set for each area. In order to achieve these objectives, construction of sewage treatment plants and industrial wastewater treatment facilities were implemented. The Xiagu Pollution Control Area, one of the priority pollution control areas, was included in the target cities of this project along with Hangzhou and Jiaxing, due to the area being a watershed city of Lake Tai.

In the "Zhejiang Lake Tai Watershed Pollution Improvement Project", the objectives set were making the water in Grand Canal clear by 2000, improving the water quality class of the rivers in Jiaxing by one level, and to improve the water quality of the rivers in the Lake Tai watershed to National Surface Water Quality Standard Class II or III[7]. In the Zhejiang Province Development Plan as well, an objective was set to increase the sewage treatment rate to 40% by 2000 and to 60% by 2010 in order to improve the environment in the cities and farming areas. This project was conducted within these plans and the relevance with development plans is high.

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

In the National Environmental Protection Eleventh Five-Year Plan (2006-2010), the objectives laid out included Chemical Oxygen Demand[8] (hereinafter referred to as "COD") reduction by 5%, ammoniac nitrogen emissions reduction by 3% in comparison with 2005

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

[6] ③:High,②:Fair, ①:Low

[7] National Surface Water Quality Standard GB3838－1988 was put into effect in 1988 by the National Environmental Protection Bureau (the current Ministry of Environmental Protection of the People's Republic of China). It categorizes water quality into 6 Classes, I – V, based on 30 water quality indicators such as Chemical Oxygen Demand (COD), with Class I being the highest and V the lowest. For Class I and II, COD must be 15mg/l or lower, 15mg/l for Class III, 20mg/l for Class IV and 25mg/l for Class V. In GB3838－2002, revised in 2002, the standards were partly lowered with COD for Class I and II being 15mg/l or less, 20mg/l for Class III, 30mg/l for Class IV, and 40mg/l for Class V.

[8] Used as a value to measure the level of water pollution. It refers to the volume of oxygen consumed when organic compounds in the water are oxidized using an oxidizing agent.

figures, as well as an urban sewage treatment rate of over 60%. This shows continued priority being placed on water pollution measures.

In the "Zhejiang Province Lake Tai Watershed Water Environment Consolidated Measures Implementation Plan" based on the 2007 "Lake Tai Water Environment Consolidated Measures Implementation Plan", all of Hangzhou, Jiaxing and Shaoxing were designated as the "Hangjiahu Region" and were specified as the target for the plan. With this, the objective of the plan was to reduce the amount of COD, ammoniac nitrogen and total nitrogen above the allowable limit by 50% of 2005 figures, maintain Class III water quality for the profile inflow into Lake Tai, and to greatly improve the water environment in the entire Zhejiang Province Lake Tai watershed. In regards to the sewage treatment facilities in the cities, the installing of denitrification and dephosphorization equipment by 2010 was mandated and it states that sewage treatment rates for the cities will be over 82% by 2012 and 90% by 2020. This project is a measure to construct sewage treatment facilities in the cities and to improve water quality, which is a major focal point of the national and provincial measures, and thus in regards to the point in time of the ex-post evaluation; too, the relevance with development plans is high.

3.1.2 Relevance with the Development Needs of China

3.1.2.1 Sewer Construction needs

At the time of the appraisal, there were many areas in Zhejiang Province that did not have any sewage treatment plant at all, and the construction of sewage treatment plants in each city and county was an issue that needed to be immediately addressed.

In Hangzhou, domestic sewage and industrial wastewater was increasing due to industrial development and an increase in population. At the time of the appraisal, only the Sipu Sewage Treatment Plant existed in Hangzhou and only sewage from three[9] sewage systems of the city's six sewage systems were being treated and the other three systems[10] were being discharged into the Grand Canal and Qiantang River. The water quality of the rivers were far below Class V standards and were affecting drinking water, agriculture and fishing downstream.

In Jiaxing, there was no central sewage treatment facility and domestic sewage was being discharged directly into the rivers without being treated. Industrial wastewater treatment was also inadequate. As of 1996, of the 27 cross-sectional monitoring sections in the city, 12 recorded water quality far below Class V, and the deterioration of water quality was becoming increasingly serious.

In Shaoxing city and county, sewers and pumping stations had been constructed since 1991, but a sewage treatment plant had yet to be constructed. Industrial wastewater had undergone simple treatment and released into Cao'e River, one of the eight major lines in

[9] No. 1, No. 2, No.3
[10] Xiasha, Jiangcun, Binjiang

Zhejiang. Domestic sewage was discharged into a nearby river were it also flowed into Cao'e River Organic pollution in the rivers due to industrial wastewater was by far the worst and cross sectional monitoring in Cao'e River deteriorated from Class III to Class V.

3.1.2.2 Project Relevance[11]

In the materials at the time of the Japan International Cooperation Agency (JICA) appraisal, the stated project objective was to improve the water quality of the rivers in the city as well as Lake Tai through the construction of sewage treatment facilities. The improvements in the water quality of both "rivers in the city" and "Lake Tai" were noted together. It is correct to assume that, in other words, the aim of the project was to improve the water quality in the rivers of Hangzhou, Jiaxing and Shaoxing, as well as to improve the water quality of Lake Tai by implementing the three subprojects. However, no clear roadmaps were shown to achieve the latter "improvement of the water quality of Lake Tai", and no specific objectives were set, resulting in poor relevance in terms of project objective setting and target setting.

(1) Relevance of Project Objective

Based on the "Lake Tai Water Quality Improvement" in the Lake Tai Watershed Pollution Improvement Plan and the "Construction of Sewage Treatment Plants in Urban Areas" in the National Environmental Protection Plan, the Chinese government requested assistance from the Japanese government. The target cities were Huzhou, Yuhang, Hangzhou and Jiaxing, which were cities in Zhejiang Province that required large-scale sewage treatment facilities, and Shaoxing which is not a Lake Tai watershed city, but a city in which the rivers were severely polluted by industrial wastewater and urgently required construction of sewers. After a survey conducted by the Japanese government, Hangzhou, Jiaxing and Shaoxing were selected from the perspective of efficiency and this project, consisting of three subprojects, was formed. Although Huzhou and Yuhand, both of which are cities in the Lake Tai Impact Area, and may have an effect on the water quality of Lake Tai, were not selected, the "Improvement of the Water Quality of Lake Tai" still remained. Although it is certain that this project was implemented to contribute to the overall water environment improvement plan of the Chinese government, it is thought that more realistic and appropriate objective settings were required such as what specifically were to be achieved by implementing this yen loan project made of multiple subprojects.

In this evaluation survey, we were unable to clarify why the "Improvement of the Water Quality of Lake Tai" was stated as a project objective, and we find it hard to expect that this project would lead to an improvement in the water quality of Lake Tai. We believe that

[11] This was not included in the ratings for relevance due to the fact that objective settings drawn from strict project objective and indicators based on logical frameworks were not required at the time of appraisal and that there was a difference in understanding between the two countries as to the role of this project.

the objective for this project should have been kept to an "Improvement of Water Quality of the Rivers in the Cities". According to the executing agency and the Jiaxing city government, the rivers in Hangzhou and Jiaxing are located downstream from Lake Tai and are also sewage waterways from Lake Tai to Hangzhou Port, and therefore have almost no effect on the water quality of Lake Tai[12]. In addition, it is a fact that the rivers in Shaoxing also have no effect on the water quality of Lake Tai.

