

People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project  
Kunming Water Diversion and Water Supply Construction Project

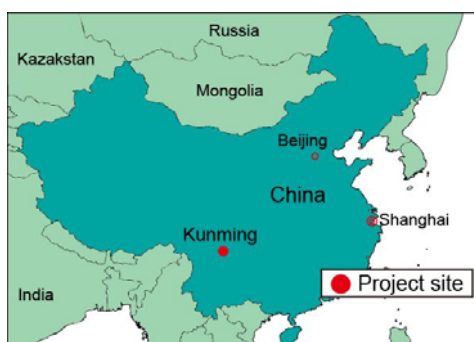
Yasuhiro Kawabata, Sanshu Engineering Consultant

## 0. Summary

The project objective was to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost exceeded the plan, and the project period was also longer than planned. Therefore, the efficiency is considered moderate. Regarding its effectiveness, the project has largely achieved its development objectives (to respond to the insufficient water supply capacity, as well as the increasing water demand, to provide stable supply of clean water for the improvement of living conditions and sanitary environment, and to enhance the regional economic development). Hence, its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is considered high.

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

## 1. Project Description



Location of Project Site



No. 7 Purification Plant  
(Sedimentation Pond and Office Buildings)

## **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, has been implemented as part of actions to improve the investment environment for attracting enterprises. The average water usage per person in 1998 was 214.1ℓ/day in urban areas, and reached the same level as that of Japan (248ℓ/day in Tokyo as of 1997). The coverage of the water supply system in urban areas has been steadily improving at the rates of 81% in 1980, and 89% in 1990. 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. This is due to increased water demand for industrial and home use as a result of rapid industrialization and urbanization which started in mid 1990s.

Kunming, the provincial capital of Yunnan Province, has been rapidly developing as a hub city of China's southwestern region, particularly as the current transit trade base with neighboring countries, such as Thailand. Regarding the urban infrastructure, particularly the water supply system, which supports the economy in Kunming, the gap between the water demand and supply capacity has been recently tight because of increase in population and industrial demand. In order to respond to the ever increasing water demand, there is an urgent need to enhance the facility's capacity. The city has long relied on Dianchi Lake (a fresh water lake) as the main water intake source. However, the water in Dianchi Lake has been severely polluted and was considered inappropriate as tap water.

## **1.2 Project Outline**

The project objective is to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project site is shown in Figure 1.

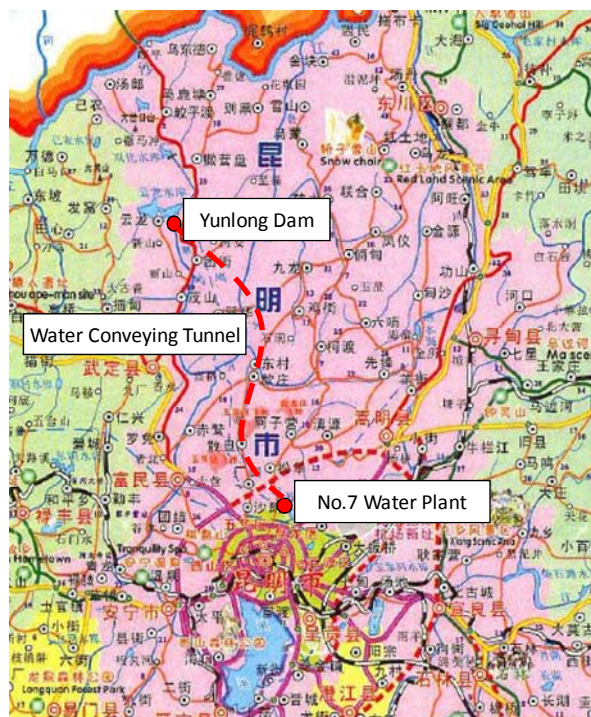


Figure 1 Location of the Project Site

|  |   |
|--|---|
| Approved Amount/<br>Disbursed Amount                   | 20,903 million yen/ 20,554 million yen  |
| Exchange of Notes Date/<br>Loan Agreement Signing Date | March 2000/March 2000   |
| Terms and Conditions                                   | Interest rate 1.70%; Repayment period 30 years (Grace period 10 years);<br>Conditions of procurement: General Untied,<br>Consultant: Interest rate: 0.75%; Repayment period 40 years (Grace period 10 years), Conditions of procurement: Bilateral tied   |
| Borrower/Executing Agency                              | Government of People's Republic of China/ Kunming Municipal Government  |
| Final Disbursement Date                                | July 2008   |
| Main Contractor<br>(over 1 billion yen)                | China Water Conservancy & Hydropower Engineering Bureau No.4 (CN), The 13 <sup>th</sup> Engineering Bureau of China Construction Company (CN), Zhong Tie No.19 Engineering Bureau Co., Ltd. (CN), CNTIC International Business Company (CN), China Railway Engineering Corporation (CN), The 16 <sup>th</sup> Engineering Bureau of CRCC (CN), Cooperativa Muratori & Cementisti C.M.C. Di Ravenna Soc. AR. (ITY), Shaanxi Provincial Bureau of Water & Electric Engineering (CN) |
| Main Consultant<br>(over 100 million yen)              | Electric Power Development Company  |

|  |  |
|--|--|
| Relevant Studies<br>(Feasibility Study and others) | Feasibility Study by Yunnan Province Hydrology and Hydro Power Survey and Design Institute (June 1997), EIA by Yunnan Province Environmental Science Research Institute (October 1998) |
| Relevant Projects                                  |  |

