Kingdom of Cambodia

Ex-Post Evaluation of Japanese ODA Grant Aid Project

"The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri"

External Evaluator: Machi KANEKO, Earth and Human Corporation

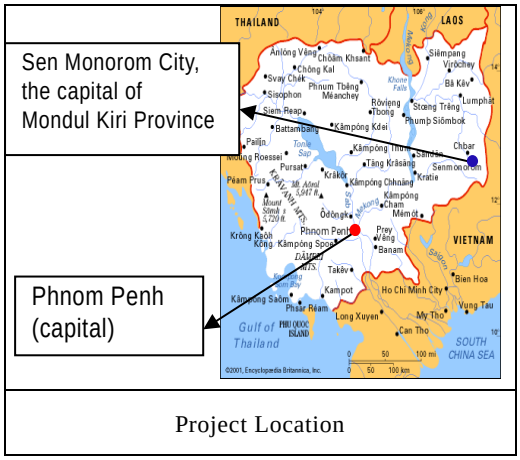
0. Summary

The objective of the Project was to supply a stable supply of electric energy by constructing micro-hydropower plants and auxiliary facilities in Mondul Kiri Province. This objective has been highly relevant with the development plan of Cambodia and development needs both at the time of planning and at the time of ex-post evaluation, therefore its relevance is high. The hydroelectric power facilities that were constructed has been maintained in good operating condition, and the objectives of power supply and electrification, which are indicators of effectiveness, have been achieved as planned. As a result, electricity availability in the target area has been vastly improved, with increase in the number of restaurants, guesthouses and hotels. There have also been increases in the number of people moving into the area and in the number of tourists visiting Sen Monorom, and thus, the Project has contributed to lead the entire growth of regional economy through the development of local tourist industry. Additionally, improvements have been seen in the widespread use of consumer electrical appliances by general households and in better public services, and thus there has been a positive impact on the living condition of rural people.

And the project cost was within the plan, however the project period was exceeded, therefore efficiency of the project is fair. With respect to maintenance of the facility, the Project provided for the foundation of an operating and maintenance system, which was fortified through the technical cooperation project afterwards. Therefore, sustainability of the project effect is high.

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

1. Project Description



Project Location

O'Moleng Micro-Hydropower Station, Intake Weir and Sedimentation Basin

1.1 Background

Many of the existing power facilities in the Kingdom of Cambodia (hereafter referred to as "Cambodia") were devastated during the civil war that took place in Cambodia over a 25-year period, with the result that power development has been significantly delayed. Because of this, as of 2002, electric power was being supplied to only around 13% of all households in Cambodia, and annual per capita power consumption was measured at 35 kWh, which was the lowest level anywhere in the Indochina Peninsular countries. Moreover, electrification was extremely slow to progress in rural areas, where about 85% of the populations live, and only 9% of households enjoyed the benefits of electricity.

The provincial capital, Sen Monorom City in Mondul Kiri Province (2004 population: about 8,000), which is the target site for the Project, is located in the mountainous near the border of Vietnam, and despite Sen Monorom City being the provincial capital, there was no public power service. Because of this, there was a chronic power shortage, and small-scale private power providers were using diesel generators to provide power only during morning and evening meal times. Additionally, private power providers set electric tariff rates at anywhere from 1,800 riels per kWh (48.3 yen/kWh) to 2,300 riels per kWh (61.7 yen/kWh), which is about 4 times that in Phnom Penh, and these high rates were impossible for people in the low income group to pay.

This situation was posing a hindrance in terms of Mondul Kiri Province being able to reduce poverty and promote rural development, and the province desired to assure a power energy source for the region at the earliest possible timing. In 1999, the Mekong River Commission carried out an investigation on small hydropower generation in Sen Monorom City and its vicinity. Based on the results of this investigation, the Cambodian Government

requested application of Japan's Grant Aid to a plan of constructing micro-hydropower plants.

In response to this request, the Project was implemented with the aim of the construction two runoff river type small hydropower plants and an auxiliary power source for the dry season, which will use diesel power generator in Sen Monorom City of Mondul Kiri Province.

1.2 Project Outline

The objective of the Project is to supply a stable electric energy by constructing a micro-hydropower plants and auxiliary facilities in Mondul Kiri Province.