(2) Relevance of Project Targets Setting

For current JICA projects, when implementing multiple subprojects for sector assistance, a quantitative data collection, to the greatest extent possible, is required for the effects of each subproject, and at the subproject level, targets must be clarified using numerical indicators. The appraisal at the time did not require that much degree of target setting and there are no numerical targets or specific project objectives for the "Improvement of the Water Quality of Lake Tai". According to the executing agency and implementing agencies, they stated that there were no specific discussions between the Japanese and Chinese sides at the time of appraisal regarding the improvement of water quality in the rivers and it is believed that there were problems in the planning during the appraisal. The environmental bureaus of each city do not regularly monitor the water quality improvement situations of the rivers for the sake of this yen loan project, and apart from Jiaxing, no data on the water quality of the rivers was provided for this ex-post evaluation. As a result, it was not possible to quantitatively evaluate the effects of two subprojects. For the river water quality improvement project, the targeted rivers, monitoring cross sections and numerical targets must be clarified and all associated persons must be in agreement.

3.1.3 Relevance with Japan's ODA Policy

In the Economic Cooperation Program for China based on the policy of placing "more emphasis on the areas such as the conservation of environments and eco-systems, the improvement of living standards and social development in the inland regions, human resources development, institution building, and technology transfers" the top priority was given to "cooperation towards resolving environmental and other global issues." In the Country Project Implementation Policy, it is stated that assistance will be provided through construction of sewers and the like.

In light of the above, 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.

[12] According to the Jiaxing Water Resource Bureau, as one Lake Tai watershed flooding measure, water would be temporarily pumped from the rivers in Jiaxing in the direction of Lake Tai during the flooding season (April – September). However, this has not been implemented in the past 10 years at least.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The construction of sewage treatment plants for each subproject was implemented mostly as planned. In regards to the construction of sewers and pumping stations, although there were changes in the Jiaxing Sewage Treatment Plant and the Shaoxing Water Treatment Plant, these were determined to be appropriate to the change in implementation conditions.

As for the Jiaxing Sewage Treatment Plant, the total extension of sewage pipes were changed from the planned 110km to 136.76km and the number of pumping stations increased from 15 to 18. The expansion of these outputs was designed to respond to the delayed construction of the terminal sewer pipe network by each county and local government, the fact that prevented service to a wider area, and to address the problem of insufficient water delivery capacity of the Number 2 Pumping Station[13]. As a result of expanding the outputs, the sewage area increased from 40.3km^2 to 1,869.2km^2 and the collection and delivery of sewage increased from 300,000 tons/day to 600,000 tons/day. The increase in sewage collection and delivery capacity led to a doubling of the treatment capacity of the Jiaxing Sewage Treatment Plant by implementing a new, second stage construction (inflow volume of 300,000 tons/day).

At the Shaoxing Sewage Treatment Plant, the construction of sewer pipes and pumping stations were not included in the yen loan project and implemented as a Shaoxing county government project. This was due to the background of the specific implementing agency[14] having been divided into the Shaoxing Water Discharge Company and the Shaoxing Water Treatment Development Co., Ltd. in November of 2001. The Shaoxing Water Discharge Company would be responsible for the sewer pipes and pumping stations, and the Shaoxing Water Treatment Development Co., Ltd. would be responsible for the sewage treatment plant. Only the construction of the sewage treatment plant would be the target of the yen loan.

As will be noted later, the expansion of the output for the Jiaxing Sewage Treatment Plant led to the prolongation of the project period and an increase in project costs. However, the fact that the sewage treatment plant construction project and the terminal sewer pipe network construction project were integrated together to expand the sewage collection volume in the region and to greatly increase the utilization ratio of the treatment facilities can be evaluated highly from the perspective of achieving the objective of this project of improving the river water quality.

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[13] As a result of the yen loan intermediate monitoring evaluation implemented in March of 2007, the implementing of a project for increased construction of the sewer pipe network and pumping stations which had already been started by Jiaxing city was approved within the limits of the yen loan authorized amount.
[14] Shaoxing Water Supply and Discharge Process Management Station

Fig. 2 Aeration tank(Hangzhou Sewage Treatment Plant)

Fig. 3 Oxidation ditch (Jiaxing Sewage Treatment Plant)

3.2.2 Project Inputs

3.2.2.1 Project Cost

Compared to the initial plan of 33.081 billion yen[15] (of which 11.256 billion yen was foreign currency), the actual total project cost was 35.967 billion yen (of which 11.24 billion yen and other 1 billion yen was foreign currency), and was slightly higher than planned (109% of the plan). The reason for this was a valid one, caused by an increase in output. The ratios against the plan, taking into account the increase or decrease in output[16] are 92% for the Hangzhou Sewage Treatment Plant, 88% for the Jiaxing Sewage Treatment Plant[17] and 111% for the Shaoxing Sewage Treatment Plant, with the ratio being 94% for the project as a whole.

3.2.2.2 Project Period

The total project period was planned to be between March 2000 and December 2003 (46 months) but the actual period was from March 2000 to January 2010 (119 months) and was significantly longer than planned (259% of the plan) and did not match the increase/decrease in output. When looked at by subproject, the Hangzhou Sewage Treatment was as planned, the Jiaxing Sewage Treatment Plant had a ratio against the plan of 290%[18], and that for the Shaoxing Sewage Treatment Plant was 219%, resulting in an

[15] Although the JICA materials at the time of appraisal note the total amount to be 33.076 billion yen, the total of the breakdown is used here.

[16] Jiaxing Sewage Treatment Plant - A comparison against the actual against the initial planned amount with the project costs for additional sewer pipes and pumping station construction costs added (planned cost). Shaoxing Sewage Treatment Plant – The actual cost was compared to the initial planned cost minus the canceled sewer pipe and pumping station construction costs.

[17] 90% of the plan, 11.877 billion yen (1.426 billion yen in foreign currency, 746 million Yuna domestic currency) was added to the initial planned output. In regards to the expanded portion of the output, in comparison with the planned 6.927 billion yen, the actual amount was 5.883 billion yen (3.45267 billion yen foreign currency, 173.41 million Yuna domestic currency), a plan ratio of 85%.

[18] The sewer pipes and pumping stations in Jiaxing are to be inspected at the same time as the completion of the Stage II construction at the sewage treatment plant. This evaluation deems the start of test operations in

overall average of 203%.

At the Jiaxing Sewage Treatment Plant, the fact that additional construction for expanded outputs took 33 months to decide upon and the construction itself took as long as 47 months, though as planned, added to the prolongation of the project period[19]. At the Shaoxing Sewage Treatment Plant, the reason for delay was that project acceptance was delayed until November of 2004, but formal operation started in June of 2002 and had no effect on project effects.

In light of the above, although the project cost was mostly as planned, the project period significantly exceeded the plan; therefore efficiency of the project is fair.

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

The objectives of the project is to "improve the water quality of the rivers in the city and Lake Tai" through the construction of sewage treatment facilities. As noted in the Project Relevance section, due to the fact that there is no clear causal relationship with project implementation and the "water quality improvement of Lake Tai", evaluation of the effectiveness will be performed using 2 stages, (1) An analysis of the operation and effect indicators of each subproject and (2) An analysis of the improvement of the water quality of the rivers and water systems affected by the effects of each subproject.

3.3.1.1 Results from Operation and Effect Indicators of Subprojects

Indicators used to determine whether or not sewage treatment facilities are being fully used include sewage treatment volume[20] and facility utilization rate[21]. For effect indicators, the annual removal volumes for COD, an indicator typically used to represent water pollution level, Biochemical Oxygen Demand[22] (hereinafter referred to as "BOD"), Suspended Solids[23] (hereinafter referred to as "SS") were used.

