Ex-Post Project Evaluation 2010: Package II-3
(China, Mongolia)

December 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

FOUNDATION FOR ADVANCED STUDIES ON INTERNATIONAL DEVELOPMENT

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Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2008, and Technical Cooperation projects and Grant Aid projects, most of which project cost exceeds 1 billion JPY, that were mainly completed in fiscal year 2007. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

December 2011
Masato Watanabe
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations, the English translation of the original Japanese version, shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

China

Ex-Post Evaluation of Japanese ODA Loan
"Hubei Small-Sized Hydropower Project"

External Evaluator: Rie Fusamae,
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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/ Loan 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: B[1])

3.1 Relevance (Rating: ③[2])

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 Plan[3], 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).

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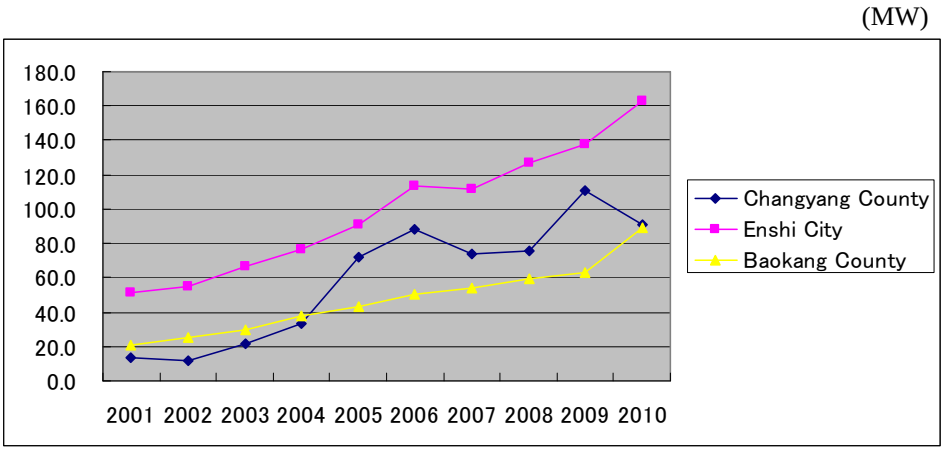
[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[2] ③: High, ② Fair, ① Low

[3] A detailed plan is under development.



Source: Hubei Changyang Zhailaihe Hydroelectric Investment Ltd. (CZHI),
Enshi Quingjiang 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 (1Yuan =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 (Signing of the L/A)	March 2006	March 2001 (Signing of the L/A)	March 2006
Enshi		March 2005		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 Effectiveness[4] (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				
		2007	2008	2009	2010	Achieve-ment rate (average)
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 Quingjiang 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 m3/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 m3/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, GSWEE

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 Quingjiang 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 levels[5]. 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

(ton/year)

Sub-project	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.

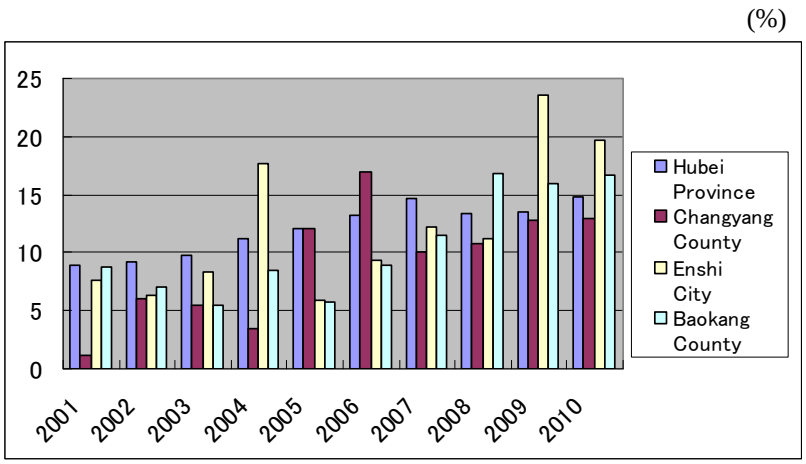
3.4 Impact

3.4.1 Intended Impacts

3.4.1.1 Impacts on the Local Economy and Poverty Reduction

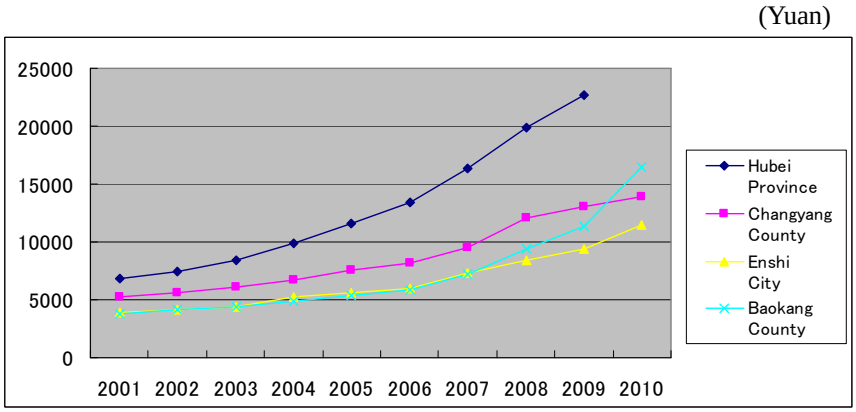
Particularly since 2007, the economies of the three counties/city have been growing (See Figure 2 and Figure 3). Enshi City marked higher growth rates than those of Hubei Province in 2009 and 2010, and Baokang County marked higher growth than the Province after 2008.

[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 problems[7].

All the three sub-projects passed the provincial government's environmental protection inspections[8], 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-projects[9].

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 standards[10].

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 standards[11]. 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/kWh[13]. 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 Quingjiang 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 China[14]. 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 Yuan[15]. 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	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*	As planned.
	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	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.
	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	The type of the dam was changed from a clay-core rock fill dam to concrete-face rock fill dam.
2.Project Period	March 2001 – March 2006 (61 months)	March 2001 – October 2006 (68 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 9,152 million yen 7,384 million yen (568 million Yuan) 16,535 million yen 9,152 million yen 1 Yuan = 13 yen (As of March 2001)	 9,147 million yen 11,357 million yen (788 million Yuan) 20,504 million yen 9,147 million yen 1 Yuan = 14.41 yen (Average between March 2001 and October 2008)

The People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan

Small-scale Hydropower Plant Construction Project in Gansu Province

External Evaluator: Naomi Ichimiya

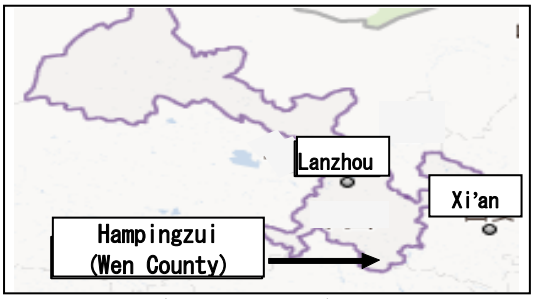
Foundation for Advanced Studies on International Development

0. Summary

This project has been highly relevant with China's development plan and development needs, as well as Japan's ODA policy at that time. The constructed small-scale hydropower plant has shown no major problem to produce the target value of 72 MW, demonstrating high effectiveness of this project. The project expenditure and period slightly exceeded planned values, but only to increase the project's effectiveness, or because the modification was unavoidable under the given circumstance at that time. Expected impacts are also observed; after the plant construction, within the power grid to which the plant supplied electricity, electric shortage was largely reduced. This led to development of local industries and increased income earned by the poverty population. The power station provides employment opportunities to the local residents and also pays careful attention and effective arrangements to the surrounding societies, an example of which is seen in the infrastructure development by the station. The station possesses sufficient technological, financial, operational, and staffing capabilities, demonstrating a high level of sustainability. In fact, operational conditions of the station are thought to be the best among the many small-scale hydropower stations in the region.

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

1. Project Description



(Project Location)

(Turbine Building, Hanpingzui 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, demand for electricity was likely to continue to grow after 2000 exceeding the increased supply capacity. Thermal power accounted for over 70 % of the national electricity production and was causing serious environmental problems. With its abundant supply of coal and pressure to sustain fast economic growth, China promoted the development of coal-fired power generation to meet the demand for electricity. China's equally abundant hydro resources were, on the other hand, mostly left unharnessed. More than 70 % of China's hydro capacity was located in

the inland western region, but less than 10 % of this potential had been utilized. Consequently electricity supply capacity in these areas remained limited. Under such circumstances, China faced challenges in the energy sector such as the diversification of power resources, the construction of hydro-electric power plants and electrification in inland rural areas, and poverty reduction through it.

The Gansu Province, the target province of this project, is located inland in the north western region of China, and is one of the least developed provinces nationwide. Under the nation's Western Development Program in 1999, Gansu Province was undergoing economic development with anticipation for an 8% GDP growth in 2000. Improvement of electric infrastructure in urban as well as rural areas was seen imperative in order to sustain such economic growth. Wen County of Longnan City, the plant construction site located in provincial boundary, was recognised as the state-level disadvantaged county though it has rich mineral and water resources. In Longan city, with a traffic and railway hub to connect between north-western and south-western part of China a steep increase in electric demand was anticipated. However its power supply did not increase to meet the demand and this hindered the economic development of the city.

1.2 Project Outline

The objective of this project is to improve electric supply capacity and prevent air pollution by constructing a small-scale hydropower plant with output control capability, thereby contributing to economic development and poverty reduction of the area.

Loan Approved Amount/ Disbursed Amount	6,543 million yen / 4,638 million yen
Exchange of Notes Date/ Loan 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: Within 6 years from signing the Loan Execution: - General untied
Borrower / Executing Agency(ies)	Gansu Province People's Government[1] /Guarantor: NA
Final Disbursement Date	October, 2007
Main Contractor (Over 1 billion yen)	-China Water Resources & Hydropower Engineering Bureau NO.11, China. -China National Electric Equipment Corporation, China.
Main Consultant (Over 100 million yen)	NA
Feasibility Studies, etc.	-Project Plan：Northwest Investigation Design and Research Institute, June, 1997. -Feasibility Study：Northwest Investigation Design and Research Institute, February, 1999. -Environmental Impact Assessment：Northwest Investigation Design and Research Institute, February, 1999 - Resettlement Plan：Northwest Investigation Design and Research Institute, February, 1999
Related Projects (if any)	This project was originally composed of Hanpingzui sub-project (Wen County, Longnan City, Gansu Province) and

[1] While this project's executing agency is the Gansu Province People's Government the actual construction was executed by Gansu Electricity Joint Corporation (Renamed to Gansu Keyuan Electric Corporation in 2009). This arrangement was done under policies of the Provincial Department of Finance to not directly execute infrastructure project, but instead entrust it to executing contractors.

	Longshou sub-project (Zhangye City, Gansu Province). The Longshou sub-project, due to circumstances at the Chinese side, later turned out from the loan scope. This project's mid-term review in 2005 confirmed that construction at Langshou had completed with Chinese budget.

2. Outline of the Evaluation Study

2.1 External Evaluator

Naomi Ichimiya, Foundation for Advanced Studies on International Development

2.2 Duration of Evaluation Study

Duration of the Study: Duration of the Study: November 2010 – December 2011

Duration of the Field Study: April 10th – April 23rd, 2010, and June 19th – June 23rd, 2011.

2.3 Constraints during the Evaluation Study (if any):

None

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

3.1 Relevance (Rating: ③[3])

This project maintained a high level of relevance with China's development policies at the time of ex-ante evaluation as well as at the time of ex-post evaluation.

At the time of ex-ante evaluation, at the national level, China launched an electricity reform plan (1998 to 1999) which aimed, in part, to expand clean-energy utilization, prohibit new construction of small thermal power stations and shut down existing small thermal power stations as well. 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 also put stress on reducing poverty and developing the local economy especially in the mountainous areas of the mid-western region.

At the provincial level, in inland and water resource-rich Gansu Province, GDP per capita was below the national average and poverty rate in the rural area was worse than the national average. Hanpingzui Hydropower Plant construction was recognized as a major project in the 9th Five-year Plan of Gansu Province and Wen County, construction site for Hanpingzui Hydropower Plant, was set as a test county by the Chinese State Council for the model small-scale hydropower project for rural electrification in China.

At the time of the ex-post evaluation, at the national level the 12th Five-year Plan (2011-2015) was formulated. The energy policy in the plan and the energy strategy, the Xidian Dongsong ("generate the electricity in the West, send it to the East") envision the diversification of energy resources and the establishment of a system for safe, stable, efficient, and environmentally clean energy production, and in so

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

[3] ③: High, ② Fair, ① Low

doing hydropower was promoted. It also aims at rural electrification at the county level and extension of small-scale hydropower capacity in rural areas by 10 million kW. In accordance, the 11th Five-year Renewable Energy Development Plan outlined importance to advance clean-energy technologies and utnilization of renewable resources such as abundant hydropower in rural areas.

At the provincial level, the 12th Five-year Plan (2011 - 2016) of Gansu Provincial set for designing hydro utilization plans including plant construction.

In light of the above, at the time of ex-post evaluation, this project was highly relevant with the state's as well as province's development plans.

3.1.2 Relevance with the Development Needs of China

This project maintains a high level of relevance with development needs of China as same as that of Gansu Province at the times of ex-ante evaluation as well as at the time of ex-post evaluation.

[Development Needs for Energy] In 1998 before the ex-ante evaluation, China's coal-fired power output amounted to more than 70 % 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 unharnessed hydro-electric resources. In the 2000s, China started to reduce its dependence on thermal power, and promote the utilization of renewable resources such as small-scale hydropower. By 2009, however, the ratio of thermal power in terms of output capacity remained around 75 %. The need for renewable clean energy, therefore; remained high.

[Regional Development Needs] In 1999, the Chinese government launched the Western Development Program to reduce disparities between the developed coastal east and the less developed inland west. Gansu Province became one of the targeted regions in this program. Wen County of Longnan City, this project's site, was recognized as a state-level disadvantaged county at the time of both ex-ante evaluation and ex-post evaluation. Income per capita in Wen County recorded 791.59 yuan[4] in 2000, whereas the national average was 2,253.42 yuan[5] in the same year. In 2009, the income per capita remained far below the national average; 2,220.00 yuan[6] in Wen Country while the national average was 5,153.17 yuan[7]. The population below poverty line was 51.8 %[8], with most of which being farmers, suggesting a county level of high development needs.

In Longnan City including Wen County electric supply was predicted to fall behind the demand increasing from economic development. For example, supply shortage was predicted to worsen from 27MW in 1999 to 56MW in 2003[9]. In the post-evaluation period, as shown in the below figure, demand and supply in Gansu Province in 2008 doubled from the 2000 level as a result of regional development. Supply increased by 40 %, which was slightly overridden by 43% demand increase, enforcing the province

[4] Gansu Province. Gansu Yearbook. 2001. http://www.gsei.com.cn/ziliao/shuju/default.asp
[5] China National Statistics Office. China Statistics Yearbook. 2001 http://www.stats.gov.cn/english/statisticaldata/yearlydata/YB2001e/ml/indexE.htm
[6] Gansu Province. Gansu Yearbook. 2010. http://www.gsei.com.cn/ziliao/shuju/gansu2010/default.htm
[7] China National Statistics Office. China Statistics Yearbook. 2010. http://www.stats.gov.cn/tjsj/ndsj/2010/indexeh.htm
[8] Gansu Development and Reform Committee. Gansu Province Analysis on Serious Issues in the First Half of 12th 5-Year Plan. http://www.gspc.gov.cn/gs125gh/ShowArticle.asp?ArticleID=3972, 2010/3/302
[9] JICA Documents (Ex-ante Evaluation Appraisal)

government to import surplus electricity from outside of the province.

In light of the above, this project at the times of ex-ante evaluation as well as at the time of ex-post evaluation has met needs of national energy policy as well as regional development needs.

Table 1 Electric Demand and Supply in Gansu Province

Unit: Twh Unit:%

Year / Contents	2000	2005	2007	2008	2005	2008
Electric Supply	**295.34**	**489.48**	**614.74**	**677.76**	**Account for the supply**	
Province Supply	280.27	506.17	618.76	690.39	-	-
Hydro	114.36	166.47	194.39	222.35	33%	32%
Thermal	165.91	339.70	424.37	468.04	67%	68%
Imported Supply	46.86	51.14	61.26	58.86	-	
Exported Supply	-31.78	-67.83	-65.28	-71.49	-	-
Electricity Consumption	**295.34**	**489.48**	**614.74**	**677.76**	**Account for the Consumption**	
Farming, Forestry, Animal Husbandry, Fishery and Irrigation	41.45	51.70	52.65	55.26	14%	8%
Industry	209.52	364.46	472.85	520.43	71%	77%
Construction	2.66	4.08	4.46	5.82	1%	1%
Traffic, Transportation, Storage and Post	9.21	15.34	24.61	27.71	3%	4%
Wholesale and Retail Trade	3.22	6.72	7.62	8.44	1%	1%
Others	7.80	14.72	16.25	19.47	3%	3%
Households	21.48	32.46	36.30	40.63	7%	6%

Source: Gansu Province Statistics Yearbook

Table 2 Electric Demand and Supply in Longnan City

Unit: Twh Unit:%

Year / Contents	2000	2005	2010	Growth Rate in 2005 (from 2000)	Growth Rate in 2010 (from 2000)
Electricity Consumption	**72,120**	**174,824**	**288,276**	142%	300%
Farming, Forestry, Animal Husbandry, Fishery and Irrigation	12,875	10,918	15,208	-15%	18%
Industry	45,753	139,713	204,559	205%	347%
Construction	567	396	9,591	-30%	1592%
Traffic, Transportation, Storage and Post	651	544	754	-16%	16%
Information Technology	674	380	1,394	-44%	107%
Hotels and Catering	1,174	1,268	2,539	158%	579%
Financial and Real Estate		521	1,483		
Government Offices		1,236	3,944		
Households	10,426	19,848	48,804	190%	368%

Source: Gansu Province Statistics Yearbook

The Chinese government launched New Village Construction Program in 2005 to improve under-developed rural areas by, for example, constructing infrastructure. Small-scale hydropower plants in China are known for promoting infrastructure development in addition to its economic impact with marginal environmental damage. This also supports that this project to construct small-scale hydropower plants in under-developed rural areas meet regional development needs.

3.1.3 Relevance with Japan's ODA Policy

This project maintained a high level of relevance with Japan's ODA policy at the times of ex-ante evaluation.

Economic Cooperation Plan for China (2001), launched at the time of ex-ante evaluation, called for

protection of seriously threatened environment and social development in inland areas. Its major issues included 1) cooperation for global issues such as environmental problems, 2) support for reformation and liberalization, and 3) assistance for poverty.

At the time, ODA Loan Plan for China by JBIC emphasized importance of three topics: 1) environment, 2) food and poverty, and 3) inland development to reduce regional disparities. Additionally, in the area of energy, assistance was focused on three issues: 1) promotion of hydropower development, 2) expansion of transmission capacity, and 3) desulfurization of thermal power plants. The Plan prioritized assistance for projects private capital could hardly support, such as poverty reduction through rural development and efficient hydro resource utilization.

In regard to Relevance, this project has been highly relevant with China's development plan and development needs, as well as Japan's ODA policy; therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The Hanpingzui sub-project construction was executed mostly as planned. The scale of generators was increased to 72 MW from its initial 60 MW. This increase in generation capacity was made considering the rated head and high-water flow set in the detailed design and a long-term benefit of the hydropower plant, also in accordance with the clean-energy promotion by the Chinese government.

Table 3 Summary of Planned and Actual Outputs

Hanpingzui Sub-project	Plans at Ex-ante Evaluation	Outcomes at Ex-post Evaluation	Reason for the Difference
Foreign Currency	Package 1 Generators Generators 60MW (20MW×3), Transformers	72 MW (24 MW×3)	Modified by the detailed design
	Package 2 Dam Construction Dam Structure (Reservoir capacity 51,000,000 m^3, 57 m height) and up- and down-stream weir construction	NA	—
	Package 3 Plant Construction Plant building and auxiliaries (incl. switch yards and transmission lines)	NA	—
	Package 4 Tunnel Construction Construction of intake tunnel and spillway tunnel, incl. steel structures.	NA	—
	Package 5 Construction Materials	NA	—
Local Currency	Tunnel Construction and Others Land consolidation for turbine building, drainage, front gate, down-stream bank consolidation	NA	—
	Consulting	NA	—
	Other Expenses Electric charges for construction, etc.	NA	—

Data given from Gansu Mingzhu Southern Hydropower Development Co. Ltd

3.2.2 Project Inputs

3.2.2.1 Project Cost (Sub-rating ③)

The expenditure under the Hanpingzui sub-project was 7,482 million JPY, a 123 % increase from the budget allocated at the time of ex-ante evaluation, however was seen mostly as planned considering the increase of the output.

Among the total budget, the Japanese ODA loan covered 4,638 million JPY, 100 % of the planned

value, whereas local investment reached to 2,844 million JPY and 161 % of the planned amount (as shown in Figure 3). The excess expenditure of local investment was however justifiable under the following circumstances: 1) Frequent rock falls were anticipated at the construction site, which necessitated extra budget for consolidation, and 2) Specification of road construction around the lake was upgraded, which raised its construction cost. Originally roads had been gravelled before the plant construction and would be left that way, but later the classification of the road was raised and so were their completion requirements, adding extra pavement, widened shoulders, and guardrails.

In China, small-scale hydropower plant construction in rural areas is often associated with nearby infrastructure improvement. The additional road construction along with the plant construction in this project was understandable given such circumstances. Therefore, increased local currency cost was thought to be a reasonable arrangement to meet the local circumstances.