Grant Limit / Actual Grant Amount	1,066 million yen / 1,059 million yen
Exchange of Notes Date	June 2006
Implementing Agency	Ministry of Industry, Mines and Energy
Project Completion Date	December 2008
Main Contractor	Konoike Construction Co., Ltd.
Main Consultant	J-POWER Co., Ltd. and Nippon Koei Co., Ltd. / Joint venture
Basic Design	May 2005
Related Projects (if any)	Technical Cooperation Project "The Project for Operation and Maintenance of the Rural Electrification on Micro-hydropower in Mondul Kiri, Cambodia" (December 2008 - March 2011) (hereafter referred to as "the technical cooperation project").[1]

2. Outline of the Evaluation Study

2.1 External Evaluator

Machi KANEKO, Earth and Human Corporation

2.2 Duration of Evaluation Study

The External Evaluator performed an evaluation study as follows in the course of this ex-post evaluation:

Duration of the Study: October 2011 - August 2012

Duration of the Field Study: March 26 – April 14, 2012 and May 26 – June 9, 2012

2.3 Constraints during the Evaluation Study

None.

[1] The relevant technical cooperation project was implemented over a two-year period starting immediately after the completion of the Project, and indicators that were set as overall goals, like the quantitative effects of the Project, were "increasing household electrification ratios" and "stable supply of electric energy".

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

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance with the Development Plan of Cambodia

At the point of planning of the Project, the Cambodian government was endeavoring to achieve an electrification rate of 25% of all households by 2010 and 70% by 2030, but because of constraints in terms of funding and technology, it was difficult to achieve these objectives without assistance. Furthermore, the Energy Sector Development Policy (2004 – 2020), which is a high-level policy of Cambodia, calls for the electrification of rural areas as a foremost issue in order to eliminate disparities between urban areas and rural areas, improve living condition, and reduce poverty. The Project was aimed at reducing poverty in Mondul Kiri Province which is located in the mountains near the border of Viet Nam, and at providing better conditions for people living there, and was relevant to development policies at the time of planning.

At the point when the ex-post evaluation was done, in the Rectangular Strategy developed by Cambodia in 2004 as a framework for national development, infrastructure refurbishment was identified as a central strategy, with "Energy Field and Power Network Development" being an item of strong focus. Moreover, the National Strategic Development Plan (2006 – 2010) formulated in order to embody the Rectangular Strategy also emphasized the promotion of power supplies, and numerical targets for electrification rates, like those at the time of Project planning, were set with the aim of increasing the electrification rate to 25% by 2010 and 70% by 2030, by means of an on-grid (grid-connected) network.

The following shows trends in the amount of power supplied by Electricité du Cambodia (EDC). Compared to 2005, when the Project was planned, the amount of power has increased more than 3.7-fold. At the same time, however, ongoing and proactive measures will be required in order to fulfill the specified objectives, and with respect to electrification in rural areas, where refurbishment has been delayed, the aim is to refurbish facilities and improve operating control technology in order to enable stable supplies of power at low prices[4].

Table 1: Trends in power supply volume in regions supplied by EDC

	2005	2006	2007	2008	2009	2010
Nationwide	145.59 GWh	199.75 GWh	268.57 GWh	349.61 GWh	441.91 GWh	542.63 GWh
Increase rate		37.20%	34.45%	30.17%	26.40%	22.79%

Source: Data provided by Electricité du Cambodia (EDC)

The above indicates that the Project is relevant with the development policy of the

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

[3] ③: High, ②: Fair, ①: Low

[4] There are not only EDC but a large number of small-scale private power contractors in rural areas in Cambodia, but the Cambodian government has a policy to promote electrification in rural areas by expanding the national grid managed by EDC in the future, making EDC's role more important.

Cambodian government, which aims at increasing the rate of electrification in rural areas.

3.1.2 Relevance with the Development Needs of Cambodia

Because of the civil war that went on in Cambodia from 1970 into the 1980s, many of the existing power supply facilities have been devastated, and the national electrification ratio was at a standstill, at 13%. Moreover, at the time when the Project was planned, electrification was concentrated in urban areas such as Takeo Province and Kampot Province on the outskirts of Phnom Penh, and electrification in rural provinces, including the target province of the Project, Mondul Kiri Province and provincial capital, had advanced very little, with few residents endowing the benefits of electricity.