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Yasuhiro Kawabata, Sanshu Engineering Consultant

### 2.2 Duration of Evaluation Study

The subject ex-post evaluation assignment was implemented as follows:

Duration of the Study : December 2010 to December 2011

Duration of the Field Study : February 20-March 5, 2011 and May 15-28, 2011

## 3. Results of the Evaluation (Overall Rating: A<sup>1</sup>)

### 3.1 Relevance (Rating: ③<sup>2</sup>)

#### 3.1.1 Relevance with the Development Plan

The China's 9th Five-Year Development Plan (1996-2000) stated that the waterworks infrastructure in rural cities was the most essential agenda, with the following targets to be achieved during the Five-Year Plan : i) increase the nationwide water supply by 40 million m<sup>3</sup>/day; ii) raise accessibility ratio to portable water in urban areas to 96%; and iii) increase average water supply per person by 40ℓ/day. The facility capacity was increased by 13.15 million m<sup>3</sup>/day by 1998 and consequently, the target should be achieved by year 2000 taking into account the facilities under construction. The target for raising accessibility ratio to portable water in urban areas had been achieved ahead of schedule in 1998. The average water supply per person in 1998 was 214 ℓ/day, which has exceeded the targeted volume of 210 ℓ/day. However, since the regions are still suffering from lack of water supply, the water supply development was one of the priority sectors in the urban development plan, as well as in the 10th Five-Year Plan that started in 2001.

In Yunnan's 9th Five-Year Plan (1996-2000) and the Provincial Development Objectives up to 2010, alleviation of poverty and promotion of regional economy had been emphasized. Particularly, the priority sectors to be promoted include economy in rural areas, energy, and tobacco/heavy electric machinery/food industries. In order to address these issues, it was considered essential to continue the development of urban infrastructure. Particularly in the water supply sector, it was proposed to implement the expansion of water supply pipelines,

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

2 ③: High, ②: Fair, ①: Low

water supply depending on the usage, and new construction/expansion of purification plants (No.1 and No. 6 Purification Plants) so that the water supply capacity in Kunming could be raised up to 830,000m<sup>3</sup>/day in 2000 from the capacity of 490,000 m<sup>3</sup>/day in 1995.

The China's 11th Five-Year Development Plan (2006-2010) included strengthening of the wellhead protection in urban areas, and promoting the construction of water supply facilities. The wellhead protection is also considered a priority agenda in the 12th Five-Year Development Plan (2011-2015). The following measures were proposed: i) expansion and rehabilitation of the aging small reservoirs; ii) rehabilitation of large/medium scale irrigation facilities; iii) countermeasure works against drought; iv) protection work for small scale reservoirs in rural areas; and v) countermeasure works for water resources for arable lands.

The Yunnan's 11th Five-Year Plan (2006-2010) states that construction of reservoirs needs to be accelerated in order to supply clean and safe water. In addition, it is proposed to raise accessibility ratio to portable water to the rural people, who do not receive the water supply services, and to increase water supply amount equal to urban areas.

In the National Development Plan and development plans for Yunnan Province and Kunming City at appraisal and post evaluation stages, the development/promotion of reservoirs and water supply facilities was a priority agenda. Thus, the project was in accordance with the National Development Plan and the development plans for the project target areas.

### 3.1.2 Relevance with the Development Needs

Regarding the urban infrastructure in Yunnan's capital city, Kunming, the expansion and enhancement of facilities, particularly water supply, was urgently needed in order to respond to the increasing water demand due to increased population and economic development. For the city, Dianchi Lake has been long an intake water resource. However, the water quality has recently deteriorated and thus, the water intake from the lake was considered inappropriate. The project's development objective is to respond to the water demand, involving construction of a reservoir along the upstream of Zhangjiuhe River in the north of Kunming city, installation of water conveying pipes up to Kunming, and construction of a purification plant and transmission/distribution pipes, was in accordance with the development needs of Kunming.

Kunming (city district) has a population of about 3.06 million as of 2008 and it is expected to be a metropolitan city with a population of 450-500 million by 2020. Thus, enhancement of water supply capacity is considered to be a top priority agenda for the development of the city. The water demand in the project target area is still increasing as population increases with the economic development, and thus the development needs in the project area was/is high at appraisal and at post evaluation.