(1) Increase in Sewage Treatment Capacity (Sewage Treatment Volume and Facility Utilization Rate)

As shown in the table below, the daily sewage treatment capacity of all three subprojects combined in 2010 was 859,600 tons, mostly as planned, and the facilities are being

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January of 2010 as completion of the project. Note that the ratio against the plan for initial planned output that does not include additional construction is 188%

[19]The planned/actual period for additional construction was implemented mostly as planned as follows.
Plan: February 2006 – June, 2009
Actual: February 2006 – December 2009 (Project acceptance was in January 2010. Construction period of 47 months)

[20] Volume accepted by the sewage treatment plant and treated.

[21] Average daily treatment volume/facility capacity

[22] A water pollution indicator and one vital regulated item for industrial wastewater. Indicates the amount of oxygen consumed by microbes when they decompose organic compounds in the water. The higher the value, the higher the level of pollution.

[23]Insoluble particulate matters suspended in the water. These include particles from clay minerals, phytoplankton, zooplankton and their carcasses as well as organic and metallic sediment from sewage and factory water discharges.

adequately utilized. With the increase in sewage volume at each plant, in addition to Stage 1 construction yen loan projects, each plant is implementing Stage 2 and Stage 3 construction and gradually expanding treatment capacity. Treatment capacity at the time of evaluation was 600,000 tons/day[24] at the Hangzhou Sewage Treatment Plant, the Jiaxing Sewage Treatment Plant had a capacity of 450,000 tons/day[25], and the Shaoxing Sewage Treatment Plant had a capacity of 900,000 tons/day. In addition at the Hangzhou Sewage Treatment Plant, capacity is to be expanded to 1.2 million tons/day by 2012 and to 600,000 tons/day at the Jiaxing Sewage Treatment Plant in order to respond to future increases in sewage volumes.

Table 1 Sewage Treatment Volume for Each Subproject

(Unit: 10,000 tons/day)

	Sewage Treatment Volume (2010)		
	Plan	Actual	Plan Ratio
Hangzhou Sewage Treatment Plant	30	26.2	87%
Jiaxing Sewage Treatment Plant	30	29.76	99%
Shaoxing Sewage Treatment Plant	30	30	100%
Total	90	85.96	96%

As can be seen in Figure 4, the facility utilization rate has steadily increased since the start of operations and in 2010 all the three plants were operating at full capacity with the Hangzhou Sewage Treatment Plant utilization rate at 87.3%, 99.2% at the Jiaxing Sewage Treatment Plant and 100% at the Shaoxing Sewage Treatment Plant. The reason for the increase in facility utilization rate in the span of only two to three years is due to the construction of terminal sewer pipe systems and connection to each household. In Hangzhou and Shaoxing, the sewer pipe system had already been constructed to some degree before the project was implemented, and the use of experience from the construction of the Sipu Sewage Treatment Plant, completed in 1992 in Hangzhou also contributed to this. Because there was no sewer network in Jiaxing, construction of the sewage system network and treatment plant were started at the same time. Although the utilization rate was a low 39% at the time of the start of operations at the treatment plant (2003) due to a delay in sewage system construction caused by the lack of funds and insufficient pump capacity; by expanding output and maintaining and upgrading these systems, the utilization rate gradually improved to 76% in 2006, 83% in 2007, 89% in 2008, and 97% in 2009.

(Unit: %)

[24] The sewage treatment volume for the whole of the Hangzhou Sewage Treatment Plant in 2010 was 501,000 tons/day.

[25] Total of Stage 1 construction (yen loan project) 300,000 tons/day and 150,000 tons/day half of the Stage 2 construction of 300,000 tons/day. The remaining 150,000 tons/day from Stage 2 construction is to be completed at the end of 2011.

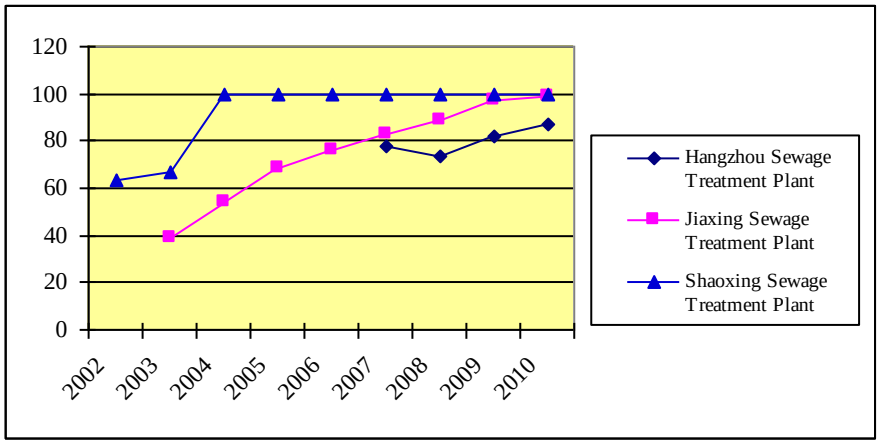

Figure 4 Facility Utilization Rate for Each Sewage Treatment Plant

Source: Hangzhou Capital Water Co., Ltd., Jiaxing United Sewage Treatment Co., Ltd., Shaoxing Water Treatment Development Co., Ltd.

Note: Data only reflects facilities constructed by using yen loans. Data could not be obtained for the Hangzhou Sewage Treatment Plant for 2003 through 2006 (Hangzhou Sewage Discharge Corporation).

(2) Reduction Volume of Pollutants

When a check was conducted in 2010 to determine how much of the pollutants that cause water contamination was removed through the implementation of this project, as shown in Tables 2 through 4, apart from the BOD at the Hangzhou Sewage Treatment Plant, all figures exceeded planned figures. This is due to the fact that the inflow water quality at each treatment plant had deteriorated more than had been anticipated and due to increased pollutant removal capacity through additional measures being taken at the Jiaxing and Shaoxing Sewage Treatment Plants.

The Jiaxing Sewage Treatment Plant in 2003 through the direction of the mayor of Jiaxing started to treat wastewater from the Xiuzhou region where there are many print dye factories. The inflow water quality to the treatment plant deteriorated and even after treatment, water quality standards could not be met. An oxidation ditch aeration unit was added using yen loans to strengthen and improve the pollutant removal rates. As a result, pollutant reduction volume increased more than planned.

At the Shaoxing Sewage Treatment Plant, COD removal was 150%, BOD 123% and SS 381% over the plan, all substantially exceeding the plan. At the planning stage, a sample of 4,000 to 5,000 tons of polluted water was collected and this was set as the anticipated inflow pollutant density. However, in reality, the inflow water quality was worse than the sample, and with the trend of annually deteriorating quality, a primary settling basin was constructed using own funds to increase removal rates. In addition, in Shaoxing city, due to the fact that it had set an objective of 100mg/l COD or less since 2008, a chemical addition system was added to the primary and secondary settling basins in 2011 as measures to improve treated water quality.

Table 2 Hangzhou Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	30,660	45,319	148%
BOD removal volume (tons/year)	18,615	18,036	97%
SS removal volume (tons/year)	24,090	26,939	112%

Source: Hangzhou Capital Water Company Limited

Table 3 Jiaxing Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	30,660	35,185	115%
BOD removal volume (tons/year)	14,345	14,591	102%
SS removal volume (tons/year)	12,812	26,256	205%

Source: Jiaxing United Sewage Treatment Co., Ltd.

Table 4 Shaoxing Sewage Treatment Plant Pollutant Removal Volume

	Plan (1999)	Actual (2010)	Against Plan
COD removal volume (tons/year)	89,790	135,123	150%
BOD removal volume (tons/year)	48,180	59,281	123%
SS removal volume (tons/year)	21,900	83,439	381%

Source: Shaoxing Water Treatment Development Co., Ltd.