Because of this, when the Project was planned, Sen Monorom City, which is the provincial capital of Mondul Kiri Province, was not connected to a public power service, and the supply of electrical energy was limited to small-scale private power providers. Moreover, there were frequent power interruptions, and electricity tariff rates ranged from approximately 48 to 62 yen per kWh, which was about 4 times the rate in Phnom Penh, and made it impossible for low income groups to pay for power. For this reason, at the time when the Project was planned, only 31.7% of households (377 households out of 1,189) had electrical power, despite Sen Monorom City being the provincial capital, and this was hindering vitalization and promotion of the area. Additionally, at the time when the Project was planned, plans to expand the national transmission system (targeted for 2016) did not include Mondul Kiri Province, and no power transmission could be expected from the outside. Furthermore, donor aid from France, Germany and other countries was concentrated primarily in Phnom Penh, delaying power development in rural provinces.

At the point when the ex-post evaluation was done, low-priced power was being supplied on a stable basis to a certain extent as a result of implementation of the Project, and the number of households contracting for power supply within the target area was increasing. Specifically, at the end of 2011, about 80% of households in the area had contracts with the Mondul Kiri branch of Electricité du Cambodia (EDC) (formerly EUMP[5]), and that number is currently increasing.

Also, in terms of the regional promotion that was expected when the Project was planned, in addition to assuring stable supplies of power, road refurbishment was also being promoted at the same time, and this was leading to increases in the population and the number of tourists. Thus, the Project is contributing to the revitalization of the regional economy, primarily in terms of the tourism industry, and is relevant to the needs of the target area.

[5] EUMP was newly established through the Project, but later, in June 2010, was taken over by Electricité du Cambodia (EDC), a large-scale government corporation, and now operates as a branch in Mondul Kiri Province of EDC.

3.1.3 Relevance with Japan's ODA Policy

With respect to the Country Assistance Plan for Cambodia, which is one of Japan's ODA policies relating to Cambodia, because Cambodia's development needs are both wide-ranging and vast in scope, assistance is being provided with a heavy emphasis on priority issues. Moreover, when assistance is implemented, sustainable economic growth and poverty reduction are foremost issues, and every effort is being made to give adequate consideration to measures that target the socially disadvantaged. There is a strong need for refurbishment of basic infrastructures devastated as a result of the long-term civil war in Cambodia, as well as to rebuild systems that have been worn down by the long-running conflict. There is also a need to cultivate personnel who can help to offset severe shortages of human resources.

By refurbishing power facilities in rural provinces, the Project is contributing to promoting the refurbishment of social and economic infrastructures in regions where development has been delayed, and is providing support for sustainable economic growth. Furthermore, improved access to power by the poverty classes in rural areas will help to reduce poverty. All of these aims are relevant with Japan's ODA policy.

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

3.2 Effectiveness[6] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

(1) Power supply and electrification ratio

Table 2: Trends in power supply, hours of power supply and electrification relating to the Project[1)]

Indicator		At time of planning (2004)	Target (end of 2013 [5 years after completion])	Achievements			
				2008[2)]	2009	2010	2011
Power Supply	Daily max.[3)]	170kW (private power providers)	400kW	267 kW	357 kW	490 kW	618 kW
	Hours of power supply	Morning: 3 hrs. Daytime: 3 hrs. Night: 6 hrs.	24-hour supply	N/A	24-hour supply	24-hour supply	24-hour supply
Electrification ratio		32%	about 80%	29.8%	71.7%	76.3%	80.5%
Contracting households/ Total households[4)]		N/A		465/1560	1180/1645	1304/1710	1444/1795