Table 4 Planned and Actual Cost of the Project

Unit: Million JPY

Subproject	Allocation*1			Execution			Ratio		
	Foreign Currency	Local Currency*2	Total	Foreign Currency	Local Currency*2	Total	Foreign Currency	Local Currency*2	Total
Hanpingzui	4,337	1,767	6,104	4,638	2,844	7,482	1.00	1.61	1.28
Longshou	1,800	3,374	5,174	—	—	—	—	—	—
Price Rise	94	82	176	—	—	—	—	—	—
Budget Reserve (5%)	312	206	518	—	—	—	—	—	—
Total	6,543	5,430	11,973	4,638	2,844	7,482	—	—	—

*1 Based on the amendment of the loan agreement agreed on November 2005.Source: JICA
*2 Local Currency 1 yuan = 14.36 JPY (Average rate during the loan period by ORANDA, years 2001 through 2007)

3.2.2.2 Project Period (Sub-rating ②)

Project period of this project was longer than planned. At the time of ex-ante evaluation this project's period was set to be 37 months, from March 2001 (L/A Signing) to March 2004. It turned out that the project ended (and hence plant operation started[10]) in September 2005, resulting actual period to be 55 month. (See Table 5 for details).

Table 5 Planned and Actual Periods of Sub-projects

Sub-project	Planned		Actual	
	Start	End	Start	End
Hanpingzui	March, 2001 (L/A Sign)	March, 2004 37 months	March, 2001 (L/A Sign)	Sept. 2005 55months

Source: JICA Documents

The major reasons for the delay include 1) unexpected consolidation of the crumbling project site, 2) extra roadwork periods for raised classification level of roads around the dam, and 3) work suspension for 6 months (from March to August) due to SARS outbreak in 2003. Especially during the SARS outbreak in 2003, in addition to preventing proliferation in the construction workers' camp, procurement then construction work was delayed because of economic and social stagnation at the state level.

[10] As defined by Project Memorandum in April, 2001.

As for Efficiency, in light of the above, the project period and cost slightly exceeded the plan, but only for reasonable purposes, and therefore, the efficiency of this project is high.

3.3 Effectiveness[11] (Rating: ③)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

At the Hanpingzui small-scale hydropower plant, even though the Sichuan Earthquake in August 2008 caused damages to structures such as dam weirs and generators, at the time of ex-post evaluation they were operating normally. The facility's output capacity / maximum output increased to 72 MW from the initially planned 60 MW. This plant was built as a base-load plant designed to reduce electric shortage of the region. Increased output capacity / maximum output is therefore considered to be enforcement to this project's objective by improving electric supply capacity.

Unplanned outrage, initially planned to be 6 days, eventually did not occur at all. Excluding the previously described suspension following Sichuan Earthquake, unexpected suspension not even once happened, an indication that daily maintenance appropriately has been conducted. On the other hand planned outrage, initially planned to be 6 days, turned out to be 55 days. This was because frequency of scheduled inspection was increased from that of the initial plan. The three generators were alternatingly suspended for inspection, to avoid suspension of the all three generators at one time.

Table 6 Planed and Actual Operation and Effect Indicators

Measures [Unit]	I Target Values at Time of Ex-ante Evaluation	II Target values at Mid-term Review (2008)*1	III Results at Ex-post Evaluation (2010)*2
This Project's Output Capacity / Maximum output [MW]	60 (2005)	72 (24 Mw×3)	72 (24 Mw×3)
Unplanned Outrage [day/year]	NA	6 (Designed value)	0
Capacity Factor [%]	NA	5,051 hours (58%) (Designed value)	53.59 %
Net Electric Energy Production [GWh]	345 (Year Unknown)	364 (Designed value)	334.53
Planned Outrage [day/year]	NA	6 (Designed value)	55
Annual Total Volume of Inflow to the Reservoir [billion m^3/year]	NA	3.41	3.2
Beneficiaries [person]			
Wen County	NA	NA	25
Longnan City	264	264	268

Source: JICA Documents for I target values of ex-ante evaluation and II target values of mid-term review. For values at the ex-post evaluation from data given by Gansu Mingzhu Southern Hydropower Development Co. Ltd

*1 Goal values at mid-term review: proposed from the Chinese side at the time of mid-term review in 2005. Goal values were set equal to the designed values.

*2 Results at the ex-post evaluation: the 2010 data were the most current. The Sichuan Earthquake damaged structures such as dam weir at the Hanpingzui plant and its repair continued until 2009. Therefore, data values from 2010 were analyzed, instead of those from 2008 Data from 2008 would be used at the mid-term review

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

This project's financial internal rate of return (FIRR) turned out 0.2 % lower than expected at the ex-ante evaluation, as a result of recalculation under following conditions: 1) income from selling

[11] Effectiveness is scored also in the light of factors regarding Impact.

electricity was included in profit, 2) construction cost, operation and maintenance cost, and tax were included in expenses, and 3) project life was set 30 years.

Despite that the income from selling electricity was lower than it had been expected at the ex-ante evaluation, a number of staff members turned out half the expected number (140), consequently reducing labour and welfare expenses.

Table 7 Financial Internal Rate of Return（FIRR）

Sub-project	Ex-ante Evaluation Value	Recalculation at Ex-post Evaluation
Hanpingzui	4.1 %	3.9 %

3.3.1.3 CO_2 Reduction

This project's carbon reduction was calculated from total power output in 2010. It turned out to be 88 % of the goal value, thought fairly close to the targeted reduction value[12].

Table 8 CO_2 Reduction

Unit: ton / year

Sub-project	Target value（2008）	Achieved value（2010）
Hanpingzui	382,000	336,000

3.3.2 Qualitative Effects

Hanpingzui Hydropower Plant is physically located in Wen County, but at the same time was connected to Longnan Grid, outside jurisdiction of Wen County Office of Electricity[13].

A research by questionnaire and hearing was conducted to study electric supply conditions at the time of ex-post evaluation. This was done to 24 parties[14] including Wen County People's Government, The County's Office of Electricity, Longnan Electric Distribution Inc. (responsible for the Longnan distribution network to which Hanpingzui Hydropower Plant was connected), and various large electric users including companies and factories in Wen County and Longnan City. The study results showed users' high levels of reliability and satisfaction to electric supply.

Both Wen County government and Office of Electricity recognize that Hanpingzui Hydropower Plant earned a reputation for reliability for its stable voltage and network since its operation had started. This became a benefit of various companies, especially its large users, and contributed to economic development

[12] Calculated as was done at the ex-ante evaluation (following IPCC Guidelines for National Greenhouse Gas Inventories Reference Manual): Heat Equivalent of Yearly Electricity Output × Carbon Emission Intensity × Adjustment Constant for Uncombustion.

[13] Hanpingzui Hydropower Plant and the Longnan Grid: In the Baishuijiang River basin, where the Hanpingzui Hydropower Plant is located, there are five hydropower plants. Among them, the Hanpingzui Hydropower Plant possesses a large generation capacity, and is incorporated into a differnet distribution network than the other four. Since its operation started in 2005, the plant is connected to the Longnan Grid through two subplants (Yulei, Zaoyang). Transmission lines are the Bicheng / Zaocheng line extended to Chen County in Longnan City. The generation capacity of Hanpingzui Hydropower Plant is 14 to 15 % of capacity of Zaoyang subplant.

[14] Large users are classified as follows:

Areas	Large users classification
Wen County	10 Parties: Steel Industry - 4, Production and Sales -4, Metallurgy- 1, Mining - 1.
Longnan City (Cheng County)	14 Parties: Production-3, Mining-4, Electricity-1, Service-4, Commerce-1, Estate agent -1.

of Wen County. Electricity in Wen County depends solely on hydropower. By promoting small-scale hydropower projects, electric supply became abundant and electric shortage in Wen County was remarkably reduced.

According to Longnan Distribution Office, before construction of the Hanpingzui plant, the main supplier had been a thermal power plant in Tianshui City, outside the grid, and this long-distance transmission caused extensive power losses. Completion of the Hanpingzui Hydropower Plant enabled within-grid electric supply, and the new electric source significantly improved reliability and stability. Hearing at Wen County Office of Electricity also revealed that electricity consumption in Longnan City increased by 2.5 fold from 2000 to 2005, but the rate of transmission loss decreased by 20 %, as supported by efficient electric supply from the nearby plant such as Hanpingzui Hydropower Plant.

Table9 Comparisons of Electricity Consumption and Transmission Losses in Longnan City

Unit: Mwh

	2000	2005	2010
Consumption	721,200	1,748,240	2,882,760
Transmission Losses	66,760	115,070	122,080
Rate of Losses	0.09 %	0.07 %	0.04 %

Source: Hearing at Wen County Office of Electricity

At the time of ex-post evaluation, not only sufficient supply of electricity was distributed throughout the eight counties and one ward in Longnan City, but also in the high-water season, occasionally surplus electricity was exported to outside the grid. There was no thermal power plant in the grid, but only multiple small-scale hydropower plants, with Hanpingzui Hydropower Plant being the largest and one of the earliest plants. Construction of this plant shortened the transmission distance, and as a result, reduced transmission losses.

Other two interview cases on large users in Wen City showed that there had been typically 2 to 3 days of blackout in one month before completion of Hanpingzui Hydropower Plant, resulting in suspending factory operation and consequent economic losses. After completion, starting in 2007, conditions largely improved and currently blackout hardly occurs.

A iron silicate production factory (Above)
A Tea Manufacture's shop (Below)

A study on the 14 large users in Longnan City showed that eight companies possessed dedicated cables from transformer subplants to their properties, and six companies possessed dedicated transformers. Each of them answered that there had been stable electric supply without blackout from the past 2005-2006 to present. These large users were located in centre of the Longnan grid, and in case of shortage, electricity was immediately imported from outside grid, and therefore hardly experience a blackout.

As for Effectiveness, in light of the above, this project has

largely achieved its planned objectives; therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts

This project's designated impact was economic revitalization and poverty reduction brought by improved electricity infrastructure, and it was seen in income increase among the farmers as well as revitalization of local industries.

Income par capita among farmers, which comprised most of the poverty population in Wen County and Longnan City, has been increasing especially since 2004-2005. For example, though the amount of income par capita was still low in Wen County, the increase rate from 2005 (the year when Hanpingzui Hydropower Plant was completed) to 2008 was 5.52 %, above the rates of Longnan City (4.99 %) and Lanzhou City (3.25 %), as shown in the figure below.

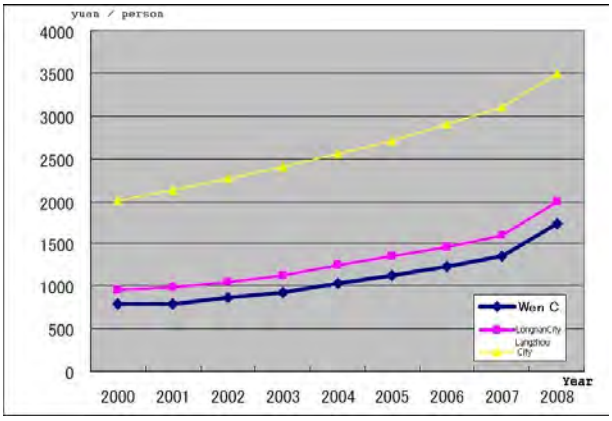


Figure 1 Income Increase par Capita

(Unit: Chinese yuan)

Region / Year	Wen County	Longnan City	Gansu Province
2005	1131	1353	2713
2006	1226	1464	2898
2007	1346	1600	3103
2008	1740	1998	3503
Increase rate from 2005 to 2008	5.53 %	4.99 %	3.25%

Source: Gansu Province Statistics Yearbook

The impact of Hanpingzui Hydropower Plant on local economy

-An interview record of an owner of iron silicate production factory

The main industries of Wen County are hydropower plants and production of iron silicate. There are 10 factories of iron silicate and the factories together employ more than 2,000 workers. There used to be blackouts two to three times in one month, and factories had to alternatingly suspend their operations. Once suspended, it would take two days to recover operational temperature in the furnaces. So altogether five to seven days were wasted. Back in 2004 and 2005, because of frequent blackouts, our business had almost gone bankrupt. Nowadays electric supply became fairly stable and we experience few operational trouble. Local employment increased, people's income went up, and we are becoming able to escape poverty.

All the 10 larger users in Wen County responded to the questionnaire with following answers; comparing before and after plant completion, there were i) increased part-time job opportunities to nearby farmers, ii) increased new and reformed housing, iii) improved road conditions and medical facilities, iv) increased investment from external parties.

The reason for i) increased part-time job opportunities was presumed to be the power plant actively supplying the job opportunities to the farmers. For ii) increased new and reformed housing, it was generally a reflection of increased income, presumably happening in Wen County. For iii) improvement of infrastructure such as communication, roads, medical facilities often accompanied small-scale hydropower plant construction in rural China, and this project seemingly has become another example of this trend; as previously described, roads around the dam was well paved, and new medical facilities, school buildings, and bridges were built or renewed by the plant company. Lastly, for iv), booming mining industry with abundant mineral resource in the county and tea manufacturing with Longjing tea (very rare in inland), both of which were activated by reduced electric shortage, has contributed to growth of investment from external parties.

Another study on large users in Longnan city (12 cases) collected following answers from almost all respondents.

-Economy: Increased profits for production and service industries.

-Income: Increased income par capita and job opportunities, and reduced emigration.

-Life: Reduced blackouts, improved security and infrastructure, and more convenient living.

However, precisely determining the impact of the plant construction on economic development required careful examination. This was because Hanpingzui Hydropower Plant was connected to the Longnan grid, and other industries were also developing under the on-going China's Western Development Program, making it difficult to determine the impact brought by the plant alone. It was commonly known that small-scale hydropower plant construction in under-developed rural areas in inland China promoted economic development in synergy with other development factors. Therefore, accomplishing initially designed impacts required appropriate coordination with other forms of development assistance.

3.4.2 Other Impacts

3.4.2.1 Impacts on the natural environment

At Hanpingzui Hydropower Plant, treatments were made to reduce noise, water and air pollution, and waste disposal by construction workers following suggestion from the environment assessment conducted by the Chinese side before the ex-ante evaluation, which called for precautious measures to prevent pollution of water in the dam and its downstream, to protect ecological systems, and to maintain scenery. According to Wen County People's Government, monitoring results have reported no major concerns about these factors.

For post-construction environmental monitoring, it was agreed at the time of ex-ante evaluation that the Wen County Office of Environmental Protection would inspect water quality up- and down-stream of the dam three times a year. At the time of ex-post evaluation, rearrangements of tasks among offices in the County resulted in transfer of this duty on environmental monitoring from Office of Environmental Protection to Office of Public Health. As shown in the below figure, before and after plant construction in 2005 show only marginal fluctuations, without signs of major problems. Wen County People's Government

expressed that electric supply reduced residents' use of firewood for cooking, which reduced air pollution by wood combustion.

Table 10 Results of Water Quality Monitoring on Hanpingzui Hydropower Plant

Measures	Period	2001	2002	2003	2004	**2005**	2006	2007	2008	2009	2010
pH	Dry season	7.1	7.2	7.4	7.3	**7.2**	7.5	7.5	7.3	7.4	7.5
	Normal Season	7.0	7.1	7.2	7.1	**7**	7.7	7.6	7.5	7.5	7.3
	Rainy season	7.1	7.1	7	7	**7.2**	7.4	7.3	7.2	7.2	7.2
Chromaticity [degree]	Dry season	5	5	5	5	**6**	6	6	6	6	6
	Normal Season	5	5	5	5	**6**	6	7	7	7	6
	Rainy season	5	5	5	5	**7**	6	7	7	7	6
SS [mg/l]	Dry season	2	2	2	2	**2.1**	2.1	2.1	2.2	3.5	3
	Normal Season	2	2.1	2	2.2	**2.1**	2.3	2.4	2.6	3.7	3.4
	Rainy season	2.1	2.3	2.2	2.4	**2.5**	3.2	3.1	4	4	3.6
BOD [mg/l]	Dry season	1.5	1.5	1.5	1.5	**1.8**	2	2.1	2.2	2	2
	Normal Season	1.3	1.3	1.3	1.3	**1.5**	1.8	1.6	1.9	1.7	1.5
	Rainy season	1.2	1.2	1.2	1.2	**1.4**	1.5	1.4	1.5	1.5	1.3
COD [mg/l]	Dry season	1.4	1.5	1.3	1.4	**1.4**	1.7	1.8	1.8	1.9	1.9
	Normal Season	1.2	1.1	1.1	1.2	**1.4**	1.5	1.6	1.5	1.6	1.6
	Rainy season	1	1.1	1	1	**1.2**	1.4	1.5	1.5	1.5	1.4
Oil contents [mg/l]	Dry season	1.5	1.4	1.5	1.5	**1.5**	1.8	2.1	2.2	2.1	2
	Normal Season	1.7	1.6	1.7	1.6	**1.8**	2.2	2.5	2.6	2.5	2.4
	Rainy season	2	1.9	2.1	2	**2.3**	2.5	2.8	3	3.1	2.7

Date provided by the Office of Public Health, Wen County through Gansu Mingzhu Southern Hydropower Development Co. Ltd

In the dam reservoir, trout farming is now becoming popular. In addition to trout farming company brought in by Wen County, local immigrants also started their own farming business. The local immigrants told that farming without technical guidance from experts was very challenging, and they were not able to earn sufficient income. Because of this, currently there were too many immigrants starting the farming business, but if the farming business becomes more accessible, it may eventually start to affect quality of dam water.

The dam weir area passed the environment protection inspection[15] conducted by the designated government, and other areas such as turbine building, office, and residential areas were under inspection, expecting to receive their certification by the end of 2011.

3.4.2.2 Resettlement and Land Acquisition

The resettled households and land acquisition in this project increased from initial plans by 170 % and 280 % respectively. Reasons for increased number of resettled households were i) the area affected by water was widened under measures of the Resident Resettlement Plan, adding more households to the resettlement list, ii) from the time of planning to the actual resettlement, some dependents grew up and started their own households, increasing the household count. For the land increase, as described above, it was because the area to be non-submerged but affected was included to land acquisition.

[15] Environment protection inspection: designed to assess project's environment protection measures and its impacts on environment. This is done mainly by sections of the government in charge of environmental protection under the Regulations on Construction Projects for Environmental Protection set by the Chinese Government. Under the Regulation, an office at the province, city, or county level is required to submit a request for operation or test-operation of a project to its higher-level office, whereby that recipient higher-level office in charge of environmental protection assesses project's facilities and actions for environmental protection, by on-site visiting and document reviewing. The higher-level office then determines whether the construction project satisfies requirements for environmental protection.

Table 11 Resettlement and Land Acquisition: Plans and Results

Sub-project	Resettlement		Land Acquisition	
	Plan	Result	Plan	Result
Hanpingzui	Appr. 1,000 rsds 230 hhds	1,686 rsds 399 hhds	Appr. 90 ha	253 ha

Abbreviations: rsds = residents, hhds = households. Source: JICA documents and Wen County Immigration documents

Table 12 Reasons for Resettlement

	Area Total	Reason for Resettlement		
		Submerge Under Water	Additional Weir Area	Modified Route 212 Construction
Total	339 hhds 1,686 rsds	259 hhds 1,288 rsds	53 hhds 264 rsds	27 hhds 134 rsds
Yùlei Xiāng	335 hhds 1,655 rsds	255 hhds 1,267 rsds	53 hhds 264 rsds	27 hhds 134 rsds
Shàngdé Xiāng	4 hhds 21 rsds	4 hhds 21 rsds	—	—

Abbreviations: rsds = residents, hhds = households Source: Wen County Immigration documents

The resettlement plan was designed by Northwest Investigation Design and Research Institute. Gansu Mingzhu Southern Hydropower Development Co. Ltd. (Operator of Hanpingzui Hydropower Plant, (hereinafter referred to as the Mingzhu Southern Co.)) and Wen County People's Government signed an agreement on residents' resettlement and compensation in June 2004 along with the resettlement plan. The actual migration process was executed by the Wen County Immigration Office.

The migration process took following steps: 1) notification to residents through mailing and town meeting, 2) individual household visits to assess compensation contents and amounts, 3) notification of compensation policy, 4) contract signing with residents, 5) preparation of housing and infrastructure, 6) actual migration. From town meetings to actual migration took approximately two years. Compensation contents were determined by government regulations[16], and this amounted to 19 million yuan. The Immigration Office received the full payment from the Mingzhu Southern Co. by March 2005.

The destination of migration was one of the five areas selected by the Immigration Office(Case A) or an area found by the immigrants themselves(Case B). Housing was built and provided to immigrants moving for Case A, and fixed payment for housing construction was provided for Case B. One primary school, one hospital, four village clinics, two bridges, and three ferry piers were prepared in the resettlement areas. These expenses were paid with compensation from the power plant. Doctors at the village clinics were paid for by subside from the Immigration Office.

According to the Immigration Office, the average income of local households was 782 Yuan in 2005 before plant completion, and 1,141.92 Yuan in 2010. In contrast, the average income of immigrant households in 2010 was 1,465.80 Yuan higher than the local residents. This was associated with the 600-yuan compensation per person, which was given from the state starting in July 2006.

[16] "Regulations on Compensations for Land Requisition and Resettling Residents due to Large- or Middle-scale Hydropower Plant Construction" (State Council Notification 74, 1991) and "Notification on Tentative Action on Land Requisition and Resettlement due to Hydropower Plant Construction by the National Development Planning Committee" (No. 2623. 2002)

Housing and bridge the plant prepared for the immigrants

Interview on resident households were conducted. The two interviewed households were selected by the Office of Immigration. One household immigrated to one of the five selected areas while the other one found the new location on their own. Both households answered that after immigration their income increased and life standards in terms of electricity, water, and transportation improved. Quality of visited houses seemed descent and their lifestyles looked reasonably affluent.

The power plant opened up mountain slopes to provide farmlands to the immigrants. It also employed approximately 40 residents as casual workers. Furthermore, if a local resident satisfied designated technical standards, s/he was given a priority to be hired. These arrangements were made to provide employment opportunities to the immigrants in the local areas.

There were not enough farmlands since the land was made by opening narrow valley zones, leaving some farmers without alternative farmlands. These immigrated farmers, however, did not have feelings of insecurity as receiving original compensation and added government compensation and pension.

3.4.2.3 Other Local Benefits

The Chinese Government was implementing various programs to resolve disparities between rural areas and cities. As a part of this, electrification project was launched in Wen County and consequently electrification is steadily progressing (see Table 8). Before this project in 1998, only 30 % of villages in Wen County were electrified. The numbers of electrified communities or households were even uncounted. At the time of ex-post evaluation every village, community, and household was electrified with minor exceptions of distant households in deep mountains.

