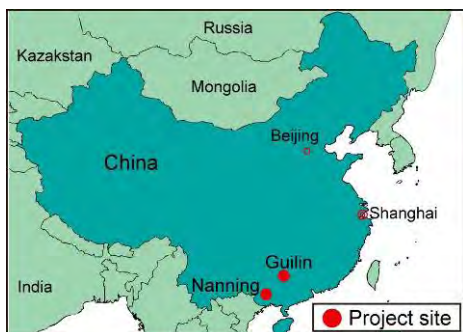


People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project  
Guangxi Water Supply Project

Junko Miura, Sanshu Engineering Consultant

**1. Project Description**



Location of Project Site



Nanning City Sanjin Water Plant  
Sedimentation Pond

**1.1 Background**

Under China's reform and open-door policies which commenced in 1979, construction and improvement of the waterworks facilities, especially in large cities along the coastal regions, have been implemented as part of actions to improve the investment environment for attracting enterprises. The average water usage per person in 2000 was 214ℓ/day in urban areas, and reached the same level (200 to 250ℓ/day) as that of Japan in 2000. The coverage of the water supply system in urban areas has been steadily improving at the rates of 81% in 1985, 89% in 1990, and 96% in 1998. On the other hand, following the rapid economic development in the coastal areas, inland's medium to large cities have been suffering from the water supply and demand gap caused by the rapid increase of water demand as a result of rapid industrialization and urbanization which started in mid 1990s.

The Guangxi Zhuangzu Autonomous Region (equivalent to 60% of the area of Japan) is located in the south of China, next to Vietnam. The region's economic development had been far behind the other coastal provinces of China until the China-Vietnam diplomatic relationship was normalized. However, the region's annual GDP growth rate in the 1990s exceeded 20%. Its average living water usage per capita in 2000 was 300ℓ /day, which was far beyond the national average of 214 ℓ /day. Because of its mild climate, most households have shower booths, resulting in high water demand particularly in the hot season (from May to November).

Meanwhile, Nanning, Guilin, Guigang, Hezhou, four out of ten major cities in the Guangxi Zhuangzu Autonomous Region faced water shortfall in 1998. There was an urgent need to increase water supply capacity in the region's capital city of Nanning because it has the largest population in the region. The water supply capacity in Guilin also needs to be increased because it is an international sightseeing city.

## 1.2 Project Outline

The objective of this project is to respond to the shortage in water supply and the increasing water demand, as well as to provide safe and stable water supply, in Nanning and Guilin cities by constructing a water supply system with capacity of 300,000 m<sup>3</sup> per day (200,000 m<sup>3</sup> in Nanning and 100,000 m<sup>3</sup> in Guilin), thereby contributing to the improvement of living and sanitary environment of the local residents and development of region's economy. The location of the project site is shown in Figure 1 and 2.

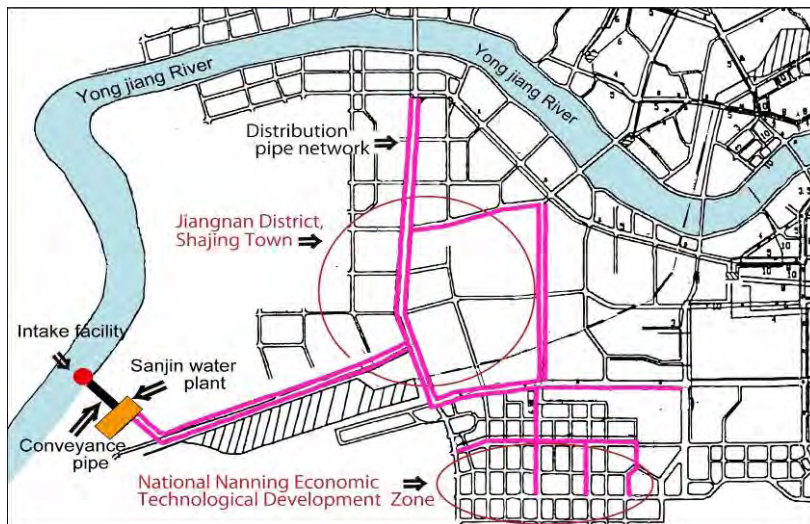


Figure 1 : Location of Project Site (Nanning City)

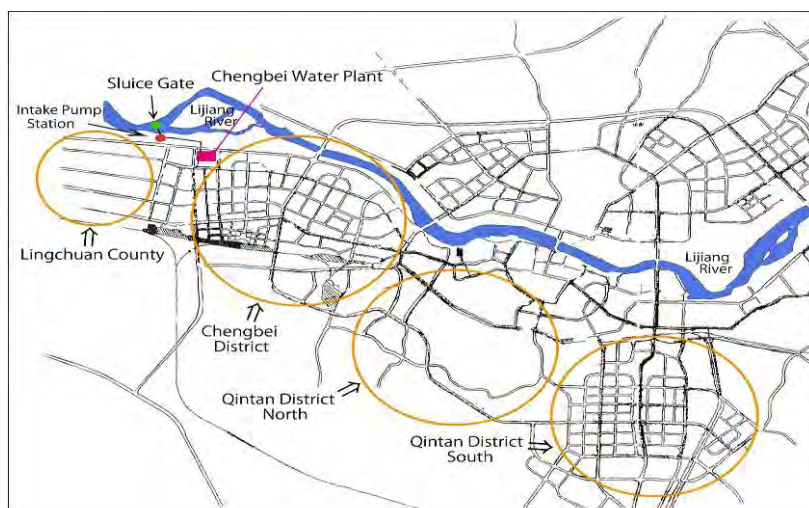


Figure 2 : Location of Project Site (Guilin City)

Approved Amount / Disbursed Amount	3,641million yen/ 3,630million yen
Exchange of Notes Date / Loan Agreement Signing Date	March, 2000/March 2000
Terms and Conditions	Interest Rate: 1.7%; Repayment Period: 30years (Grace Period: 10years); Conditions for Procurement: General Untied
Borrower / Executing Agency	July 2005
Final Disbursement Date	The Government of the People's Republic of China / Guangxi Zhuangzu Autonomous Region People's Government
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million yen)	None
Feasibility Study, etc.	F/S by Central and Southern China Municipal Engineering Design and Research Institute (Nanning: July 1999, Guilin: January 1998)

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Junko Miura, Sanshu Engineering Consultant

### 2.2 Duration of Evaluation Study

Duration of the Study :November, 2009 to August, 2010

Duration of the Field Study : January, 3rd to 11th, 2010 and April 11th to 19th, 2010

### 2.3 Constraints during the Evaluation Study

No particular constraints.

