

0. Summary

The project is highly relevant with the policy of the Chinese Government that aims to improve power supply capacity and develop clean energy as well as with the electricity needs of the target areas. It is also in line with the Japanese government’s assistance policy. Although the operation of the constructed power plants has been affected by precipitation (Changyang and Enshi power plants) and reservoir water levels (Baokang power plant), expected effects of the project have been largely generated with net electric energy production of about 80% of its targeted value in all three plants. On the other hand, there are some issues regarding the project’s efficiency given the higher than expected project costs and longer than planned project periods for the Enshi and the Baokang sub-projects. In addition, sustainability of the project has been somewhat challenged by the severe financial status of the implementing body of the Baokang sub-project due to the significant increase in the project cost and lower than expected energy production resulting from the construction of a power plant upstream. Little concern has, however, arisen in regards to technical and structural aspects of the operation and maintenance of all three power plants.

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

1. Project Description



Project Locations



Changyang Zhailaihe Hydropower Plant

1.1 Background

Electric power development has been given focus as a driving force to sustain high rates of economic growth in the People’s Republic of China (hereinafter referred to as China). Even though supply capacity had rapidly increased, demands for electricity were likely to continue to grow after 2000. Thermal power accounted for over 70 percent of the national electricity production and was causing serious environmental problems. With its abundant supply of coal, China promoted the development of coal-fired power generation to meet the increasing demand for electricity as a result of economic development. China’s equally abundant hydro resources were, on the other hand, mostly left unexploited. More than 70 percent of China’s hydro capacity was located in the western region, but less than 10 percent of this potential had been utilized. Consequently electricity supply capacity in some areas in inland China remained scarce. Under such circumstances, the major challenges China was facing in the energy sector including the diversification of power resources, poverty reduction through rural electrification and the

construction of small-scale hydro-electric power plants.

Hubei Province is located inland and enjoys abundant hydro resources. Although the province's GDP per capita was average for China at the time of the project appraisal, the province's rural areas still had many people living in poverty and both the national government and the provincial government designated the three target counties/city as impoverished areas. In 1999, Hubei Province's growth rate was 8.3% and the development of electricity infrastructure was considered imperative in order to sustain such growth. A substantial increase in electricity demand was expected in the three counties/city as well where insufficient electric supply in face of expanding demand had already constrained economic growth.

1.2 Project Outline

The objective of this project is to enhance the power supply capacity of the beneficiary counties/city and prevent air pollution by constructing small-sized hydropower plants with peak regulation capacity in Hubei province (an inland, water-abundant province), thereby contributing to the development of the local economy as well as poverty reduction.

Loan Approved Amount/ Disbursed Amount	9,152 million yen / 9,147 million yen
Exchange of Notes Date/ Agreement Signing Date	March 2001 / March 2001
Terms and Conditions	Interest Rate: 0.75% Repayment Period: 40 years (Grace Period: 10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	The Government of the People's Republic of China / The Hubei Provincial People's Government
Final Disbursement Date	October 2008
Main Contractor (Over 1 billion yen)	China Gezhouba Water & Power (Group) Co. (China), China Water Resources & Hydropower Engineering Bureau No. 11 (China)
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	"Zaolaihe Multi-purpose Hydroelectric Project Preliminary Design Report," Hubei Institute of Water Conservancy and Hydropower Engineering Survey and Design, December 1998. "Dalongtan Multi-purpose Dam Project Feasibility Study Report (Preliminary Design)," Investigation and Design Institute of Changjiang Water Resource Commission, October 1995. "Feasibility Research of Siping Water Power Plant," Hubei Water Resource Exploration and Design Institute, March 1999.
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Rie Fusamae, Foundation for Advanced Studies on International Development

2.2 Duration of Evaluation Study

Duration of the Study: November 2010 – December 2011

Duration of the Field Study: April 10, 2011 – April 27, 2011, June 27, 2011 – June 30, 2011

3. Results of the Evaluation (Overall Rating: B¹)

3.1 Relevance (Rating: ③²)

3.1.1 Relevance with the Development Plan of China

The project was aligned with the policies of the Chinese National Government as well as the Hubei Provincial Government at the time of the project appraisal. The Chinese Government launched an electricity reform plan (1998 to 1999) which aimed, in part, to expand clean-energy utilization, prohibit construction of small thermal power stations and shut down existing thermal power stations. The clean-energy resources the government assumed included small- and medium-scale hydroelectric power generation and therefore construction of hydroelectric power plants was to be given priority in the 10th Five-Year National Development Plan (2001-2005). The plan was expected to reduce poverty and to develop the local economy especially in the mountainous areas of the mid-western region. At the provincial level, the three sub-projects were included in priority projects identified in the Hubei Provincial Government's 9th Five-Year Development Plan. The target counties/city of Changyang County, Enshi City and Baokang County were all designated as testing counties by the State Council for the model small-scale hydropower project for rural electrification in China.