Source: Data provided by EDC

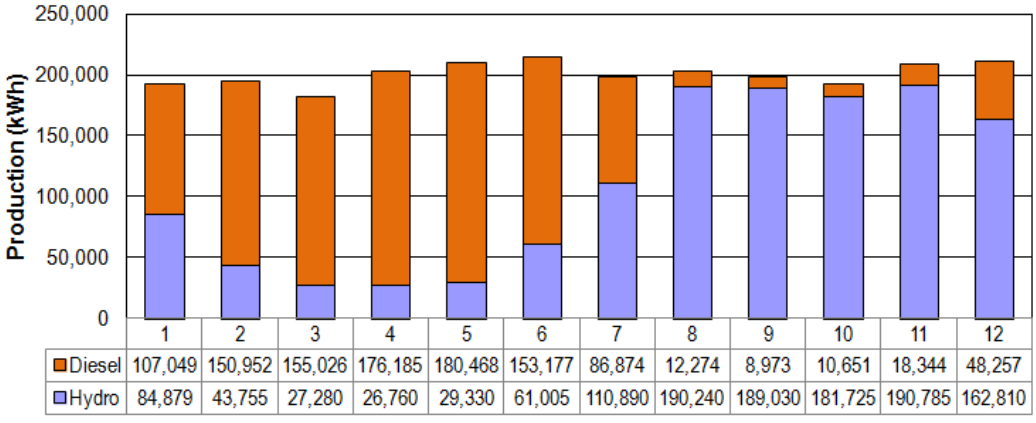
Notes: 1) Each indicator covers Sen Monorom City.
2) The power facility went into full-fledged operation in December 2008. For this reason, the period of operation indicated for 2008 is the figure for one month.

[6] Effectiveness should be judged in consideration of impact to determine a rating.

3) Daily maximum: Anticipated demand for power was measured at the time of planning, and the daily maximum power demand five years after the completion of the project, which is the target year for the outcome, was set at 400 kW. Also, where hydropower is in full operation during normal seasons and diesel power is used as reserve power, the aim was to apportion hydropower and diesel power during the dry season, when river flow rates are low, achieving a stable power supply (400 kW) year-round.
4) According to the report prepared at the completion of the relevant technical cooperation project, "The value for total households is the number of buildings within range of the power distribution network in Sen Monorom City, and was calculated by taking the value surveyed in September 2009, prior to electrification, as the base, with a performance increase rate up to that point of 5.5%. Because of this, the electrification ratio is an estimated value." For this reason, it should be noted that the electrification ratio noted above is not the actual performance value. However, the number of contracted households is the actual value.
The indicators that were set as overall goal of the relevant technical cooperation project, like the quantitative effects of the Project, were "increasing household electrification ratios" and "stable supply of electric energy".

Table 2 above shows trends in power supply, electrification ratio and other parameters in 2008 and later years. As a result of implementation of the Project, power supply had reached a daily maximum of 618 kW by 2011, with power being supplied 24 hours a day, and the objectives set at the time of planning were achieved. For the electrification ratio as well, the value immediately following completion of the Project (December 2008) was 29.8% (465 of 1,560 households), but the number of contracted households continued to increase subsequently, and as of December 2011 the ratio had reached 80.5% (1,444 of 1,795 households). Thus, the value of 80%, which had been set as the target value for 2013, has already been met.

Figure 1 below shows a breakdown of power production volume by month, categorized by power production source. Starting around July, when the rainy season begins in Mondul Kiri Province, the percentage of power produced using hydropower begins to increase, and until the dry season approaches in December, the amount of power supplied using diesel power generation, which incurs fuel costs, is kept low. Thus, the facility is operating as planned in the initial planning.



	1	2	3	4	5	6	7	8	9	10	11	12
Diesel	107,049	150,952	155,026	176,185	180,468	153,177	86,874	12,274	8,973	10,651	18,344	48,257
Hydro	84,879	43,755	27,280	26,760	29,330	61,005	110,890	190,240	189,030	181,725	190,785	162,810

Figure 1: Monthly power production by generation source in 2011

Source: Data provided by EDC Mondul Kiri branch

In 2011, the daily maximum supplied power was 618 kW, which was approaching the level of 670 kW that is the power production capability limit for the Project. Because further power increases are anticipated, EDC has formulated and implemented planning for importing power from Vietnam, and this power transmission began on January 19, 2012[7]. Once power is being transmitted from Vietnam, diesel power generation facilities will be used as last priority in the system fuel mix and as reserves, in the event of an interruption in power transmission from Vietnam, a water shortage, or a breakdown at a hydropower plant, and will serve in a backup capacity.