### 3.1.3 Relevance with Japan's ODA Policy

According to the Overseas Economic Cooperation Implementation Policy (issued on December 1, 1999 and valid up to March 2002), the Japanese aid policy towards China focused on alleviation of disparity between regions, particularly giving priority to inland regions and the development of the economic and social infrastructure which would promote self-motivating economic development to advance the development of the private sector and democratic markets, as well as a well-balanced development to support a market-oriented economy. At the appraisal stage, the project was in accordance with the Japanese aid policies.

The project has made significant contributions to the Chinese development plan and needs, as well as Japan's ODA policies, and is therefore considered highly relevant.

## 3.2 Efficiency (Rating: ②)

### 3.2.1 Project Outputs

The project outputs (planned and actual) are summarized in Table 1.

Table 1 Comparison of project outputs (planned and actual)

| Item                                      | Planned   | Actual   |
|---|---|--|
| ① Yunlong Dam <sup>3</sup><br>(Reservoir) | <ul style="list-style-type: none"> <li>• Crest length: about 240m</li> <li>• Dam height: about 80m</li> <li>• Reservoir capacity: about 400 millionm<sup>3</sup></li> <li>• Reservoir area: 20km<sup>2</sup></li> <li>• Reinforced concrete gravity dam</li> </ul>  | <ul style="list-style-type: none"> <li>• about 240m, as planned</li> <li>• 77.3m, almost as planned</li> <li>• about 484 million m<sup>3</sup> (about 20% increase)</li> <li>• 20km<sup>2</sup>, as planned</li> <li>• as planned</li> </ul> |
| ② Water Conveying Tunnel <sup>4</sup>     | <ul style="list-style-type: none"> <li>• from Yunlong dam to No.7 purification dam about 100 km</li> </ul>  | <ul style="list-style-type: none"> <li>• about 100 km, as planned</li> </ul>   |
| ③ No.7 Purification Plant                 | <ul style="list-style-type: none"> <li>• Purification capacity: 400,000m<sup>3</sup>/day (Phase I)</li> <li>• Condensed sedimentation rapid filtration</li> </ul>   | <ul style="list-style-type: none"> <li>• Purification capacity: 400,000m<sup>3</sup>/day as planned</li> <li>• as planned</li> </ul>   |
| ④ Distributing Facilities                 | <ul style="list-style-type: none"> <li>• Total length of distributing pipes: about 90km</li> <li>• Pumping station: 2 units with a capacity of 50,000m<sup>3</sup>/day each</li> </ul>  | <ul style="list-style-type: none"> <li>• 93.4 km, almost as planned</li> <li>• Pumping station: as planned</li> </ul>  |
| ⑤ Consulting Services                     | <ul style="list-style-type: none"> <li>• Detailed designs/preparation of bidding documents, assistance in bidding and advice</li> <li>• Supervision and assistance/advice on construction of difficult works</li> <li>• Technical assistance/advice (including safeguard issues)</li> <li>• Inputs (foreign) 3 persons, 40M/M, (local) 3persons, 10M/M</li> </ul> | <ul style="list-style-type: none"> <li>• Scope of Work, as planned</li> <li>• Inputs (foreign) 8 persons, 44M/M, (local) 5 persons, 10M/M</li> </ul>   |

Source: Response to the Questionnaire

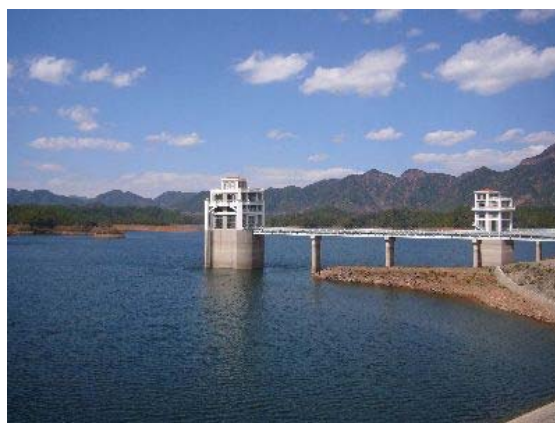
Note 1: Phase 2 work of the purification plant (capacity of 200,000 m<sup>3</sup>/day) commenced in 2007 and completed by end October 2010.

3 (for reference) Dimensions of the Miyagase Dam (multi-purpose dam), which is the water intake source for water supply serving for the 2/3 area of Kanagawa Prefecture including Yokohama, Kawasaki and Sagami-hara are as follows: crest length: about 400m, dam height: 156m, reservoir capacity: about 193 million m<sup>3</sup> and reservoir area: 4.6km<sup>2</sup>.

4 The length of 100km conveyance pipes is equivalent to the distance between Lake Ashinoko in Hakone and Tokyo downtown. As shown in the picture on page 8, pipes with a diameter of 3m were installed along the topography in the mountainous terrain. About 90km, which is 90% of the total length is tunnel sections and pipes were installed in tunnels. Thus, the construction work was a difficult one involving hauling the construction materials to the job site in the heavy mountainous terrain.

As shown in Table 1, the project outputs including the reservoir (Yunlong dam) and water supply facilities (conveyance tunnel, a No. 7 purification plant, and transmission/distribution facilities) have been constructed almost as planned.