At the time of the ex-post evaluation, the 12th Five-Year National Development Plan (2011-2015) was formulated. The energy policy stated in the Plan (which continues from the 11th Plan) envisions the diversification of energy resources and the establishment of a system for safe, stable, efficient and clean energy production, and in so doing promotes hydropower. It also aims at rural electrification at the county level and extension of small-scale hydropower capacity in rural areas by 10 million kW. A summary of the 12th Five-Year Provincial Development Plan³, which also retains policies adopted in the 11th Plan, promotes energy saving and at the same time pursues expansion of power generation capacity, optimization of energy resource composition, and development of new energy resources. The project is therefore in line with the present policy of the Provincial Government. It should be noted, however, that as far as hydropower is concerned, the Provincial Government pursues sensible power development rather than the acceleration of development given that, by the end of the 11th Five-Year Plan period (2006-2010), 88.3% of the available hydro resources have been exploited or being exploited: the highest exploitation level among all the provinces.

3.1.2 Relevance with the Development Needs of China

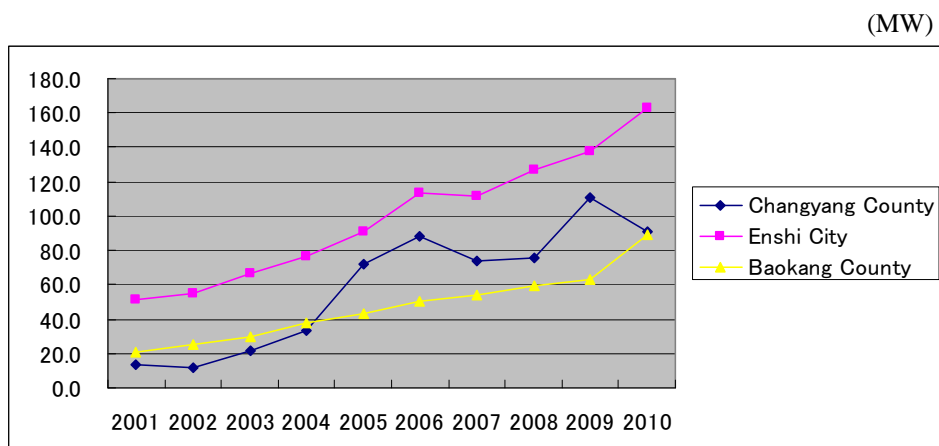
In 1998 before the ex-ante evaluation, China's coal-fired power output amounted to more than 70 percent of the national total, and the ratio of coal-fired plants was also high. This biased dependency caused problems including limited coal-transport capacities and air pollution in urban areas. On the other hand, China was rich in unexploited hydro-electric resources. In the 2000s, China started to reduce its dependence on thermal power, and promote the exploitation of renewable resources such as small-scale hydropower. By 2009, however, the ratio of thermal power in terms of output capacity remained around 75 percent. The need for renewable clean energy therefore remains high.

In addition, demand for electricity had surpassed supply in the target areas of the project at the time of the project appraisal whereas further increases in demand were expected due to economic development. Although the Hubei Provincial Government as well as the government of each county/city have strived to expand power generation capacity, growth in demand is still significant due to continued economic development (See Figure 1).

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

² ③: High, ② Fair, ① Low

³ A detailed plan is under development.



Source: Hubei Changyang Zhailaihe Hydroelectric Investment Ltd. (CZHI),
 Enshi Qingjiang Dalongtan Water and Electricity Exploiting Co. Ltd. (DWEE),
 Gezhouba Siping Water Power Electricity Exploration Ltd. (GSWEE)

Figure 1 Peak Load in Target Counties/City

3.1.3 Relevance with Japan's ODA Policy

The Japanese Government's Economic Cooperation Plan for China (2001) launched at the time of the project appraisal, called for protection of seriously threatened environments and social development in inland areas. Its priority issues included cooperation for global issues such as environmental problems and assistance for poverty reduction.

At the time, the Japan Bank for International Cooperation (JBIC) focused its assistance for China on three areas: 1) environment; 2) food and poverty; and 3) inland development to reduce regional disparities. JBIC specified the promotion of hydropower development as one of its priority areas. They also gave priority to projects that private capital would be reluctant to support, such as rural development projects for poverty reduction and efficient hydro resource utilization projects.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

A hydropower plant with a planned capacity was constructed on each project site. Planned outputs were delivered in the Changyang sub-project, and in the Enshi sub-project with minor change. For the Baokang sub-project, the type of the dam was changed to fit the geological conditions which were found to be different from those identified in the feasibility study. (See Table 1 and the last page of the report for details of the outputs.)

Table 1 Summary of planned and actual outputs

Sub-project	Planned	Actual	Reasons for Changes
Changyang	A hydropower plant with 3 units of 12MW capacity each [Major construction / equipment] Dam, Power Intake, Headrace Tunnel, Powerhouse, Electro-mechanical Equipment, and Permanent Highways.	As planned.	