(2) Electricity tariff rates

Table 3: Electricity tariff rates for the Mondul Kiri branch of Electricité du Cambodia (EDC)

Indicator		At time of planning (2004)	Target (end of 2013 [5 years after completion])	Achievements				
				2008 (before project)	2008 (after project)	2009	2010	2011*2)
Electricity tariff rates (riels/kWh)	General household	1800 riels/ kWh~2300 riels/ kWh (Private power providers)	Avg. about 670riels/ kWh *1) (18.0 yen/kWh)	2800 riels/kWh ~3500 riels/kWh (Private power providers)	1700 riels/ kWh	1500 riels/ kWh	1500 riels/ kWh	1500 riels/ kWh
	Restaurants, guesthouses, hotels etc.				1900 riels/ kWh	1700 riels/ kWh	1700 riels/ kWh	1700 riels/ kWh
	Factory				1700 riels/ kWh	1700 riels/ kWh	1700 riels/ kWh	1700 riels/ kWh

Source: Data provided by EDC

Notes: 1) The target values for tariff rates were set based on the ability of residents to pay (opinion poll) and on values calculated for the cost price of power generation. In the target values, electricity tariff rates were slightly higher than when the basic design was done because of design changes (the number of hydropower bases was changed from three locations to two, and the output of diesel power generation, which is governed by fuel costs, increased slightly. See the section on "Effectiveness").

2) Based on the exchange rate for December 2011, figures were calculated at 1,500 riels = 28.6 yen. Also, even in minority (Pnong people) villages, electricity tariff rates were set at the same level as those for cities, at 1,500 riels / kWh. If there are likely to be discrepancies in usage conditions, however, appropriate measures will be taken.

With respect to electricity tariff rates, as indicated in Table 3 above, the actual value in December 2011 was 1,500 riels / kWh (28.6 yen / kWh), which was more than the target value of 670 riels / kWh (18.0 yen / kWh). Furthermore, as shown in Table 4, the electricity tariff rate in Phnom Penh is 610 riels / kWh, which is higher than in other provinces.

At the same time, however, electricity tariff rates charged by private power providers in Sen Monorom City in 2008 ranged from 2,800 riels / kWh (63.5 yen / kWh) to 3,500 riels / kWh, and had skyrocketed further compared to the time when the planning was formulated.

[7] Because EDC does not have experience with systems for connecting the hydropower of the Project and the power being imported from Vietnam, a request was made to implement follow-up cooperation on the Japan side after the relevant technical cooperation project has been completed, and four Japanese experts were dispatched from October 2011 until March 2012. Also, EDC headquarters bore all the cost of constructing the system for connecting power being imported from Vietnam.

When compared to these rates, the electricity tariff rates based on the Project were about half the amount, which is a significant improvement. Moreover, the per capita Gross National Income (GNI)[8] when the Project was planned (2005) was US$ 1,020, while the GNI in 2010 was US$ 2,080. Thus, it is assumed that households were better able to pay the tariff rates than when the Project was planned. So even though the tariff rates were set higher than the target values, it is believed that this trend is one factor in the steady increase in the number of households contracting for electricity.

Table 4: Electricity tariff rates in principal cities (2011)

Province	Electricity tariff rates riels/kWh	Notes
Phnom Penh	610	50 kWh/month or less
Takeo	920	Low-use households
Siem Reap Sihanoukville	820	Low-use households
Battambang	1,000	Low-use households
Prey Veng	1,220	Low-use households
Mondul Kiri	**1,500**	**All households**
Kratie	1,700	All households

Source: Data provided by EDC

According to an explanation by EDC, the low electricity tariff rates set in Phnom Penh was putting pressure on management by EDC, but based on the experience that it was difficult to increase tariff rates once they had been decided, currently the tariff rates are decided by the procedure that each power contractor/producer calculates the required cost then Electricity Authority of Cambodia (EAC) examines it. Moreover, compared to the point when the target values for the electricity tariff rates were first set (2004), the price of crude oil[9] has more than doubled, and this has been pushing up the unit cost of power generation in the dry season, when there is greater reliance on diesel power generation.

Currently, there are no problems with management by the Mondul Kiri branch of EDC, and based on EDC's experiences in other provinces to date, the current tariff rates are judged to be appropriate. Once the transmission of power (coming from hydropower) from Vietnam has stabilized, however, and contracts with large consumers such as factories have advanced, it will be necessary to review these tariff rates based on revenue balances and other parameters.