### **3. Results of the Evaluation (Overall Rating: A)**

#### **3.1 Relevance (Rating: a)**

##### **3.1.1 Relevance with the Development Policy of China**

Since the mid 1990s, China has been suffering from water supply and demand gap (industrial water, daily life water and others) caused by the rapid industrialization and urbanization. As a result, it was determined that the capacity of water supply facilities needs to be enhanced. In addition, there were issues of contamination in the water source from the river, as well as low water table level, therefore requiring for better water sources and water conservation measures. Consequently, it was noted in China's 9th Five-Year Development Plan (1996-2000) that the waterworks infrastructure in rural cities was the most essential agenda, thereby setting the following specific objectives: (a) increase in the nationwide water supply by 40 million m<sup>3</sup>/day; (b) raise accessibility ratio to portable water in urban areas to 96%; and (c) increase average water supply per person by 40ℓ/day during the planned period. The current 11th Five-Year Development Plan (2006-2010) gives priority to the enforcement of control and conservation of sources for drinking water and increase of water supply facilities.

The objective of the 9<sup>th</sup> Nanning Five-Year Plan (1996-2000) was to enhance the water supply capacity to 1,140,000 m<sup>3</sup>/day by 2000. In order to achieve this objective, the construction of Sanjin Water Plant was selected as one of the four new projects. In the current 11<sup>th</sup> Five-Year Plan (2006-2010), priority is continuously given to the development of the water supply system. The plans are to increase the water supply capacity to 1,400,000 m<sup>3</sup>/day by 2010 and achieve 100% of the population served.

The objective of the 9<sup>th</sup> Guilin Five-Year Plan (1996-2000) was to enhance the water supply capacity to 550,000 m<sup>3</sup>/day and achieve 100% of population served in the urban area by 2000. In order to achieve this objective, the city planned to enhance its water treatment capacity through new construction and expansion of plants with a water supply capacity of 210,000 m<sup>3</sup>/day. In the current 11<sup>th</sup> Five-Year Plan (2006-2010), priority is continuously given to the development of water supply system. It is targeting to increase the water supply capacity to 1,040,000 m<sup>3</sup>/day by 2010.

##### **3.1.2 Relevance with the Development Needs of China**

In Nanning City, there were five water plants with a total capacity of 840,000 m<sup>3</sup>/day at the time of appraisal in 2000. However, three out of five water plants have been utilized over 30 years, making the facilities outdated. As a result, production cost was high. In addition, the density of

existing distribution pipes was low and the diameter of the pipes was small, which resulted in inefficient water supply. Furthermore, because there was no water pipe near Nanning South Station (Jiangnan District, Shajing Town) of Nankun Railway<sup>3</sup>, which made it impossible to provide water to the newly developed area along the railway. Along with the economic development and rise in population served, it was estimated that there would be water shortfall of 145,000 m<sup>3</sup>/day in 2000. In addition, a part of the project target area was designated as the National Nanning Economic Technological Development Zone in 2001. For these reasons, water demand remained high at the ex-post evaluation.

In Guilin City, there were four water plants with a total capacity of 325,000 m<sup>3</sup>/day<sup>4</sup> at the time of appraisal in 2000. However, the density of existing distribution pipes was low, which resulted in inefficient water supply. In addition, water quantity and pressure were not sufficient in some areas. It was estimated that water supply would not meet the increasing water demand along with the rise in population<sup>5</sup>. In particular, Chengbei and Qintan Districts, where railway and residences were expected to be developed, were located far away from the city center. Therefore, it was crucial to increase the water treatment capacity and to connect new distribution pipes. At the time of ex-post evaluation, Chengbei and Qintan Districts were developing as commercial and residential areas and a part of Lingchuan County was rapidly developing as Balijie Economic Development Zone. Along with the increase in population served, water demand remained high.

### **3.1.3 Relevance with Japan's ODA Policy**

According to the Overseas Economic Cooperation Implementation Policy (December, 1999), the Japanese aid policy towards China focused on the development of economic and social infrastructure which would promote self-motivating economic development. Thus, the project is consistent with Japanese aid policy at the time of appraisal.

This project has been highly relevant with the China's development plan, development needs, as well as Japan's ODA policies, therefore its relevance is high.

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3 Nankun Railway, which opened in 1997, is the major railway with the total of 828 km between Nanning City and Kunming City of Yunnan Province.

4 The four water plants with the total of 315,000m<sup>3</sup>/day (Guilin Water Supply Company) and one water plant with a total of 10,000 m<sup>3</sup>/day (Lingchuan County Water Supply Company).

5 40,000m<sup>3</sup>/day shortfall was estimated for 2000.

### 3.2 Efficiency (Rating: b)

#### 3.2.1 Project Outputs

Facilities were constructed as scheduled, except for the extension of the conveyance pipe. The conveyance pipe was extended due to the relocation of the construction site of Sanjin Water Plant in Nanning City by 3km towards east. The ground level of the initially planned construction site proved to be too low. The scope of this project for the two plants is summarized in Table 1 and the scope for each plant is summarized in Table 2.

Table 1 : Output (Total of two water plants) (Planned and actual)

Facilities	Planned	Actual
Water intake	Sluice gate, intake pipes, water intake pump stations, Capacity: 400,000 m <sup>3</sup> /day	As planned
Water conveyance	Conveyance pipes: approximately 2.5km	Approximately 5.3km (+2.8km)
Water purification	Flocculation basin, sedimentation basin, and filtration pond. Capacity: 300,000 m <sup>3</sup> /day	As planned
Water distribution	Distribution pipes: approximately 52km	As planned <sup>6</sup>

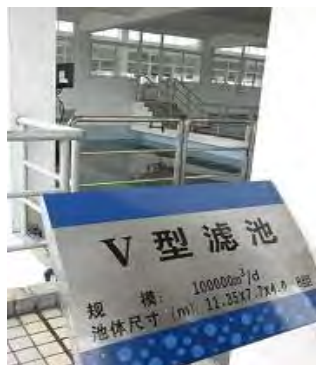
Source: JICA appraisal documents, Responses to the questionnaire

Table 2 : Output (each water plant) (Planned and actual)

Water Plant	Intake (10,000 m <sup>3</sup> /day)		Conveyance (km)		Purification (10,000 m <sup>3</sup> /day)		Distribution (km)	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Nanning	20	20	Approx. 1	Approx. 4	20	20	Approx. 27	Approx. 27
Guilin	20	20	Approx. 1.5	Approx. 1.3	10	10	Approx. 25	Approx. 25
Total	40	40	Approx. 2.5	Approx. 5.3	30	30	Approx. 52	Approx. 52

Source: JICA appraisal documents, Responses to the questionnaire

<sup>6</sup> In the JICA appraisal document, it was mentioned that distribution pipe with small-diameter was planned to be installed with the local currency in addition to 52km (which was installed with foreign currency). But, the planned length of small-diameter pipe was not mentioned. At the time of ex-post evaluation, the extension of pipe between DN300-500 was 27km in Nanning City and 25km in Guilin City. Thus, the total distribution pipe including small-diameter pipe was 54km in Nanning City and 50km in Guilin City, 104km in total.