Regarding the consulting services, even though at the appraisal stage three foreign engineers (two tunnel experts and a structural engineer) were planned to be involved, during the implementation it became clear that additional expertise (geology/soils, hydrology, and environment) was needed. Thus, the number of engineers was increased by 5. However, the input by foreign experts (M/M) slightly exceeded the original plan (by 10%).



Yunlong Dam (Reservoir and Intake Tower)

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The estimated total project cost at appraisal was 53.412 billion yen, of which the Japanese ODA loan was to be used only for the foreign currency portion amounting to 20.903 billion yen and the rest was to be financed by Yunnan Province and Kunming City. However, the actual total project cost was 69.076 billion yen, of which the Japanese ODA loan amount was 20.526 billion yen and the rest was funded by Yunnan Province and Kunming City. It exceeded the planned cost, equivalent to 129% of the planned project cost or 137% in Chinese yuan. The main reasons for the cost increase/decrease are as follows:

- 1) Yunlong dam: i) Due to the poor geological condition, design changes and variations were made during implementation; ii) Additional roads for maintenance were constructed along the reservoir; iii) In addition, a management office building and an apartment for the staff in charge of management and operation were constructed and iv) The equipment for transmitting water was also procured.
- 2) Water conveying facilities: The topographical and geological conditions were much worse than originally identified at the feasibility stage. Thus, the excavation volume

for conveyance tunnels has substantially increased and design changes/variations were made. One of reasons for cost increase was that the construction cost for temporary roads access to the job site for installation of conveyance pipes was not estimated at the planning stage.

Table 2 Comparison of Project Costs (Planned and Actual)

| Item                         | Planned     |              |             |              |             | Actual      |              |             |              |             |
|------------------------------|-------------|--------------|-------------|--------------|-------------|-------------|--------------|-------------|--------------|-------------|
|                              | Foreign     | Local        |             | Total        |             | Foreign     | Local        |             | Total        |             |
|                              | Million yen | Million yuan | Million yen | Million yuan | Million yen | Million yen | Million yuan | Million yen | Million yuan | Million yen |
| Yunlong Dam                  | 708         | 256          | 3,846       | 303          | 4,554       | 444         | 574          | 8,098       | 605          | 8,542       |
| Conveying Facilities         | 14,180      | 326          | 4,889       | 1,271        | 19,069      | 16,552      | 1,116        | 15,757      | 2,289        | 32,309      |
| Purification Plant           | 1,899       | 207          | 3,100       | 333          | 4,999       | 1,886       | 213          | 3,007       | 347          | 4,893       |
| Distributing Facilities      | 2,057       | 111          | 1,671       | 249          | 3,728       | 1,490       | 168          | 2,376       | 295          | 4,166       |
| Administration /taxes        | 0           | 229          | 3,435       | 229          | 3,435       | 0           | 73           | 1,037       | 73           | 1,037       |
| Price Escalation             | 930         | 193          | 2,890       | 255          | 3,820       |             |              |             |              |             |
| Contingencies                | 989         | 96           | 1,446       | 162          | 2,435       |             |              |             |              |             |
| Consulting Services          | 140         | 0            | 0           | 9            | 140         | 154         | 0            | 0           | 11           | 154         |
| Land Acquisition             |             | 605          | 9,080       | 605          | 9,080       | 0           | 834          | 11,766      | 834          | 11,766      |
| Interest during Construction |             | 144          | 2,156       | 144          | 2,156       | 0           | 440          | 6,209       | 440          | 6,209       |
| Total                        | 20,903      | 2,167        | 32,509      | 3,561        | 53,412      | 20,526      | 3,418        | 48,250      | 4,894        | 69,076      |

Source: Appraisal documents and Response to the Questionnaire

Note 1: Exchange rate at appraisal: 1 yuan=15 yen, Exchange rate at post evaluation: 1 yuan=14.114 yen (simple average figure between 2000 and 2008 checked by the evaluator)

Note 2: According to the JICA's record, the total disbursed amount is 20,554 million yen. According to the executing agency, 28 million yen was returned to the China Export and Import Bank.

- 3) Land acquisition and resettlement cost: Costs for the land acquisition were paid to individuals and the resettlement/compensation costs were paid for houses, arable lands, forest, orchards and others. With respect to resettlement of minority households, the cost for constructing facilities and infrastructure (including churches, cemeteries, and schools) for each community have also been accrued in order to maintain the minority group's culture, custom and life style.
- 4) Interest during the project implementation: The borrowed amount in local currency was tripled against the planned loan amount, and thus the interest amount was increased.