Moreover, according to the beneficiary survey, there is a high level of satisfaction concerning unit prices of electricity, which are significantly lower than earlier prices, but because the amount of monthly payment for electricity is higher than before, an increasing number of households are not necessarily satisfied with the current unit prices for electricity. As indicated in Figure 2 at the right,

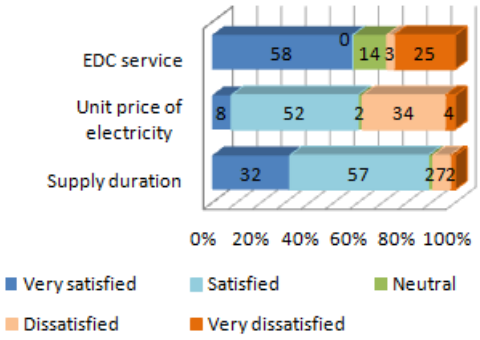


Figure 2: Satisfaction with supply time, electricity unit price, and EDC service (results of beneficiary survey)

[8] The Gross National Income (GNI) figures for 2005 and 2010 are based on data provided by the World Bank.

[9] At the time when the Project was planned, the price of crude oil (WTI) used to calculate the unit cost of power generation was US$ 41.45 per barrel (2004), but by 2011 it had soared to US$ 95.05 per barrel.

about 90% of the residents are satisfied with the amount of time that power is supplied, but about 40% are dissatisfied with the unit price of electricity, and this is one factor that is lowering the degree of satisfaction with EDC services. Conversely, however, as shown in Figure 3, the number of household appliances owned by residents is increasing, and electricity usage time is increasing in step with the increase in

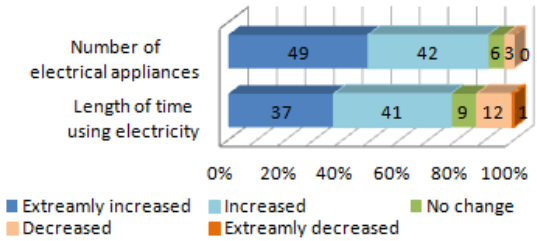


Figure 3: Increases/decreases in number of electrical appliances and length of time using electricity
(results of beneficiary survey)

appliances, so higher amounts for electricity are a natural outcome. Some residents, however, are unhappy that unit prices have been set higher than those of other provinces, and some are expressing distrust in the way that meters are read. Thus, there are apprehensions that the increase in the amounts being paid for electricity will prompt dissatisfaction with EDC

services. EDC is about to increase opportunities to offer explanations to residents, including the calculation method of electricity charges and accuracy of meters, but it is believed that the time is coming when personnel who deal with complaints of residents will have to be prepared as well as more effort will have to be put into educating people about saving electricity, so that electricity will be used more carefully.

3.2.2 Qualitative Effects

As a result of the Project, electric power can now be supplied 24 hours a day, which means that emergency surgeries can now be performed around the clock including emergency treatment at night as well as vaccines can be maintained in a stable state at Sen Monorom Referral Hospital[10], all of which contribute to improved services for local residents.

This hospital is the largest-scale hospital in Mondul Kiri Province, and is the only hospital that can accommodate obstetric surgeries. Prior to the implementation of the Project, however, the hospital relied on civilian power companies and household diesel generators for its power supplies, and was unable to use medical devices that required power on an ongoing basis. In interviews, physicians stated that

Table 5: No. of outpatients seen in 2011
(Sen Monorom Referral Hospital)

	In province	Other provinces/ districts	Total
Transferred from health centers	43	38	81
Autonomous treatment	1620	0	1620
Total	1663	38	1701

Source: Interviews conducted at Sen Monorom Referral Hospital

[10] Sen Monorom Referral Hospital was established in 1986, and the current facility was refurbished in 2004 through ADB assistance after the civil war and comprises 17 wards. There are three physicians, one intern, 26 nurses, six midwives, and 100 beds, and the hospital serves as a referral hospital supporting medical services in the province.

they now have access to stable power supplies, and are able to perform emergency surgeries at night and engage in other aspects of treatment without worrying about power (see Tables 5 and 6). And the hospital has an operating room that was donated by a medical organization in France, but power was necessary even during surgeries performed during the day, and it was confirmed that the Project has contributed to the improvement of medical services in the target area as a result of power supply.