Table 13 Change in Electrified Rates in Wen County

	Electrified Villages	Electrified Communities	Electrified Households
1998	30 %	-	-
2010	100 %	100 %	98 %

Source: Results of Interview at Wen County Office of Electricity

Wen County People's Government noted that this project allowed securing sufficient electricity, and this freed the residents from "climbing up mountains to pick woods for warming bodies and cooking." The project provided sufficient electricity for local economic development from clean energy, and furthermore, promoted employment of the local residents, achieving remarkable improvements of life standards. Not only supplying electricity but also the infrastructure such as roads, irrigation, fish-farming was continuously developed, adding more contribution to income generation of local residents. At the ex-post evaluation, no negative impact was observed.

As for Impact, in light of the above, the project demonstrated positive impacts on environment, immigrants, local societies and residents.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance (Sub-rating ③)

Two organizations were involved in the Hanpingzui sub-project at the time of ex-post evaluation. They were the Mingzhu Southern Co. (Gansu Mingzhu Southern Hydropower Development Co. Ltd.) responsible for operation, management, maintenance, accounting, and human resource management of the plant, and Gansu Keyuan Electric Corporation (hereinafter referred to as the Keyuan Co.[17]) in charge of financial management and ranking-officer management.

The Mingzhu Southern Co. originally started as a project team for the plant construction within the Gansu Mingzhu Hydropower Development Co. Ltd. This company was the project executing agency at the time of ex-ante evaluation. The project team was seperated from this company at the time of plant completion to specialize itself in operation of the plant.

The Keyuan Co. was a corporation governed under the Gansu Province Electricity Corporation and was a main investor to the Mingzhu Southern Co.

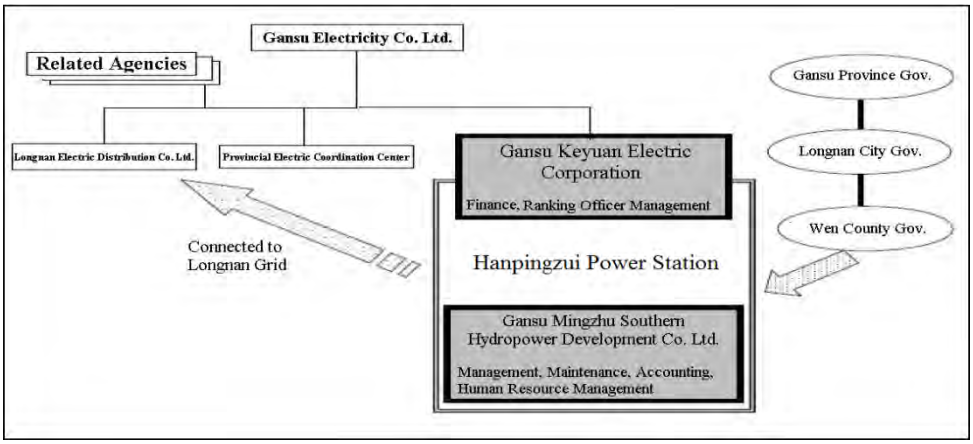


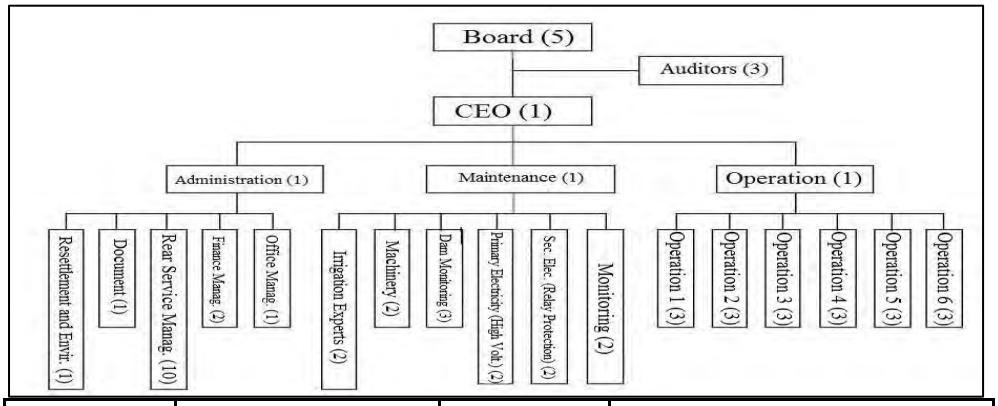
Figure 2. Organization Diagram related to the Hanpingzui Hydropower Plant.

The organizational structure of the Mingzhu Southern Co. maintained its form since the time of planning. (See Figure3 for details)

The mechanics of the Department of Operation and Department of Maintenance mostly possessed diplomas of the secondary-vocational level or higher. The average age was 26 and a male-female ratio was 3 to 1. The technological division consisted of Department of Operation and Department of Maintenance, and the administration division was solely of Department of Administration. Staff members were classified as upper managers, managers, or general staff members, and training was conducted to each class accordingly. The training cost was set to be 2 % of total salary payment, which increased each year.

[17] This company was renamed in 2009 from the Gansu Electricity Joint Corporation. Its areas of business expanded to various industries. Only three staff members in the company were in charge of Hanpingzui Hydropower Plant.

The People's Government of Wen County, where the Hanpingzui Hydropower Plant was located, holds responsibility to supervise operation and management of the power plant. The County government acknowledged that the Keyuan Co. was appropriately governing structural, financial, and technological aspects of the plant operation.



	Office	Personnel	Note
Department of Technology	Operation	19	3 personnel in one team, alternating.
	Inspection and Repair	14	
General Affairs Dep.	General Office	16	Incl. Officers for Resettlement and Environmental Protection
Higher Management		9	

Gansu Mingzhu Southern Hydropower Development Co. Ltd

Figure 3. Organizational Structure of the Mingzhu Southern Co.

3.5.2 Technical Aspects of Operation and Maintenance

The Director of the plant have served as a director of thermal, hydro, as well as wind power plants, well experienced as a director for altogether 28 years. The average age of all staff members including the mechanics was 28, with most of them having 5- to 10-year experience. At the ex-post evaluation, no issue concerning the technological aspect was recognized.

13 weeks training was conducted for newly employed person before assignment. Afterwards, training continued under the director's supervision. Various other training opportunities such as OJT in other plants and training held by the Provincial Electricity Corporation through director's personal connections were also available. A test was conducted each year to assess outcomes of training and skill development.

There was regular awarding to staff members for their outstanding performance or skill acquisition. This seemed to raise motivation of the staff members.

3.5.3 Financial Aspects of Operation and Maintenance

The financial conditions of the Mingzhu Southern Co., the operator of the plant, is shown in the below table. Revenue, net operating profit, and net profit all decreased in 2008, due to the damages to the facilities by the Sichuan Earthquake, and also in 2009, when repair was undergoing. It was in 2010 that the revenue largely recovered, and so did the profit, to the level before the earthquake.

Income by selling electricity, however, remained only 63 % of the target value. The output at the

sending end, known to affect the income, showed little difference to the target value. The selling price increased by 124 % from the ex-ante evaluation to the ex-post evaluation. The difference between the target and achieved values was presumably brought by the fact that selling price assigned by the Province Development Reformation Committee did not increase expectedly[18].

Table 14 Financial Details

	2005	2006	2007	2008	2009	2010
Gansu Mingzhu Southern Hydropower Development Co. Ltd.（Operating Hanpingzui Hydropower Plant）						
Revenue	21,468,535	50,006,567	58,354,909	53,555,357	58,820,690	66,000,167
Net Operating Profit	10,124,145	25,353,929	20,029,849	15,288,081	15,196,751	20,068,922
Net Profit	10,124,145	25,353,929	20,029,849	15,288,081	17,367,335	20,068,922
Fixed Assets	496,002,428	504,995,379	448,586,046	425,483,163	404,013,067	381,079,824
Current Assets	67,888,415	2,738,999	30,337,225	1,197,763	833,826	2,048,230
Stated Capital	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000
Total Assets*1	696,379,956	777,430,238	643,011,416	591,409,917	562,156,411	528,783,154
Current Liabilities	206,972,501	187,688,854	59,377,754	32,720,389	53,101,204	26,594,200
Fixed Liabilities	379,634,816	454,634,816	447,128,533	407,128,533	342,128,533	312,128,533
Total Liabilities	586,607,317	642,323,671	506,506,287	439,848,922	395,229,737	338,709,293
Operation &Maintenance	2,020,000	1,870,000	3,610,000	4,100,005	7,780,000	16,040,000

Gansu Mingzhu Southern Hydropower Development Co. Ltd *1 Total Assets: In addition to the fixed and current assets, accounts receivable are included, and therefore, not necessarily equal to the sum of fixed and current assets.

In fact, both the power plant and the parent company were not concerned about this difference in the expected and actual incomes. The expected income was rather thought to be set inappropriately. The Hanpingzui Hydropower Plant was one of the plants[19] under coordination and management of the Province Electricity Coordination Center. The income was determined not by billing from the power plant, but by the buying price notified from the Electricity Coordination Center.

Table 15 Target and Result Incomes by Selling Electricity

Sub-project	Target* (million yuan)	Results (million yuan)						Average Achieving Ratio
		2005	2006	2007	2008	2009	2010	
Hanpingzui	104	21.5	50	58.35	53.55	58.82	66	49 %

*Target: Same as designated values. At the times of both the ex-ante evaluation and the mid-term evaluation (2005), designated values were applied. Date:Gansu Mingzhu Southern Hydropower Development Co. Ltd

Table 16 Transition of Selling Price of Electricity

(Unit: yuan / Kwh)

Time	At ex-ante Evaluation	Until 2005	After 2006
Unit Price	0.183	0.219	0.227

The increased price in 2006 is due to national policy to promote clean energy.

3.5.4 Current Status of Operation and Maintenance

The Sichuan Earthquake in 2008 caused the following damages, reducing the generation output by 30 million Kw.

[18] According to staff members of the power plant, the selling price of electricity generated by non-thermal means (i.e. hydro and wind) has been increased more than the thermally generated electricity has. This arrangement was to promote use of renewable energy in China. This price increase may not have been as much as it was expected.

[19] At the time of construction, this power plant would become a large-output plant in the region. Its generation conditions would be controlled in relation to the demand-supply balance of the whole province, as well as the grid.

i) The shaft of the second generator was displaced resulting in frequent horizontal fluctuation. Repaired in September 2008. Cost 450,000 yuan.

ii) Structural damage (partial) to the dam. Repaired in May 2009.

iii) Repairing generator building and administration building.

According to the plant director, damages had been controlled to the best ability possible, and were all in normal use at the time of ex-post evaluation. Except for cracks in the wall and 3- to 4-cm difference in level before the entrance, no sign of damage was seen. It was for 25 days that all the three generators had been forced to stop simultaneously, and the basic functions of generators recovered at the end of year 2009, three months after the earthquake. Complete recovery of all the plant facilities, including structural repair of the building, was achieved one year after the earthquake. After repair, the generators were in good operational conditions, and with increased volume of water current, the total electricity output increased after the earthquake. The repair cost was all paid for by the Mingzhu Southern Co.

Maintenance inspection was done as follows. Difference in the inspection frequencies to the plan was a result of on-site adjustment. Emergency manuals were also being implemented.

Preparation of spare parts for maintenance was properly managed. Imported parts, such as electric valves, magnetic switches, and monitoring panels, need long delivery periods to the inconveniently located plant, in addition to their large price fluctuations. Therefore, these parts were to be ordered to distributors well in advance. The present monitoring system could be used for a while. Renewing the entire system would be too expensive, and for the time being no immediate action was being planned.

Table 17 Comparison of Maintenance Frequency

Equipment/Facilities		Planned (2000)	At Ex-post Evaluation (2010)
Turbines Generators	Daily Inspection	When necessary	3 times / week
	Minor Repair	2 times / year	1 time / year
	Major Repair	1 time / year	1 time / year
Transformers	Inspection	1 time / 10 years	3 times / week
Dam	Inspection	1 time / 5 years	1 time / week

Gansu Mingzhu Southern Hydropower Development Co. Ltd

There were six teams, with three personnel in each team, in the Department of Operation in charge of generator operation. Based on director's experience they were arranged as follows; four teams take turns for operation, while one team was off duty and the last one was in training or research. There was one leader in each team responsible for staff management, through which maximum team performance was expectedly achieved. As at one point young staff members resigned consecutively from the plant, arrangements to improve employee retention were made. By these countermeasures cost of recruit and training due to staff resignation was well under control .

According to the Longnan Distribution Office, which was involved in operation of several small-scale hydropower plants in the Longnan Grid, the operational conditions of Hanpingzui Hydropower Plant were the best in the region. As far as the Distribution Office was aware, the Hanpingzui Hydropower Plant achieved good operational conditions by emphasizing operational safety and in so doing, maintenance of the equipment and facilities was frequently conducted and malfunctions were immediately repaired. Other

means included saving water resources by shortening maintenance periods and maximizing efficiency of hydro utilization by avoiding disposal of unexploited water. This was achieved through accurate prediction of waterfall amount aided by frequent communication with the weather section.

The parent Keyuan Co. was in possession of two hydropower businesses. Hanpingzui Hydropower Plant was more profitable, and the company was hopeful that this steady business condition would continue in future.

In light of the above, no major problems were observed in the financial, operational, or maintenance systems, therefore sustainability of the project effect was high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project's relevance was high because the project met 1) policies of the Chinese government to increase electricity supply capability and to promote clean energy development, 2) local area's needs for electricity, and 3) assistance agenda of Japan at the time. Effectiveness was also high from following observations; no operational problem was seen at the constructed power plant, and expected outcomes were mostly achieved. Efficiency was lower in comparison because the project budget and project duration turned out to be greater than planned. Structural, financial, and technological aspects of operation and maintenance were inferred to be appropriate.

In light of the above, this project was 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

1) Importance of Establishing Common Units and Measurements with the Partner Country

In this project, there were measures whose interpretation varied between the executing agency and JICA. For example, the executing agency and JICA had different definitions on the same term (i.e. Capacity factor). In another case, calculation was differently done from one year to another (i.e. net electric energy production), and in such cases confirmation and agreement required quite some time.

Such descriptions as "operation time (day)" and "suspension time (day)" were interpreted differently (sometimes these numbers indicated days, sometimes hours) even among the staff members of the power plant. Currently JICA has established common definitions of measurements and calculation formula with partner countries before signing, and recorded agreed definitions in the Record of Discussion or agreements. Lessons from this project also emphasized the importance of explicitly stating common measures,

definitions, and calculations between JICA and its partner countries.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	**Foreign Currency** Package 1 Generators Generators 60 MW(20 MW×3), Transformers Package 2 Dam Construction Dam Structure (Reservoir capacity 51,000,000 m^3, 57 m height) and weir construction Package 3 Plant Construction Building and auxiliaries Package 4 Tunnel Construction Construction of intake tunnel and spillway tunnel, incl. steel structures. Package 5 Construction Materials **Local Currency** Tunnel Construction and Others Land consolidation of turbine building, drainage, main gate, down-stream bank consolidation Consulting Other Expenses Electric charges, etc.	**Foreign Currency** Package 1 Generators Generators 72 MW(20 MW×3), Transformers Package 2 Dam Construction Dam Structure (Reservoir capacity 51,000,000 m^3, 57 m height) and weir construction Package 3 Plant Construction Building and auxiliaries Package 4 Tunnel Construction Construction of intake tunnel and spillway tunnel, incl. steel structures. Package 5 Construction Materials **Local Currency** Tunnel Construction and Others Land consolidation of turbine building, drainage, main gate, down-stream bank consolidation Consulting Other Expenses Electric charges, etc.
2. Project Period	March 2001 to March 2004 (37 months)	March 2001 to September 2005 (55 months)
3. Project Cost Amount in foreign currency Amount in local currency Total Japanese ODA loan portion Exchange rate	Hanpingzui Sub-project 4,638 million yen 1,299 million yen(123.05 million yuan) 5,937 million yen 4,638 million yen 1 yuan = 13 yen (As of October 2000)	Hanpingzui Sub-project 4,638 million yen 2,844 million yen(198.05 million yuan) 7,482 million yen 4,638 million yen 1 yuan = 14.36 yen (Average from March 2001 to October 2007)

Mongolia

Ex-Post Evaluation of Japanese ODA Loan Project

"The Rehabilitation Project for the 4thThermal Power Plant in Ulaanbaatar (I) (II)"

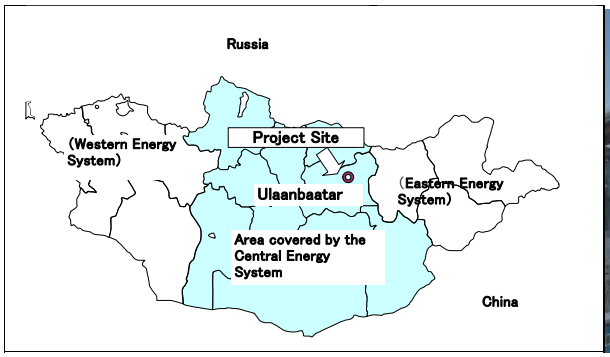
External Evaluator: Nobuko Fujita,
Foundation for Advanced Studies on International Development

0. Summary

The project was implemented as a part of the continued assistance to the 4th thermal power plant (hereafter, TPP4) that was in critical condition after the withdrawal of human resource support from the former Soviet Union in the early 90's. Given TPP4's considerable significance as the largest source of electricity and heat supply in Mongolia, the project was highly relevant. The effectiveness of the project is high since the operation rate of the boilers increased (thanks to a radical drop in number of forced outages), and since a significant reduction in coal consumption and CO_2 emission per unit of electricity generated was obtained. Also, the stabilisation of and the substantial increase in the country's energy supply helped improve the credibility of the Central Energy System (hereafter, CES) as a whole. Although the energy sector policy of the country is now in transition and the external environment is uncertain, sustainability of the project itself is evaluated as high.

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

1. Project Description



（Project Location）

（The 4th Thermal Power Plant）

1.1 Background

Mongolia has a total land size of 1.56 million km² (four times that of Japan). Its population is around 2.75 million, out of which 1.24 million people, or 45%, live in the capital city of Ulaanbaatar (2010). Electricity is provided by CES, Western Energy System, and Eastern Energy System, with CES providing over 90% of the country's electricity.

In CES, TPP4 provides 73％ of the area's electricity and 62% of the area's heat (2010). It was built with assistance from the former Soviet Union and commenced operation in 1983. However, after Russian funding ended and Russian engineers were pulled out in 1991, the boiler's auto-control system stopped functioning which constrained power generation. Moreover the indirect firing system being used at TPP4 was causing frequent mechanical trouble and posed a high risk of explosion: all of which were destabilizing factors for electricity supply[1]. Furthermore, due to a low combustion efficiency, TPP4 consumed large amount of coal thereby emitting high levels of air pollutants.

Although CES was importing electricity from Russia to offset the shortages, outages and drops in temperature for central heating were frequent which seriously affected industrial production and people's daily life, especially in winter. To improve this situation, the rehabilitation of the automatic control system of the boilers and conversion to a direct firing system had become important at TPP4.

1.2 Project Outline

The objective of this project is to increase the reliability and combustion efficiency of TPP4's existing facilities and to reduce air-pollutant emissions (by rehabilitating an automatic control system and switching to a direct firing system) and thereby contributing to the improvement of people's daily life and the industrial development of Ulaanbaatar through a more stable supply of electricity and heat.

Loan Approved Amount/ Disbursed Amount	I: 4,493 million yen/4,493 million yen II: 6,139 million yen /6,072 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	I: October 1995/ October 1995 II: February 2001/March 2001
Terms and Conditions	Interest Rate: I: 2.3％ II:0.75% Repayment Period: I:30 years II:40 years (Grace Period: 10 years) Conditions for Procurement: I: general untied II: general untied (bilateral tied for consultants)
Borrower / Executing Agency(ies)	Ministry of Mineral Resources and Energy [2] (implementor:TPP4)/Guarantor: Government of Mongolia
Final Disbursement Date	I: April 2002, II: July 2008
Main Contractor (Over 1 billion yen)	I:Austrian Environment Sgpiwaagner-biro (Austria)・Nissho Iwai(JV) II: ITOCHU
Main Consultant (Over 100 million yen)	Electric Power Development Co., Ltd.
Feasibility Studies, etc.	Feasibility Study on the Rehabilitation Project for the 4th Thermal Power Plant in Ulaanbaatar: Japan Consulting Institute, 1991

[1] In an indirect combustion system, pulverized coal is stored temporarily and poured into boilers as needed. In a direct burning system, coal is poured into the boiler for burning right after pulverization.

[2] Currently, Energy Authority under the Ministry of Mineral Resources and Energy (see 3.5.1.).

	SAPROF: August 1995
Related Projects	<Technical Cooperation> ・Dispatch of experts (1996~01, operation and maintenance) ・ JICA Development Study Supporting the Rehabilitation Project of the 4th Thermal Power Plant in Ulaanbaatar Mongolia (2001~ 2002) ・ Senior Volunteer（20, Electricity field, 2002~ 2011） <Grant> ・Emergency equipment provision（1991, 4 mil. yen） ・ Rehabilitation Project for Improvement of the 4th Thermal Power Station in Ulaanbaatar (1992~1994, 2.415 bil. yen), Phase II (1.173 bil. yen, 1996), Follow-up (50 mil. yen, 2007)

2. Outline of the Evaluation Study

2.1 External Evaluator

Nobuko Fujita, 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: January 17 – January 28, June 13－June 17, 2011

2.3 Constraints during the Evaluation Study (if any)

None.

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

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance with the Development Plan of Mongolia

The Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia (2008-2021) points out Mongolia's limited and unreliable power supply as one of the country's weaknesses and aims for self- sufficiency in energy in light of the growing energy needs of the Gobi region. The Mongolian Integrated Power System Program (enacted in 2002 and amended in 2007) lays out Mongolia's vision for the energy sector and targets the integration of its power systems (by laying out power generation facilities nationwide), providing a stable supply of electricity to local regions and exporting electricity.