Guilin Chengbei Water Plant  
Filtration Pond



Nanning Sanjin Water Plant  
Flocculation Pond



Guilin Chengbei Water Plant  
Pumps for transmission

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Period

The project period took longer than planned. The planned project period at appraisal was from March 2000 (Loan Agreement signing) to June 2004 (completion of the project), for a total of 52 months. The actual period was from March 2000 (Loan Agreement signing) to August 2005 (commencement of water supply)<sup>7</sup>, for a total of 66 months (127% of the planned period). The reasons for the delay are described below:

Nanning City: Due to the relocation of the construction site of the water plant, the time spent on negotiation between some villagers and the implementation agency regarding compensation for crops and the price of land resulted in the delay of the civil work.

Guilin City: The civil work was delayed due to the following reasons: 1) the agreement between the implementing agency (Guangxi Zhuangzu Autonomous Region) and Guilin Municipal People's Government regarding the project implementation was behind schedule, and 2) the decision by the Department of Road regarding the altitude of the newly constructed road where distribution pipes were planned to be installed was late.

However, the period of civil work was ahead of schedule. The planned duration for civil work was 45 months for Nanning City and 57 months for Guilin City. The actual period was 40 months for Nanning City and 44 months for Guilin City. Relevant parties in both cities attempted to minimize the impact of the delay in civil work. This was possible because the Project Management Offices (PMOs) in both water supply companies (consisting of 10-16 members from construction, facility/equipment, and finance sections) accelerated the process of

<sup>7</sup> According to the JICA appraisal document, the definition of the project completion is the commencement of operation of the two water plants. After the test run of the two water plants, 1) water was supplied to users, 2) water charges were collected for the water from the two water plants. Therefore, in this project, the date of the test-run is the commencement of operation.

civil work and conducted coordination between the progress of the civil work and procurement (See Lessons Learned).

### **3.2.2.2 Project Cost**

The total project cost estimated at appraisal was 7,268 million yen (of which the Japanese ODA loan amount was 3,641 million yen and the rest was to be locally funded). The actual total project cost was 7,527 million yen (of which the Japanese ODA loan amount was 3,630 million yen and the rest was locally funded), which slightly exceeded the planned cost (104% of the planned amount). The cost increase for both Nanning and Guilin City was due to escalation of materials (steel pipes, cast-iron pipes, cement, etc.) and labor costs.

In this project, similar to other projects in China, the equipment was procured through International Competitive Bidding (ICB), and a procurement agent conducted the bidding procedures in coordination with the O&M agencies in the two cities<sup>8</sup>. There were two reasons why the total project cost remained at as low as 104% despite the sharp rise in construction materials and labor costs. First, before the agent prepared the bidding document, both O&M agencies in the two cities conducted a study on detail specification based on the Detail Design considering the approved loan amount (for facilities/equipment) and informed the procurement agent of the detail specification. Second, before the procurement agent prepared the bidding document, it conducted the following: 1) a full market research based on the detail specification provided by the O&M agencies; 2) identification of the facility/equipment which requires higher performance and more budget among all the required items; and 3) decision of the final specification of the facility/equipment (See lessons learned).

Both project period and project cost exceeded the plan, therefore efficiency of the project is fair.

## **3.3 Effectiveness (Rating: a)**

### **3.3.1 Quantitative Effects**

#### **3.3.1.1 Results from Operation and Effect Indicators**

##### **(1) Solving water supply capacity shortage and meeting water demand**

The estimated and actual population served, water supply capacity and water demand in Nanning City (City and suburbs) is summarized in Table 3. The actual population served exceeded the planned figure during the first and second year after the project completion.

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<sup>8</sup> Guangxi Zhuangzu Autonomous Region People's Government was the project's implementing agency. However, the O&M agencies (water supply companies) of Nanning City and Guilin City conducted a study of detail specification based on the Detailed Design in coordination with the procurement agent.



The water demand is also continuously increasing. However, the project has increased the supply capacity to a total of 200,000 m<sup>3</sup>/day, which has solved the water supply capacity shortage and met the water demand in the future.

Table 3 : Population served, water demand and supply capacity in Nanning City/suburbs  
(Estimate/Actual)

Indicators (Unit)	1998 Actual	1 year after completion		2 year after completion		3 year after completion	4 year after completion
		2005 Estimate	2006 Actual	2006 Estimate	2007 Actual	2008 Actual	2009 Actual
Population in the area (ten thousand persons) (City + suburbs) (A)	138	180	255	185	260	264	N/A
Population served (ten thousand persons) (B)	108	153	161	158	185	197	N/A
Percentage of population served (%) (C) = (B) / (A)	78	85	63	85	71	75	N/A
Water supply capacity (ten thousand m <sup>3</sup> /day) (D)	84	104 Note 2	114 Note 3	114	114	114	114
Maximum water demand (water supply amount) (10,000 m <sup>3</sup> /day) (E) Note 1	85	117	86 (74% of estimate)	121	89 (74% of estimate)	99	106
Water shortfall (ten thousand m <sup>3</sup> /day) (F) = (D) - (E)	1	13	-28	7	-25	-15	-8

Data source: Baseline and estimate figures are from the JICA appraisal document. Actual figures are from the Answer to the questionnaire. The percentage of population served was not indicated in the JICA appraisal document, thus it was calculated from the population served and the total population.

Note 1: Actual figures are the maximum water supply amount.

Note 2: The total of 20,000 m<sup>3</sup>/day was increased by project completion (Sanjin Water Plant).

Note 3: The total of 20,000 m<sup>3</sup>/day was increased by project completion (Sanjin Water Plant) and the increase of 10,000 m<sup>3</sup>/day is due to the expansion of Chencun Phase II (2006).