### 3.2.2.2 Project Period

The actual project period exceeded the plan. The project period planned at appraisal was from March 2000 (Loan Agreement signing month) to April 2006 (project completion) with a total period of 74 months. However, the actual project period was from March 2000 (Loan Agreement signing date) to March 2007 (commencement of water supply) with a total period of 85 months, or equivalent to 115% of the plan. Regarding the conveyance facility, which was considered to be a critical path in the total implementation plan, the commencement of work itself was delayed by about two years since sufficient time was spent for the geotechnical investigation, field surveys and detailed designs before the commencement of field work. However, since the actual construction period was shortened by 10 months, the delay of project completion (starting water supply) was delayed by 11 months. At the time when water supply started in March 2007, the total length of transmission/distribution pipes completed was 92.7 km. However, the remaining 0.7km section was completed with the local funds in June 2010 after the installation route was decided following the newly defined city planning of Kunming city.



Conveyance Pipes

Since the project cost exceeded the plan, and the project period was also longer than planned, the efficiency is therefore considered moderate.

## 3.3 Effectiveness (Rating: ③)

### 3.3.1 Quantitative Impacts

#### 3.3.1.1 Results from Operation and Effected Indicators

##### (1) Improvement of Water Supply Facility Capacity in Kunming

The balance of water demand and supply capacity in urban Kunming City is shown in Table 3.

Table 3 Balance of Water Demand and Supply Capacity in Urban Kunming City

Unit: 0,000m<sup>3</sup>/day

| Year                                      | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  |
|---|-------|-------|-------|-------|-------|-------|
| Population water supplied (0,000 persons) | 165   | 180   | 210   | 245   | 275   | 299   |
| Water demand ①                            | 114   | 117   | 122   | 130   | 140   | 152   |
| Supply capacity ②                         | 96.5  | 102.5 | 142.5 | 142.5 | 142.5 | 162.5 |
| Balance between demand and capacity ②-①   | -17.5 | -14.5 | 20.5  | 12.5  | 2.5   | 10.5  |

Source: Response to the Questionnaire

Note 1: The reason for the capacity increase from 965,000m<sup>3</sup>/day in 2005 to 1,025,000m<sup>3</sup>/day in 2006 is due to the addition of a new plant with a capacity of 6m<sup>3</sup>/day.

Note 2: Water supply from the purification plant (Phase 1 with a capacity of 400,000m<sup>3</sup>/day) commenced in March 2007 and that from Phase 2 with a capacity of 200,000 m<sup>3</sup>/day commenced in October 2010.

Upon completion of the project, the water supply capacity has exceeded the water demand, and thus the stable water supply has become possible. According to the executing agency, even with the drought in Yunnan Province in 2010, which has occurred only once in 100 years, the urban Kunming city did not experience any water stoppage because of the reservoir and the purification plant that were constructed under the project. The people's daily life was not affected either.

## (2) Amount of Raw Water supplied from Yunlong Dam

The amount of raw water supplied from the Yunlong Dam is shown in Table 4.

Table 4 Amount of Raw Water Supplied from Yunlong Dam

Unit: 0,000m<sup>3</sup>/day

|                              | 2005 | 2009 | 2010 |
|------------------------------|------|------|------|
| Amount of raw water supplied | 53.7 | 57.0 | 60.5 |

The amount of raw water supplied by Yunlong Dam has been increasing since 2005, and it is currently equivalent to the amount (600,000 m<sup>3</sup>/day), which No. 7 purification plant can handle. The amount of water supplied by Yunlong Dam, which is less than the supply capacity, is about 70% of the water supplied to Kunming city. Thus, this water supply system is considered to be a life line for Kunming people.

## (3) Supply of Safer Water

The water quality supplied by Yunlong Dam meets the Class 2 National Standards<sup>5</sup>. The water quality transmitted from No.7 Purification Plant also meets all the to-be- monitored items of the National Standards (turbidity, bacteria count, coli form count, manganese, iron, zinc content, etc.), and it has been proven to be suitable as tap water.

5 To be applied to the plant with a supply capacity of 500,000-1,000,000m<sup>3</sup>/day.

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

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

FIRRs at appraisal and at post evaluation are shown in Table 5.

Table 5 FIRRs at Appraisal and at Post Evaluation

|      | At appraisal | At post evaluation |
|------|--------------|--------------------|
| FIRR | 6.2%         | 1.84%              |

Benefits: Water charge revenue

(the current water charge is 2.45 yuan/m<sup>3</sup>)

Costs: Construction costs, and operation/maintenance costs

Project Life: 50 years

The reasons for the lower FIRR at post evaluation were: i) the actual project cost was increased by 37% against the planned cost; and ii) the water charge rates were not increased to the level assumed at the planning stage (3.2 yuan/m<sup>3</sup>).

### 3.3.2 Qualitative Effects

#### (1) Response to the still Increasing Water Demand

After the project was completed in 2007, the phase 2 work of No. 7 Purification Plant was also completed, and thus the stable water supply to the Kunming people became possible. The raw water of 600,000 – 700,000m<sup>3</sup>/day has been transmitted to Kunming, and 600,000m<sup>3</sup> of water has been purified at No.7 Purification Plant, and the rest of water has been transmitted to other plants.

#### (2) Provision of Stable Supply of Clean Water

Since the raw water transmission from Yunlong Dam commenced in March 2007 and the water intake from Dianchi Lake, which had been long an intake supply, was prohibited, the water quality supplied to the people in Kunming has been tremendously improved.