The Energy Sector Master Plan (2000–2020), approved in 2002, indicates that TPP4 will maintain its crucial role in electricity and heat supply even after 2020, considering that

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

[4] ①: High, ② Fair, ③ Low

some of the aging power plants are expected to close down by 2020[5]. The Master Plan will be revised by November 2011, but even in the revised version, TPP4 is given a core role in CES[6].

3.1.2 Relevance with the Development Needs of Mongolia

Mongolia's imports of electricity to compensate for supply deficiencies amounted to 15.3% of its total electricity demand in 1995. Despite such imports there were frequent outages which caused shutdowns in factory production lines, and drops in heat temperature during severe winters. This was a serious problem since heat could not be imported.

Currently, prospects for a growth in mining and manufacturing are high and annual increases of between 3.2～7.7% are expected[7]. By 2015, the demand for heat is also expected to increase by 29.0% (compared to 2010)[8] due to a government policy to make the Ger area into apartments[9].

3.1.3 Relevance with Japan's ODA Policy

The basic framework of cooperation with Mongolia (1994, Ministry of Foreign Affairs of Japan) states that Japan places emphasis on strengthening economic infrastructure and diversification of industry. Also, at the 4th conference of Consultative Group on Mongolia, Japan indicated its support for the rehabilitation of TPP4 in light of the necessity to support the energy sector.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project consisted of two phases, Phase I and II. Phase I was consisted of the

5 Among five thermal power plants of CES, 2nd thermal power plant is said to be shutdown in near future as its lifetime expired in 2009. Service life of 3rd thermal power plant will expire in 2011 and therefore will be shutdown in phases. Although 5th thermal power plant is expected to be built by 2020, TPP4 will keep playing an important role till then. As of the boilers of TPP 4, 20～28 years elapsed since their operationalization, and the Russian standard machine life is 25 years. However, the Energy Authority believes this project can extend the service life by 20 years. With proper maintenance and repair, they plan to make TPP4 play a core role in electricity supply of CES.（Source: Master Plan and the Energy Authority. (January 20, 2011)).

6 Hearing from Energy Authority. This revision has received support from the Japan Fund for Poverty Reduction.

7 Document supplied by the Energy Regulatory Authority

8 Document supplied by the National Dispatching Center

9 Area with Gers (Mobile residence of Mongolian nomads) and wooden houses surrounding the center of the city where nomads and others who migrated in Ulaanbaatar live.

installation and renewal of machinery for the recovery of the self-control system for four out of eight boilers, and conversion of the firing system method of the mills from indirect to direct (Table 1). In Phase II, the four remaining boilers underwent similar installations and renewals, and the exciter systems for the generators were also rehabilitated.
In both phases, outputs were produced as planned, except for the consulting service for Phase II which was extended by 1.36 MM[10].

Table 1 Major Output

Phase	Plan	Achievement	Differentiation
I	(1) Rehabilitation of automatic control system Boiler No. 1 ~4） (2) Conversion from indirect to direct firing system (ditto) (3) Rehabilitation and installation of associated machineries (ditto) (4) Consulting service 94MM	(1) Renewal of boiler control system, installation of chemicals injector, blow control system, data processing system, operation simulator, etc. (2) Installation of vertical mill motor,coal weighing machine, pulverized coal feeding tubes, ventilators, etc. (3) Renewal of boiler tubes, etc. (4) 94MM	(1)~(4) as planned
II	(1) Rehabilitation of automatic control system (Boiler No.5~8） (2) Conversion from indirect to direct firing system (ditto) (3) Rehabilitation and installation of associated machineries (ditto) (4) Stabilizing operation (5) Consulting service 108MM	(1) Same as Phase I (2) Same as Phase I (3) Same as Phase I (4) Renewal of the exciter system (5) 109.36MM	(1)~(4) as planned (5) increase by 1.36MM

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total cost for Phase I and II amounted to 11,873 mil. yen opposed to 12,343 mil. yen as planned (96% of planned amount). In Phase I, the local cost exceeded the planned cost by 20%, however it decreased by 17% in yen terms due to currency depreciation. Although the consulting service in Phase II was extended as mentioned above, it was financed by contingency funds and TPP4's own funds, which kept the total costs within the budget.

3.2.2.2 Project Period

The project period was 121 months which was longer than planned (136%). Completion of the project was delayed by 16 months in both phases[11]. Causes for delay in Phase I included; the delay in procurement, taking time for removal of underground concrete to install equipment, as well as deliberate commissioning. In Phase II, the first package out

[10] Because continuous advice regarding management and adjustment of boilers was necessary.

[11] The project period is defined as starting the month of loan agreement signing to the completion of commissioning.TPP4 uses the same definition. And since there was 17 months blank between Phase I and II, project period was defined extracting this period.

of seven needed 15 months from public notice of pre-qualification to contract signing which slowed down other packages[12]. Moreover, installation works were extended by 2-3 months, and commissioning took longer than expected due to a drop in the temperature of the boilers. All of these contributed to the project period's overrun.

Although the project cost was within the plan, the project period needed to be extended, therefore efficiency of the project is fair.

3.3 Effectiveness[13] (Rating: ③)

3.3.1 Quantitative Effects

The boiler operation rate, which was an indicator set during the appraisal, was mostly achieved. The auxiliary rate and the frequency of boiler suspension (which indicate the combustion efficiency and the facility's reliability) also improved considerably. In addition, the consumption of coal and heavy oil were reduced which contributed to energy conservation.

3.3.1.1 Results from Operation and Effect Indicators

（1） Improvement of efficiency and facility reliability of TPP4

① Operation rate of boilers

As for operation rate of the boilers, the target was mostly reached (Table 2). The maximum output of TPP4 in 2010 increased by 50% compared to that of 1995 (By January 2011, it increased by 80%, reaching 576MW)[14]. Power production (sending end) increased by 92.7% in the same period, which indicates an obvious effect of this project （Figure 1）.

Table 2 Operation and Outcome Indicators

indicators	baseline (1995)	target (1999)	actual (2010)	actual/baseline (%)
Boiler operation rate （%）*1	41.3	60.0	59.5	144.1
Maximum Output （MW）	320		481	150.3
Power Production (sending end)（MWh/y）	1,314,906		2,533,470	192.7
Net Thermal Efficiency （%）*2	50.6		56.4	111.5
Auxiliary Power Rate （%）	20.5		13.8	67.3
Rate of boiler failure due to mechanical problems （%）*3	47.7		13.1	27.7

*1：Annual operating hours (8 boilers total) （24h x 365 days x 8 boilers）

*2：Annual power production（sending end）x 860/annual fuel consumption x heat valuex100. It indicates thermal efficiency.

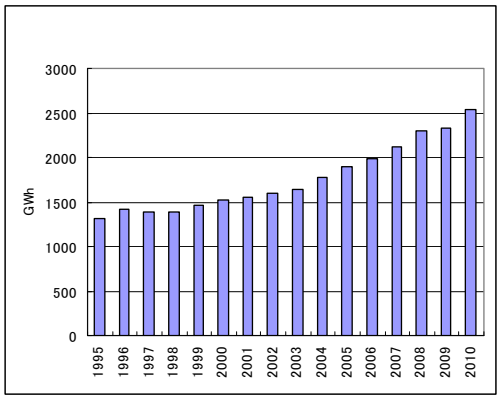
[12] It took a long time to examine the tender document in terms of technical aspects such as how performance could be adjusted depending on different kinds of coal.

[13] Effectiveness is scored also in the light of factors regarding Impact.

[14] As for turbines, the maximum output of No5 (2007) and No.6 (2010) was raised from 80MW to 100MW by TPP4's own fund, bringing the total maximum output to 580MW.

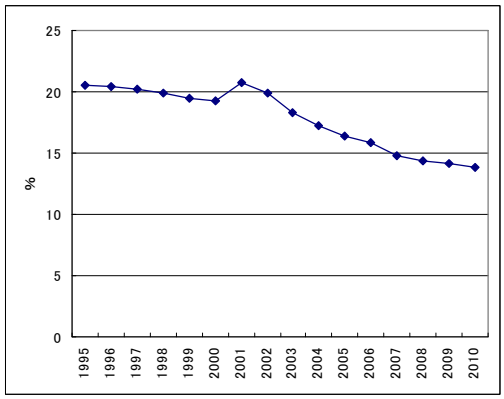
*3：Among total operating hours x 8, total hours in which boilers were suspended

（Source：TPP4）



(Source：TPP4)

Figure1：Power Production of TPP4 (sending end)



(Source：TPP4)

Figure2：Auxiliary Power Rate of TPP4

② Auxiliary Power Rate

The Auxiliary Power Rate (the rate of consuming produced electricity within the power plant) decreased to 13.8% in 2000 from 20.5% in 1995 (Figure2). It is lower than any of the other four coal firing power plants[15] in CES (ranging from16.0%～22.1% in 2010) indicating that TPP 4 has the most efficient power production in CES.

③ Shutdown of boilers

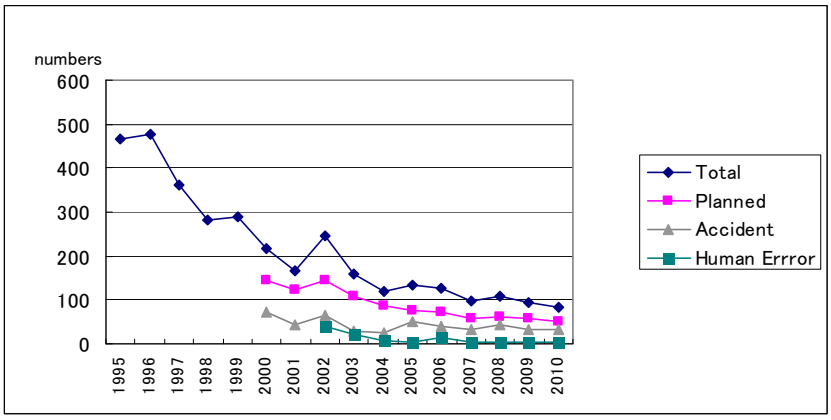
In 2010, the hours of boiler shutdown was one fourth that of 1995 (table 3). The number of boiler shutdown has decreased substantially across the board including; planned shutdowns, accidental shutdowns, and shutdowns due to human error (Figure3).

Table3 Hours of boiler shutdown

	1995	2000	2010
Hours of boiler shutdown （8 boilers total, h/year）	33,459	29,411	9,212

(Source：TPP4)

[15] Four other power plants are TPP2, TPP3 in Ulaanbaatar, Darhan and Erdenet Thermal Power Plants.



(Source：TPP4)

Figure3　Frequency of boiler shut down

（2）Environmental improvement effect

Although consumption of coal increased due to the increase in power production, the amount per unit power generation in 2010 decreased by 11.5% compared to year 2000, reaching the target (11.3%). Likewise, CO_2 emission increased in absolute terms but decreased in terms of unit power production by 16.4% compared to year 2000 surpassing the goal of 11.5 % (Table 4).

As for heavy oil consumption, the amount in 2010 is less than one third that of year 2000, due to a decrease in the number of boiler shutdowns (less re-starting operation).

As for SO_2 and NOx, it is hard to compare current data with that of 1995 because the detailed measurement conditions in 1995 are unknown; however, unit production wise, SO_2 was halved, and NOx is unchanged. Since neither desulphurization equipment nor NOx removal system is installed, the decrease in SO_2 is most likely due to the change in combustion and the electrostatic precipitator.

Table4 Environmental improvement effect

	1995 (reference)	2000 (baseline)	2008 (target)	2010 (actual)
Electricity generation (generation end)（MWh/y）	1,654,000	1,910,000		2,940,600
Total consumption of coal（t/y）	1,968,502	2,190,369		2,985 ,000
Coal consumption per unit production of electricity（t/MWh）	1.190	1.147		1.015
Rate of change per unit production of electricity (compared to 2000) （%）			－11.3%	－11.5%
CO_2 emission（t/y）	2,755,895	3,007,508		3,868,560
CO_2 emission per unit production of electricity（t/MWh）	1.6662	1.5746		1.3158
Rate of change per unit production of electricity (compared to 2000)（%）			－11.5%	-16.4%
Heavy oil consumption（t/y）	20,085	4,793		1,366
SO_2 emission（t/y）	9,236.2			7,402.2
SO_2 emission per unit production of electricity（t/MWh）	5,580			2,520
Rate of change per unit production of electricity (compared to 2000) (%)			－45%	－54.8%
NOx emission（t/y）	5,232.5			9,280.6
NOx emission per unit production of electricity（t/MWh）	3,163			3,157
Rate of change per unit production of electricity (compared to 2000) (%)			－22%	-0.2%

（Source：target: Appraisal report. CO_2emission is calculated considering the proportion of different kind of coals, others are from data provided by TPP4. Since there was no accurate measurement of SO_2 and NOx for the period 1999~2008, 1995 data was used as a baseline.）

SO_2 concentration in exhaust falls below Mongolian National Standards (2008) in 2010 although NOx exceeds the Standard by 40~70% for the boilers using Shive-Ovoo coal (Table 5). TPP4 pays attentions to air pollutants and conducts monitoring of exhaust twice a month and the installation of a smoke stack monitor is being planned to constantly measure pollutants[16].

Table 5 Air pollutants in the exhaust of TPP4 boilers compared to National Standards

Boiler No.	coal	SO_2	NOx
No.3,4	Baganuur	0.11～0.33times	1.03～1.06times
No.5,6,7	Shivee-Ovoo	0.1～0.3times	1.42～1.76times

（Note: Mongolian National Standards are set according to the size of power plants. The above comparison was made using TPP4 size standards. Source: Air Quality Agency of the Capital City）

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

Combining Phase I and II, the IRR for the period 1996~2020 was re-calculated as follows.

Table 6 Recalculated IRR as of ex-post evaluation

	FIRR (%)		EIRR (%)	
	appraisal	ex-post evaluation	appraisal	ex-post evaluation
Phase I	8.8	6.2	10.5	26.2
Phase II	17.4		18.8	

[16] Environmental monitoring is conducted every four years by private consultant companies, although its recommendations are not binding and follow-up reporting is not necessary. Starting 2010, Air Quality Agency of the Capital City is in charge of monitoring and its enhancement is expected.

As for FIRR, a before and after comparison is not appropriate since the decrease of electricity imported from Russia, which is not in TPP4's account, was calculated as a benefit at the time of the appraisal. The relatively low 6.2% FIRR is influenced by tariff controls.

EIRR was calculated under the same conditions as the appraisal. This project contributed to electricity import savings, and given that the expected import price was twice as high in 2010, the benefit (import savings) pushed EIRR as high as 26.2%.

3.3.2 Qualitative Effects

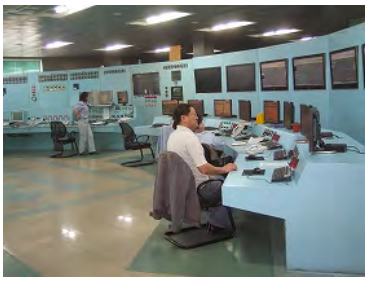
(1) Number of explosive accidents in the plant

By introducing a direct firing system, fire caused by storage of pulverized coal, which happened 16 times in 1996, was prevented and there have been no further explosions since 2000[17].

(2) Reduction of operation and maintenance cost

By efficient firing, the project saved 388,080t of coal or 4,424 mil. Tug (around 290 mil. yen) a year in 2010 compared to 2000[18]. Restarting a boiler takes 25~26t of heavy oil which amounts to 15 mil. Tug (around 1 mil. yen) each time. Efficient firing and reduction in the number of boiler halts contributed to reduce operation and maintenance costs.

This project has largely achieved its objectives; therefore its effectiveness is high.

		
Control Room	Mill	Boiler Tubes

3.4 Impact

3.4.1 Intended Impacts

（1） Stabilization of power supply

In a survey targeting large scale users of electricity in CES and residents of Ulaanbaatar

[17] TPP4 hearing.
[18] 1yen=15.22Tg（2010 Average）.

and Darhan city[19], 75.6% responded that power supply improved (in terms of fewer outages and stable voltage) compared to the 1990s. Large scale users reported smoother business operation and increase in production due to a stable power supply, and reduction of machinery failures due to stabilization of voltage. Residents of both cities mentioned less problem for preparing meals (since there is no town gas supplied in Mongolia, electricity is used for cooking in apartments).

In the 1990s, even though electricity was supplied to Ulaanbaatar by sacrificing some local areas, planned outages still occurred in Ulaanbaatar, neither of which is seen today[20].

Although outages have decreased in comparison to the 1990s, they started to increase again since 2007 (Table 7). Beneficiary survey also shows that there are 3~26 hours of outages depending on where they live (Table 8).

Causes of outages in 2009 relate to problems of distribution facilities (41%), planned outages (34%), natural disasters (6.4%), and generation and transmission-related problems (1.3%)[21]. The recent increase in outages is caused by a tightening of supply due to increasing demand as well as distribution-related problems.

According to the distribution company, causes of distribution problems are cable accidents (48%), natural disasters (8.3%), and others (33.8%), and aging distributional facilities is a serious concern[22]. The transmission company states that transmission facilities are also aging since they were installed by the former Soviet Union in the 1980s and only 10-20 percent has been rehabilitated[23].

Table 7　Number of outages（CES）

	1995	2000	2005	2006	2007	2008	2009	2010
Number of outage in CES	184	12	11	6	27	99	159	238*

（*estimate, source：Energy Statistics 2010）

[19] Beneficiary survey was conducted in January and February 2011 targeting 30 large users, 30 households in Ulaanbaatar, and 30 households in Darhan city, who have been doing business or living in Darhan since 1990s. As for Ulaanbaatar, 12 households living in apartment with electricity and heat supplied, 10 households living in Ger and 8 households living in wooden houses with electricity (proportion reflects actual proportion of housing situation in Ulaanbaatar). Also, since location determines frequencies of outages, sample numbers were distributed according to proportion of the population in the 3 central districts, 3 suburban districts, and 3 remote districts.) In Darhan city, 18 households living in apartments and 12 households living in Ger were selected, which were also broken down to 12 central and 18 suburban households. All were asked about their satisfaction with the energy supply, comparisons to 1990s, and their conception about TPP4.

[20] Interview at Ministry of Mineral Resources and Energy

[21] Energy Regulatory Authority Annual Report 2009

[22] Interview at Ulaanbaatar Electricity Distribution Network State Owned Joint Stock Company

[23] Transmission facilities with 25 year life spans have already been used for 45 years. Interview at Central Regions Electricity Transmission Grid State Owned Joint Stock Company

Table 8　Frequency and hours of outage (2011)（beneficiary survey）

	Frequency/year	Average hours/time
large scale users in CES	4.6	2hours36’
Ulaanbaatar residents	13.1	1 hour57’
Darhan residents	2.2	1hour16’

(Source：Beneficiary Survey. Frequency and hour differs depending on location in a city.)

（2）Increase in heat supply

In comparison to 1995, heat supply in 2010 shows a 41.4% increase. According to the beneficiary survey, 68.4% responded that heat supply improved compared to the 1990s. (Heat supply stabilized and there were fewer disruptions in heating.) Heat and hot water supply is crucial in winter when temperature falls below 30 Celsius.

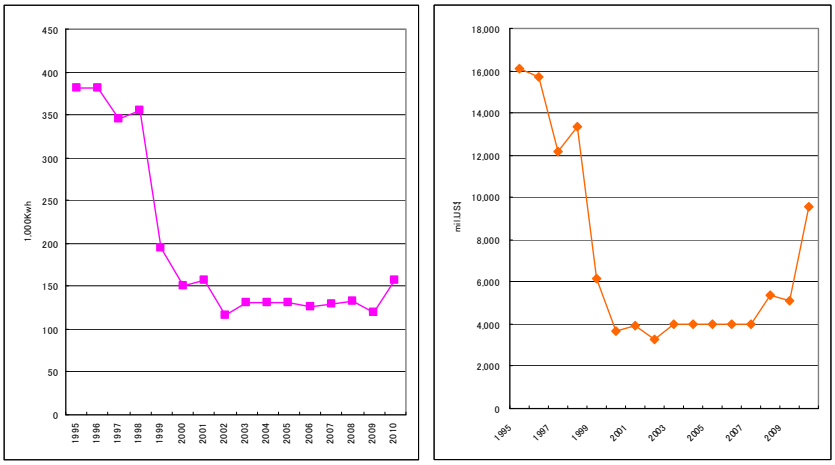
Table 9　Heat supply

	1995	2000	2010
heat supply（1,000 GCal）	2,148	2,608	3,038

(Source: TPP4)

（3）Decrease of electricity imports from Russia

Electricity imports have dropped substantially and are only one third of that in 1995, representing 4.9% of total demand in 2009. Imports, however, started increasing in 2010 when the economy, especially the mining sector, started recovering from the Lehman shock (Figure 4). In monetary terms, imports have decreased from 1995, although they are on the rise again since the unit cost has been on the rise since 2008 (Figure 5).



（Source：Energy Statistics2010）

Figure 4 Electricity Imported (kWh)　Figure 5 Electricity Imported (US$)

3.4.2 Other Impacts

(1) Impacts on the natural environment

As stated before, this project contributed to the reduction of CO_2 and SO_2 per unit of power production by reducing coal consumption. On the other hand, in absolute terms, TPP4 remains one of Ulaanbaatar's contributors to air pollutants.

Air pollution in the capital city is serious. According to fixed ambient air monitoring stations, NO_2 concentration is 0.8~3.6 times the national standard (depending on annual average from monitoring spots), SO_2 concentration is 2.6~5.7 times, SPM (PM10) is 0.7~4.5 times. In winter, all pollutants exceed national standards at every monitoring spot[24].

Such pollution is caused by; three coal fired power plants, boilers and stoves for houses and Gers that are not connected to the central heating system, and exhaust gas from the rapidly increasing use of vehicles. Pollution is exacerbated in that dust in a dry climate can more easily be carried up by wind, at the same time the upper atmosphere is stable and pollutants are not easily diffused[25].