The estimated and actual population served, water supply capacity and water demand in Guilin City (City and Lingchuan County) is summarized in Table 4. The actual population served exceeded the planned figure during the third year after project completion<sup>9</sup>. The percentage of population served in the city area reached 100% during the third year after project completion. The project has increased the supply capacity to a total of 100,000 m<sup>3</sup>/day, which has solved the water supply capacity shortage. However, the actual water demand both in Guilin City and Lingchuan County did not reach the estimated level. Thus, there is extra capacity at the time of ex-post evaluation.

<sup>9</sup> The data for actual population served one year after the project completion was not obtained, therefore it was not possible to compare with the estimate.

At the time of appraisal, it was estimated that water supply total of 40,000 m<sup>3</sup>/day would be provided to Lingchuan County after the project completion. However, because Lingchuan County expanded its own water supply capacity, the Chengbei Water Plant was supplying only 10,000 m<sup>3</sup>/day to some parts of Lingchuan Country, such as Balijie Economic Development Zone.

Table 4 : Population served, water demand and supply capacity in Guilin City/Lingchuan County  
(Estimate/Actual)

Indicators (Unit)	1998 Actual	1 year after completion	3 year after completion	4 year after completion
		2005 Estimate	2008 Actual Note3	2009 Actual
Population in the area (thousand persons) (City and Lingchuan County)(A)	645	705	950	NA
Population served (thousand persons) (B)	Guilin City	431	508	600
	Lingchuan County	10	32	30
Percentage of population served in Guilin city area (%) (C) Note 1	92	94	100	NA
Guilin city area + Lingchuan County Water supply capacity (ten thousand m <sup>3</sup> /day) (D)	32.5	46.5	45 Note 4	45
Guilin maximum water demand (water supply amount) (ten thousand m <sup>3</sup> /day) (E)	32.5	42	32 (76% of estimate)	34 (81% of estimate)
Water supply to Lingchuan County (ten thousand m <sup>3</sup> /day) (F) Note 2	1	4	1	1
Guilin City + Lingchan County water shortfall (ten thousand m <sup>3</sup> /day) (G) = (D) - ((E)+(F))	1	-1	-12	-10

Data source: Baseline and estimate figures are from the JICA appraisal document. Actual figures are from the Answer to the questionnaire.

- Note 1: In the JICA appraisal document, the water system coverage was estimated only for Guilin city area (not including Lingchuan County).
- Note 2: Water supply capacity: 10,000 m<sup>3</sup>/day. The estimated figure for 2005 is not the estimated water demand, but the estimated figure based on the water supply amount in 1998.
- Note 3: Because the actual figure as of two year after the project completion was not obtained, the actual figure as of three year after the project completion is shown in the table.
- Note 4: As planned, the total of 100,000 m<sup>3</sup>/day was increased by the completion of this project (Chengbei Water Plant), and the total of 40,000 m<sup>3</sup>/day was increased by the expansion of Chencun Phase II. However, because Bingjiang Dakoujing Water Plant (15,000 m<sup>3</sup>/day, commenced in 1976) was closed in 2002, the water supply capacity in Guilin city area and Lingchuan County is 450,000 m<sup>3</sup>/day upon the project completion.

In order to determine the effect of the project, the average amount and maximum water supply, and facility utilization rate of the two water plants are summarized in Tables 5 and 6, respectively.

The average facility utilization rate during the second year after the project completion (2007) remained at low level: 47% at Sanjin Water Plant and 69% at Chengbei Water Plant.

However, it rose to 61% and 76%, respectively, at the time of ex-post evaluation (2009). These are considered normal compared to the average facility utilization rate in the cities designated by government ordinance in Japan (59%). The national average in Japan is 65%. Meanwhile, the facility utilization rate (maximum) during the second year after project completion (2007) reached 79% in Sanjin Water Plant and 85% in Chengbei Water Plant. It rose to 98% and 104%<sup>10</sup>, respectively, at the time of ex-post evaluation (2009). It is therefore determined that the project facilities are fully utilized.

Table 5 : Daily average and maximum water supply amount and facility utilization rate of Nanning City Sanjin Water Plant (Actual)

Indicators (Unit)	2006	2007 (2 year after completion)	2008	2009
Average water supply (ten thousand m <sup>3</sup> /day)	6.5	9.4	10.4	12.2
Facility utilization rate (average) (%)	33	47	52	61
Maximum water supply (ten thousand m <sup>3</sup> /day)	9.2	15.7	14.1	19.5
Facility utilization rate (maximum) (%)	46	79	71	98

Source: Responses to the questionnaire

Table 6 : Daily average and maximum water supply amount and facility utilization rate of Guilin City Chengbei Water Plant (Actual)

Indicators (Unit)	2006	2007 (2 year after completion)	2008	2009
Average water supply (ten thousand m <sup>3</sup> /day)	6.8	6.9	7.4	7.6
Facility utilization rate (average) (%)	68	69	74	76
Maximum water supply (ten thousand m <sup>3</sup> /day)	7.8	8.5	8.4	10.4
Facility utilization rate (maximum) (%)	78	85	84	104

Source: Responses to the questionnaire

## (2) Stable Supply of Safe Water

### 1) Water quality

The water quality distributed from the water plant meets all the criteria of the national standards (revised in 2006), therefore it is considered appropriate as tap water. Basic items of water quality are monitored at the water quality monitoring rooms in the water plants every day. The national standard of water quality and monitoring results (as of November 2009) are summarized in Table 7.

<sup>10</sup> However, as shown in Table 4, there are extra capacity of 100,000 m<sup>3</sup> in Guilin City and Linchuan Xian. In addition, Chengbei Water Plant has extra land for the expansion of 100,000 m<sup>3</sup> in the same compound with the facility constructed by the project to prepare for the increase of water demand in the future.