The number of complaints from citizens in Kunming regarding water stoppage, insufficient water pressure, and water quality was 24,273 in 2006, of which 42% of the calls were received by the customers' service section of the water company. After the project was completed, the number of complaints was substantially reduced down to 7,891 in 2009 (about 70% reductions), of which only 5% of the calls were received by the customers' service section and most of calls were from outside the area not served. From these figures, it is considered that the stable water supply has contributed to the promotion of economic activities.

At the post evaluation stage, beneficiary surveys through interviews were conducted in the project targeted area. The total number of respondents was 100, including 7

businessmen, 61 company employees, 7 teachers, 2 students, 10 civil servants and 10 others. The classification of respondents by sex was 39% female and 61% male. From the surveys, it was confirmed that ninety-six (96) % of respondents has admitted that the project has contributed to enhancement of the living standards. Main other results of the beneficiary surveys are as follows:

- 1) Contribution to stable water supply: 91%
- 2) Perception on the sufficient supply amount: 94%
- 3) Perception on the substantial raise of water pressure: 93%
- 4) Perception on improvement of water quality (turbidity, taste, smell): 93%
- 5) Reduction of time needed for house work<sup>6</sup>: 95% (recognized reduction)

From the above results, it is considered that the project has contributed to the improvement of living conditions and sanitary environment.

Therefore, the project has largely achieved its development objective, and its effectiveness is considered high.

### 3.4 Impact

#### 3.4.1 Appearance of Intended Impacts

##### (1) Contribution to the Regional Economic Development

The invested amount by enterprises outside the province to Kunming and the exported amount are shown in Table 6.

Table 6 Invested Amount by Enterprises outside the Province and the Exported Amount

|  | 2006   | 2007   | 2008   | 2009   | 2010    |
|--|--------|--------|--------|--------|---------|
| Invested amount by enterprises outside the province (billion \$) | 151.95 | 197.13 | 251.12 | 346.13 | 467.289 |
| Exported amount from Kunming (million \$)                        | 2,330  | 3,261  | 3,542  | 2,972  | 5,327   |

Source: Response to the Questionnaire

Since the stable supply of safer water to private households and also to the commercial and industrial purposes became possible by the project, the number of enterprises including foreign firms such as Pepsi Cola, Nestle, and Caterpillar and the investment have increased and thus, the export to the neighboring countries (Thailand, Vietnam, Laos and others) has increased as well. The reason for reduction of the export amount in 2009 is that the world economy was affected by the Lehman's fall.

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<sup>6</sup> Since before the project, water stoppage and lack of water pressure occurred during day time, extra time was needed to store water during night time. After the project, water is available any time needed by getting a faucet turned on.

### 3.4.2 Other Impacts (Positive or negative impacts)

#### (1) Impacts on the surrounding environment

At appraisal, the two concerned issues were: i) impacts to the downstream water (flow volume and water quality) due to the dam construction; and ii) the sludge comes up during the process of water purification. Regarding the impacts to the downstream water, since Yunlong Dam is a reservoir, in which the impurity settles down and the water is purified by itself, the water purified to some extent has been discharged so that no negative impacts have been observed. In addition, since one of objectives for the reservoir construction was to distribute water to the irrigation facilities along the downstream area, the water distribution to the irrigation facilities has been made during the drought season for the past few years. Thus, no issues are observed. The sludge that came up during the purification process has been dried and compacted in the treatment facility within the purification plant, and has been transported to the designated reclaimed area.

#### (2) Land acquisition and Resettlement

The actual figures, including the land area acquired mainly for dam construction (about 85ha), the number of resettled people (about 11,800 persons), and costs for land acquisition and compensation for resettlement (652.57 million yuan for land acquisition and 181.08 million yuan for compensation paid to individuals with a total amount of 833.65 million yuan) were almost equal to the estimate at the planning stage.

According to the executing agency, a Resettlement Action Plan was prepared for resettlement of people. Compensation was paid by item and according to its value, and standard unit prices for land, buildings/houses, forest, arable land, orchards and others have been set. Compensation to the private properties was paid to each household and assets that belonged to the local government or community was paid to its group. People totaling about 11,800 have resettled to Anning City, Guangdu District, Xishan District and other locations in the suburb of Kunming by December 28, 2002. Some of resettled people are family members of the minority group. According to the executing agency, sufficient consideration was made for them so that they could maintain their traditional custom, culture, and life style also in the newly resettled area. Construction of cultural facilities in the dwelling area is one of examples provided. This was confirmed by seeing the houses, a church and a meeting place by the evaluation team while visiting the resettled area (Xishan District) inspecting the evaluation team. Through interviews with people resettled, it was confirmed that they were satisfied with the compensation made.