(3) Discharge Water Quality

The discharge water quality in 2010 for each subproject meets standards. At the Hangzhou Sewage Treatment Plant, the standard for discharge water quality at the time of appraisal was GB8978-1996 Class 2 in the “Integrated Wastewater Discharge Standard” (COD120 mg/L, BOD30 mg/L, SS35 mg/L) but because it was known then standards would be made stricter soon, phosphorus and nitrogen removal processes were added together with the choice of treatment technology to comply with the new standards. At the Jiaxing Sewage Treatment Plant, as noted above, because the quality of the inflow water had deteriorated, it was not possible to meet the standards by 2006-2007. With the setting of treatment plant inflow water standards in 2008, standards were met from 2008 onwards through the improvement of inflow water quality from strengthened wastewater treatment at factories and the additional oxidation ditch aeration facilities installed to increase pollutant removal rates.

At the Shaoxing Sewage Treatment Plant, the COD effort target values are expected to

be achieved in Shaoxing through additional measures in 2011 as noted above. In addition, the strengthening of "Textile Industrial Wastewater Discharge Standards" [26] is expected to be passed in the near future and measures are being considered to comply with these standards. It is anticipated that the treated water quality will further improve in the future.

Table 5 Discharge Water Standards and Actual Results for Each Sewage Treatment Plant

(Unit: mg/L)

	Hangzhou Sewage Treatment Plant		Jiaxing Sewage Treatment Plant		Shaoxing Sewage Treatment Plant	
	Standard	Actual	Standard	Actual	Standard	Actual
	GB18918-2002 Class I B	2010	GB8978-1996 Class II	2010	GB4287-1992 Class II	2010
COD	60	43.1	120	95.82	180	113
BOD	20	7.4	30	19.85	40	9.62
SS	25	8.3	30	18.2	100	32

Source: Hangzhou Capital Water Company Limited, Jiaxing United Sewage Treatment Co., Ltd., Shaoxing Water Treatment Development Co., Ltd.
Note: GB18918-2002 – "Urban Sewage Treatment Plant Pollution Emission Standards", GB8978-1996 – "Integrated Wastewater Discharge Standards", GB4287-1992 – "Textile Industrial Wastewater Discharge Standards"

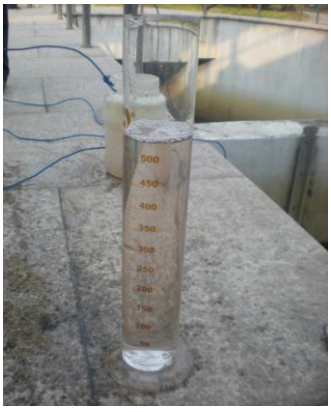

Fig. 5 Treated water (Hangzhou Sewage Treatment Plant)

Fig. 6 Before treatment (right) and after treatment (left) (Jiaxing Sewage Treatment Plant)

3.3.1.2 Improvement of Water Pollution

In regards to evaluating the improvement of water quality, rivers which would be affected through the implementation of each subproject based on pre-project implementation untreated water discharge status in the target areas were selected as shown in table 6. We attempted to obtain water quality data from the treated water discharge points as well as monitoring cross-sections downstream.

We were unable to obtain data from the supervising agencies, the Hangzhou Environment Bureau and the Shaoxing Environment Bureau, and therefore for the Hangzhou Sewage Treatment Plant, we referred to data on the water quality of the Qiantang River from the Zhejiang Province Environmental Status Bulletin to conduct

[26] GB4287 -2008: BOD25mg/L, COD100 mg/L, SS70 mg/L, ammoniac nitrogen 15 mg/L, TP mg/L.

evaluations from the perspective of water quality degradation control. Because the Qiantang River is a major river stretching for 688 kilometers and because the water quality is affected by many factors beside this project, it is impossible to analyze the relationship between the effects of the subproject from the disclosed water quality data for the entire Qianting River. For the Shaoxing Sewage Treatment Plant, a qualitative evaluation was conducted based on questionnaire results from the beneficiaries.

Table 6 Target Rivers for Each Subproject

Subproject	Target River	Monitoring Cross-section
Hangzhou Sewage Treatment Plant	Qiantang River	Shangzhakou, Qipu, Zhitoujiao, Number 9 Dam
Jiaxing Sewage Treatment Plant	27 rivers in Jiaxing city	64 locations in the city
Shaoxing Sewage Treatment Plant	Cao'e River	Dongjiang flood gate, Honggi flood gate, Xinsanjiang flood gate

Note: Jiaxing city is located in the center of the Yangtze River delta and the rivers in the city make up the river network. Because it is difficult to specify rivers, the target was set as the water quality of the main rivers (the average of 27 rivers)

(1) Hangzhou City

From Figure 7 we cannot see a clear change in the water quality of the Qiantang River as a whole. The population of Hangzhou city increased by 680,000 people between 2000 and 2009 and the economy grew greatly as well with annual average growth rates of GDP and industrial output at 15.4% and 18.6% respectively. Taking into consideration the fact that increase in population and economic growth are factors in the deterioration of water quality as well as the fact that target treatment area is an economic development zone accounting for 70% of the industrial wastewater discharge, it can be said that this project is contributing to the controlling of the deterioration of the water quality of the Qiantang River.

(Unit: %)

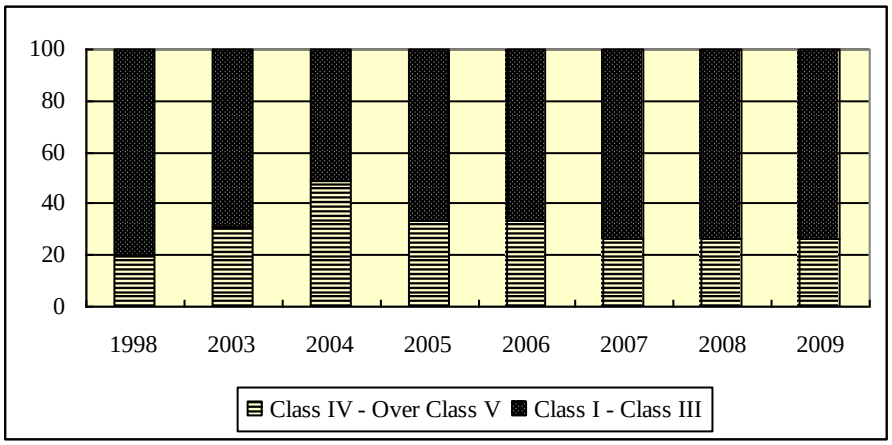

Figure 7 Changes in Qiantang River water quality

Source: Zhejiang Province Environmental Status Bulletin

(2) Jiaxing City

As can be seen from Figure 8, of the 64 monitoring cross-sections in 27 rivers in the city, the ratio of Over Class V, has been gradually declining since 2006 and was drastically reduced in 2009. The treatment area of the Jiaxing Sewage Treatment Plant is large, covering approximately 80% of the entire city, and it is thought this project is having a substantial effect on the water quality of the rivers in the city. The improvement trend since 2006 coincides with the gradual increasing of the facility utilization rate of the treatment plant. It is believed that the effects from the strengthening of wastewater treatment by major polluting companies led to many of the monitoring cross sections showing improvement from Over Class V to Class V.