Table7 : Monitoring results of water quality of the two water plants

	National standard of water quality (GB5749-2006)	Sanjin Water Plant (Nanning)		Chengbei Water Plant (Guilin)	
		Before treatment	After treatment	Before treatment	After treatment
Ph	$\geq 6.5, < 8.5$	7.71	7.69	7.87	7.66
Turbidity (NTU)	$< 1$	6.6	0.7	2.2	0.3
Smell	None	None	None	None	None
Bacteria count (CFU/ml)	$< 100$	120	0	245,000	2
Coli form count (CFU/100ml)	0	6,400	0	4,600	0
Iron (mg/L)	$< 0.3$	0.14	0	NA	0.1
Manganese (mg/L)	$< 0.1$	$< 0.050$	$< 0.050$	0.010	0.001
Lead (mg/L)	$< 0.2$	0.02	0.02	NA	0.02

Source: Responses to the questionnaire



Water monitoring room at Sanjin Water Plant (Nanning City)



Water monitoring room at Chengbei Water Plant (Guilin City)

## 2) Water Pressure<sup>11</sup>

According to O&M agencies in both cities, the water pressure in the target area is sufficient and stable. According to Guangxi Lucheng Water Supply Company, the average water pressure at the outlet in Sanjin Water Plant is 0.4MPa<sup>12</sup>. Before the project completion, the water pressure in the target area in Nanning City was between 0.06 ~ 0.15MPa. Upon the project completion, the water pressure in Jiangnan District (commercial and residential area) is between 0.1 and 0.2MPa<sup>13</sup>, and the water pressure in National Nanning Economic Technological Development Zone (commercial, industrial and residential area) is between 0.28 and 0.3MPa<sup>14</sup>.

11 The typical water pressure, MPa (Mega Pascal) in Japan ranges between 0.05 and 1.0 Mpa, depending on geographical conditions. For example, 0.5 Mpa is the pressure level that water can be transmitted without a pump up to 35m (equivalent to 10 to 11 floor of a building).

12 Project Completion Report (April 2007)

13 At a community meter in Jiangnan District.

14 At the meter of a commercial facility in Jiangnan District, who was one of the respondents of the beneficiary survey.

According to Guilin Water Supply Company, the average water pressure at the outlet in Chengbei Water Plant is between 0.35 and 0.37MPa<sup>15</sup>. Before the project completion, the water pressure in the target area in Guilin City was between 0.08 and 0.2MPa. Upon the project completion, the water pressure is approximately 0.3 MPa<sup>16</sup>.

### 3.3.1.2 Results of Calculations of Internal Rate of Return (IRR)

#### Financial Internal Rate of Return (FIRR)

Using the same assumptions at appraisal<sup>17</sup>, the financial internal rate of return (FIRR) was recalculated. The FIRR at ex-post evaluation was beyond the estimate. The reasons for the higher FIRR could be that the actual water charges exceeded the average water charges used at appraisal in 2006 (one year after project completion) or the income from water charges exceeded the estimated figures. The FIRR for Guilin City was not recalculated due to lack of some data. The economic internal rate of return (EIRR) was not calculated at appraisal, therefore was not recalculated at the ex-post evaluation.

Table 8 : Financial internal rate of return (FIRR)

	FIRR
At appraisal	6.1%
At post evaluation	10.48%

Source: JICA appraisal document and responses to the questionnaire

15 Project Completion Report (April 2007) and interview with Guilin Water Supply Company (January 2010).

16 This data is from the water charge collection station of Guilin Water Supply Company in Balijie Economic Development Zone in Lingchuan County.

17 The assumption used at the appraisal is that the total project cost and increased operation/maintenance costs during the operation stage, are “costs” and that the income from the water charges is “benefits”, Project life: 30 years.

### 3.3.2 Qualitative Effects

Beneficiary surveys through interviews were conducted in the target area of Nanning City and Guilin City<sup>18</sup>. The total number of respondents for each city was 100<sup>19</sup> and the classification of respondents by sex was 29% female and 71% male. Respondents perceived the improvement in the following categories: (a) the time of interruption of water supply 98% (196 persons); (b) water quantity 97% (194 persons); (c) water pressure 93% (185 persons); (d) color 92% (184 persons); (e) taste 93% (185 persons); and (f) smell 93% (186 persons). The survey showed that the project contributes to stable supply of clean water.

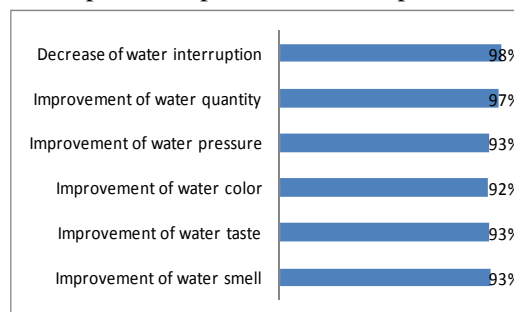


Figure 3 : Results of survey (N=200)

In both cities, this project has largely achieved its objectives: 1) meeting water supply capacity shortage and water demand (improvement in population served, percentage of population served and design capacity); 2) stable supply of safe water (improvement in water supply interruption, water quality and water pressure), and 3) the facility utilization rate is high, therefore its effectiveness is high.

## 3.4 Impact

### 3.4.1 Intended impacts

#### 3.4.1.1 Improvement of living and sanitary environment

According to the beneficiary survey, this project has contributed to the improvement of living and sanitary environment through the reduction in cases of water-borne diseases and required time for fetching water. Result of the beneficiary survey in each city is summarized below.

In Nanning City, ninety-six percent (96 persons) of the beneficiary survey respondents evaluated that the project has contributed to the improvement of sanitary and living conditions and reduced the amount of time from fetching water. Before project completion in 2005, each household in the rural area had to store water in tanks due to limited water supply (three times a day). After project completion, the availability of water supply 24 hours day as well as sufficient water pressure made the following possible: time saved from storing water, use of hot showers,

18 Nanning City: Jiangnan District, National Nanning Economic Technological Development Zone (Industrial, commercial and residential area). Guilin City: Chengbei District, Jintan District, a part of Lingchuan County including Balijie Economic Development Zone (Commercial and residential area)

19 There was no significant difference between the survey result of Nanning City and that of Guilin City.

and direct use of water supply in the farm. Meanwhile, improvement in water pressure in the urban area made it possible to utilize hot showers, while the 24-hour water supply made it possible to use the water tanks only for emergency.

In Guilin City, ninety-six percent (95 persons) of the beneficiary survey respondents evaluated that the project has contributed to the improvement of sanitary and living conditions and reduced the amount of time from fetching water. Before the project completion in 2005, the respondents in rural area depended on wells for water. However, after project completion, having water supply 24 hours a day made the following possible: freed from fetching water; decline in water-borne diseases, such as diarrhea; and use of hot showers. Meanwhile, in the urban area, time saved in storing water and improved water pressures in upper floors were perceived as impacts of the project.