The compensation and welfare contents provided by the local government or communities include the following:

- 1) arable land: 1,000~1,300m<sup>2</sup>/person
- 2) land for dwelling: 100~150m<sup>2</sup>/household (depending on number of family members)
- 3) house: 22m<sup>2</sup>/person (brick house)
- 4) forest and cemetery: area taking into accounts the condition of the allocated site
- 5) access roads to the neighboring schools
- 6) continuous financial assistance: 600 yuan/person/year (for 20 years since July 2006)

Based on the above, it is considered that the social impact due to the land acquisition and resettlement has been well alleviated by provision of appropriate compensation and support.

### **3.5 Sustainability (Rating: ③)**

#### **3.5.1 Structural Aspects of Operation and Maintenance**

In 2006, Kunming Tongyong Water Supply Company (KTWSC), jointly owned by Kunming Water Supply Company and French Veolia Water Company, was established. The operation and maintenance work for the No. 7 Purification Plant has been entrusted to KTWSC. The number of KTWSC staff engaged in the operation and maintenance work for No.7 Purification Plant is 61, including 15 administrative staff and 46 technical staff. The number of staff of the Maintenance and Management Section of KTWSC, responsible for the repair work including the regular maintenance and comprehensive inspection, is 34 and that of the Business Operation Section is 14.

When the project was completed in May 2009, Yunnan Fengyuan Water Supply Company (YFWSC), which is owned by Kunming Water Supply Company (60%) and Yunnan Urban Investment and Construction Company (40%), was established. Since then YFWSC has been responsible for operation and maintenance of the intake facility (Yunlong Dam) and for the overall management of No. 7 Purification Plant, including its operation and maintenance work and the loan repayment.

#### **3.5.2 Technical Aspects of Operation and Maintenance**

Of the 46 technical staff of No. 7 Purification Plant, 10 staffs are senior technicians, with associate degrees or above are responsible for water treatment, and the remaining 36 are technicians. Of the 34 staff of the Maintenance and Management Section of KTWSC, 21 staffs have professional certificates (high voltage operation, electrician, hazardous chemicals, and others). The company's Personnel Section has regularly provided a staff training program on the daily operation work. In addition, a few times a year the joint venture company, Veolia Water Company, send experts to KTWSC for training. In August 2010, a water specialist provided a special training program on water treatment process, and an equipment specialist on the equipment operation and maintenance. The specially selected staff has been also sent to a

special training program outside of Kunming, and thus the company has been eager to educate staff and strengthen its institutional capacity.

### 3.5.3 Financial Aspects of Operation and Maintenance

YFWSC, instead of Kunming Water Supply Company, which was the executing agency during project implementation, has been responsible for operation and maintenance of the intake facility and for the overall management of No. 7 Purification Plant, including its operation and maintenance work and the loan repayment. The main sources of income for YFWSC are sales from raw water to KTWSC and the subsidy from Yunnan Province and Kunming city, which is used to repay its loans. The revenue and expenditures of Yunnan Fengyuan Water Supply Company for 2010 is shown in Table 7.

Table 7 Revenue and Expenditures of Yunnan Fengyuan Water Supply Company (2010)

| Item                                       | Million yuan |
|--|--------------|
| Business revenue                           | 114.69       |
| Non business revenue                       | 143.87       |
| Operation and Maintenance cost             | 68.63        |
| Depreciation of equipment and fixed assets | 96.31        |
| Financing expenses                         | 65.31        |
| Business revenue                           | 28.32        |

The financial status of YFWSC recorded a surplus in 2010.

The major share holder of KTWSC and YFWSC is Kunming Water Supply Company (100% owned by Kunming City), and thus the water business has been controlled and managed by Kunming Municipal Government. Since the transmitted and distributed water from No. 7 Purification Plant, with Yunlong Dam as its water resource, has occupied about 70% of supplied water to Kunming, the financial status of YFWSC is considered to be stable. The present water charge rate is 2.45 yuan/m<sup>3</sup> (for home use), which is slightly lower than that in other cities. According to the beneficiary surveys, 90% of respondents answered that the present water rate was reasonable. The change of water charge rates is eventually determined by the city's Price Regulation Bureau, referring to the water company's financial status, charge rates of other public utilities and other factors. As the on-going sewage work has been completed, the review of water charge rates will be made.

### 3.5.4 Current Status of Operation and Maintenance

Currently, YFWSC is responsible for operation and maintenance of the intake facilities at Yunlong Dam, and the high-quality water has been transmitted to No. 7 Purification Plant,

adjusting the opening gates. The amount of transmitted water has been measured at the transmission gate of the intake facility and at the intake gates of No.7 Purification Plant. The maintenance work for the intake facilities has been regularly carried out according to the relevant regulations and manuals.

KTWSC has been responsible for operation and maintenance of No.7 Purification Plant. Minor problems during regular operation are generally resolved by the Plant. Only when the problem is difficult to be resolved by the Plant, the Operations Section of KTWSC handles the problems. The Maintenance and Management Section of KTWSC is responsible for repair work, including the regular maintenance and comprehensive inspection.

Based on the above, since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is considered high.