(Unit: %)

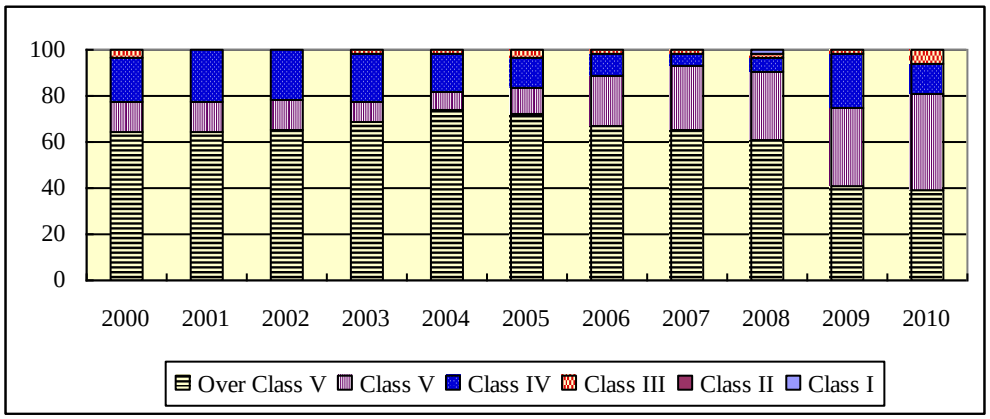

Figure 8 Water quality at 64 monitoring cross sections in the rivers in Jiaxing city

Source: Jiaxing City Environment Bureau

(3) Shaoxing City

The old city area of Shaoxing is enclosed by the Ring River, and rivers in the surrounding areas spread out like a net. Because these rivers flow into the Cao'e River, the city's river network has an effect on the water quality of the Cao'e River.

With a view to confirming the effects of this project, a survey was conducted among 100 residents of the old city area within the Ring River, asking them about changes in the water quality of the rivers in the old city area and the Ring River. The results showed that after implementation of the project, 75% responded that the rivers were "Greatly cleaner" or "Slightly cleaner" and 22% responded that "Not much cleaner" or "Not cleaner at all". We learned that many people were aware of the improvement of the water quality in the nearby rivers as a result of the implementation of this project. Sixty percent of the

respondents stated that the cause for the cleaner rivers were “Construction of sewage treatment plant”, “Industrial wastewater regulations” and “Construction of sewers”. These results confirmed the effects of the project. Regarding uses of the river before and after implementation of the project, “Scenery/Recreation”, “Aquaculture”, “Use of Wupengchuan boats[27]” responses increased and “For industrial use” and “Polluted water that can’t be used for anything” responses decreased. From this, we can see that the improvement in water quality has led to the diversification in the use of the river.

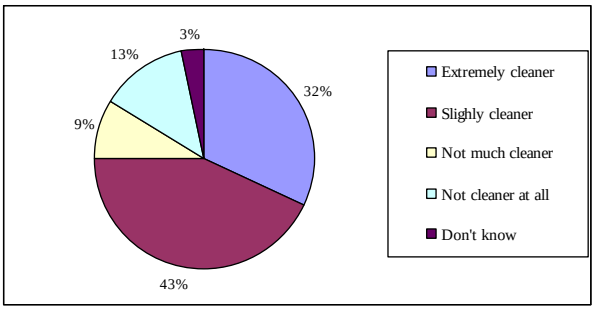

Fig. 9 Changes in river water quality before and after project implementation

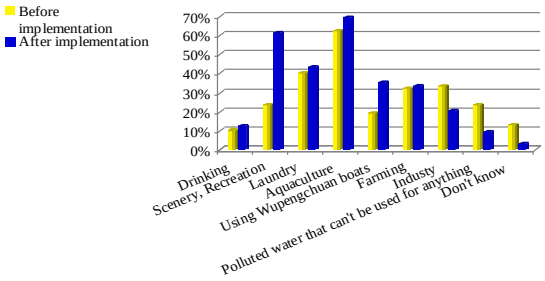

Fig. 10 River use before and after project implementation

Fig. 11 Inland rivers and Wupengchuan boats

As the implementing agency pointed out as well, not only was sewage for Shaoxing city and Shaoxing county being treated after implementation of the project, the number of factories decreased from 500 to 300 due to closures and mergers and the advancement of primary treatment of industrial wastewater led to the improvement trend for the water quality of the Qiantang River[28].

3.3.1.2 Results of Calculations of Internal Rates of Return

At the time of appraisal the Financial Internal Rate of Return (FIRR) was calculated with the project life being 20 years, sewage treatment income being the benefit, and the costs being construction costs, sewage treatment costs and maintenance and management costs. The results were 3.8% for the Hangzhou Sewage Treatment Plant, 2.4% for the Jiaxing

[27] A river boat with black cover for water traffic in Shaoxing City, also used for touristic purposes
[28] This is not a judgment based on quantitative data.

Sewage Treatment Plant, and 6.3% for the Shaoxing Sewage Treatment Plant. After a recalculation using data obtained for the Jiaxing and Shaoxing sewage treatment plants at the time of the ex-post evaluation, both came out negative. This was due to the drastic increase in project costs for the Jiaxing Sewage Treatment Plant as well as a 30% increase in maintenance and management costs. For the Shaoxing Sewage Treatment Plant, the actual sewage treatment costs were set lower than that assumed at the time of the appraisal, the income distribution ratio was set at 60% for the company managing the sewer network which was lower than the maintenance and management costs, and the facts that the maintenance management costs were 1.3 times that set during the appraisal and taxes were included in the costs affected the numbers.

3.3.2 Qualitative Effects

Refer to the Impact section

In light of the above, this project has largely achieved its objectives; therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts (Improvement of the living environment of residents)

Through the construction of sewage treatment plants, this project anticipated the improvement of the living environment of the residents. In order to verify this, the Shaoxing Sewage Treatment Plant was selected from the three subprojects[29] and a beneficiary survey was conducted through a questionnaire. The survey area included Luxunguju, Bazi Bridge, Zhou Enlai guju and the area near Cai Yuanpei guju, and conducted among 100 residents on the inside of the Ring River. The details are shown in Table 7. Although these beneficiary survey results are not necessarily representative of all beneficiaries because of the small sample size, it can be seen that beneficiaries generally recognize that the water quality of the rivers in the beneficiary area has improved after implementation of the project and the living environment has also improved.

[29] The reason why the Shaoxing Sewage Treatment Plant was selected is because, of the 3 subprojects, it had conditions ideal to confirming the effects of the project. In Hangzhou city, there are 4 treatment plants in the city and some discharge their waters into the same river making it difficult to confirm the effects of this project even if the water quality of the river improves. For Jiaxing city, the beneficiary area is expansive and because there is a river network, it is difficult to specify a survey area. In comparison, in Shaoxing city, there are no sewage treatment plants other than the one constructed by this project. In addition, although rivers spread in many areas within the city, the Ring River runs through the center of the city with a residential area in the old-city area with a very long history. The rivers are intimate part of the residents' living and it is an area where improvements in water quality will lead to changes in living environments.

Table 7 Beneficiary Survey Targets

Gender	Male	64%
	Female	36%
Age	20 - 29	21%
	30 -39	36%
	40 - 49	30%
	50 - 59	9%
	60 and older	4%

(1) Changes in living environments

The percentage of respondents who responded that the changes in water quality of the rivers after implementing the project gave “a positive effect on living environment” was 81%. To be more specific, 84% responded “Scenery has improved”, 63% responded “There is no more foul odor”, and 60% responded that “We can now enjoy the waterfront”. Comparing the figures for before and after project implementation, the percentage of people who use the river has increased from 72% to 90%, and in particular, the percentage of people who enjoy walks along the river increased from 48% to 83%. In response to the question of what effect the improvement of river water quality has had other than living environment, 86% responded “Improvement of sanitary environment” and 37% also responded “Control of groundwater pollution”. From this, we can see that the improvement of river water quality directly relates to changes in living environment.