Enshi	A hydropower plant with 3 units of 10MW capacity each [Major construction / equipment] Dam, Power Intake, Headrace Tunnel, Powerhouse, Electro-mechanical Equipment, Transmission Line, Distribution Line, and Pipeline for Water Supply.	Mostly as planned. - The type and length of a pipeline for water supply facility was changed. - A feed pump was added to the outputs.	The location of the water plant was yet to be determined at the time of planning.
Baokang	A hydropower plant with 2 units of two 30MW capacity units [Major construction / equipment] Dam, Spillway, Power Intake, Intake Tunnel, Powerhouse, and Electro-mechanical Equipment.	The type of the dam was changed from inclined clay-core rock fill dam to concrete-face rock fill dam.	Some geological conditions that had not been identified in the F/S were found.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The actual cost of the project was slightly higher than planned: amounting to 20,504 million yen, equivalent to 124% of the estimated cost. Of the total cost, the Japanese ODA loan covered 9,147 million yen or 100% of the planned amount whilst local investment amounted to 11,357 million yen, or 154% of the plan. (See Table 2)

Table 2 Planned and actual cost of the project

(Million yen)

Sub-project	Planned			Actual		
	Foreign Currency *1	Local Currency *2	Total	Foreign Currency	Local Currency *3	Total
Changyang	3,109	975	4,084	3,112	1,181	4,294
Enshi	3,365	1,508	4,873	3,365	2,406	5,771
Baokang	2,667	4,342	7,009	2,669	7,769	10,438
Price escalation	—	260	260	—	—	—
Contingency	10	299	309	—	—	—
Total	9,152	7,384	16,535	9,147	11,357	20,504

*1 Based on the amendment of the loan agreement agreed on November 2005.

*2 Converted to JPY at the rate used at the project appraisal (1 Yuan =13 yen).

*3 Converted to JPY at an average monthly rate during the loan period by ORANDA (1Yuan =14.41 yen)

Source: CZHI, DWEE, GSWEE

The actual cost covered by local currency significantly exceeded the plan with regard to the Enshi and the Baokang sub-projects. The causes of the excess in the Enshi sub-project were: the resource gap resulting from the depreciation of the yen against the Chinese Yuan which had to be filled; the costs for land acquisition and resettlement which turned out to be higher than initially estimated; and the ODA loan amount which was not sufficient to cover rising prices for construction materials and also to comply with instructions from the Construction Bureau of the Hubei Provincial Government to ensure construction quality.

In the Baokang sub-project, on the other hand, a significant amount of funding was spent on various adjustments made to fit the complex geological conditions of the project site, which included: the change of the dam type; more construction work for slop protection; more tunnelling and foundation works; and increased costs for compensation as a result of the expansion of areas to be submerged. A proposal for the increase of the project cost as well as

changes in outputs and volume of construction work was examined by the Hubei Province Development and Reform Commission and was approved as needed.

3.2.2.2 Project Period

The project period (from the signing of the Loan Agreement (L/A) to the start of full operations of all three power plants) was 68 months: slightly longer than the planned 61 months (111% of the plan). The period of each sub-project is shown in Table 3.

Table 3 Planned and Actual Periods of Sub-projects

Sub-project	Planned		Actual	
	Start	Completion	Start	Completion
Changyang	March 2001	March 2006	March 2001	March 2006
Enshi	(Signing of the L/A)	March 2005	(Signing of the L/A)	April 2006
Baokang		September 2003		October 2006

There were delays in the Enshi and the Baokang sub-projects whilst the Changyang sub-project was completed within the planned time period. The delay of the Enshi sub-project is attributable to a cofferdam accident resulting from a flood that occurred during the project implementation (See Section 3.4.2). Construction was suspended from May to October 2004 and then gradually resumed. On the other hand, since the construction area for the Baokang sub-project stretched beyond the authority of Xiangfan City which administers the Baokang County, administrative coordination for the resettlement of residents was protracted causing a significant delay to the start of the project.

As seen above, both the project cost and the project period exceeded the plan, therefore efficiency of the project is fair.

3.3 Effectiveness⁴ (Rating: ③)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

Major indicators show that there are no serious problems with the operations of the three power plants, although some indicators such as net electric energy production, capacity factor, and annual total volume of inflow to the reservoir have been affected by the varying amounts of rainfall from year to year (See Table 4).

Table 4 Key Operation and Effect Indicators

Indicator	Planned	Actual				Achievement rate (average)
		2007	2008	2009	2010	
Changyang Sub-project (Changyang Zhailaihe Hydropower Plant)						
Net Electric Energy Production (GWh/yr)	112	116.1	108.9	80.2	86.1	87%
Maximum Output (MW)	36	36	36	36	36	100%
Unplanned Outage Hours (hr/yr)	0	91	110	73	90	—
Planned Outage Hours / Hours in Operating Reserve* (hr/yr)	N.A.	2,256	2,688	3,816	3,768	—
Capacity Factor (%)	36	36.8	34.5	25.4	27.3	86%
Annual Total Inflow to the Reservoir (million m ³ /yr)	520	510	540	400	450	91%

⁴ Effectiveness is scored also in the light of factors regarding Impact.