### 3.4.1.2 Contribution to the development of regional economy

According to the beneficiary survey, the water supply expansion through the project has contributed to the regional economic development, such as the new and existing economic development zones, increase in commercial facilities and hotels, and the increase in production of industrial products. The result of the beneficiary survey is summarized below.

In Nanning City, 100% (100 persons) of the beneficiary survey respondents evaluated that the stable water supply has contributed to the region's economic development. According to the town office in Shajing Town, Jiangnan District, with the stable water supply from Sanjin Water Plant it will be possible to plan and implement the development of the new ASEAN Electric Technological Zone and International Industrial Material Transport Zones. In addition, most respondents (27 enterprises) in Shajing Town responded that stable water supply is the most important factor in deciding on new investments. Furthermore, it was learned that stable water supply has contributed to the increase in industrial production. For example, according to Nanning Dadou Concrete Company Ltd., the production of concrete increased rapidly after 2006.

Table 9 : Concrete production amount in the past four years

Year	2006	2007	2008	2009
Concrete production amount	65	85	97	113

Data source: Nanning Dadou Concrete Company Ltd.

According to the government office in the National Nanning Economic Technological Development Zone, the land size of the zone is growing rapidly after the stable water supply was secured in 2006. The land size of the zone was 16km<sup>2</sup> in 2006, and it rose to 40 km<sup>2</sup> (2.5

times) at the time of ex-post evaluation. It is considered that the stable water supply from Sanjin Water Plant supports the expansion of the zone. However, the government office warned that some parts of the existing distribution pipes became outdated because those were installed in the 1990s before the area was developed as the Economic Technological Development Zone. In addition, the diameter of the existing distribution pipes is small in some area, causing unstable water supply. The government office in the development zone and Guangxi Lucheng Water Company are currently replacing the obsolete pipes by sharing the financial burden, and plan to complete the replacement within two years.



Nanning National Economic Technological Development Zone



Guilin City Balijie Economic Technological Development Zone  
(View from the water plant)

In Guilin City, 98% (98 persons) of the beneficiary survey respondents evaluated that the stable water supply has contributed to the region's economic development. According to the town office in Dingjiang Town, 120 accommodation facilities, 10 communities and 3 commercial complexes were newly constructed in Dingjiang Town after the stable water supply was secured in 2006. According to the management committee in Balijie Economic Technological Development Zone (a part of Lingchuan Country), the zone is rapidly developing after the water supply was secured in 2006. The planned land size of the zone was 4km<sup>2</sup>, but it was increased to 9km<sup>2</sup> with a total population of 30,000 at the time of ex-post evaluation.

### **3.4.2 Other impacts**

#### **3.4.2.1 Impacts on the natural environment**

No particular negative impact on the natural environment has been observed.

Sanjin Water Plant recycles the water used in the production process by the water recycling system. Although it was planned to have the sludge concentrated, machine-dried and dumped in the disposal area, it was kept at the sludge processing room instead because of its very limited amount. This is because the raw water quality is good. In Chengbei Water Plant, sludge is concentrated, machine-dried and dumped in the disposal site in Xiangshan District. However,



similar to Sanjin Water Plant, the sludge amount is very limited due to the good quality of raw water.

In preparation for chlorine leakage accidents, both water plants installed the automatic alarm system for chlorine leakage and gas absorption equipment, and formulated an emergency response plan. They are regularly implementing trainings. Both water facilities have planted trees and maintained a satisfactory natural environment.



Water recycling pond at Sanjin Water Plant in Nanning



Sludge treatment facility at Sanjin Water Plant



Sanjin Water Plant with green plants

### 3.4.2.2 Land acquisition and Resettlement

The change of the location of Sanjin water plant required resettlement of three houses.

The negotiation between some villagers and the implementing agency regarding compensation for land and crops took some time, which resulted in the delay of civil work. Meanwhile negotiation was made possible with the support from village authorities, and the payment of the compensation both for land and crops was made in

accordance with the government regulations. Therefore, it is believed that the process of land acquisition and resettlement was conducted properly. During the site visit, it was confirmed that the living environment of the resettled residents was satisfactory. In Guilin City, the waste land was chosen for the construction site, therefore, resettlement was not required and the land acquisition was implemented smoothly.



New residence of resettled households in Nanning City

As mentioned above, the project has contributed to the improvement of living and sanitary environment and development of the region's economy. No negative impact has been observed.

### 3.5 Sustainability (Rating: a)

#### 3.5.1 Structural Aspects of Operation and Maintenance (O&M)

Guangxi Lucheng Water Company is responsible for O&M of the Sanjin Water Plant in Nanning City. This company has a total of 1,170 staff and 8 water plants with a total capacity of 1,140,000 m<sup>3</sup>/day. Guilin Water Supply Company is responsible for O&M of the Chengbei Water Plant in Guilin City. This company has a total of 600 staff and 4 water plants with a total capacity of 440,000 m<sup>3</sup>/day. Breakdown of the O&M staff of each water plant is summarized in Table 10.

Table 10 : Breakdown of the O&M staff of each water plant

(unit: persons)

Group Plants	Technological maintenance	Operation	Chemical inspection	General Affairs/ Technological management Note 1	Plant Manager /Deputy Manager	Total	Required estimated number at appraisal Note 2
Sanjin (Nanning)	8	23	9	9	2	51	100
Chengbei (Guilin)	7	21	4	3	3	38	78

Source: JICA appraisal document and responses to the questionnaire

Note 1 : General Affairs in Sanjin Water Plant, and Technological Management in Chengbei Water Plant.

Note 2 : This number is based on non-automation.

The characteristics of the two water plants regarding O&M system are summarized below.

- 1) The organizational system and division of responsibilities among groups are clear.
- 2) Required staff for O&M is positioned properly.
- 3) Management standard and productive efficiency have been enhanced through automation by the project. This enabled the O&M agency to operate and maintain the water plant with half the staff than estimated at the appraisal.
- 4) Some former members of the Project Management Office (PMO) established in each water company are supporting the O&M system as a Deputy General Manager (Nanning City) and a Plant Manager (Guilin City) at the time of ex-post evaluation.

#### 3.5.2 Technical Aspects of Operation and Maintenance

In light of the reasons mentioned below, no major problems have been observed in the technical capacity in operation and maintenance.

- 1) Required operation and maintenance manuals and regulations<sup>20</sup> were provided.

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<sup>20</sup> Central control panel operation manual, electronic facility operation and maintenance regulations,

- 2) Sufficient number of staff with appropriate level in each field<sup>21</sup> was assigned for operation and maintenance of the water plants.
- 3) Staff of the water purification plant had required certificates and adequate skill in each field. Training was regularly provided to staff on each job post.