(2) Changes in livelihoods from sewer connections

The percentage of households that did not have sewer connections prior to the implementation of the project was 13%. Of the 13%, 77% responded that after being connected to the sewage system “The area around that house has become more sanitary”, 62% responded that “We have a toilet in the house now” as well as “There is less flooding around the house when it rains”. A further 38% responded that “There is no foul odor any more”. There were 54% of respondents that said that they are “Extremely satisfied” with the sewer connections and 46% responded that they are “Mostly satisfied”. Although the cases of new connections to the sewage system through the implementation of the project were not many in number, satisfaction was very high and it can be determined that this has had a positive effect on livelihoods.

(3) Awareness of water quality improvement measures

The percentage of people who responded that they are “Aware” or “Somewhat aware” that the Shaoxing city government was implementing water quality improvement measures was 71%. Awareness and evaluation of water quality improvement measures were high, with 84% being satisfied with these measures.

3.4.2 Other Impacts

(1) Impact on the natural environment

Measures against odors and noise that were planned for all subprojects at the time of appraisal were being taken and we did not find any particular problems at the project locations. The Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plants are located away from residential areas and there are no problems with odor or noise. At the Jiaxing Sewage Treatment Plant, additional measures such as placing covers over the entire sewage storage pool, where odors can easily occur, as well as bio-deodorizing are being taken.

In regards to sludge treatment, we confirmed that sludge of the Hangzhou Sewage Treatment Plant, is dehydrated using the sludge thickener and dehydrator unit and then disposed at a landfill site as originally planned. By the use of most advanced sludge treatment technologies hardly in use by other plants in China, 100% recycling and reuse of the sludge has been achieved since 2009 at the Jiaxing Sewage Treatment Plant and since 2008 at the Shaoxing Sewage Treatment Plant.

At the Jiaxing Sewage Treatment Plant, approximately 400 tons per day of dehydrated sludge is made harmless and converted to resources by the "sludge centralized drying and mix-incineration method." The sludge is transported by truck to the Jiaxing Xiuzhou, Thermal Power Plant where after drying together with sludge from other sources, it is mixed with coal and incinerated. The residue is sold to cement companies. Depending on the dehydration method, at the current stage the moisture content of the sludge is either 60% or 82% and the higher the moisture content, the higher the cost required for reuse. Because of this efforts are being made to realize a sludge treatment method that is economical, safe and reliable. In addition, possibilities were explored to introduce a technology for recovery of phosphorus from sludge incineration ash from a local government or a private company in Japan, but this has not moved forward.

At the Shaoxing Sewage Treatment Plant, sludge is dehydrated and is temporarily deposited at a location within the plant premises protected by measures to prevent uncontrolled release. Leachate of the temporary deposit is mixed with rainwater, re-treated at the treatment plant and then discharged. The dehydrated sludge is burned as fuel at the Central Energy Development Co., Ltd, which is located near the treatment plant. Some of the residue is used as material for cement.

Fig. 12 Sludge with 60% moisture content
(Jiaxing Sewage Treatment Plant)

Fig. 13 Mixture of dehydrated sludge and coal
(Jiaxing New Jies Thermal Power Plant)

In 2009 in China, the "Technical Guideline of Sludge Treatment and Disposal for Municipal Wastewater Treatment Plant" was issued a part of the National Environmental Protection Standards. It mandated the realization of reducing the volume of sludge, stabilizing, detoxifying as well as the total re-use of sludge. However, in order to realize such sludge disposal, there are many issues regarding sludge treatment facility construction costs, sludge treatment costs, treatment technology and sludge treatment guidelines and regulations. With this in mind, the sludge treatment methods started at the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant are expected to be model examples of sludge dehydration and incineration procedures. Both are efficient and simple methods that combine dehydration and electricity generation through incineration, and require few facilities. Maintenance is easy and relatively low cost at 100 to 120 Yuna per ton. In terms of the environment, there is no dust or odors, and little noise. At the Jiaxing sewage treatment plant, research is currently being conducted on reducing the moisture content of dehydrated sludge as well as on other recycling methods. It is expected to play an advanced role in the Chinese sewage treatment industry.

(2) Relocation of residents, acquisition of land

For the Hangzhou Sewage Treatment Plant, 44 hectares of land was acquired as planned, and 11 households, 57 residents in total, were relocated. According to the executing agency, relocation procedures were duly conducted based on the Land Administration Law of China. At the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment plant, the land area acquired has changed along with the increase/decrease in outputs. For the Jiaxing Sewage Treatment Plant, the planned area was 21.9 hectares but the actual acquired land was 30.96 hectares. For the Shaoxing Sewage Treatment Plant, the planned area was

67.2 hectares, but the actual acquired land was 43.2 hectares. No residents were relocated for these two plants.

As noted above, the construction of sewage treatment facilities in Shaoxing has improved the water quality of the river network in the treatment area, which has in turn led to an improvement in the livelihoods of the residents. Although this also depends on how close the relationship between the lives of the residents and the rivers is, we can at the least say that we can assume the same positive impact was felt in Jiaxing as well, where an improvement in the water quality of the rivers in the city were confirmed. The executing agency has evaluated this subproject as having a substantial contribution on city construction in the Jiaxing, a city that aims to become a national environmental city, a national sanitary city, and an environment-friendly city by attracting foreign companies. The beneficiaries of this project were estimated to be 1.76 million people[30] in 2009 and can be said to have a certain degree of positive impact as a project as a whole.

3.5 Sustainability (Rating:③)

Although there have been no changes in the organization of the executing agency or the project as a whole as of the time of ex-post evaluation, there were changes in the implementing agencies. Evaluation of sustainability was mainly based on the implementing agencies that are currently operating, maintaining and managing the subprojects.

3.5.1 Structural Aspects of Operation and Maintenance

(1) Overall structure

The Zhejiang Provincial People's Government oversees the entire project and the operation and maintenance of the three subprojects are implemented by each implementing agency under the jurisdiction of the Hangzhou, Jiaxing, and Shaoxing Municipal People's Governments. The point of contact for the Zhejiang Provincial People's Government was the Urban-Rural Development Bureau, Finance Bureau was in charge of financial monitoring, and the Environmental Protection Bureau was responsible for environmental aspects. However, because the Environmental Protection Bureau was not involved in this project from the time of appraisal, it is not involved in the management of the yen loan project effects, or the monitoring of operations maintenance management.

(2) Implementing agency of each subproject

1) Hangzhou Sewage Treatment Plant

[30]Calculated from the daily volume of water used per person in each city as well as daily domestic wastewater treatment volume. Hangzhou Sewage Treatment Plant 490,000 people, Jiaxing Sewage Treatment Plant 850,000 people, Shaoxing Sewage Treatment Plant 420,000 people.

Although the Hangzhou Sewage Discharge Corporation[31] was the implementing agency until 2006, that year, the Hangzhou government decided to transfer some plants, including the yen loan portion of the Hangzhou Sewage Treatment Plant, from the urban management office that was conducting financial management at the time, to a private organization. As a result of international bidding the Tianjin Capital Environmental Protection Group Co., Ltd. acquired the special operating permits[32] for 25 years under the Transfer-Operate-Transfer (TOT) scheme. A merger in April of 2006 with the Hangzhou Urban Construction & Investment Group Co., Ltd. established the Hangzhou Capital Water Company Limited, the implementing agency[33]. As the management organization for the public aspects of sewer operations, the Hangzhou Sewage Discharge Corporation concluded a sewage treatment service contract with Hangzhou Capital Water Company Limited and implements the monitoring and control of sewer operations.