Enshi Sub-project (Enshi Qingjiang Dalongtan Hydroelectric Power Plant)						
Net Electric Energy Production (GWh/yr)	130	105.5	117.2	83.9	101.9	79%
Maximum Output (MW)	30	30	30	30	30	100%
Unplanned Outage Hours (hr/yr)	0	0	0	0	0	—
Planned Outage Hours* (hr/yr)	N.A.	720	533	567	433	—
Hours in Operating Reserve* (hr/yr)	—	4,208	4,535	4,724	4,875	—
Capacity Factor (%)	49	48.5	44.6	31.9	38.8	84%
Annual Total Inflow to the Reservoir (million m ³ /yr)	2,200	2,803	2,548	1,532	1,605	96%
Baokang Sub-project (Gezhouba Siping Hydroelectric Power Plant)						
Net Electric Energy Production (GWh/yr)	181	151.6	157.7	134.7	154.2	83%
Maximum Output (MW)	60	60	60	60	60	100%
Unplanned Outage Hours (hr/yr)	0	0	0	0	0	—
Planned Outage Hours* (hr/yr)	60	60	60	60	60	—
Hours in Operating Reserve* (hr/yr)	—	2,394	2,613	3,280	2,980	—
Capacity Factor (%)	34	29.0	30.0	25.6	29.3	84%
Annual Total Inflow to the Reservoir (million m ³ /yr)	994**	991	999	722	783	88%

* Standby time determined by the power grid company as reserve capacity.

**The target was set at the time of the detailed design of the project, not at the planning stage.

Source: Minutes of Discussions signed on September 2000, CZHI, DWEE, GSWE

The operation of the Changyang Zhailaihe Hydroelectric Power Plant constructed under the Changyang sub-project has been good. With regard to net electric energy production and capacity factor, their targets were met in 2007 when there was a normal level of precipitation and even the averages for the 4 years following the project's completion exceeded 85% of the targets. Although there were unplanned outage hours every year, they were mostly due to requests from the state power grid company for power supply adjustment purposes.

The Enshi Qingjiang Dalongtan Hydroelectric Power Plant built under the Enshi sub-project reached on average about 80% of its target in terms of net electric energy production and capacity factor though its performance has been greatly affected by the amounts of rainfall.

The performance of the Gezhouba Siping Hydroelectric Power Plant of the Baokang sub-project has also been as good as the other two plants exceeding 80% of its target for the same indicators. However, its capacity has been constrained by on-going construction of another dam plant upstream, for the sake of which it has had to discharge water in the reservoir and therefore the water level in the reservoir has not risen to expected levels⁵. The power plant changed its target for yearly net electric energy production from 181 GWh to 158GWh for the period up to 2014 when the construction of the upstream dam will be completed.

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

The financial internal rate of return (FIRR) was recalculated on the same assumptions as those applied at the time of the appraisal (See Table 5). The results show that the FIRR is lower than estimated at the time of the appraisal for each of the three sub-projects.

⁵ Although actual annual total inflow to the reservoir is not far from the target as can be seen in Table 4, the target was set taking the impact of the upstream dam construction into consideration.

Table 5 FIRR for each sub-project

Sub-project	At appraisal	At ex-post evaluation
Changyang	8.9%	4.1%
Enshi	6.5%	2.4%
Baokang	7.0%	1.7%

A main factor underlying the lower FIRR is that the incomes of all three power companies from electricity sales are lower than initially estimated due to the lower unit prices set by the government (See Section 3.5.3 for details). As far as the Baokang sub-project is concerned, the substantial increase in the project cost has also contributed to the lower than expected FIRR.

3.3.1.3 CO2 Emission Reduction

CO2 emission reduction was recalculated for each power plant based on annual energy production in 2007 when precipitation was normal. The levels of emission reduction were almost as expected (See Table 6)⁶.

Table 6 CO2 Emission Reduction

Sub-project	(ton/year)	
	Estimated at appraisal	Actual (2007)
Changyang	approx. 97,000	approx. 107,000
Enshi	approx. 113,000	approx. 118,000
Baokang	approx. 157,000	approx. 141,000

3.3.2 Qualitative Effects

Through interviews and questionnaires, the evaluation team surveyed some major consumers of electricity in the three counties/city regarding electricity supply including corporations, factories and medical institutions. The results show a high level of satisfaction for electricity supply: all 23 respondents answered that supply is sufficient and stable; 16 of the respondents indicated that they have fewer power outages; and many of them pointed out that there are no longer restrictions on the use of electricity and short-time power outages occur only a few times a year for maintenance purposes and that they are always informed beforehand. It should be kept in mind, however, that such improvements cannot necessarily be attributed to the effects of the three projects since all three power plants are connected either to a local power grid or a provincial power grid and therefore distribution areas by any one particular plant cannot be specified.

Based on the above observations, it can be concluded that this project has largely achieved its objectives; therefore its effectiveness is high.