The number of the water plant staff in charge of operation and maintenance by technical grade is shown in Table 11. Certificates/training contents are shown in Table 12.

Table 11 : O&M staff of each water plant by technical grade

Water Plants						(unit: persons)
	Engineer	Assistant Engineer	Senior Technician	Middle Technician	Primary Technician	Total
Sanjin (Nanning)	9	8	5	6	4	32
Chengbei (Guilin)	2	11	5	9	10	37

Source: Responses to the questionnaire

Note: Not all of the water plant staff are engineers/technicians, thus the total number in Table 11 is less than the total number of Table 10.

Table 12 : Required certificates and training contents of the O&M staff

Water Plants	Certificate and training contents
Sanjin (Nanning)	Staff was sent to the Labor Bureau in Nanning for training on electrical system, chlorine injection and water quality monitoring. After obtaining certificates, staff was assigned to respective department. New staff received training at the three levels: company, water plant, and department levels. On-the-job training on the mechanics, electrical system and automation were provided and an achievement test was conducted twice a year.
Chengbei(Guilin)	Before the project completion, staff was sent to Shanghai, Beijing and Xiamen for training on automation, mechanics and electrical system. It was mandatory for the staff in charge of water quality inspection to receive training at Guilin City Tianyuan Water Quality Testing Center and to obtain certificates at the Labor Bureau in Guilin City. Upon project completion, on-the-job training on the chlorine injection, mechanics and automation were provided and an achievement test was conducted once a month. Irregular exams were also conducted.

Source: Responses to the questionnaire

### 3.5.3 Financial Aspects of Operation and Maintenance

The financial situation of each O&M agency, income/expenditure of the Sanjin Water Plant and O&M expenses (budget and actual), water charges by category are shown in Tables 13-18. Because Guilin Water Supply Company does not have a balance sheet on specific water plant, income/expenditure data for Chengbei Water Plant is not available.

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chlorine injection automatic operation regulations, automatic operation regulations for pumps for water transmission.

21 Water supply, electronics, power system, automation, measurement, computers, chemistry.

Table 13: Main Business Income and Expenditure of Sanjin Water Plant

(Unit : ten thousand yuan)

	2007	2008	2009
Income from water charge	3,073	3,363	3,959
Expenses	2,560	2,863	2,996
Operating Income	513	500	963
Income Tax	77	75	144
Net Profit	436	425	819

Data source: Guangxi Lucheng Water Company.

Table 14 : Major financial performance and indicators of  
Guangxi Lucheng Water Company

(unit: million yuan)

Year	2006	2007	2008
<b>Financial Performance</b>			
①Total capital	1,840	2,324	2,436
②Current assets	238	463	470
③Current liabilities	523	769	773
④Equity capital	388	452	657
⑤Sales	243	359	400
⑥Net income	64	83	20
<b>Financial Indicator</b>			
Profit Ratio of Total Capital (%) ⑥/①	3.5	3.6	0.8
Total Asset Turnover (times) ⑤/①	0.13	0.15	0.16
Net Income to Sales Ratio (%) ⑥/⑤	26.3	23.1	5.0
Current Ratio (%) ②/③	45.5	60.2	60.8
Equity Ratio (%) ④/①	21.1	19.4	27.0

Data source: Financial Statement of Guangxi Lucheng Water Company.

Financial index are calculated based on the financial statement.

Table15 : Major financial performance and indicators of  
Guilin Water Supply Company

(unit: ten thousand yuan)

Year	2007	2008	2009
<b>Financial Performance</b>			
①Total capital	68,482	77,235	84,422
②Current assets	12,623	20,001	1,774
③Current liabilities	15,312	18,535	20,189
④Equity capital	37,733	39,042	41,540
⑤Sales	10,888	10,463	11,174
⑥Net income	1,143	172	200
<b>Financial Indicator</b>			
Profit Ratio of Total Capital (%) ⑥/①	1.7	0.2	0.2
Total Asset Turnover (times) ⑤/①	0.16	0.14	0.13
Net Income to Sales Ratio (%) ⑥/⑤	10.5	1.6	1.8
Current Ratio (%) ②/③	82.4	107.9	8.8
Equity Ratio (%) ④/①	55.1	50.5	49.2

Data Source: Guilin Water Supply Company.

Financial index are calculated based on the financial statement.

Table 16 : Budget and actual of the O&amp;M cost

(unit: ten thousand yuan)

Plants	Budget for 2006	Actual for 2006	Budget for 2007	Actual for 2007 Note
Sanjin (Nanning)	1,905	1,832 (96% of the budget)	2,735	2,410 (88% of the budget)
Chengbei (Guilin)	1,700	1,611 (95% of the budget)	1,800	1,659 (92% of the budget)

Data source: Responses to the questionnaire.

Note : The increase between 2006 and 2007 is due to utilities, chemicals (Chlorine, alum, etc.) and salaries.

Table 17 : Water charges by category in Nanning City

(unit: yuan / m<sup>3</sup>)

Category	1998 Note 1	2000	2003	2005 (project completion)	2008	2010 Note 2
Household	0.62	0.72	0.81 ~ 1.22	1.05 ~ 1.58	1.05 ~ 1.58	1.45 ~ 2.90
Industry Note 3	0.65	0.75	0.84	1.09	1.09	1.49
Commerce	1.01	1.25	1.34	1.64	1.64	1.49
Special Note 4	NA	NA	2.50	3.60	3.6	4.97
Construction	NA	1.70	1.70	2.00	2.00	2.20

Data source: Guangxi Lucheng Water Company

Note 1 : Water Charge Collection Rate in 1998 was 99.5% (Data Source: JICA Appraisal Document)

Note 2 : Water Charge Collection Rate in 2009 was 99.67% (Answer to the questionnaire)

Note 3 : Water charges of industrial and commercial category became that of non-household category since 2010.

Note 4 : Special category includes car-washing, beauty salon and sauna.

Table 18 : Water Charges by category in Guilin City

(unit : yuan / m<sup>3</sup>)

Category	2005 (project completion)	2007	2010 Note1
Household	0.75	1.00	1.00
Administration	0.90	1.70	1.70
Industry	0.90	1.36	1.62
Commerce	1.30	1.90	
Special Note 2	1.60	5.00	5.00

Data source: Guilin Water Company

Note 1 : Water Charge Collection Rate in 1998 was 99.7% (JICA Appraisal Document), and that in 2009 was 99% (Answer to the questionnaire).