The Hangzhou Capital Water Company Limited consists of one office, four departments and 100 employees. It is a subsidiary of the Tianjin Capital Environmental Protection Group Co., Ltd., a publicly traded company with experience in sewage treatment in Tianjin. Monitoring of treated water is conducted through measurements of collected samples, and 24-hour, automatic online water quality inspection equipment, the results of which are sent to the provincial environmental protection bureau. The Zhejiang Environmental Protection Bureau and the Hangzhou Environmental Protection Bureau conduct regular and unscheduled water quality inspections and there are no problems in structure.

2) Jiaxing Sewage Treatment Plant

The implementing agency for the Jiaxing Sewage Treatment Plant is the government-owned Jiaxing United Sewage Treatment Co., Ltd, which has one office, seven departments, one sewage treatment plant and 90 employees. The investor is the Jiaxing Water Resources Investment Group Co., Ltd.[34] and the ratio for the 12 counties, districts and the Nanhu Changyuan Sewage Co., Ltd., is 51%, 47.64% and 11.36% respectively. The Jiaxing United Sewage Treatment Co., Ltd. acquired Quality Management Standard ISO9001 certification and Environmental Management Standard ISO14001 certification in February 2001 and is working towards a well-developed internal management structure.

In addition to treated water monitoring being conducted within the treatment facility, the Jiaxing Environmental Protection Bureau, Zhejiang Environmental Protection Bureau and the Ministry of Environmental Protection of the People's Republic of China also conducts

[31] A government-owned company with 100% investment from Hangzhou Urban Construction & Investment Group co., Ltd. which conducts monitoring of sewage treatment. Also conducts operation and maintenance of the Sipu Sewage Treatment Plant in Hangzhou city.
[32] For the 25 years of the special permit period, operates the sewage treatment plant, and after the special permit period ends, hands over the properly operating plant without charge to the urban management office or a specified organization.
[33] Investment ratio is 7 to 3.
[34] A government owned company with 100% investment from Jiaxing State Assets Administrative Committee.

regular and unscheduled inflow and treated water quality inspections. The automatic online water quality inspection equipment measures eight items and sends the results to the provincial environmental protection bureau.

3) Shaoxing Sewage Treatment Plant

At the time of appraisal, the implementing agency was the Shaoxing Environmental Protection and Development Co., Ltd. a public company which the Jiexing Sewage Engineering Administration Department had invested 85% and the Prefectural Environmental Protection Industrial Development Co., Ltd. and Xianlv Industry Co., Ltd. had invested 15%. In November of 2001, soon after the appraisal, Jiexing Sewage Engineering Administration Department had been divided into the Shaoxing Water Discharge Company and the Shaoxing Water Treatment Development Group Co., Ltd. and the Shaoxing Water Treatment Development Group Co., Ltd. was in charge of the operation and maintenance of the sewage treatment plants. This company is a partnership between the Shaoxing City Water Group Co., Ltd. (40%) and the Shaoxing County Water Group Co., Ltd. (60%) with 16 departments and 319 employees. It is one of the largest sewage treatment plants in China and in 2004, it was evaluated as one of the top 10 sewage treatment plants in regards to operational quality management in China, and there are no problems in structure.

Monitoring of treated water is conducted by collecting samples in the treatment plant and measuring the sample. The results are reported to the Shaoxing County Environmental Protection Bureau, the Shaoxing City Environmental Protection Bureau the Shaoxing County Water Group Co., Ltd., the Shoaxing City Water Group Co., Ltd. and the Zhejiang Urban-Rural Development Bureau. In addition, regular and unscheduled water quality inspections are conducted by the Shaoxing County Environmental Protection Bureau (monthly), the Shaoxing City Environmental Protection Water Bureau (six times a year), and the Zhejiang Environmental Protection Bureau (four times a year).

3.5.2 Technical Aspects of Operation and Maintenance

At the Hangzhou Sewage Treatment Plant, a lot of the employees are experience personnel who were transferred there from the Hangzhou Sewage Discharge Corporation. Of the 48 employees in the maintenance management department, approximately 70% are technical specialists and there are no technical problems. At the Jiaxing Sewage Treatment as well, the persons in charge have an average of 17 years of job experience and workers with a certain level of technical skill perform maintenance management operations. At the Shaoxing Sewage Treatment Plant, of the 43 employees in the maintenance management department, 51% are holders of technical certifications, and the ratio of relatively young workers is high with an average job experience of 11 years. In addition to

matching the technical levels of the operations with the employees, appropriate maintenance management is being implemented through internal and external training programs.

As can be seen, technical evaluation standards have been set for operations and maintenance management for all subprojects, and employees that meet these standards are being employed at the sites. There are training and evaluation standards in order to increase knowledge on maintenance management operations and to improve technical skills, and we determine that there are no problems.

3.5.3 Financial Aspects of Operation and Maintenance

1) Hangzhou Sewage Treatment Plant

Although were not able to obtain financial data from the Hangzhou Capital Water Company Limited, we believe that there are no major financial problems based on the following reasons. The main source of capital for the Hangzhou Capital Water Company Limited are contributions from the Tianjin Water Discharge Corporation, a government owned company and it is also the beneficiary of a preferential taxation system such as in real estate taxes and land usage taxes. The sewage treatment service contract concluded between the Hangzhou Water Discharge Corporation and the Hangzhou Capital Water Company Limited provides for payment of compensation based on the treated water volume that meets standards. The contract rate is assessed every year based on the maintenance management costs of the treatment plant. At the time of evaluation, the maintenance management cost was 0.8 Yuna per cubic meter and the contract rate slightly exceeded this.

Although loans are to be paid back from the Hangzhou Capital Water Company via the Hangzhou city government and the Zhejiang provincial government, the flow of yen loans for the subprojects mean that the re-lending contractor is the Hangzhou city government and the loans are protected by government guarantees.

2) Jiaxing Sewage Treatment Plant

Table 8 shows the 2006 to 2008 financial indicators for the Jiaxing United Sewage Treatment Co., Ltd. Net profit to sales and return on capital are both negative with accumulated losses for 2009 being 12.6 million Yuna. The sewage treatment rates are 0.9 Yuna per cubic meter for households, 1.7 Yuna per cubic meter for commercial users, and 2 to 2.4 Yuna per cubic meter for industrial use. All are around the same or higher than that set at the time of appraisal. However, a centralized sewage treatment contract was concluded between the company and the urban sewer network companies in 12 counties and districts that manage the sewer network and profit distribution to the Jiaxing United Sewage Treatment Co., Ltd. is fixed at 70%. The reasons for the negative profit ratio

include: the fact that this is lower than the operational costs and the fact that management and financial costs account for over 20% of the sales. According to the implementing agency, an approximately 30% increase in sewage treatment rates were planned in 2011 and losses to be stemmed after the rate increase. Due to the fact that operational efforts are being made to cut costs and the fact that it is a government-owned publicly traded company with a high public nature, we believe that there are no major obstacles in sustainability. There is still a need to keep a careful eye on the plant going forward.

Table 8 Financial indicators of the Jiaxing United Sewage Treatment Co., Ltd.

	2006	2007	2008	2009
Return on assets (%)	-0.7%	-1.8%	-2.7%	-0.7%
Gross margin ratio (%)	7.4%	6.0%	12.9%	12.3%
Net margin ratio (%)	-11.4%	-20.8%	-33.2%	-10.1%
Total asset turnover (times	0.06	0.09	0.08	0.07
Current ratio (%)	550.3%	207.1%	112.7%	193.6%
Equity ratio (%)	43.6%	32.2%	23.5%	19.4%
Cashflow (Yuan)	94,151,214	148,538,720	178,065,484	267,201,855

Source: Jiaxing Water Resources Investment Group Co., Ltd.