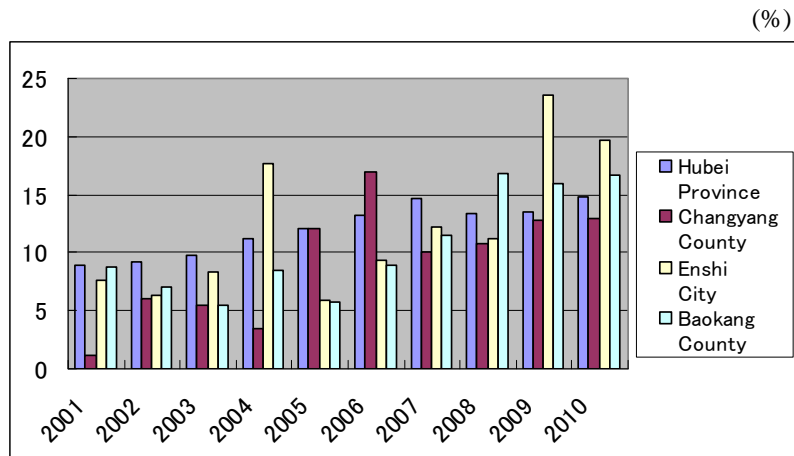
3.4 Impact

3.4.1 Intended Impacts

3.4.1.1 Impacts on the Local Economy and Poverty Reduction

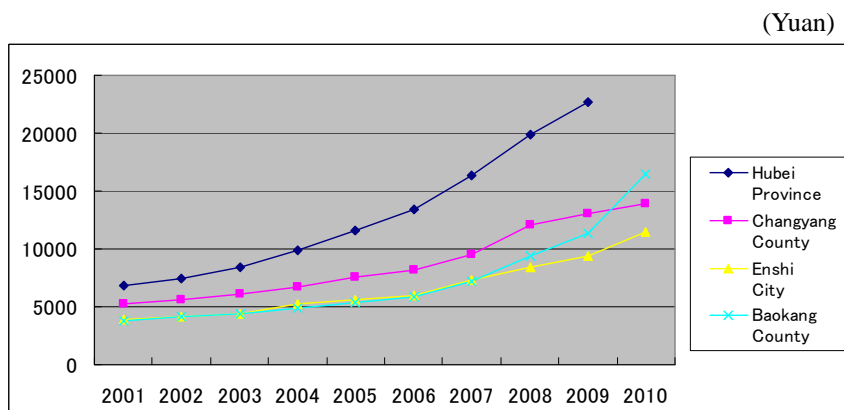
Particularly since 2007, the economies of the three counties/city have been growing (See Figure 2 and Figure 3). Enshi City marked higher growth rates than those of Hubei Province in 2009 and 2010, and Baokang County marked higher growth than the Province after 2008.

⁶ Carbon emission reduction is calculated based on the following calculation formula adopted at the appraisal: Annual electric energy production converted in TJ (energy unit) x Carbon Emission Factor (CEF) for coal x a fraction value of carbon oxidized for coal. It was then converted to CO2 emissions. ("Revised IPCC Guidelines for National Greenhouse Gas Inventories," Work Book (Volume 2) and Reference Manual (Volume 3).)



Source: Hubei Province Statistics Yearbooks, County/City Governments

Figure 2 GDP Growth Rates by County/City



Source: Hubei Province Statistics Yearbooks, County/City Governments

Figure 3 GDP per capita by County/City

Poverty has been reduced in all the three counties/city as their economies have grown. In Changyang County, the number of people living in poverty has decreased from 133 thousands in 2005 to 93 thousands in 2010, whilst the poverty ratio reduced from 47% to 35% in Enshi City and from 38% to 25% in Baokang County in the same time period. It is however difficult to clarify a correlation between the project and poverty reduction or economic growth given the fact that power distribution areas cannot be specified as mentioned above and also given that there have been many newly constructed power plants within the same power networks.

The major electricity consumers surveyed by the evaluation team acknowledged that the recent improvement in the power supply which includes the project's contribution is a promoting factor in the development of the local economy (See Table 7).

Table 7 Results of Surveys of Major Electricity Consumers about Impact of Improved Power Supply on Local Economy

Response	Number of respondents (total number of respondents)			
	Changyang (5)	Enshi (7)	Baokang (6)	Total (18*)
Revenues in the manufacturing industry have increased.	3	5	5	13
Employment opportunities have expanded.	4	5	4	13
Revenues in the service industry have increased.	2	3	5	10
Agricultural productivity has improved.	2	2	5	9
Investments have increased.	1	4	3	8

*The number of valid responses was 18 out of a total of 23 respondents.

Surveyed consumers also responded that: power outages have been reduced (16 respondents); the income level has increased (9 respondents); and employment opportunities have expanded (9 respondents). Such responses indicate that improved power supply has positively impacted the lives of local residents.