## **4. Conclusion, Lessons Learned and Recommendations**

### **4.1 Conclusion**

The project objective was to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development through responding to the insufficient water supply capacity, as well as the ever increasing water demand, and providing stable supply of clean water by constructing the reservoir along the upstream of Zhangjiuhe river in the north of Kunming city, and a purification plant and its related water supply facilities. The project has been highly relevant because of its substantial impact to the Chinese and provincial development plans and needs, as well as Japan's ODA policies. The actual project cost exceeded the plan, and the project period was longer than planned. Therefore, its efficiency is considered moderate. The project has largely achieved its development objectives (to respond to the insufficient water supply capacity and ever increasing water demand, to provide stable supply of clean water, to contribute to the improvement of living conditions and sanitary environment, and to enhance the regional economic development), therefore its effectiveness is considered high. Since no major problems have been observed in the operation and maintenance system (organizational setup, technical capacity and financial status), sustainability of the project is also considered high.

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

### **4.2 Recommendations**

#### **4.2.1 Recommendations to the Executing Agency**

None.



#### 4.2.2 Recommendations to JICA

None.

#### 4.3 Lessons Learned

The project included construction of a reservoir (with a capacity of about 400 million m<sup>3</sup>), water conveying tunnels (about 100km), a purification plant (400,000 m<sup>3</sup>/day), and transmission/distributing facilities (with a total pipe line length of 90km). The actual total project cost was 69 billion yen. Each component was a huge civil work by itself. Due to lack of detailed technical investigations, major design changes/variations occurred during project implementation and the costs for land acquisition and resettlement exceeded the plan by about 40%. With respect to a huge project involving several major project components such as this project, it is recommended to invite external experts to the project appraisal team in order to improve the assessment and appraisal quality. It would be possible to reduce the design changes and variations and consequently to minimize cost increase and extension of the project period by undertaking more detailed review on the technical appropriateness to be applied.

### Comparison of the Planned and Actual Scope of the Project

| Item                       | Planned   | Actual   |
|----------------------------|---|--|
| ① Outputs                  |   |  |
| 1) Yunlong Dam (Reservoir) | <ul style="list-style-type: none"> <li>• Crest length: about 240m</li> <li>• Dam height: about 80m</li> <li>• Reservoir capacity: about 400 millionm<sup>3</sup></li> <li>• Reservoir area: 20km<sup>2</sup></li> <li>• Reinforced concrete gravity dam</li> </ul>  | <ul style="list-style-type: none"> <li>• About 240m, as planned</li> <li>• 77.3m, almost as planned</li> <li>• About 484 million m<sup>3</sup> (about 20% increase)</li> <li>• 20km<sup>2</sup>, as planned</li> <li>• As planned</li> </ul> |
| 2) Water Conveying Tunnel  | <ul style="list-style-type: none"> <li>• From Yunlong dam to No.7 purification dam about 100 km</li> </ul>  | <ul style="list-style-type: none"> <li>• About 100 km, as planned</li> </ul>   |
| 3) No.7 Purification Plant | <ul style="list-style-type: none"> <li>• Purification capacity: 400,000m<sup>3</sup>/day (Phase I)</li> <li>• Condensed sedimentation rapid filtration</li> </ul>   | <ul style="list-style-type: none"> <li>• Purification capacity: 400,00m<sup>3</sup>/day as planned</li> <li>• as planned</li> </ul>  |
| 4) Distributing Facilities | <ul style="list-style-type: none"> <li>• Total length of distributing pipes: about 90km</li> <li>• Pumping station: 2 units with a capacity of 50,000m<sup>3</sup>/day each</li> </ul>  | <ul style="list-style-type: none"> <li>• 93.4 km, almost as planned</li> <li>• Pumping station: as planned</li> </ul>  |
| 5) Consulting services     | <ul style="list-style-type: none"> <li>• Detailed designs/preparation of bidding documents, assistance in bidding and advice</li> <li>• Supervision and assistance/advice on construction of difficult works</li> <li>• Technical assistance/advice (including safeguard issues)</li> <li>• Inputs (foreign) 3 persons, 40M/M, (local) 3persons, 10M/M</li> </ul> | <ul style="list-style-type: none"> <li>• Scope of Work, as planned</li> <li>• Inputs (foreign) 8 persons, 44M/M, (local) 5 persons, 10M/M</li> </ul>   |
| ② Duration                 | March 2000 (L/A) ~<br>April 2006 (project completion)<br>(74 months)  | March 2000 (L/A) ~<br>March 2007 (Water supply)<br>(85 months)   |
| ③ Project cost             |   |  |
| Foreign currency           | 20,903 million yen  | 20,526 million yen   |
| Local currency             | 32,509 million yen  | 48,250 million yen   |
|                            | 2,167 million yuan  | 3,418 million yuan   |
| Total                      | 53,412 million yen  | 69,076 million yen   |
| Yen Loan Portion           | 20,903 million yen  | 20,526 million yen   |
| Exchange rate              | 1 Yuan = 15 yen<br>(as of June 1999)  | 1 yuan = 14.114 yen<br>(Average of September 2000 ~ September 2008)  |