Note 2 : Special category includes car-washing, beauty salon and sauna.

The financial situation specific to respective water plants/companies, which are drawn from the financial tables, are summarized below.

#### Sanjin Water Plant (Nanning)

- 1) After the project completion, income from water charges and net profit are increasing.

- 2) Income from water charges exceeds expenses every year
- 3) Although net profit in 2008 has slightly decreased, a little increase in the total assets turnover in the past three years shows that the company is making a profit as more equipment is put to use.

#### Chengbei Water Plant (Guilin)

The Guilin Water Supply Company's sales are slightly increasing in the past three years and remains with a surplus. (Because the existing distribution pipes were replaced on a large scale in 2009, the current asset was decreased tentatively and fixed asset was increased. However, it is expected that the leakage ratio will decrease and the efficiency of production cost will be enhanced in the near future. Thus, it is determined that there is no major problem with the financial situation.)

Meanwhile, the financial situation shared by the two plants, drawn from the financial tables, are summarized below.

- 1) O&M actual expenses have been maintained at almost ninety percent of the budget and the amount is increasing yearly.
- 2) Water charges have been revised every two to three years by the Municipal Price Bureaus both in Nanning City and Guilin City.
- 3) Water charge collection rates are kept almost at 100%.

It is determined that water charges for both cities are appropriate due to the following reasons.

- 1) Compared with the water charges in other cities in China in 2009, the charges of Nanning and Guilin are appropriate (Household category: Jingdezhen 1 yuan, Chongqing 2.1 yuan, Beijing 2.8 yuan. Commercial category: Jingdezhen 1.6 yuan, Chongqing 1.8 yuan, Beijing 4.1 yuan).
- 2) According to the beneficiary survey, eighty to ninety percent of the respondents responded that the current water charge is appropriate<sup>22</sup>.

Based on the financial situation, O&M expenses and water charges of the two water plants, no major problems have been observed regarding the financial status of operation and maintenance.

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22 According to the beneficiary survey, 83% (83 out of 100 persons) of the respondents in Nanning City responded that the water charge is appropriate and 17% responded expensive (No one responded "reasonable"). Meanwhile, 91% (91 out of 100 persons) of the respondents in Guilin City responded that the water charge is appropriate and 9% responded expensive (No one responded "reasonable")

### 3.5.4 Current Status of Operation and Maintenance

Examination of the facilities by operation and maintenance staff is conducted once a day, weekly, monthly and quarterly depending on the facility. There has been no major problem so far. Minor problems have been recorded and handled accordingly. It was confirmed during field inspection that facilities were well organized and maintained.



Monitoring room at Chengbei Water Plant in Guilin City



Monitoring room at Sanjin Water Plant in Nanning City



Manuals and repair record of Sanjin Water Plant

No major problems have been observed in the operation and maintenance system, therefore sustainability of the project is high.

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

Although the efficiency of the project is considered fair, the project's relevance, effectiveness and sustainability are considered high. In light of the above, this project is evaluated to be (A) highly satisfactory.

### 4.2 Recommendations

#### 4.2.1 Recommendation for the improvement of the effectiveness to the O&M agency (Guangxi Lucheng Water Company) and the Management Committee in National Nanning Economic Technological Development Zone

In the National Nanning Economic Technological Development Zone, some parts of the existing distribution pipes became over-aged, and the diameter of the existing distribution pipes is small to accommodate the water demand as well as the rapid growth of the zone. Under this condition, it is recommended that the replacement of the existing pipes should be completed within two years as scheduled.

#### 4.2.2 Recommendation to JICA

None.

### **4.3 Lessons Learned**

#### **4.3.1 Lessons learned related to procurement (Good practice)**

In this project, similar to other projects in China, the procurement agent conducted bidding procedures on behalf of the implementing agency (Guangxi Zhuangzu Autonomous Region People's Government). Two factors contributed to the selection of appropriate suppliers and maintained the amount within the budget. First, before the agent prepared the bidding document, both O&M agencies in the two cities conducted a study on detail specification based on the Detail Design considering the approved loan amount (for facilities/equipment) and informed the procurement agent of the detail specification. Second, before the procurement agent prepared the bidding document, it conducted the following: 1) a full market research based on the detail specification provided by the O&M agencies; 2) decision of the facility/equipment which requires high performance and budget; and 3) decision of the final specification of the facility/equipment. Therefore, these steps are effective in cases where a procurement agency conducts bidding procedures on behalf of the implementing agency.

#### **4.3.2 Lessons learned for the improvement of efficiency (Good practice)**

When a procurement agent conducts bidding procedures on behalf of the implementing agency, it is very important for the Project Management Office in the O&M agency (consisting of staff from relevant sections such as construction, equipment and finance) to frequently coordinate with the procurement agent regarding the progress of civil work and procurement implementation plan. This coordination is important in preventing delays in the project period. Taking for example the schedule of pumps for transmission, sequence of the schedule is in the order of civil work, installation of equipment, and civil work. It is not possible to change the order of these steps even if there is any delay. Therefore in order to minimize the delay, it is essential to make frequent coordination and adjustments between the progress of civil work and the arrival of equipment.



**Comparison of the Original and Actual Scope of the Project**

Item	Original	Actual
① Output		
1) Intake facilities	• Capacity 400,000 m <sup>3</sup> /day (a sluice gate, intake pipes, intake pump)	• As planned
2) Conveyance facilities	• Conveyance pipes 2.5km	• Approximately 5.3km (Approximately 2.8km increase)
3) Purification facilities	• Capacity 300,000 m <sup>3</sup> /day (rapid filtration method)	• As planned
4) Distribution facilities	• Distribution pipe: approx. 52km(excluding small -diameter pipe) (There is no planned figure)	• As planned (Small-diameter pipe: Approx. 52km)
② Project period	March 2000 ~ June 2004 (52month)	March 2000 ~ August 2005 (66 months)
③ Project cost		
Foreign currency	3,641million yen	3,630 million yen
Local currency	3,628million yen (241million yen)	3,897 million yen (263 million yen)
Total	7,268million yen	7,527 million yen
Japanese ODA loan	3,641million yen	3,630 million yen
Exchange rates	1yuan = 15Japanese Yen (As of June 1999)	Nanning City 1yuan = 15.47yen (August 2002 ~ July 2005 average) Guilin City 1yuan = 13.91yen (June 2001 ~ August 2004 average)