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

Based on recommendations made in the reports on environmental impact assessment conducted by independent institutions prior to the project appraisal, the implementing bodies took measures for the conservation of water quality, ecosystems and landscape. They also reconstructed submerged infrastructures and took action to reduce the impact on transportation.

Water quality, air quality and noise during the construction were regularly monitored (annually or a few times a year) either by the implementing bodies or the county/city governments. In addition, wastewater from construction sites, smoke from boilers, soil and public health were also monitored in some project sites. Monitoring activities have not uncovered any serious problems⁷.

All the three sub-projects passed the provincial government's environmental protection inspections⁸, which identified no serious impacts on the environment.

3.4.2.2 Land Acquisition and Resettlement

Areas of land acquired and the number of people relocated are largely as estimated in Changyang and Enshi. In the Baokang sub-project, on the other hand, more land acquisition than planned was required.

⁷ Environmental monitoring reports of the Changyang County Government, the Enshi City Government and the Baokang County Government, and interviews with them.

⁸ An inspection to examine the appropriateness of environmental protection measures and actual impacts on the environment was carried out on each project at its completion by a team led by the Hubei Provincial Government and consisted of representatives from the environmental protection bureaus of the concerned local governments and environmental experts.

Table 8 Area of Land Acquisition and Number of Relocated People

Sub-Project	Area of Land Acquisition		Number of Resettled People	
	Planned	Actual	Planned	Actual
Changyang	approx. 150ha	145ha	approx. 100	153
Enshi	approx. 180ha	113ha	approx. 2,000	1,063
Baokang	approx 340ha	873ha	approx. 3,000	3,479

Source: JICA documents, County/City Governments

The resettlement process included the following steps: public consultation; assessment of compensation; notification of compensation policy; signing of agreement with residents to be relocated; development of lifelines; and relocation of residents. Actual relocation took place normally about a year after public consultation, but in the shortest case, residents had only three months before relocation. The amount of compensation was assessed by certified institutions based on the government's compensation standards. Compensation and some additional support were provided largely according to resettlement plans prepared prior to the project appraisal with regard to the Changyang and the Enshi sub projects. Regarding the Baokang sub-project, the commencement of the project was substantially delayed as mentioned above and therefore the County Government took action to speed up the resettlement process by providing extra compensation to those to be relocated and also by applying the government's preferential treatment for farmers to them. The payment of compensation was completed in all three sub-projects⁹.

The evaluation team visited and interviewed some resettled residents in Enshi City (4 households) and Baokang County (3 households) in order to learn about the current state of resettled people and the actual resettlement process. All of the interviewees noted that their income has increased and their standard of living has improved after resettlement, though in 6 of the 7 households, the increased income is explained by the fact that they gave up farming and have become migrant workers. All respondents also answered that the period from public consultation to relocation was sufficient. In Changyang, interviews were cancelled in consideration of differences in understanding between the County Government and resettled residents regarding the compensation standards¹⁰.

3.4.2.3 Unintended Positive/Negative Impact

In May 2004, a cofferdam built in the project site collapsed due to a flood in the Qingjiang River area where the Enshi sub-project was located, killing construction workers and passengers on a microbus which was driving on a downstream river bank. Construction was gradually resumed after October 2004 when the Enshi City Government confirmed that safety standards were adequate. In order to prevent such an accident, the City Government as well as the implementing body took preventive measures including occasional inspections on construction safety, reinforcement of a warning system for citizens, training of concerned staff of the implementing body and the government to enhance accident management, preparation of preventive measures by the project against flood accidents.

To sum up, the expected positive impacts have been observed. Although there was a negative impact during the project implementation, the concerned government and the implementing body have taken appropriate countermeasures and action to prevent similar incidents.

⁹ Interviews with County/City Governments of Changyang, Enshi and Baokang and relocated residents.

¹⁰ Changyang County Government

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

Operation and maintenance of the constructed power plants have been undertaken by the implementing bodies of the respective sub-projects, namely the Hubei Changyang Zhailaihe Hydroelectric Investment Ltd. (CZHI), and the Enshi Quingjiang Dalongtan Water and Electricity Exploiting Co. Ltd. (DWEE), both of which were established for the construction, operation and maintenance of respective power plant with funds from local power companies, state-owned enterprises (SOEs) and private firms. Initial shareholders of both companies have all been replaced in line with the government's reform process of SOEs which began in 2004. The change have had no significant financial and organizational impacts so far while management and administration have been more ordered by, for example, applying more strict accounting standards¹¹. For the Baokang sub-project, Hubei Nanhe Water Power Electricity Exploration Ltd. (NWPEE) was initially set up in the same manner as the CZHI and the DWEE, and looked after preparatory work for the project. However, since the ODA loan amount was less than they had expected before the project appraisal, a new company Gezhouba Siping Water Power Electricity Exploration Ltd. (GSWEE)¹² was founded in September 2003 to raise more funds with investment from NWPEE's shareholders to engage in construction, operation and maintenance of the plant.