The beneficiary survey shows that 60% of large scale users and 73.3 % of Ulaanbaatar residents think TPP4 has a negative environmental impact. Although, since there are other power plants close-by, the respondent might not necessarily be able to identify the source of pollution. Among the negative environmental impacts associated with TPP4, 53.3% pointed out exhaust gas and 8.3% pointed out flying coal dust and ash.

・Dust in exhaust gas

An electrostatic precipitator (ESP) was installed at the time of installation and the removal rate has been improving (up to 97.98% in 2010). However, due to the aging of the ESP, the frequency of mechanical problems has been increasing and TPP4 is considering using their own funds to renew the ESP.

・Coal dust

In downwind regions of TPP4, flying coal dust is a problem. Coal is carried into TPP4 by open wagon and stored open air (about 260,000t regularly). In April and May when the wind is strong, coal dust is blown downwind and windows are covered by dust and ash as mentioned below. TPP4 tries to prevent such blow-off by sprinkling water.

・Ash

After combustion, coal ash is carried to an ash pond 3km away from TPP4 as slurry. When the ash pond becomes full, it is covered by soil. In 2000 and 2008 part of ash pond retaining wall collapsed and ash flowed off into the surrounding area (into Tora River in

[24] Data provided by the National Agency of Meteorology Hydrology and Environment Monitoring

[25] According to simulations conducted by S. Guttikunda of the rate of contribution to pollution by each pollutant, No2, 3, and 4 power plants total contributes 34% of PMS in Ulaanbaatar, 59% of SO2, and 56％of NOx (Urban Air Pollution Analysis for Ulaanbaatar, 2007). Contribution by each power plant is simulated by JICA Technical Cooperation Project "Capacity Development Project for Air Pollution Control in Ulaanbaatar City."

2000). The ash pond has been re-enforced since then[26] and it is usually under water or snow; however, during the dry season, strong wind can blow ash away and although TPP4 takes preventative measures by pouring water in the ash pond to adjust the water content of the ash, they are sometimes unsuccessful.

（TPP4,View from the Ash Pond）

（2）Land acquisition and resettlement

Land acquisition and resettlement did not occur for this project.

（3）Other positive/negative impact

Thanks to a more stable supply of electricity and heat, the TPP4 project has improved the reliability of CES itself[27].

In light of the above, this project made a stable supply of heat and electricity possible, contributed to the reduction of outages in CES and saved foreign currency by reducing electricity imports.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

Organisational structure for operation and maintenance is in place and staffs are properly assigned. Due to organizational reforms, the executing agency has been changed from the Ministry of Energy, Geology, and Mining to: the Ministry of Infrastructure and the Ministry of Fuel and Energy. At the time of the ex-post evaluation, TPP4 is administered by the Energy Authority which is under the Ministry of Mineral Resources and Energy.

Actual implementing organisation of the project, TPP4, is a 100% state owned joint stock company (41% owned by the Ministry of Mineral Resources and Energy, 39% by the National Property Committee, and 20% by the Ministry of Finance). Privatization is not foreseen in the next 15 years[28].

Operation and maintenance is carried out by the Operation Department, and the Repair

[26] Current ash pond is made by building a wall after banking first and second ash pond, and is said to be available for another 5 years. After that, the third and fourth ash ponds currently being land filled will be banked and used as the next ash pond.

[27] Interviews at Energy Authority, Energy Regulatory Agency, National Dispatching Center, Central Regions Electricity Transmission Grid State Owned Joint Stock Company, Ulaanbaatar Electricity Distribution Network State Owned Joint Stock Company, Ulaanbaatar district heating company.

[28] Interview at Energy Authority

Department is in charge of maintenance. As of January 1st, 2011, the total staff count is 1,456. Staff count is broken down as follows; 1,063 are in the Operation Department (including 293 in Boiler Section), 161 in Research and Development Department (including 106 in the maintenance shop, in charge of repair and fabrication of parts), 98 in Management Department (finance and procurement), and 128 in Administration Department (canteen, transport, clinic, etc.).

3.5.2 Technical Aspects of Operation and Maintenance

Operation's training is conducted at the operation simulation room which was provided by the project and which comes equipped with control panels just like actual control rooms and are suitable for the improvement of operational techniques. The skill and knowledge of the staff are improved by training courses and on-the-job training. A major training course is conducted once a month for all the energy-related organisations in CES[29] and other overseas training includes training by JICA.

Operation and maintenance manuals are still in use. All the spare parts are imported from China, Russia, and Japan, however no particular problem was reported regarding procurement.

Along with the project's two JICA Experts, twenty Senior Volunteers (SV) have been dispatched on an ongoing basis between 1996 and today. Their fields cover not only energy supply, but management, maintenance, personnel administration, environmental management, procurement and others. Their long standing advice contributed to the improvement of operations and management. Especially when a group of SVs were dispatched from a private Japanese firm, management and personnel administration improved in addition to technical aspects.

3.5.3 Financial Aspects of Operation and Maintenance

In Mongolia, power plants became joint-stock companies in 2001 in order to introduce the principle of market mechanism into the energy sector and each company is required to maintain financial independence. However, the amount of power production by each plant is instructed by the National Dispatch Center and tariffs are set at a relatively low level compared to international standards (tariffs are set by the Energy Regulatory Authority with the consent of the Parliament)[30]. All the power companies have difficulties making profit independently with the tariffs set so low.

TPP4 is facing loan repayments in addition to the need to secure funds for repair and new

[29]Participants' performance is evaluated in the crisis management course and re-training is required for unsuccessful participants. He/she cannot go back to work without a passing grade, and ultimate failing of the course causes demotion or job displacement (interview at TPP4).

[30] Power tariff in Mongolia is 25~63% of that of Sri Lanka, Philippines, and Indonesia whose GDPs are about the same level as Mongolia (2008, Japan Electric Power Information Center).

investment[31]. TPP4's net profit was negative for the period from 2007 to 2009, due to factors including an increase in the price of coal (2008 prices were 1.5 times 2006 prices) and currency losses（Mongolia's currency depreciated 56% between 2007 and 2009）. However, net profit turned positive in 2010 because the electricity tariff was raised 17.35% in February, 2010. Heat production costs exceeds the sales costs at TPP4 (production costs were, 1.7 times the sales cost in 2010[32]) which reflects the national cross subsidy energy policy which subsidizes losses in heat supply by electricity sales. A major heating price increase is not easy in a country with long and harsh winters.

TPP4's financial situation will stabilise if the electricity and heat tariff is raised to the breakeven point. The Government of Mongolia has been making efforts to improve the situation by promoting market mechanisms and encouraging the entry of private businesses. The Parliament approved Resolution #72 in December 2010 with regard to subsidizing losses in the energy sector for three years as well as promoting the liberalisation of the energy sector. Therefore, TPP4 received a 3.487 bil. Tg subsidy from the government in 2010. Whether or not energy prices will be raised to the level at which TPP4 can make ends meet without subsidies depends on the implementation of Resolution #72.

Although there are concerns regarding TPP4's future financial situation, even if energy prices do not rise to a self-sustaining level for TPP4, considering the importance of TPP4, the Government will most likely support an extension of the resolution. Therefore, it is unlikely to jeopardize the sustainability of the outcome of the project.

Table 10　Financial condition of TPP4（in mil. Tg）

	Total sales profit	Sales and other cost	Operational profit	Non-operational profit	Net profit
2006	2377	1,399	978	-722	256
2007	2619	1,440	1,178	-1,412	-234
2008	1741	1,295	446	-10,811	-10,365
2009	-2,704	1,695	-4,400	-17,623	-22,023
2010	-207	1,313	-1,520	15,114	13,594

（Source：Energy Statistics for 2006, TPP4 for 2009.2007~2010）

3.5.4　Current Status of Operation and Maintenance

Operation and maintenance is generally good and over-halls are done regularly (every four years for boilers and every five years for turbines). Mill roller plates are repaired every 5,000 hours which is equivalent to about once a year.

[31] Repayment of loan to JICA is 5 mil US$/year (6.6 billion Tg), and the repayment to ADB and KfW is 320,000US$.Outstanding balance for JICA loan is 79 million US$, for ADB and KfW is 7 million US$ in the end of 2010.

[32] In case of electricity, production cost is 0.9 times sales cost.

The number of times boilers are shut off has been decreasing year by year, however eight shut offs occurred in January 2011 which caused concern. The reason why the boiler operation rate remains at 60% even though it improved compared to 1995 is that repair takes five to seven days once a boiler stops. The causes of shut off of boilers include the burst of air heater pipes, adhesion of ash and slug in the heaters and pre-heaters (especially the boilers using higher ash content Shivee-Ovoo coal), steam leaks from pipes and valves, etc. In order to prevent shutoffs, TPP4 is now considering: 1) periodical checkups and rehabilitation of air heater pipes and water wall, 2) installation of pre-air heater to prevent adhesion of ash and slag, and 3) installation of a boiler soot blower[33].
Other major TPP4 rehabilitations include, installing a washing device in the condenser tube of the turbine (KfW loan is under request), rehabilitation of aged generator breakers, installation of a hot water feeding pump, construction of a heat exchange station for expanding heat supply, replacement of an electrostatic precipitator, all by TPP4's own funding or government subsidies. Also, TPP4 has a plan to synchronize the automatic control of the turbine operation system with the automatic boiler controls. With all of the planned rehabilitations mentioned, TPP4 is trying to further stabilise energy supply.

Although there is some concern about TPP4's financial conditions, no major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was implemented as a part of the continued assistance to the 4th thermal power plant that was in critical condition after the withdrawal of human resource support from the former Soviet Union in the early 90's. Given the considerable significance of TPP4 which is the largest source of electricity and heat supply in Mongolia, the project was highly relevant. The effectiveness of the project is high since the operation rate of the boilers increased thanks to a radical drop in the number of forced outages, and a significant reduction has been identified in coal consumption and CO_2 emission per unit of electricity generated. Also, the substantial increase in and stabilisation of energy supply has contributed to the improvement in the credibility of the Central Energy System as a whole. Although the energy sector policy of the country is now in transition and the external environment is uncertain, sustainability of the project itself is evaluated as high.
In light of the above, the project is evaluated to be highly satisfactory.

[33] Interview of TPP4 and a Senior Volunteer.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In order to prevent boiler shutoffs: periodical inspection, repair, and renewal in addition to countermeasures to prevent adherence of ash and slag are necessary. Also, in the future, installation of desulfurization and NOx removal devices should be sought in order to cut down the emission of pollutants, and continuous attention should be paid to prevent dispersion of coal dust and ash.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Many JICA experts and senior volunteers were dispatched to TPP4 continuously since 2002 in order to complement hardware assistance with technical support. In one particular case, a group of Senior Volunteers were sent from a private company (eight SVs in 2002~2006) and introduced Japanese-style work force management. The “5S” movement introduced then still remains operational today. As such, the effect of cooperation can be enhanced using a combination of hard and soft assistance.

Column 1: High visibility of the project

Beneficiary survey shows that 51.2% said they knew this project well or were somehow informed. Although it was a loan project, people are aware of the assistance from Japan in view of its significance in their lives.

Column 2: Bond shown in disaster

At the time of an earthquake and tsunami in 2011, all the employees of TPP4 donated one day’s worth of salary to Japan.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1.Project Outputs	I:(1)Recovering function of automatic control system of the 4 boilers (2) Switching to a direct firing system of the 4 boilers (3) Repair of the boiler incidental facilities (4) Consulting service: 94MM II:(1) Switching to a direct firing system of the 4 boilers (2) Modernization of automatic control system of boilers (3) Boiler tube exchange (4) Exchange of the generator excitation equipment (5) Repair of boiler incidental facilities (6) Consulting Service :108MM	I: (1)~(4) As planned. II: (1)~(6) As planned (7) Consulting Service: 109.36MM
2.Project Period	I: October 1995 – May 1998 (33 months) II: March, 2001 – October 2005 (56 months)	I: October 1995 – October 1999 (49 months) II: March, 2001 –February 2007 (72 months)
3.Project Cost		
Amount paid in foreign currency	I: 4,493 mil. yen II: 6,139 mil. yen	I: 4,493 mil. yen II: 6,072 mil. yen
Amount paid in local currency	I: 798 mil. yen (3,522 mil.Tg.) II: 922 mil. yen (8,017 mil.Tg.)	I: 658 mil. yen (4,235 mil. Tg.) II: 650 mil. yen (6,632mil. Tg.)
Total	I: 5,282 mil. yen II: 7,061 mil. yen	I: 5,151 mil. yen II:6,722 mil.yen
Japanese ODA loan portion	I: 4,493 mil.yen II: 6,139 mil.yen	I: 4,493 mil. yen II: 6,072 mil. yen
Exchange rate	I: 1Tg=0.224yen（1995Average） II:1Tg=0.115 yen (2001 Average)	I: 1Tg=0.155yen (1996～2001 Average) II:1Tg=0.098yen(2002~2008Average)

Mongolia

Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Improvement of Water Supply Facilities in Ulaanbaatar in Mongolia"

External Evaluator: Maki HAMAOKA,

Foundation for Advanced Studies on International Development

0. Summary

The objective of the project, which is to provide a stable water supply for the citizens of Ulaanbaatar City, was achieved by improving the water supply facilities at the upper and central water source areas through this project. As a result of enhancing the water supply capacity, effects were brought; in particular, the improved convenience in fetching water for the residents of the Ger area[1] and an improvement in the stability of the water supply.

Several cases of defects have arisen to date in the facilities constructed, but appropriate repairs have been made in each case by the contractor or the Water Supply & Sewerage System Co. of Ulaanbaatar City (USUG). The operation and maintenance system of USUG is clear, and there is also a certain degree of technical capability. With respect to its financial aspects, its operating income is increasing year by year and the budgets for the operation and maintenance of the facilities constructed by this project have been continuously secured. An issue of some concern is that foreign-exchange losses on settlements upon refund of principal and payment of interest for loans to the World Bank and the Spanish Government are imposing a burden on USUG.

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

1. Project Description

Project Location

Wells Pump Stations along the Tora River

1.1 Background

In Mongolia, there has been a rapid influx of population from the rural areas to the capital city of Ulaanbaatar following such events as the liberalization of the economy after 1990 and the mass death of livestock during the snow damage that occurred during 1999-2000. The rate of population growth

[1] The Ger area, located in Ulaanbaatar is an area where public infrastructure, including water and power supply and sewerage systems, is not so well developed.

of the city was less than 1% before 1992, but increased greatly to approximately 3-4% in 1993 and after. At the time of the basic design study (2003), a population increase of 3% a year until 2015 was forecast. Based on the future population forecast and the anticipated increase in demand for water due to the improvement of the living environment as a result of modernization, at the time of the basic design study, a shortage of water of 18,000 m^3/day was projected for 2010. Therefore, securing drinking water for citizens by developing new water sources and improving water distribution facilities has been an urgent issue.

1.2 Project Outline

The objective of this project is to provide sufficient and safe water to the inhabitants of Ulaanbaatar by improving the water supply facilities at the upper and central water source areas.

Grant Limit/Actual Grant Amount	1,685 million yen/1,674 million yen
Exchange of Notes Date	Detailed Design：January, 2004 Construction Works: May, 2004
Implementing Agency	Water Supply & Sewerage System Co. of Ulaanbaatar City (USUG)
Project Completion Date	November, 2006
Main Contractor(s)	Dai Nippon Construction Co., Ltd.
Main Consultant(s)	NJS Consultants Co., Ltd.
Basic Design	"Basic Design Study on the Project for Improvement of Water Supply Facilities in Ulaanbaatar in Mongolia", JICA/NJS Consultants Co., Ltd., December, 2003
Detailed Design	February, 2004 – January, 2005
Related Projects (if any)	<u>Technical Cooperation</u> • Development Study "The Study on the Water Supply System in Ulaanbaatar (1993-1995） • Dispatch of an expert for a review of the "Master Plan 2020 for Ulaanbaatar City (Water supply improvement)" (1999-2001) • Acceptance of Technical Training Participants (country focused training and dialogue, region focused training and dialogue, project counterpart training) • Development Study "The Study on the City Master Plan and Urban Development Program of Ulaanbaatar City in Mongolia (UBMPS)" (February, 2007-November, 2009) <u>Grant Aid</u> • "The Emergency Rehabilitation of Water Supply Facilities in Ulaanbaatar City" (1996-1998) (Phase-1) • "The Ulaanbaatar Water Supply Development Project in Gachuurt in Mongolia" (in process) (Phase-3) <u>Other Donors</u> • World Bank "Ulaanbaatar Services Improvement Project (USIP)" (1997-2003) • World Bank "Second Ulaanbaatar Services Improvement Project (USIP 2)" (2004-2011) • Netherlands Government "Water Operator Partnerships (WOPs)" (2007-2010)

2. Outline of the Evaluation Study

2.1 External Evaluator

Maki HAMAOKA, 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: January 17–February 1, 2011, June 13–22, 2011

2.3 Constraints during the Evaluation Study (if any)

Nil

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

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance with the Development Plan of Mongolia

The objective of this project has been highly relevant with the national development plan and water sector plans of Mongolia and development needs at the time of both the ex-ante evaluation (2003) and the ex-post evaluation (2011).

The Economic Growth Support and Poverty Reduction Strategy (EGSPRS) (2003) stated the "improvement of basic life and industrial infrastructure" as its priority objectives. The Ulaanbaatar Master Plan targeting the year 2020 (2003) placed emphasis on the construction of apartments, electric power supply and construction of water supply facilities. Water supply was given focus among them in order to meet population growth.

At the time of the ex-post evaluation, the Millennium Development Goals Based Comprehensive National Development Strategy of Mongolia (2008) included a "national apartment program", which included a stable water supply for Ger Area. With regard to water sector policy, the Water National Programme approved in November 2010 stated a reinforcement of water supply services, such as the development of new water sources to increase the water supply capacity for Ulaanbaatar City, the renovation of existing water pipes for the supply of water to apartment areas, and an increase in the number of "water kiosks" (communal water points) in Ger Area.

3.1.2 Relevance to the Development Needs of Mongolia

(1) Population growth in Ulaanbaatar

The population in Ulaanbaatar City has increased by 3-4 % annually since 1993. In 2009, it reached 1.17 million, which is equivalent to 40% of the total population of Mongolia. Among nine administrative districts in Ulaanbaatar City, USUG provides water supply services to six districts but not the three satellite districts. The population in these six districts has increased by 4-5 % annually

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

[3] ③: High, ② Fair, ① Low

and reached 1.1 million in 2010. According to the development study conducted by JICA in 2009, the population of Ulaanbaatar City is expected to reach 1.25 million in 2015 if it continues to increase by 3.2 % annually from 2010 to 2015, and to 1.43 million in 2020 if it continues to increase by 2.3 % from 2015 to 2020.

After the completion of this project in 2007, the daily maximum water supply capacity increased from 222,000 m^3/day to 240,000 m^3/day and the water demand of Ulaanbaatar citizens has been satisfied. However, if the water demand continues to increase along with rapid population growth, the daily maximum water supply is expected to exceed the daily maximum water supply capacity of USUG (see the figure below). To cope with a prospective water shortage, a grant aid project, "The Ulaanbaatar Water Supply Development Project in Gachuurt in Mongolia" (Phase 3 of Japanese grant aid for the water supply in Ulaanbaatar City), is underway in order to increase the daily maximum water supply from 240,000 m^3/day to 265,000 m^3/day by 2014 by developing a new water source and constructing water service pipes.

Figure 1：Estimation of daily maximum water supply

Source：Preparatory Survey (Basic Design) Report on the Ulaanbaatar Water Supply Development Project in Gachuurt in Mongolia (2010)

The population of Ulaanbaatar City is expected to keep increasing in and after 2014, which is the target year for the grant aid project described above. However, there is no remaining capacity for the further development of ground water from the existing water sources (upper and central water sources), which have been developed for the purpose of drinking water. 25,200m^3/day, corresponding to the differential in water demand in 2014, will be provided by the above grant aid project currently being carried out, but it is forecast that in case the population continues to increase in 2014 and after, there will be a water shortage of 23,575m^3 (the difference between the daily maximum demand and supply capacity) in 2020. As can be seen, the demand for water in Ulaanbaatar City remains high[4].

3.1.3 Relevance with Japan's ODA Policy

The Japanese government has placed priority on assistance in four priority areas that include support

[4] The water demand is estimated based on the daily maximum water supply (Preparatory Survey (Basic Design) Report on the Ulaanbaatar Water Supply Development Project in Gachuurt in Mongolia (2010)).

for basic human needs (education, health and medical services and water supply), since policy dialogues on assistance policy were held between Japan and Mongolia through the High-Level Mission on Economic and Technical Cooperation in 1997. With regard to the water supply, the assistance policy included cooperation for a stable water supply by improving and expanding existing facilities and improving water quality. In light of the above, this project is highly relevant with Japan's ODA policy at the time of the ex-ante evaluation.

This project has been highly relevant with Mongolia's development plan and development needs, as well as with Japan's ODA policy; therefore, its relevance is high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

Outputs by the Japanese side were produced as planned though there were slight changes in design, as mentioned below.

Table 1：Main outputs

[Construction Works and Supply of Material]		
Rehabilitation	Transmission Pump Station at Upper Water Source: 5 sets	
	Distribution Pump Station at Central Water Source: 2 sets	
New Facilities	Well Pump Station at Upper Water Source: 16 sets	
	Water Hammer Prevention Equipment	
Supply Material	Insulation Works (at well pump periphery pipe): 55 wells (39 existing wells and 16 newly developed wells))	
[Soft Component]		
Area	No. of Participants from USUG	Expected Result
Business Structure Strengthening	3	・ Water tariff calculation model
Efficiency Increase of Water Supply Facilities Operation and Management	3	・ Operation manual on upper water source facilities ・ Guidance for effective water supply system operation
Leakage Detection	5	・ Basic technology information ・ Leakage investigation plan
Environmental Water Quality Monitoring	4	・ Monitoring plan
Public Relations Improvement	3	・ Materials for information awareness

The main changes from the initial design were changes in the locations of several wells, which also caused changes in the distance of pipelines. These design changes are judged to be appropriate because they were changed precisely in accordance with the result of detailed design and condition changes during construction.