3) Shaoxing Sewage Treatment Plant

Although sales for the Shaoxing Water Treatment Development Co., Ltd. are increasing annually, net profit to sales have been negative since 2008. The sewage treatment rates for Shaoxing city in 2010 were 0.5 Yuna per cubic meter for households, 1.5 Yuna per cubic meter for commercial users, and 1.8 Yuna per cubic meter for industrial use. These are relatively lower when compared to other cities. In addition the income distribution between the Shaoxing County Water Discharge Corporation which operates and manages the sewer lines and pumping stations and the Shaoxing Water Treatment Development Co., Ltd. is 4 to 6. Reasons for the negative numbers are the fact that this is lower than operating costs and the fact that the management and financial costs are high. Capital ratio is 18.5% (2010) and current ratio is less than 100%, and therefore mid- and long-term stability as well as solvency is considered low. However, the sewage treatment rates in Shaoxing were changed in December of 2008 and the fact that industrial rates will increase to 3 Yuna per cubic meter and the possibility of the distribution ratio with the discharge corporation being changed from 4:6 to 3.5:6.5 are positive factors from the financial perspective. When considering the public nature of the sewage treatment, it is hard to think that there will be any major problems with the sustainability of this project.

The government aims for the soundness and profitability of the sewage treatment project, and there is no compensation from the government and going forward, reduction in maintenance management costs through more efficient operations within the sewage

treatment plant is required.

Table 9 Financial indicators of the Shaoxing Water Treatment Development Group Co., Ltd.

	2007	2008	2009
Return on assets (%)	0.5%	-2.6%	-1.3%
Gross margin ratio (%)	15.9%	9.8%	19.3%
Net margin ratio (%)	1.7%	-13.3%	-5.5%
Total asset turnover (times)	0.29	0.19	0.23
Current ratio (%)	101.2%	88.6%	66.3%
Equity ratio (%)	19.6%	8.7%	7.5%
Cashflow (Yuan)	69,941,668	78,494,686	83,883,925

Source: Shaoxing Water Treatment Development Group

3.5.4 Current Status of Operation and Maintenance

Although we see issues such as ageing and corrosion in some of the facilities, maintenance and repairs have been strengthened and appropriate upgrading plans have been established and there are no major obstacles. Specifically, every implementing agency has evaluated the status of operations and maintenance as being good and we have confirmed through facility inspections that appropriate operations and maintenance is being conducted.

In light of the above, despite the weak finances of the implementing agencies of the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant, because there are improvement factors at the time of evaluation, the high public nature of the sewage treatment project and the fair reassessment of rates going forward, we cannot say that there are major problems with sustainability. No major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In order to achieve its environmental protection objectives, the Chinese government placed top priority on water contamination measures and urban environment measures and implemented various efforts to accomplish these measures. This project is part of these measures and was implemented in the cities of Hangzhou, Jiaxing and Shaoxing in Zhejiang Province, where industrialization and urbanization were progressing rapidly. Hangzhou and Jiaxing were designated as watershed cities of Lake Tai, where pollution is becoming increasingly serious. Shaoxing being a city of history culture was designated as a national priority tourist destination. Thus, all three cities had the highest need and priority for this project which aimed to improve the water quality in rivers by constructing a central sewage treatment facility.

The Hangzhou Sewage Treatment Plant as the wastewater treatment facility for the city's economic development zone, and the Jiaxing Sewage Treatment Plant and the Shaoxing Sewage Treatment Plant being the sole sewage treatment plants in their respective cities, all play a vital role in the sewage treatment of each city. Facility utilization for each is high and the treated water meets standards. The plants are contributing to the improvement of the water quality of the rivers in these cities as well as the living environments of nearby residents. Although there are some financial issues for the implementing agencies for each plant, they have no effect on the sustainability of the project effect.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In the management of a JICA yen loan project, it is expected that the project effects be monitored on a continual basis as an element of project operation and management even after the completion of the project. While the executing agency of this project has not been officially requested to monitor the project effects, the executing agency and implementing agencies are well-advised to monitor by themselves not only the project effects at the treatment plants but also the effects on water quality of the rivers concerned. It is hoped that all the agencies involved soon agree on an organizational structure necessary to enable either data acquisition from the competent environmental bureaus of their cities, or otherwise collect alternatively reliable data.

4.2.2 Recommendation to JICA

At the Jiaxing Sewage Treatment Plant and Shaoxing Sewage Treatment Plant, reuse and detoxification treatment of dehydrated sludge for use as fuel at thermal power plants has

already started and it has progressed to the stage where it can almost be used as a model for sludge dehydration and incineration processes. On the other hand, lowering of the moisture content of the sludge has become an issue.

In Zhejiang, the effort target is to incinerate 80% of the sludge, and going forward, technology and know-how will be required in order to recycle resources in a stable manner and at low cost in order to decrease the volume, stabilize and detoxify sludge. Sludge treatment is an area where the superiority of Japanese technology is expected to be able to contribute to, and it is hoped that indirect support will be provided to the sustaining and development of the field based on the JICA's efforts in the sludge treatment field to date.

4.3 Lessons Learned

This project was implemented using three subprojects with the objective of "The improvement of water quality in the rivers in the city and Lake Tai". However, in regards to the project objective of "Improving the water quality of Lake Tai", there was a divergence between the project implementation and the project objective. Taking into consideration the conditions at the time of the appraisal, one interpretation of the planned project concept may be "multiple subprojects with a common objective." Another interpretation would be that the project was planned as a sort of sector assistance project, as requested by the Chinese side, consisting of subprojects designed to achieve the higher goal of "Improving river water quality." If the former interpretation holds, concrete project objectives should have been defined when laying out the project plans and subprojects selection should have been made and their respective targets set in realistic and appropriate manners with full attention to their rationale to the defined project objective. If the latter interpretation holds, plans should have been laid out so that the effects of each subproject can be quantitatively grasped to the best extent possible. Either way, in order for JICA to perform consistent, coherent project management, it is essential to set appropriate and specific targets, as well as to explain and share these project targets with the associated persons of the recipient country already from the project appraisal stage.

End

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Ouput		
1. Hangzhou Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day	(1)As planned
	(2)Sewer pipe extension 25km	(2)Sewer pipe extension 18.3km
2. Jiaxing Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day	(1)As planned
	(2)Sewer pipe extension 110km	(2)Sewer pipe extension 136.76km (Initial plan length 92.36km, additional 44.4km)
	(3)15 pumping stations	(3)18 pumping stations (Initial planned amount 14, additional 4)
3. Shaoxing Sewage Treatment Plant construction	(1)Inflow volume 300,000 tons/day	(1)As planned
	(2)Sewer pipe extension 16km	(2)Canceled
	(3)4 pumping stations	(3)Canceled
(2) Project Period	March, 2000 – December, 2000 (46 months)	March, 2000 – January, 2010 (119 months)
(3)Project Cost		
Amount paid in Foreign currency	11,256 million yen	11,204 million yen
Amount paid in Local currency	21,825 million yen (1,445 million Yuna)	23,763 million yen (1,694 million Yuna)
Total	33,081 million yen	35,967 million yen
Japanese ODA loan portion	11,256 million yen	11,204 million yen
Exchange rate	1 Yuna＝15 yen (As of March, 2000)	Hangzhou Sewage Treatment Plant 1 Yuna=13.95 yen

		(1999 – 2004 average) Jiaxing Sewage Treatment Plant 1 Yuna=14.01 yen (1999 – 2010 average) Shaoxing Sewage Treatment Plant 1 Yuna=14.15 yen (1999 – 2002 average)