Compared to the initial plan, all three companies have downsized their manpower usage. The actual number of CZHI and DWEE personnel is about 70% compared to the plan (See Table 9). Nevertheless, routine operation and maintenance of the plants have been carried out without difficulty on three shifts by three persons per shift. Operation and maintenance records have been thoroughly kept in all three power plants and there have been no unplanned outage hours for mechanical failures and human error.

Table 9 Number of Personnel of Implementing Bodies

Implementing body	Planned	Actual (operation & maintenance personnel)
Hubei Changyang Zhailaihe Hydroelectric Investment Ltd.	36	25 (12)
Enshi Quingjiang Dalongtan Water and Electricity Exploiting Co. Ltd.	71	49 (36)
Gezhouba Siping Water Power Electricity Exploration Ltd.	--	49 (26)

Source: CZHI, DWEE, GSWEE

3.5.2 Technical Aspects of Operation and Maintenance

All three companies have technical staff with many years of experience: an average of 10 to 20 years in CZHI and GSWEE; and 5-10 years in DWEE. They received training from the project's equipment suppliers and after the project completion, each company organized training by themselves and also sent their staff to training organized by quality control authorities and power industry groups. No concerns regarding technical capability were found in the evaluation study.

3.5.3 Financial Aspects of Operation and Maintenance

Financial status of the three companies is shown in Table 10.

¹¹ Interviews with the CZHI and the DWEE.

¹² The company does not have an official English name and therefore the name here is given by the external evaluator only for the sake of report writing.

Table 10 Financial Status of Implementing Bodies

	2007	2008	2009	2010
Hubei Changyang Zhailaihe Hydroelectric Investment Ltd.				
Current assets (thousand Yuan)	72,017	68,018	66,227	75,921
Total assets (thousand Yuan)	365,740	358,017	348,226	347,885
Current liabilities (thousand Yuan)	9,112	16,704	8,906	9,423
Equity capital (thousand Yuan)	100,235	53,860	64,681	47,548
Sales (thousand Yuan)	33,450	31,365	23,059	24,857
Net profit (thousand Yuan)	N.A.	9,956	5,008	6,142
Liquidity ratio (%)	790.4	407.2	743.6	805.7
Equity ratio (%)	27.4	15.0	18.6	13.7
Return On Assets (%)	N.A.	2.8	1.4	1.8
Net profit to sales ratio (%)	N.A.	31.7	21.7	24.7
Enshi Quingjiang Dalongtan Water and Electricity Exploiting Co. Ltd.				
Current assets (thousand Yuan)	40,194	10,878	9,635	26,309
Total assets (thousand Yuan)	415,280	372,471	353,553	359,126
Current liabilities (thousand Yuan)	70,700	47,627	60,288	36,481
Equity capital (thousand Yuan)	84,874	87,918	43,988	19,204
Sales (thousand Yuan)	31,076	34,662	22,668	27,835
Net profit (thousand Yuan)	1,783	1,615	-11,853	6,458
Liquidity ratio (%)	56.9	22.8	16.0	72.1
Equity ratio (%)	20.4	23.6	12.4	5.3
Return On Assets (%)	0.4	0.4	---	1.8
Net profit to sales ratio (%)	5.7	4.7	---	23.2
Gezhouba Siping Water Power Electricity Exploration Ltd.				
Current assets (thousand Yuan)	47,134	38,963	45,458	45,538
Total assets (thousand Yuan)	736,737	724,287	713,168	695,703
Current liabilities (thousand Yuan)	316,237	320,411	96,845	91,024
Equity capital (thousand Yuan)	89,470	41,916	39,349	17,741
Sales (thousand Yuan)	45,114	45,973	39,890	45,677
Net profit (thousand Yuan)	-5,525	-16,623	-7,552	-1,644
Liquidity ratio (%)	14.9	12.2	46.9	50.0
Equity ratio (%)	12.1	5.8	5.5	2.6
Return On Assets (%)	---	---	---	---
Net profit to sales ratio (%)	---	---	---	---

* Figures exclude "foreign currency gains/losses" indicated in each company's profit and loss statement.

** Sales from water supply are included.

Sources: Financial statements of CZHI, DWEE and GSWEE

There are no serious problems with the financial condition of the CZHI. The DWEE has also made profits except for 2009 when the precipitation level was low. The GSWEE has operated at a loss due to the larger than planned project investment on the one hand and the much lower than estimated sales income on the other. Both the lower than anticipated electricity production and the lower than anticipated electricity unit price has led to low sales income. The unit price was set by the government at 0.36 Yuan/kWh while the price recommended at the time of the appraisal was 0.559 Yuan/kWh¹³. As a result, income from sales has been less than half its target

¹³ For the power plant in Changyang, a recommended price was 0.58 Yuan/kWh, and for the Enshi power plant, 0.36 Yuan/kWh.

(See Table 11).