Outputs by the Mongolian side (the installation of well pump hot insulation material, the construction of power cables for well pumps, the removal and disposal of pumps located in existing pump stations, the acquisition of land, and the acquisition of an Environmental Impact Assessment (EIA)) were

produced as planned.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost borne by the Japanese side was lower than the planned cost. The actual grant cost was 167.4 million yen against the planned cost of 168.5 million yen (equal to 99.4% of the planned cost). The difference between the planned cost and the actual cost was caused by design changes and the difference between the ceiling cost of the tender and the contract cost for the construction works. For this ex-post evaluation, only the costs of the Japanese side were compared since the actual cost borne by the Mongolian side was not available.

3.2.2.2 Project Period

The actual project period was 32.5 months against the planned period of 32.5 months (100% of the planned period).

Both the project cost and project period were within the plan; therefore, the efficiency of the project is high.

3.3 Effectiveness (Rating: ③[5])

3.3.1 Quantitative Effects (Operation indicators)

Sixteen wells were newly constructed in the upper water sources by this project, and the water supply capacity increased from the previous 222,000 m^3 to 240,000 m^3 per day, which enabled USUG to meet the water demand until 2010. In addition, by renewing the existing conveying pumps in the upper water sources and the existing distribution pumps in the central water sources, it has been made possible to appropriately convey the planned amount of water.

Table 2：Operation indicators

Indicator (Unit)	Baseline (2003)	Target (2007)	Actual (2007)	Actual (2009)	Actual (2010)
Daily Maximum Water Supply Capacity (m^3/day)	222,000	240,000	240,000	240,000	240,000
Water Development Capacity of Transmission Pumps at Upper Source (m^3/day)	72,000	90,000	90,000	90,000	90,000
Actual Amount of Water Developed at Upper Source (m^3/day)	32,472		48,180	47,075	52,283
Water Distribution Capacity at Central Water Source (m^3/day)	N.A.	96,000	96,000	96,000	96,000
Actual Amount of Water Distributed from Central Water Source (m^3/day)	78,675		67,809	62,078	57,992
Daily Maximum Water Supply (m^3/day)		223,296	236,834	231,785	177,192
Daily Average Water Supply (m^3/day)		194,910	192,167	145,843	142,683

Source：USUG

[5] Effectiveness is scored also in the light of factors regarding Impact.

Transmission pump at upper source

Remote control panel at central source

In addition to the above mentioned quantitative effects, with regard to electrical power, the improvement of energy efficiency though the renewal of aging pumps was expected at the time of the basic design study. In fact, an improvement in the efficiency of power consumption has been reported with respect to the upper water source.

3.3.2 Quantitative Effect (Effect Indicators)

With respect to effect indicators, the percentage of population served and the rate of accounted-for water are shown in the table below. A steady increase in the percentage of population served is seen, as well as an improvement in the rate of accounted-for water. It is considered that the improvement of the rate of accounted-for water resulted from the installation of water meters in water conveyance pump stations in 80 locations and the installation of water meters in the approximately 3,300 businesses to which USUG supplies water. This is in addition to enhancements through the soft component of this project, which are comprised of such efforts as biannual inspections and the diagnoses of leakages of the water mains.

Table 3：Effect indicators

Indicators		2004	2005	2006	2007	2008	2009	2010
Population in the Service Area（thous. persons）		861.5	896.8	930.3	967.2	1,008.7	1,048	1,100
Population Served (thous. persons）		800.8	848.1	883.1	924.8	967.4	998.4	N/A
Percentage of Population Served (%)		93.0	94.6	94.9	95.6	95.9	95.3	N/A
Water supply per capita (L/capita/day)	Apartment Area	204	190	206	234	232	204	N/A
	Ger Area	6.6	7.4	8.1	7.2	6.8	6.6	N/A
Accounted-for Water Rate (%)		N/A	78.5	76.1	80.8	83.9	84	N/A

Source：USUG

3.3.3 Qualitative Effects

In interviews with USUG it was found that before carrying out this project, there were cases in which the water would freeze during conveyance, but that, as a result of increasing the number of wells from 39 to 55 through the construction of new wells by this project, the amount of water conveyed and the speed of water flow increased. The effect was a reduction in the cost of water supply attained through the water not freezing during conveyance even without warming with boilers, as had to be done

previously.

This project has largely achieved its objectives; therefore; its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts

As a part of this ex-post evaluation, a survey of the citizens of Ulaanbaatar was conducted during January and February of 2011, as a beneficiary survey to evaluate the impacts of this project[6].

3.4.1.1 Change in Water Supply

30% of the respondents in the apartment areas and 70% in the Ger area answered that "there was a change". Of the Ger area, in the target areas of the project carried out by the World Bank, previously water tankers came to supply water to water-tanks in the areas. Now the water supply capacity has been enhanced by this project and the water conveyance pipes were expanded and directly connected to the kiosks (communal water points) by the World Bank project. As a result of this, the residents are now able to obtain water at any time and they more strongly appreciate the change compared to residents of the apartment areas.

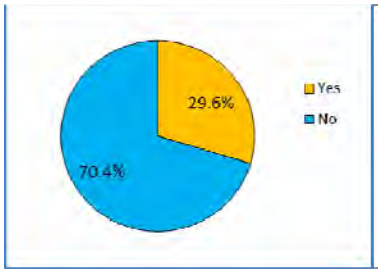


Figure 3 : Changes in water supply after 2007 (Apartment area)

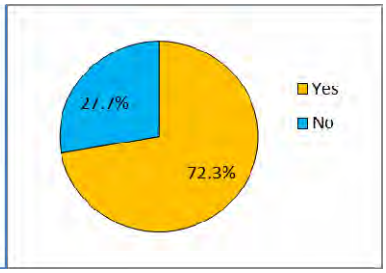


Figure 4 : Changes in water supply after 2007 (Ger area)

3.4.1.2 Concrete Changes

In the Ger area, 90% or more of the respondents refer to the reduction in time to fetch water (including a reduction in waiting time). In the apartment areas, 65% of the respondents refer to the stability of the water supply, 15% refer to the water pressure and the water quantity respectively. According to interviews with USUG, there were many complaints by the users that in the past, the water did not reach higher floors in the apartments to inadequate water volume/pressure.

A water kiosk in the Ger area which was connected to the water tank behind in the past)

[6] To compare the water supply before-and after the project, the survey targeted citizens who lived in the area before 2006, namely, before the project completion. The sample households were 246 in total in six districts of the USUG service area, 84 households from the apartment area and 162 households from the Ger area.

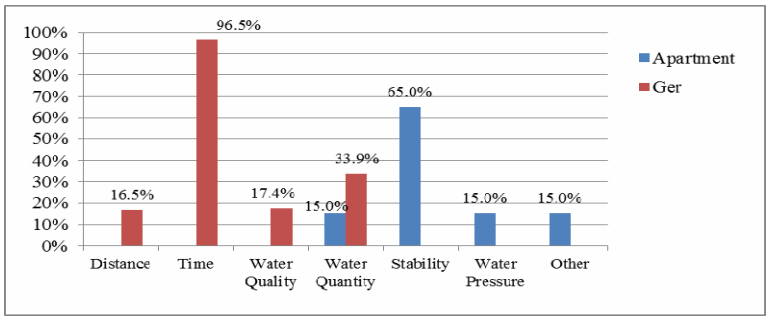


Figure 5: Concrete changes (multiple answers)

3.4.1.3 Views of Users Concerning Water Quality

With regard to the water quality, approximately 55% of the sample households in the apartment areas answered “very good” or “good”, and 85% in the Ger areas answered “very good” or “good”. Half of the households who answered “very poor” or “poor” refer to “taste” as the reason for the answer[7].

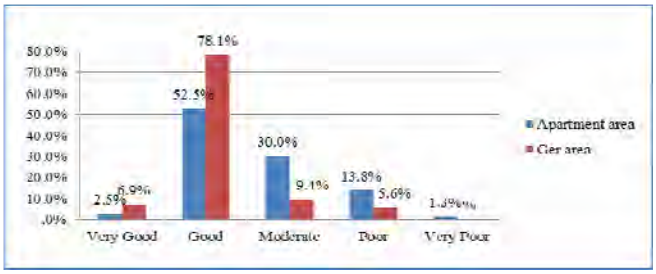


Figure 6：Views of users on water quality

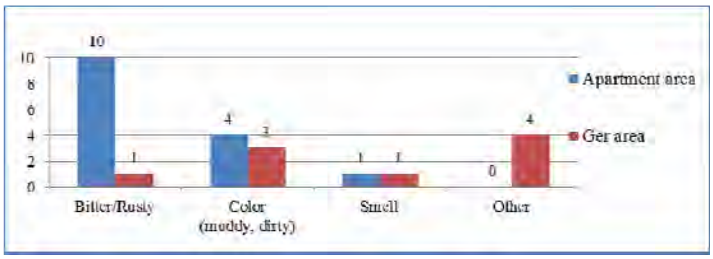


Figure 7：Reasons for dissatisfaction with water quality (multiple answers)

3.4.1.4 Satisfaction with the Water Supply Service

The satisfaction with the present water supply service is as shown in the table below. Approximately 70% of the respondents in the apartment areas and 90% or more in the Ger area are satisfied. The reason most frequently given for “poor” or “very poor” is “water quality”.

[7] However, as it is conjectured that taste and color are the results of corrosion of the water mains and water distribution pipes inside buildings, which take place beyond the warm water supply center (CTP), it may be said to be outside the purview of USUG.

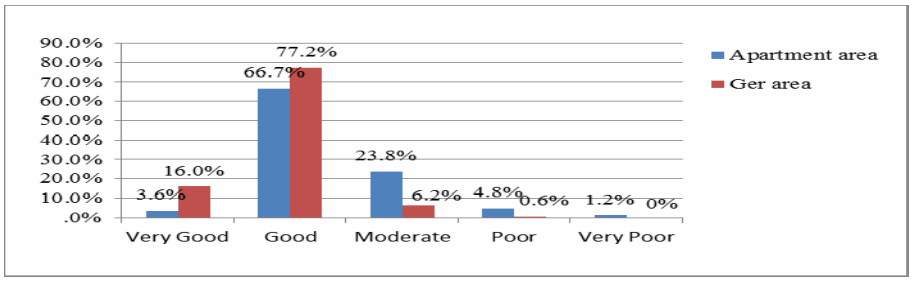


Figure 8： Satisfaction with the water supply service

Table 4： Reasons for dissatisfaction with the water supply service (multiple answers)

Reasons	Apartment area	Ger area	Total
Water quality	5	1	6
Water leakage	1	0	1
Water charge	1	1	2
Distance	0	1	1
Total	5	1	6

Although there were expectations of the reduced incidence of water-borne infectious diseases at the time of the basic design study, no incidence has been found of a water-borne infectious disease in the beneficiary survey of either before or after the implementation of the project.

3.4.2 Other Impacts

Various training programs were implemented as a soft component (technical assistance) of this project in 2005. The descriptions below show the recognized positive impacts of the soft component implementation.

3.4.2.1 Effect of joint work of the Japanese and Mongolian parties (Change in USUG Staff Attitudes Toward Duties)

According to the interviews with USUG, USUG staff changed their attitudes toward duties while they were working with Japanese consultants on the supervision of construction. The examples include: (1) they started making work plans (e.g. weekly or biweekly plans); (2) they carried out those plans while monitoring their progress; and (3) they improved working conditions and paid more attention to safety control on-site (e.g. they always put on uniforms and gloves, held morning meetings, and made reports on safety without negligence).

3.4.2.2 Effect of Soft Component

(1) Reinforcement of Administration

The contracted consultant provided USUG staff with a training session to enhance administrative abilities. After the training, USUG revised the water tariff three to four times by applying the simulation model acquired through the training. In addition, USUG included the prediction of the water rate in the five-year plan for the first time, which they did not do in the previous plans (it was

applied to the plan for 2006 to 2010). Furthermore, accounting reports came to be shared among the executives on a quarterly basis; the reports had been circulated only in the Finance Department previously.

(2) Reinforcement of Water Leakage Detection

A training session was provided for the improvement of leakage detection skills by using the devices that were provided in Phase 1 (grant aid before this project). USUG now carries out water leak detection every season (twice a year) based on the "Leakage investigation plan" prepared during the above-mentioned training. USUG carried out such investigations at 731 points from 2006 to 2010 and identified 545 pipe positions, which comprised 75% of the total.

Before the plan, USUG dug the ground to identify the positions. They occasionally cut electric cables by mistake while digging the ground. Owing to the use of the devices mentioned above, they eliminated these mistakes. USUG investigate not just the pipes within their responsibility. They also check the pipes in the factories and provide training of how to use the water leakage detection devices to the power and heat suppliers in response to requests.

(3) Reinforcement of Public Relations and Promotion of Users' Awareness

A plan to promote awareness among water users was prepared for the years following 2005. The actions below have been taken according to the plan:

- Campaign to improve the awareness of saving water as well as knowledge of water-related matters; it is held over a period of three months in association with "World Water Day" (March 22) each year.
- Seminars and forums in cooperation with the Natural Environment Information Center (NGO).
- Creation of the symbol of USUG (a water drop)[8] as well as enlightening tools for children such as picture books and puzzles to distribute.
- Creation of four kinds of stickers for the promotion of water saving awareness. The stickers were sent to ministries and government offices, elementary schools and contracted companies.

Symbol of USUG

No environmental impacts or problems with regard to land acquisition and relocation of residents by this project have arisen. With regard to environmental protection, during the construction phase, the consultant always determined the locations of the wells and pipelines in the presence of the Ministry of the Environment to avoid environmental impacts. Negative environmental impacts have not arisen since. In addition, efforts in the conservation of water resources on the Mongolian side have been taking place, such as regular monitoring of the water quality of the ground water which is being

[8] The water drop symbol was created by one of the USUG staff members that participated in the "Training Course for Water Works Engineering Training for Cold Regions" held at Sapporo, Hokkaido in 2005; the trainee got an idea from the symbol of the Sapporo Waterworks Bureau.

strictly conducted by USUG, and the prevention of excessive development by national designation of the Tora river basin as a water resource protection district.

From the above, it can be confirmed that the enhancement of the water supply capacity by this project is contributing to the improvement of the convenience of the water supply for residents and that the effects are being realized to a certain degree.

3.5 Sustainability (Rating:②)

3.5.1 Structural Aspects of Operation and Maintenance

It is judged that there is no problem with the system of operation and maintenance of the facilities/equipment developed by this project, in accordance with the following points.

The role of the organization of USUG is clear, as are its internal assignments. In the upper water source, which has been improved by this project, 49 engineers such as pump station engineers, electrical engineers, well-repair workers, well electrical engineers, welders, boiler mechanics, lead pipe workers and boiler men are working on the operation and maintenance of equipment such as six units of water conveyance pumps. In the central source, about thirty employees assigned to the maintenance team are carrying out regular inspections, recording and reporting the operating conditions of all wells and equipment as well as repairs as required.

There are continuing structural reforms being carried out with the goal of making the organization more efficient through the technical cooperation, “Water Operator Partnerships (WOPs)” (2007-2010), conducted by the Netherlands Government. The technical cooperation through “WOPs” includes components spanning a wide range, such as business reinforcement, leakage detection, and technical assistance on water quantity measurement. This is in addition to the organizational reforms described above, and the enhancement of the organizational capability and the technical capability of the staff of the entire USUG is being carried out continuously.

3.5.2 Technical Aspects of Operation and Maintenance

The operation and maintenance of each facility/piece of equipment is being appropriately carried out by USUG, and there is no problem regarding the technical aspects of operations and maintenance. It is considered that inputs from various schemes, such as the technical support provided by Phase 1, the soft component of this project and the acceptance of trainees (country-focused training, general training, counterpart training), are also having their effects.

Although several cases of defects have arisen to date in the facilities constructed, appropriate repairs have been made in each case by the contractor or USUG. The records of operations and maintenance and the records of repair works of the facilities and equipment are kept in a notebook for each piece of equipment by workers and are also managed electronically.

3.5.3 Financial Aspects of Operations and Maintenance

Although the financial balance of USUG has been in the red, sales profits have been largely increasing these years and no financial problems have been observed with regard to the expense of the operations and maintenance of facilities constructed by this project.

The gross operating income of USUG was in the red for 2005 and 2006, but has returned to profit since 2007. The sales income is producing profits that sufficiently exceed the operating expenses (maintenance costs, sales expenses, general administrative expenses), but the operating profit has been in deficit every year since 2005. According to USUG's five-year plan for 2011 to 2015, a return to profit is expected in 2013 and thereafter if the water rates are raised incrementally and the loan issue described below is resolved.

In terms of cash flow, the cash income from sales and customers has been increasing steadily since 2005. This appears to be the result of the taking of effect of measures taken in regard to water rate collection and water leakage. For example, the rate of accounted-for water, which had been 45% in 1998, has exceeded 80% since 2007 with the drive to install water meters (100% in 2009) in public facilities, which are the main customer group.

An issue of concern with respect to USUG's finances is the incurring of losses on exchange rate changes on settlements for refunds of principal, and payment of interest due to foreign exchange losses for loans such as the USIP1 of the World Bank loan and project loans from the Spanish government (upgrading of the processing of the central sewerage facility). USUG has continued to ask the Parliament since 2004 to make foreign exchange losses on settlement a national investment through the revision of the act on the urban water supply and sewerage facilities. It is said that this will be deliberated and approved in the Parliament in the near future, but it had not yet been approved as of August 2011. The resolution of this issue is the key to the improvement in the future financial status of USUG.

3.5.4 Current Status of Operations and Maintenance

The facilities constructed by this project have been mostly functioning well since the completion of the project to date. The main defects since the start of the utilization of the facilities and the measures taken by USUG are as follows:

- With regard to the wells in the upper water source, an inability to control ON-OFF of the pumps was found during the inspection for defects in 2007. In eight of the well pumps, the pumps and motors were replaced by the contractor, since a lowered insulation resistance was found.
- In 2008, control panels in intake pump facilities in four locations were damaged by lightning strikes. Three of these were repaired independently by USUG. USUG included in the 2010 budget the repair of one facility that received great damage, such as the charring of instrumentation, upon field validation by the Japanese supplier manufacturer, and the repair was completed.

In this way, not only have routine inspections of the facilities been made, but also appropriate repairs have been carried out for defects and no particular problem has arisen.

Some problems have been observed in terms of financial aspects; therefore, the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the project, which is to provide a stable water supply for the citizens of Ulaanbaatar City, was achieved by improving the water supply facilities at the upper and central water source areas through this project. As a result of enhancing the water supply capacity, effects were brought; in particular, the improved convenience in fetching water for the residents of the Ger area and an improvement in the stability of the water supply.

Several cases of defects have arisen to date in the facilities constructed, but appropriate repairs have been made in each case by the contractor or the Water Supply & Sewerage System Co. of Ulaanbaatar City (USUG). The operation and maintenance system of USUG is clear, and there is also a certain degree of technical capability. With respect to its financial aspects, its operating income is increasing year by year and the budgets for the operation and maintenance of the facilities constructed by this project have been continuously secured. An issue of some concern is that foreign-exchange losses on settlements upon refund of principal and payment of interest for loans to the World Bank and the Spanish Government are imposing a burden on USUG.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Nil

4.2.2 Recommendations to JICA

Nil

4.3 Lessons Learned

Nil

Mongolia

Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for Improvement of Primary Education Facilities (Phase II) in Mongolia”

External Evaluator: Maki HAMAOKA,

Foundation for Advanced Studies on International Development

0. Summary

This project was implemented in order to ease overcrowded classrooms and to improve learning environments by constructing classrooms and other facilities and providing educational equipment and teaching materials to the ten target schools. The improvement of the learning environment of primary education is relevant to Mongolia’s development plan and development needs, as well as to Japan’s ODA policy; therefore, its relevance is high. The efficiency of the project was judged to be fair, because the project period significantly exceeded the planned period. This resulted from unintended factors, including the unsuccessful bidding for selected contractors for construction works in the second stage and a subsequent implementation review study to review the original design and the cost estimate. In regards to the effectiveness of this project, although the number of classrooms has increased as planned and overcrowding has eased, it has been observed that many schools received a smaller number of students per classroom than the Mongolian standard (36 students per classroom). This was due to a decrease in the population of school-age children and primary school enrollments in the target area, and the reorganization of school districts and changes in the school year system. In the meantime, less crowded classrooms and better school equipment have improved the learning environment and helped students to be better motivated to attend school and learn and have also helped teachers to prepare for lessons more efficiently. Overall, the effectiveness of the project is found to be fair, considering that it has led to a higher lesson quality and higher academic achievements.

As for the sustainability, each school has adequately appointed staff personnel in charge of the operation and maintenance of facilities/equipment and has well-functioning school committees consisting of parents and local community members. Therefore, there is no problem with schools’ operation/management structures. Also, no financial problems have been observed since operation and maintenance expenses of constructed facilities have been sufficiently covered by various funding sources. Facilities and equipment that were improved and provided by the project have been used carefully and very well kept with minor repair work done by each school, indicating no major problem with status of operation and maintenance.

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

1. Project Description

Project Locations

Orkhon No. 16 School

1.1 Background

Since the 1990s, Mongolia has made it a top priority to develop human resources that are capable of meeting the challenges of democratization and a transition to a market economy, and made the basic education sector a key issue in line with this approach, However, the transition to a market economy plunged the nation into socioeconomic turmoil and contributed to the deterioration of the national financial condition, which impacted on the education sector greatly. The national education budget and number of teachers reduced, educational facilities and materials deteriorated, and dormitories were no longer free of charge. The market economy also altered industrial structures in particular and triggered an acute population flow from rural to urban areas. As a result, urban areas experienced a drastic increase in students and a significant lack of education facilities, which led to teachers having to teach multiple shifts, and a drop in school enrollments. Overall, education had gone from bad to worse[1]. Amid such devastating conditions, improving primary education facilities became an urgent issue.

1.2 Project Outline

The objective of this project is to ease overcrowded classrooms and to improve learning environments by constructing classrooms and other facilities and providing educational equipment and teaching materials to the ten target schools in Darkhan City (Darkhan-Uul Province) and Erdenet City (Orkhon Province).