Table 11 Targeted and Actual Sales Income

Implementing body	Target (million Yuan)	Actual (million Yuan)				Achievement rate (average)
		2007	2008	2009	2010	
Hubei Changyang Zhailaihe Hydroelectric Investment Ltd.	45	39.1	36.7	27.0	29.1	73%
Enshi Qingjiang Dalongtan Water and Electricity Exploiting Co. Ltd.	67	36.4	40.9	29.4	35.6	53%
Gezhouba Siping Water Power Electricity Exploration Ltd.	101	52.8	53.8	46.7	53.5	52%

Note: Both targeted and actual figures include 17% VAT.

Source: CZHI, DWEE, GSWEE

Although the GSWEE submitted a request to the Hubei Provincial Government for rescheduling of the loan repayment, it is unlikely to be approved by the the Export-Import Bank of China¹⁴. The GSWEE expects that electric energy production will reach its original target after 2014 when the construction of the upstream power plant will be completed, and thereby the financial condition of the company will improve with estimated annual net profit of 10 million Yuan¹⁵. Although the GSWEE is not likely to receive any support from the Baokang County Government, which has made it clear that it is not in a position to provide any financial support to a stock company, the Hubei Provincial Government does not regard the GSWEE's financial problem as serious since the company's largest shareholder is a SOE.

3.5.4 Current Status of Operation and Maintenance

All three power plants have had no major troubles with their facilities and equipment. Daily check-ups of equipment have been done and periodic inspection has been provided in each power plant on a monthly, quarterly or annual basis. All the power plants have had an overhaul every year. Inspections of the dam have been carried out every month or a few times in the flood season depending on the power plant. In addition, operation and maintenance records have been properly kept in all three power plants as mentioned above.

All necessary spare parts are available within the country and there is no difficulty with their procurement.

The above findings indicate that since some problems have been observed in terms of the financial condition regarding operation and maintenance, the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project is highly relevant with the policy of the Chinese Government that aims to improve power supply capacity and develop clean energy as well as with the electricity needs of the target areas. It is also in line with Japanese government's assistance policy. Although the operation of the constructed power plants have been affected by precipitation levels (Changyang and Enshi power plants) and water levels in the reservoir (Baokang power plant), expected effects of the project have been largely generated with net electric energy production of about

¹⁴ Response from Export-Import Bank of China to an inquiry from JICA China Office

¹⁵ A request made by the Baokang County Government for rescheduling.

80% of its targeted value in all three plants. On the other hand, there are some issues regarding efficiency of the project given the higher than expected project costs and longer than planned project periods in both the Enshi and the Baokang sub-projects. In addition, sustainability of the project has been somewhat challenged by the severe financial status of the implementing body of the Baokang sub-project due to the significant increase in the project cost and lower than expected energy production resulting from the construction of a power plant upstream. Little concern has however arisen in technical and structural aspects of operation and maintenance regarding all three power plants.

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

4.2 Recommendations

None.

4.3 Lessons Learned

The project has been affected by the construction of another power plant in a different county. In such a case, it is necessary for the upper tiers of the administration such as the provincial government or the city government to take the lead in advance coordination or to consider appropriate impact mitigation measures.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	<p>1) Changyang Sub-project A hydropower plant with 3 units of 12MW capacity each. a. Dam: a double curvature arch dam, spillways b. Power diversion: a power intake, headrace tunnels, a surge chamber c. Powerhouse d. Electro-mechanical equipment: turbines, generators e. Switch yard and relevant equipment f. Permanent highway* g. Seepage control facility*</p> <p>2) Enshi Sub-project A hydropower plant with 3 units of 10MW capacity each. a. Dam: a concrete gravity dam, spillways b. Power diversion: a power intake, headrace tunnels, a surge chamber c. Powerhouse d. Electro-mechanical equipment: turbines, generators e. Switch yard and relevant equipment f. Transmission and distribution lines g. Urban water supply facility: a pipeline for water supply</p> <p>3) Baokang Sub-project A hydropower plant with 2 units of two 30MW capacity units a. Dam: a clay stone core wall dam, spillways b. Power diversion: a power intake*, headrace tunnels*, a surge chamber c. Powerhouse d. Electro-mechanical equipment: turbines, generators e. Switch yard and relevant equipment</p>	<p>As planned.</p> <p>Mostly as planned: - The type and length of a pipeline for water supply facility were changed from a concrete pipe of 9,860m to a ductile pipe of 875m. - A feed pump was added to the outputs.</p> <p>The type of the dam was changed from a clay-core rock fill dam to concrete-face rock fill dam.</p>
2. Project Period	March 2001 – March 2006 (61 months)	March 2001 – October 2006 (68 months)
3. Project Cost		
Amount paid in Foreign currency	9,152 million yen	9,147 million yen
Amount paid in Local currency	7,384 million yen (568 million Yuan)	11,357 million yen (788 million Yuan)
Total	16,535 million yen	20,504 million yen
Japanese ODA loan portion	9,152 million yen	9,147 million yen
Exchange rate	1 Yuan = 13 yen (As of March 2001)	1 Yuan = 14.41 yen (Average between March 2001 and October 2008)