Grant Limit / Actual Grant Amount	Stage 1: 902 million yen / 861.411 million yen Stage 2: 917 million yen / 882.484 million yen
Exchange of Notes Date	Stage 1: June 17, 2002 Stage 2: August 11, 2003, June 27, 2005, (Note: Because the bidding conducted in March 2004 for the second stage construction was unsuccessful and there was not going to be sufficient time for the required work, the budget for the fiscal year 2003 was used only for the detail design and bidding-related tasks and the remaining amount was returned to the national treasury. Subsequently, from January to June 2005, an implementation review study was conducted for the review of the original design and the cost estimate, and in June of the same year, the Exchange of Notes for the second stage was re-signed.)

[1] Under the socialist system, human resources development was a top priority issue. Until the 1980s, the country had a high education standard: the enrollment rate in primary education was 98%; the adult literacy rate was 96%. National education budgets were maintained at 14% of Gross Domestic Product (GDP). However, after 1990, the education standard fell due to socioeconomic turmoil caused by the market-oriented economic reforms; the enrollment rate in primary education plunged to 81% and the adult literacy rate plunged to 82.2% in 1994. National education budgets fell to 3.8% of GDP in 1993.

Implementing Agency	Responsible Agency: Ministry of Education, Culture and Science (hereafter the "MECS") Implementing agency：Education and Culture Department of Orkhon Province, Education and Culture Department of Darkhan-Uul Province
Project Completion Date	Stage 1: February, 2004 Stage 2: March, 2007
Main Contractor(s)	Stage 1: Obayashi Co., Ltd. Stage 2: Kanto Kensetsu Kogyo Co., Ltd.
Main Consultant(s)	Mohri Architect and Associates, Inc. Yokogawa Architects and Engineers, Inc.
Basic Design	"Basic Design Study on the Project for Improvement of Primary Education Facilities (Phase II) in Mongolia", JICA, Mohri Architect and Associates, Inc., Yokogawa Architects and Engineers, Inc., February, 2002
Implementation Review Study	First Year: January – March, 2005 Second Year: April – June, 2005
Related Projects (if any)	Technical Cooperation • Dispatch of education policy advisor (2003-2005) • Project formation study (2001) • Technical cooperation project, "Strengthening the Planning Capacity for In-Service Teacher Training (2003-2006) • Technical cooperation project, "Teaching Methods Improvement Project Towards Children's Development in Mongolia" (2006-2009) • Dispatch of Japan Overseas Cooperation Volunteers (JOCV) in group "Community-based School Rehabilitation Project" (2002-) Grant Aid • The Project for Improvement of Primary Education Facilities (Phase I) (1999-2001) • The Project for Improvement of Primary Education Facilities (Phase III) (2004-2007) • The Project for Improvement of Primary Education Facilities (Phase IV) (2008-in process) • Grassroots Human Security Aid (Renovation/Enlargement of School Facilities and Dormitories) Other Donors • ADB "Education Sector Development Program (ESDP)"(1996-2002), "Second Education Development Project (SEDP)"(1997-2003) • World Bank "Rural Education and Development Project"(2006-2012) • Fast Track Initiative (FTI) (2007-2009)

2. Outline of the Evaluation Study

2.1 External Evaluator

Maki HAMAOKA, 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: January 17 - February 1, 2011, June 13 - 22, 2011

2.3 Constraints during the Evaluation Study (if any)

Nil

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

3.1 Relevance (Rating: ③[3])

The objective of this project has been consistently relevant with the national development plan and education sector plans of Mongolia and development needs at the time of both the ex-ante evaluation (2002) and the ex-post evaluation (2011).

3.1.1 Relevance with the Development Plan of Mongolia

With regard to the development plan of Mongolia, at the time of the ex-ante evaluation (basic design study), the Mongolian Action Plan for the 21st Century (1999) stated the importance of education as a drive to sustainable social and economic development. The Action Plan of the Government of Mongolia for 2000-2005 (1999) that was formulated as implementation plan of the above plan included the construction and the expansion of schools to ease overcrowding in classrooms, and the operation, maintenance and rehabilitation of schools in rural areas as concrete strategies to provide equitable opportunity and access to education. At the time of the ex-post evaluation, the Action Plan of the Government of Mongolia for 2008-2012 (2008) focused on the development of public education in line with an international standard,[4] and the improvement of education and school enrollment rates to produce continuously creative and intellectual human resources.

With regard to the education sector policy, the Basic Principle of Education Reform 1997-2005 (1996) placed emphasis on overcoming the shortage of education facilities. The Education Sector Strategy of Mongolia 2000-2005(1999) included the rehabilitation, the extension and the construction of classrooms and dormitories in rural areas and continuous provision of furniture and educational equipment as concrete means for the improvement of school facilities and educational equipment. Afterwards, the Master Plan to Develop Education of Mongolia in 2006-2015 (2006) focused on the improvement of disparities in educational opportunities and the creation of an environment and conditions to provide quality education as objectives of primary and secondary education. This Master Plan maintains the improvement of the environment of primary education as a priority concern, even after it was revised in 2011.

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

[3] ③: High, ② Fair, ① Low

[4] In Mongolia, a transition to a 12-year general school system has been underway as part of educational reforms to meet international education standards. In the Education Reform Principles issued in 1997, the long-term goal is a 12-year general school system instead of the conventional 10-year system, and as the first phase toward this goal, the Revised Education Law was issued in 2002 which set forth an 11-year general school year system (out of which five years are in primary education and four years in lower secondary education, and a total of nine years are mandatory). In line with this law, an 11-year school system was introduced, with the school age brought down to seven years old from the previous age of eight years old in 2005-2006. In the school year of 2008-09, the school age was further brought down to six years old. The plan is to complete the transition to a 12-year system by 2015.

3.1.2 Relevance with the Development Needs of Mongolia

(1) Sufficient level of education facilities at the time of the basic design study

From the late 1990s to when the basic design study was conducted, there was a drastic increase in school enrollment rates in the target provinces, and hence, the need for the improvement of elementary and secondary education facilities was quite high. As indicated in the table below, between 1995 and 1999, the enrolment rate in general education rose by 17.5% in Darkhan-Uul Province and 32.6% in Orkhon Province, and for 2000/2001, rose by 7.2% and 9.5% respectively. The number of schools, on the other hand, increased from twenty in 1995 to twenty-one in 2000 in Darkhan-Uul, and from twelve to nineteen in Orkhon, far from accommodating the increased demand. Incapable of handling the sudden increase of students, there were many schools in these two provinces that had no choice but to provide a substandard educational environment, such as dividing school hours into three shifts or conducting classes in the hallways, horse stables and meeting halls. There was a desperate need for more classrooms in the target provinces.

(2) Demographics of the target area

When comparing the enrollments in general educational schools at the time of the basic design study (2001) and the target year of the first stage (2005), there was a 10.7 % increase in Darhan-Uul Province and a 9.7 % increase in Orkhon Province. A comparison between the general educational enrollment from 2003 (the base year for the second stage when an implementation review study was conducted) and the target year 2007 revealed a 6.4% decrease in Darkhan-Uul Province and a 6.1% decrease in Orkhon Province, indicating a decreasing trend in the number of children enrolled in school during the project (or from 2005 or 2006). As later described in 3.3, the number of students in the target schools has also been on the decrease, resulting in less-than-expected enrollment rates for the target year of the project. However, demographic movements were influenced by socio-economic conditions[5] and vary from year to year (refer to table 2-4)[6], and this trend is considered to be an unpredictable external factor.

Table 1: Number of students in full-time general educational schools

(In thous. persons)

		1995	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total	Number	403.8	470	494.6	510.3	527.9	537.3	557.5	556.9	542.5	537.5	532.1	522.1
	Growth rate (%)		16.4%	5.2%	3.2%	3.4%	1.8%	3.8%	-0.1%	-2.6%	-0.9%	-1.0%	-1.9%
Darkhan-Uul	Number	16.6	19.5	20.9	21.4	21.7	22.0	22.2	23.7	22.1	20.6	19.8	19.1
	Growth rate (%)		17.5%	7.2%	2.4%	1.4%	1.4%	0.9%	6.8%	-6.8%	-6.8%	-3.9%	-3.5%
Orkhon	Number	13.5	17.9	19.6	21.0	21.2	21.4	22.3	21.5	20.7	20.1	19.7	19.0
	Growth rate (%)		32.6%	9.5%	7.1%	1.0%	0.9%	4.2%	-3.6%	-3.7%	-2.9%	-2.0%	-3.6%
Ulaanbaatar	Number	121.7	150.0	162.5	169.5	176.0	180	185.6	186.2	185.2	184.3	185.0	184.3
	Growth rate (%)		23.3%	8.3%	4.3%	3.8%	2.3%	3.1%	0.3%	-0.5%	-0.5%	0.4%	-0.4%

Source: National Statistical Office of Mongolia

[5] Some Mongolians choose to give birth in accordance with the Tibetan Buddhist calendar, which is said to cause the birthrates to fluctuate greatly depending on the year. Also, due to the nation's recent transition to a market economy, there has been continuous population flows from rural areas into urban areas since the 2000s.

[6] Table 2, 3 and 4 show demographic movements of school-age children. Table 2: in Darkhan City where two target schools, Darkhan No. 4 and Od 3 schools are located, Table 3: in Hongol Soum where Darkhan No. 11 school is located, and Table 4: in Erdenet City of Orkhon province where seven target schools are located.

Table 2: School-age population by 5-year age group (Darkhan City of Darkhan-Uul Province)

Age		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0-4 years	Population	5,682	4,177	3,968	4,835	5,281	5,231	5,121	5,378	5,843	6,461
	Growth rate(%)		-26.5	-5.0	21.8	9.2	-0.9	-2.1	5.0	8.6	10.6
5-9 years	Population	6,975	5,705	5,559	5,946	6,505	6,807	6,629	6,600	6,376	5,480
	Growth rate(%)		-18.2	-2.6	7.0	9.4	4.6	-2.6	-0.4	-3.4	-14.1
10-14 years	Population	9,321	8,363	8,496	8,042	8,152	8,344	7,808	7,631	7,330	6,479
	Growth rate(%)		-10.3	1.6	-5.3	1.4	2.4	-6.4	-2.3	-3.9	-11.6

Source: National Statistical Office of Mongolia

Table 3: School-age population by 5-year age group (Hongol Soum of Darkhan-Uul Province)

Age		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0-4 years	Population	706	670	653	631	588	500	511	444	471	572
	Growth rate(%)		-5.1	-2.5	-3.4	-6.8	-15.0	2.2	-13.1	6.1	21.4
5-9 years	Population	732	673	661	628	622	660	642	433	417	572
	Growth rate(%)		-8.1	-1.8	-5.0	-1.0	6.1	-2.7	-32.6	-3.7	37.2
10-14 years	Population	785	791	774	757	710	700	655	451	533	526
	Growth rate(%)		0.8	-2.1	-2.2	-6.2	-1.4	-6.4	-31.1	18.2	-1.3

Source: National Statistical Office of Mongolia

Table 4: School-age population by 5-year age group (Erdenet City of Orkhon Province)

Age		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0-4 years	Population	5,909	6,073	6,167	6,111	5,674	5,960	5,870	6,420	6,699	7,573
	Growth rate(%)		2.8	1.5	-0.9	-7.2	5.0	-1.5	9.4	4.3	13.0
5-9 years	Population	8,169	8,337	8,524	8,672	8,490	8,123	8,030	7,841	7,091	6,739
	Growth rate(%)		2.1	2.2	1.7	-2.1	-4.3	-1.1	-2.4	-9.6	-5.0
10-14 years	Population	9,662	9,985	10,381	10,477	10,471	10,414	10,142	9,629	8,641	7,970
	Growth rate(%)		3.3	4.0	0.9	-0.1	-0.5	-2.6	-5.1	-10.3	-7.8

Source: National Statistical Office of Mongolia

3.1.3 Relevance with Japan's ODA Policy

The Japanese government has placed priority on assistance in four priority areas that include "support for basic human needs (education, health and medical services and water supply)", since policy dialogues on assistance policy were held between Japan and Mongolia through the High-Level Mission on Economic and Technical Cooperation in 1997. With regard to the education sector, the assistance policy included cooperation for the improvement of educational facilities and capacity building of teachers. In light of the above, this project is highly relevant with Japan's ODA policy at the time of the ex-ante evaluation.

This project has been highly relevant with Mongolia's development plan and development needs, as well as to Japan's ODA policy; therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Outputs by the Japanese side, namely, construction of primary education facilities in the ten target schools as well as provision of furniture and basic materials, were produced as planned as mentioned below, although there were slight changes in design[7].

Table 5: Main outputs

Item	Plan			Actual		
	Total	Stage 1	Stage 2	Total	Stage 1	Stage 2
1. Construction of Facilities				All items were procured as planned.		
No. of Target Schools	10	4	6			
Classroom	117	60	57			
Students' Toilet (Large)	6	4	2			
Students' Toilet (Medium)	2	2	0			
Students' Toilet (Small)	3	0	3			
Students' Toilet (Extra Small)	2	0	2			
Teachers' Toilet	13	6	7			
2. Provision of Furniture & Equipment (for classrooms)						
Teachers' Desk	117	60	57			
Teachers' Chair	117	60	57			
Students' 2-Seater Desk (Large)	1,026	540	486			
Students' 1-Seater Chair (Large)	2,052	1,080	972			
Students' 2-Seater Desk (Small)	1,080	540	540			
Student's 1-Seater Chair (Small)	2,160	1,080	1,080			
Blackboard	117	60	57			
Bulletin Board	117	60	57			
Meeting Table	31	14	17			
Chair	166	84	82			
Cabinet	55	30	25			
3. Provision of Educational Equipment						
Basic Educational Equipment	10	4	6			

Outputs by the Mongolian side (securing of land for the project, land preparation work, removal of existing obstacles including buried objects, securing of access road to each project site, securing of space for storage of construction materials and connecting of temporary electrical power, water, and

[7] The following changes were made to the initial design after the detailed design.
(1) Orkhon No. 18 school: Cancelation of the installation of a coal-run boiler and its accessory facility due to the direct connection of hot water pipes for heating. Installation of hot water service pipes to the building, ② Cancelation of the installation of a water tank due to the connection of the water main, ③ Cancelation of the installation of fire alarms, and installation of a fire hydrant and emergency warning equipment, ④ Cancelation of the installation of a sewer water storage tank, and the sewer water main has been connected, (2) Orkhon No. 16 and 17 schools: underground boilers and coal storage were moved to the first floor in other buildings, or underground coal storage was moved to an outside storage area, (3) Adding fire-resistant coatings on steel stair frames, and (4) Change of the rooftop inspection opening to an exterior ladder. The change indicated in (1) has been made because Orkhon province Erdenet City's had improved infrastructure, which had not been expected at the time of the project plan. The changes (2) and (3) were made in accordance with instructions from the Ministry of Infrastructure, which had not been included in the original design. (4) Changes were due to the discontinued production of rooftop inspection openings.

sewage lines for construction, connecting of infrastructure to each project site including power lines, heating supply lines, water supply pipes, drainage lines and telephone lines) were produced as planned.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost borne by the Japanese side was lower than the planned cost. The actual grant cost was 1,788 million yen against the planned cost of 1,856 million yen (equal to 96% of the planned cost). The difference between the planned cost and the actual cost was caused by design changes and the difference between the ceiling cost of the tender and the contract cost for the construction works. For this ex-post evaluation, only the costs of the Japanese side were compared since the actual cost borne by the Mongolian side was not available.

3.2.2.2 Project Period

The project period was significantly longer than planned. The actual project period was 64 months against the planned period of 37 months (173% of the planned period).

In the first stage, the actual period was 20 months against the planned period of 18.5 months. The difference was due to the fact that the detail design took eight months against the planned 6.5 months, since the procedure to change the detail design took time. The second stage took 44 months against the planned period of 18.5 months. This is due to: (1) the project being stopped only after the detailed design and bidding procedure by the consultant because of unsuccessful bidding to a select contractor, (2) following (1), an implementation review study had to be conducted from January to June 2005 in order to review the original design and the cost estimate, and (3) although the work was contracted in December 2005, construction works did not start until March 2006, a three-month delay to avoid severely cold winter. These factors, including unintentional ones, resulted in a total actual project period of 44 months for the second stage.

Although the project cost was within the plan, the project period was significantly exceeded; therefore, the efficiency of the project is fair.

3.3 Effectiveness (Rating:②[8])

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

After the overcrowded conditions were alleviated through this project,[9] the learning environment was significantly improved at the entire target schools compared to prior to the project; hence, the initial

[8] Effectiveness is scored also in the light of factors regarding Impact.

[9] The alleviation of the overcrowded condition refers to 36 students per classroom at maximum according to the Mongolian standard and two shift classes. The Orkhon No. 17 school, where twelve classrooms were constructed by this project, has maintained two shifts by using three classrooms of the existing school that are too old to use.

purpose of the project was achieved to a certain extent. On the other hand, at most of the target schools, both the school enrollment rate and the number of students per classroom were below the initial estimate. While the school enrollments at two of the target schools turned out to be 98% of the initial goal for that year, thus almost reaching the goal, five schools only had 50-70% of the initially expected number of students compared to the initial targets, and one school only had 36%. Considering that the project should have resulted in the appropriate number of students per improved classroom, the effectiveness of the project is limited, though external factors such as demographic movements were partially to blame (see Table 6).

Table 6: Secular change of the number of students

Prefecture	School	Stage	Target Target year for the Stage 1: 2005 Target Year for the Stage 2: 2007			Number of Students															
			Projected Enrollment	# of clrm after the project	Projected # of students per clrm	# of clam in use	# of students (2004-2005)	# of students per clrm	# of students (2005-2006)	# of students per clrm	# of students (2006-2007)	# of students per clrm	# of students (2007-2008)	# of students per clrm	# of students (2008-2009)	# of students per clrm	# of students (2009-2010)	# of students per clrm	# of students (2010-2011)	# of students per clrm	Ratio to the initial target
Darkhan-Uul	Darkhan No. 4	2	1,436	21	68	20							1,036	**52**	1,076	54	1,098	55	1,121	56	82%
	Darkhan No.11	2	678	13	52	13							373	**29**	395	30	373	29	341	26	50%
	Darkhan Od-3	2	439	8	55	8							n.a.		286	36	279	35	266	33	61%
Orkhon	Orkhon No. 2	2	899	13	69	13							563	**43**	556	43	513	39	569	44	63%
	Orkhon No.3	1	3,023	45	67	45	3,528	78	3,327	**74**	3,448	77	3,332	74	3,302	73	2,069	46	1,936	43	64%
	Orkhon No.6	1	739	12	62	10							495	**50**	543	54	584	58	602	60	98%
	Orkhon No.7	1	1,259	17	74	17							1,061	**62**	1,088	64	986	58	986	58	78%
	Orkhon No.16	1	1,329	20	66	18	4,351	218	803	**45**	805	45	719	40	640	36	515	29	428	24	36%
	Orkhon No.17	1	793	12	66	15									830	55	994	66	973	65	98%
	Orkhon No.18	1	694	12	58	12	611	51	604	**50**	536	45	507	42	490	41	474	40	482	40	69%

clrm: classroom

Note 1: The number in bold shows the result of the target year.
Note 2: The number of classrooms in use means classrooms currently used to give lessons.
Note 3: Orkhon No.17 school belonged to Naram Complex by the year 2007/2008 and became an independent school. The number of students per classroom was calculated according to each situation.

Below are the factors that may have caused fewer enrollments compared to the estimate.

① Accuracy of school statistics

At the time of the basic design study, the number of students enrolled for the target year was calculated based upon the numbers reported to the Education and Culture Department of the respective target provinces by each target school every year. Interviewing school staff during this ex-post evaluation, however, revealed that the student numbers reported during the basic design study were larger than actual numbers. Although MECS's instruction has successfully made them report accurate student numbers for the last two to three years prior to this ex-post evaluation, such poor accuracy in basic information has become a major cause for discrepancies between the target and the actual number of students, and at the same time, a constraint on this evaluation. As a matter of fact, in the past schools tended to report larger number than the actual enrollment, as budgets are allocated to each school according to the number of students.

② Impact of school district reorganization and changes in the school system

Some school districts were combined and expanded due to the district reorganization and it was found that a significant number of students switched to some non-target schools with better facilities or downtown schools with kindergartens attached（i.e. Orkhon-3, 16, 18 schools).

In addition, most schools expected to have students in both primary schools (1st-4th grades in the 10-year system) and lower-secondary schools (5th-8th grades in the 10-year system) at the time of the basic design study. However, not only in the project's target schools but also in the entire target area, classroom allocation changed from the initial plan because of the changes to the school system implemented from the year 2005/2006 (from the 10-year system to an 11-year system), followed by school consolidations. For example, four schools out of the ten target schools expected to have students in both primary (1^{st}-5^{th} grades in the 11-year system) and lower-secondary (5^{th}-8^{th} grades in the 10-year system) programs, but it turned out that they only had students in the primary program (1^{st}-5^{th} grades in the 11-year system). In these cases, the numbers of students they expected for lower-secondary programs is almost equivalent to the differences between the target numbers and the actual numbers.

3.3.2 Qualitative Effects

According to the answers to the questionnaires, the usability or the practicality of school facilities is judged to be almost good (except for some complaints about desks and chairs being too heavy to move, or too weak).[10] In the interviews with school principals and teachers, as well as in focus group discussions during the site visit,[11] schools built through this project developed good reputations for providing bright and warm atmospheres even during winter and a comfortable environment that motivate students to learn, and large blackboards for better usability and easier viewing.

Table 7: Usability of school facilities

	Very Good	Good	Poor	Very Poor
Brightness (Daylight)	7	3	0	0
Classroom Size	7	3	0	0
Desks for Students	3	4	2	1
Chairs for Students	2	5	2	1
Desks for Teachers	3	6	1	0
Chairs for Teachers	3	4	3	0
Blackboard	6	4	0	0
Bulletin Board	5	4	1	0

Source：Result of the questionnaires

Note: The above result is the answers from the respective ten target schools.

Newly provided school equipment is also being utilized effectively and contributing to an increase in

[10] Desks and chairs were made to Mongolian standard specifications at the time of project planning, but they are now made lighter, and desk heights are adjustable.

[11] The focus group discussions were organized in each target school (ten target schools) in January 2011 during the field survey. A total of 105 people participated in the discussions including teachers, staff, parents and students.

students' enthusiasm for learning. Specifically, in math classes, various shaped rulers are useful for drawing shapes on the blackboards, or even simply showing differently shaped rulers makes teaching easier. And in another class, it was confirmed that using a map of Mongolia actually promotes students' interest in the subject.

This project has somewhat achieved its objectives; therefore, its effectiveness is fair.

3.4 Impact

3.4.1 Intended Impacts

The following impacts were confirmed through the result of the questionnaires distributed to the target schools, interviews with principals and teachers during the field survey and the focus group discussions organized as a beneficiary survey of this ex-post evaluation.

3.4.1.1 Change in motivation for school attendance and learning (decrease in absences/tardiness)[12]

It became more convenient to commute to school because students now attend schools closer to their homes, taking less time to commute and eliminating the need to take buses early in the morning or late at night. This has led to less absences and a decrease in incidences of students arriving late. The trend is particularly significant at four schools built in the Ger area (Od-3 school in Darkhan-Uul Province, No. 16, 17, 18 schools in Orkhon Province). Other positive changes have been also recognized, including that, "students find schools to be fun places, and thus they do not skip or refuse to go to school anymore," and, "improved sanitary conditions reduced absences from sickness."

3.4.1.2 Improved quality of classes and academic performance[13]

With teachers' rooms and heating equipment improved by this project, teachers' working shifts decreased from three shifts to two or even one, which has provided teachers with more time to explore better teaching methods or prepare for their classes. In addition, school equipment provided by this project is well utilized to enhance their teaching. Such improvements in the teaching environment have led to improvements in teaching content, which in turn boosts students' academic performance. These positive effects are clearly demonstrated by the fact that teachers and students of the target schools have been awarded various province- or nation-wide academic prizes as shown in the table below.

[12] This impact was not expected at the time of the basic design study and was added and examined for this ex-post evaluation.
[13] This impact was not expected at the time of the basic design study and was added and examined for this ex-post evaluation.

Table 8: Schools awarded by the nation or province

School	Award Content
Darkhan No. 4	・ Awarded by the province in 2007, 2008 and 2009 for excellent academic results ・ First prize in 2010 at a national academic contest ・ More than twenty teachers won prizes including the highest prize in a national teaching competition. Topics awarded were history, society, chemistry, biology, Mongolian language and physics
Darkhan Od-3	・ Awarded by the nation in 2009 and 2010 as a school that achieved the objective "to achieve 90 – 100 % of the initial target in regard to the preparation of classes"
Orkhon No. 2	・ In a national presentation competition, a chemistry teacher won the first prize in 2009 and a special award in 2010
Orkhon No. 7	・A mathematics teacher won third prize in a national teaching competition
Orkhon No. 16 (Orkhon Complex)	・ Several teachers won prizes in 2011 in competitions: first prize in Mongolian language, third prize in Mongolian characters and third prize in history. ・ Selected as one of best twenty schools in top-level management

Source: Answers to the questionnaires, result of the focus group discussions

3.4.1.3 Enhanced school life through more extra-curriculum activities

Shorter commute times and reduced shifts have given more time for after-school club activities, and supplemental study and homework time (particularly for students with no heat at home). As an indication of this effect, it should be noted that Orkhon No. 6 school (Bayan-Undur Complex school) and Orkhon No. 16 (Orkhon complex school) were chosen as "the school with most flourishing club activities of the year" by MECS for the year 2008/2009 and 2010/2011 respectively.

3.4.1.4 Utilizing school facilities for community activities

At the time of the basic design study, the school facilities targeted by this project were expected to have the indirect effect of serving communities with insufficient infrastructure or public facilities. Four out of the ten target schools have been confirmed as being utilized for various events in the community, residents' meetings, and voting stations.

3.4.1.5 Ripple effects on neighboring schools

According to the Education and Culture Department of Orkhon Province, improvements brought by this project have had a ripple effect on surrounding schools. As the educational environment of target schools improved, their teachers and students have become more enthusiastic and worked harder. This change also had positive effects on other schools, boosting the competitiveness of the entire province. This ripple effect has resulted in, for example, an increase in national academic awards given to schools in the province.[14]

[14] In the national contest in the year 2010/2011, fourty seven teachers and students participated in competion of thirteen subjects from Orkhon Province. Three of them won the highest award, three won prizes for excellence and three won third prize.

3.4.2 Other Impacts

There was no land acquisition and resettlement for this project. No impact on the natural environment due to the construction of school facilities was reported.

In light of the above, in addition to indirect impacts expected at the time of the basic design study, various impacts such as the change in motivation for school attendance and learning, improved quality of classes and academic performance, and a ripple effect on neighboring schools have been also confirmed.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

(1) System at School Level

Staff personnel in charge of facility/equipment operation and maintenance are assigned to each school, and conduct routine check-ups, simple repairs and maintenance, as well as regular reporting to the principal on operations and maintenance. For serious failures that the school is unable to handle, the Construction Department of the provinces or city heating company (for heating equipment) will take necessary measures upon request from the school. Schools may also directly contract the repair work to private repair companies in the area or in Ulaanbaatar City.

(2) Function of School Committees

Each school has a school committee comprising of school staff, local residents, parents and students. There is no rule for the number of members or composition, and thus they vary by school. Tasks of school committees include the approval of school management strategies, plans, policies and financial reporting, annual evaluations of school operations, auditing school operation reports, coordinating various opinions on education, making proposals for improvement plans, and auditing school administration.

There is an established school-wide operation and maintenance system in which daily operations and maintenance work of school facilities and equipment are supported not only by the school, but also with the participation of parents and the local community.

3.5.2 Technical Aspects of Operation and Maintenance

There is no problem in the operation and maintenance of school facilities/equipment from technical aspects since they have been appropriately maintained except for serious failures that are technically too difficult to repair for the target schools. Most repair works have been done without trouble by technical staff at each school. (For details of facility failure, please see 3.5.4 Current Status of Operation and Maintenance)

School facilities and classroom furniture are maintained by teachers, staff and parents. At most target

schools, there has been some minor failure of doors, windows, furniture (desks and chairs), or cracks in the walls. In most cases, they have been repaired by school staff and parents during summer vacations.

3.5.3 Financial Aspects of Operation and Maintenance

There is no concern with regard to financial aspects of the operation and maintenance of facilities constructed by this project, since the national budget for the education sector has been constantly secured. Operation and maintenance costs have also been constantly secured by finding various financial sources in addition to the ordinary budget in the target two provinces, and necessary costs have been maintained at the level of individual schools by collecting a certain contribution from parents as necessary.

(1) Budget of MECS

The national budget and the budget for the education sector under the jurisdiction of MECS are indicated in the table below. The education budget has been occupying 12-17% of the national budget and it has been increasing every year along with the recent rapid economic growth. The annual expenditure of MECS is approximately 1.5 billion Tg for the renewal of educational facilities and equipment. For the fiscal year 2010, 1.05 billion Tg was allocated to renovate 201 educational facilities, with 840 million Tg expended for the renovation of dormitories and kindergartens. The renovation/renewal budget for schools and kindergartens increased to 920 million Tg for the fiscal year 2011.

Table 9: National budget and budget for the education sector

(In mil. Tg)

	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
1. National Budget	615,771.3	752,486.4	764,597.1	1,237,008.0	1,747,310.5	2,466,774.4	2,321,599.6
2. Budget for the Education Sector	105,550.5	132,528.0	136,935.9	181,099.5	216,034.5	348,023.4	361,599.6
3. Gross Domestic Product (GDP)	1,461,169.2	1,910,880.9	2,266,505.5	3,715,000.0	5,464,300.0	6,130,300.0	6,482,000.0
Ratio of the Budget for the Education Sector to the National Budget	17.1%	17.6%	17.9%	14.6%	12.4%	14.1%	15.6%
Ratio of the Budget for the Education Sector to the GDP	7.2%	6.9%	6.0%	4.9%	4.0%	5.7%	5.6%

Source: MECS

(2) Budget for the Education and Culture Department of the Target Provinces

In both provinces, large parts of the provinces' budget for education go to salaries and social insurance. These expense items constitute 60-70% and 70-80% of the provinces' education budget in Darkhan-Uul Province and Orkhon Province respectively.

Table 10: Education budget of Orkhon Province

(In mil. Tg)

Item	2003/2004		2004/2005		2005/2006		2006/2007		2007/2008		2008/2009		2009/2010	
	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)
1. Salary	1,368	49.4	1,670	49.3	1,874	50.1	2,443	51.9	3,771	49.6	6,316	63.6	6,834	62.9
2. Insurance	359.1	13.0	435.8	12.9	493.2	13.2	655.8	13.9	995	13.1	631.9	6.4	657.8	6.1
3. Electricity	63.7	2.3	66.5	2.0	63.2	1.7	68.7	1.5	66.7	0.9	83.5	0.8	85.2	0.8
4. Heating	448.9	16.2	469.5	13.8	647.4	17.3	737.8	15.7	803.7	10.6	930.2	9.4	1,220.4	11.2
5. Water Supply & Treatment	47.2	1.7	65.8	1.9	70.7	1.9	77.4	1.6	117.2	1.5	118.1	1.2	112.9	1.0
6. Current Renovation	131.5	4.7	198.8	5.9	90.3	2.4	91.1	1.9	65.2	0.9	83.9	0.8	52.8	0.5
7. Food	212.1	7.7	247.3	7.3	287.7	7.7	385.1	8.2	342.3	4.5	494.8	5.0	676.5	6.2
8.Other	139.1	5.0	236.6	7.0	216.8	5.8	249.1	5.3	1,446.0	19.0	1,279.7	12.9	1,218	11.2
Total	2,769.5	100.0	3,390.2	100.0	3,743	100.0	4,708	100.0	7,607	100.0	9,939	100.0	10,858	100.0

Source: Education and Culture Department of Orkhon Province

Table 11: Education budget of Darkhan-Uul Province

(In mil. Tg)

Item	2003/2004		2004/2005		2005/2006		2006/2007		2007/2008		2008/2009		2009/2010		2010/2011	
	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)
1. Salaries	1,181	62.0	1,438.5	59.8	1,512.5	58.7	2,127.7	63.0	2,981.1	65.0	4,744.5	69.3	4,743.6	69.7	5,110.6	68.6
2. Social Insurance	311.7	16.4	379.8	15.8	399.3	15.5	563.4	16.7	787.0	17.2	474.4	6.9	521.8	7.7	562.2	7.5
3. Electricity	29.7	1.6	30.7	1.3	33.2	1.3	33.2	1.0	43.6	0.9	50.9	0.7	46.3	0.7	56.3	0.8
4. Heating	281.9	14.8	373.3	15.5	433.4	16.8	433.7	12.9	505.4	11.0	506.1	7.4	477.7	7.0	517.7	7.0
5. Water Supply & Treatment	45.2	2.4	62.8	2.6	74.8	2.9	74.8	2.2	106.0	2.3	107.3	1.6	120.9	1.8	129.2	1.7
6. Current Renovation	9.5	0.5	37.3	1.5	37.3	1.4	15.9	0.5	21.6	0.5	27.9	0.4	13.6	0.2	39.1	0.5
7. Food	11.4	0.6	18.9	0.8	22.2	0.9	32.5	1.0	35.8	0.8	42.5	0.6	41.4	0.6	33.1	0.4
8.Other	33.529	1.8	63.680	2.6	61.846	2.4	93.707	2.8	107.552	2.3	895.143	13.1	842.128	12.4	999.264	13.4
Total	1,903.7	100.0	2,404.9	100.0	2,574.6	100.0	3,374.9	100.0	4,588.1	100.0	6,848.8	100.0	6,807.4	100.0	7,447.3	100.0

Source: Education and Culture Department of Darkhan-Uul Province

Costs for current renovations allocated as facility maintenance (and repair) costs, on the other hand, do not take up very much of the ordinary budget. In Darkhan-Uul Province, less than 1% has been allocated since the project completion (after 2007). In Orkhon Province, nearly 6% had been allocated for facility maintenance in the year 2004/2005 but the budget for current renovation has been a decreasing trend every year. According to the target provinces' Education and Culture departments, old and decrepit schools and kindergartens are given priority for national budget allocations distributed for facility renovation/renewal, and relatively new facilities, such as ones targeted by this project, have little chance of receiving the budget. The Education and Culture Department of the target provinces, therefore, has been receiving funds other than from the national budget to cover extra budgetary repair costs if necessary.[15]

[15] Various sources include special budget funds from the Minister of Education, Culture and Science, City budget, donations from factories (copper plants in the case of Orkhon Province, steel plants in the case of Darkhan-Uul Province), and investment from the World Bank or the Asian Development Bank (in the case of Darkhan-Uul Province).

(1) School Budget

Each school first applies for its budget to the Education and Culture Department of the province, and then the Education and Culture Department submits it to MECS for compilation. There has been no change in the breakdown of expense items of seven target schools in Orkhon Province; with approximately 60% for salaries, wages and supplementary costs, and 10% for social insurance, totaling 70% for each school. A uniform 0.5% is allocated for current renovations (maintenance). The table below shows the budget for Orkhon No. 3 school as an example (the amount varies by school, but the ratio is the same.)

Table 12: School budget (Orkhon No. 3 School)

(In mil. Tg)

Item		2004/2005		2005/2006		2006/2007		2007/2008		2008/2009		2009/2010		2010/2011	
		Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)	Amount	Ratio(%)
1	Salaries	106.2	61.3%	113.0	61.3%	141.3	61.3%	167.9	61.3%	214.5	61.3%	272.2	61.3%	306.8	61.3%
2	Insurance	17.3	10.0%	18.4	10.0%	23.0	10.0%	27.4	10.0%	34.9	10.0%	44.3	10.0%	50.0	10.0%
3	Electricity	2.5	1.5%	2.7	1.5%	3.3	1.5%	4.0	1.5%	5.1	1.5%	6.4	1.5%	7.3	1.5%
4	Heating	17.2	9.9%	18.3	9.9%	22.8	9.9%	27.1	9.9%	34.7	9.9%	44.0	9.9%	49.6	9.9%
5	Water Supply & Treatment	3.7	2.2%	4.0	2.2%	5.0	2.2%	5.9	2.2%	7.5	2.2%	9.6	2.2%	10.8	2.2%
6	Current Renovation	0.9	0.5%	1.0	0.5%	1.2	0.5%	1.5	0.5%	1.9	0.5%	2.4	0.5%	2.7	0.5%
7	Food	12.6	7.3%	13.4	7.3%	16.7	7.3%	19.9	7.3%	25.4	7.3%	32.2	7.3%	36.3	7.3%
8	Training	3.2	1.8%	3.4	1.8%	4.2	1.8%	5.0	1.8%	6.4	1.8%	8.2	1.8%	9.2	1.8%
9	Other	9.8	5.6%	10.4	5.6%	13.0	5.6%	15.4	5.6%	19.7	5.6%	25.0	5.6%	28.2	5.6%
	Total	173.4	100.0%	184.5	100.0%	230.7	100.0%	274.2	100.0%	350.1	100.0%	444.3	100.0%	500.8	100.0%

Source: Education and Culture Department of Orkhon Province

In the case of Darkhan-Uul Province, labor expenses make up 40-70% of the overall budget while 0.5-3% is set aside for maintenance.[16]

According to the answers to the questionnaires and interviews, eight out of ten target schools do not have a sufficient maintenance budget, and each school saves on other expense items to finance facility repair works, or collects small amounts of money (about 1,000-2,500 MNT) from parents as a school building maintenance fee (for walls, doors and/or equipment) to cover maintenance and minor repair costs of classroom equipment. In cases when it is necessary to allocate extra maintenance costs, schools have been able to manage extra budgetary repair works by appropriating other expenses or resources, as mentioned earlier. Thanks to these financing efforts, there have not been any cases where necessary repairs have been delayed because of the unavailability of the maintenance budget. We can therefore expect that there will not be any major financing problems with facility operations and maintenance unless some serious failures occur.

3.5.4 Current Status of Operation and Maintenance

Interviews and site visits revealed that each school building is cleaned daily, and educational materials provided by this project are well organized and stored in designated spaces. Furthermore, there are slogans and illustrations posted on hallways and walls, and physical exercise spaces set up in hallways

[16] In the case of three target schools in Darkhan-Uul Province, the breakdown ration differs by year and by school.

for students to get enough exercise during the winter when it is too cold to play outside. This leads us to conclude that the school facilities improved by this project have been well and carefully managed and maintained.

Physical exercise space in hallways (Darkhan Od-3 School)

Toilets cleanly maintained even 7 years after the completion of the project (Orkhon No. 16 school)

As mentioned above, target schools check on facility and equipment conditions on a regular basis, and conduct regular maintenance and minor repair works. School facilities and equipment have been well maintained except for the following:

At the time of the ex-post evaluation, four schools were found to have leaky roofs, one school had a failure with a water heater, and three schools had out-of-order toilets. None of these problems is causing major damage to the functioning of the school.

Regarding the four schools with leaky roofs, two schools in Darkhan-Uul Province built during the second stage still had a valid five-year waterproof warranty, and thus the roofs were repaired by a contractor from July to August 2011. The other two schools with leaky roofs in Orkhon Province had been built during the first stage and completed in 2004, and have not had their roofs repaired completely, although the schools have taken various measures including repainting the ceilings and replacing vinyl sheets. Because the warranties for these schools have expired, the Mongolian side continues to take care of the problems in these two schools. Despite remedial measures taken by schools, the Education and Culture Department and contractors in the target province, failures with water heaters and toilets have not yet been rectified. Currently, they are contacting an appropriate contractor in Ulaanbaatar City, and continuing their repair.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented in order to ease overcrowded classrooms and to improve learning environments by constructing classrooms and other facilities and providing educational equipment and teaching materials to the ten target schools. The improvement of the learning environment of primary education is relevant to Mongolia's development plan and development needs, as well as to Japan's

ODA policy; therefore, its relevance is high. The efficiency of the project was judged to be fair, because the project period significantly exceeded the planned period. This resulted from unintended factors, including the unsuccessful bidding for selected contractors for construction works in the second stage and a subsequent implementation review study to review the original design and the cost estimate. In regards to the effectiveness of this project, although the number of classrooms has increased as planned and overcrowding has eased, it has been observed that many schools received a smaller number of students per classroom than the Mongolian standard (36 students per classroom). This was due to a decrease in the population of school-age children and primary school enrollments in the target area, and the reorganization of school districts and changes in the school year system. In the meantime, less crowded classrooms and better school equipment have improved the learning environment and helped students to be better motivated to attend school and learn and have also helped teachers to prepare for lessons more efficiently. Overall, the effectiveness of the project is found to be fair, considering that it has led to a higher lesson quality and higher academic achievements.

As for the sustainability, each school has adequately appointed staff personnel in charge of the operation and maintenance of facilities/equipment and has well-functioning school committees consisting of parents and local community members. Therefore, there is no problem with schools' operation/management structures. Also, no financial problems have been observed since operation and maintenance expenses of constructed facilities have been sufficiently covered by various funding sources. Facilities and equipment that were improved and provided by the project have been used carefully and very well kept with minor repair work done by each school, indicating no major problem with status of operation and maintenance.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Improving the accuracy of basic data

During the ex-post evaluation, it was found that school enrollment figures reported to the consultant at the basic design study may have been larger than actual figures. For the last two to three years, MECS has strengthened its supervision to determine and report accurate numbers of registered students. It is recommended that this trend is continued, as the availability of such basic data is crucial for accurately identifying development needs, planning for suitable aid programs, and making appropriate evaluations before and after the project.

(2) Remedial measures for leaky roofs

Despite repeated repair efforts on the part of the schools, leaky roofs of two schools in Orkhon Province have not been completely repaired, partially due to difficulties in identifying the exact locations of the leaks. In consideration of this situation, it is recommended that the Mongolian side

(Education and Culture Department and schools) take necessary measures as soon as possible, with technical assistance (such as identifying the causes of failure, effective repair methods and materials) sought from specialized contractors with expertise.

Column 1：Involvement of Japan Overseas Cooperation Volunteers in enhancing school education

A Japan Overseas Cooperation Volunteer (JOCV, Field: Youth Activity) has been dispatched to Orkhon No. 6 school to help students who are unwilling to attend school or study by teaching them the joy of creation through arts and craft lessons so that they have something to look forward to at school. For example, he taught students how to make ornaments using readily available materials (recycled paper), displayed works made by students on a bulletin board provided by this project, and as a school club activity, taught them about the history of paper, and initiated a number of other activities. On "Teachers Day" this year, he was chosen as the "most favorable teacher". This is a good example of a synergetic effect of an effective JOCV activity enhancing school education at the schools built by the grant aid provided by Japan.

Students' works displayed on a bulletin board provided by this project

Students' works individually kept

Column 2: Effectiveness of the linkage between a technical cooperation project and a grant aid

In addition to the improvement in learning environments by this project, JICA's technical cooperation project called the "Teaching Methods Improvement Project Towards Children's Development in Mongolia" (2006-2009) has developed school materials, which were distributed to schools nationwide through provincial education and culture departments, and contributed to improving the quality of school education (the materials developed by the above project were printed and distributed nationwide, by taking advantage of the collateral fund for food aid).[17] Comments from school teachers who utilize these materials include: "We've received 27 science textbooks. I find them all very useful, and use them every day", "These materials changed our teaching method, and children understand better", and, "I have taken the training based on this textbook. The textbooks were distributed to every teacher, and so we all have our own to use every day, which is very convenient." Overall, comments indicate positive effects they have on lessons.

Column 3: Thanks from Mongolia

Improvement of school facilities implemented by this project also nurtured appreciation and friendship toward Japan among involved parties in the target provinces, and teachers and students of target schools has been keeping the schools well with appreciation in their hearts. Following the Great East Japan Earthquake in March 2011, a fund-raising was initiated by teachers, parents and students of ten schools built by this project, to show their condolences and goodwill toward Japan.

[17] Collateral funds are funds produced through the sale of products bought by the recipient country through a loan or grant aid.