Figure 6: Number of births in 2011 (Sen Monorom Referral Hospital)

Category		Total	Still-births
Normal deliveries		271	0
Difficult births	Cesarean sections	12	
	Severe hemorrhages	7	0
	Eclampsia	5	0
	Other	3	0
Total		298	0

Source: Interviews conducted at Sen Monorom Referral Hospital

3.3 Impact

3.3.1 Intended Impacts

(1) Development of the regional economy and tourism industry

As indicated in Table 7, the number of restaurants, guesthouses and hotels in Sen Monorom City has been increasing from one year to the next, and improvements in the power situation as a result of the Project have been helping to promote the development of tourism. Furthermore, the number of tourists visiting Sen Monorom City in 2011 surpassed 60,000, which was three times the approximate number of 20,000 tourists who visited in 2008.

Table 7: Trends in tourists visiting Sen Monorom City

Category	2008	2009	2010	2011
No. of restaurants	16	18	20	27
No. of guesthouses & hotels	19	19	22	25
Tourists	21,420	30,256	50,568	63,636
Increase in tourists (%)	-	41 %	67 %	26 %

Source: Data provided by EDC

The increase in the number of tourists has been spurred by the refurbishment of National Road No. 7[11] and National Road No. 76[12], as well as by other improvements that have made it significantly easier to reach Mondul Kiri Province. Because of this, a number of large-scale hotels are currently being constructed in several locations, and further development of the tourism industry can be

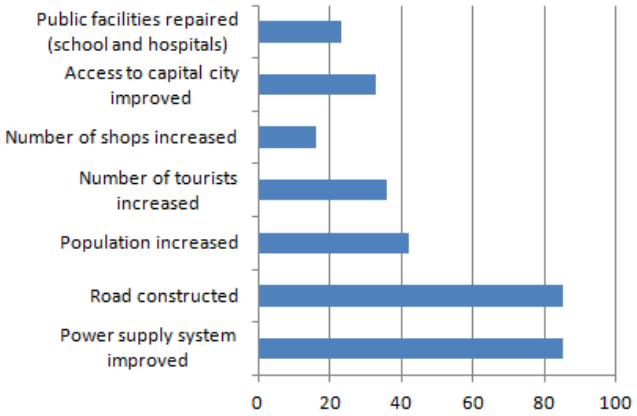


Figure 4: Reasons for the positive turnaround in the economy (results of beneficiary survey)

[11] Japan grant aid project: Between Phnom Penh and Kompong Cham
[12] China preferential loan project: Between Mondul Kiri and Ratanakiri

expected.

In the results of the beneficiary survey conducted among residents, 85% of households responded that the economy was better than prior to the Project, and as shown in Figure 4, the primary reasons cited for the turnaround were electrification within city limits, and refurbishment of roads. The survey indicates that residents feel that implementation of the Project has had a positive impact on the development of the regional economy by means of the electrification of Sen Monorom City.

(2) Improvement of residents' living conditions

In Cambodia, a greater percentage of the population has been moving to urban areas, and as shown in Table 8 below, the population of Sen Monorom City has been increasing from around 8,000 at the planning stage. According to an explanation by EDC, there had been an increase in incomers from other provinces. In interviews conducted at the Sen Monorom market, many of the residents who depend on trading to make a living have moved there from other provinces, and in interviews conducted with those residents, the reason for selecting Sen Monorom as a place to live was that electricity was available, as well as a rich natural environment.

Table 8: Trends in population in Sen Monorom City and principal public facilities

	2005	2008	2009	2010	2011
Population	about 8,000	9,572	9,838	9,940	N/A
Hospitals	1	1	1	1	1
Elementary schools	3	3	3	3	3
Junior high schools	1	1	2	2	2
High schools		1	1	1	1
Streetlights	0	0	135	135	170

Sources: Documents provided by EDC, 2008 population census, trial calculations by EDC based on increase rates in 2009 and later

Power line in Laoka. Electricity is being provided to contracting households.

Also, as shown in Figure 8, the numbers of schools and streetlights have increased as well, and residents' living conditions have been improving. Residents have voiced the opinion that better lighting has brought about improvements in public safety. Additionally, the Project (stable power supply) is seen as a significant turning point that has greatly changed the living condition in Sen Monorom City, and there has been a dramatic pickup in movements of both people and commodities such as immigrants and tourists since around 2009. As a result, the city has seen an increase in the number of guesthouses and hotels being built, as well as the number of restaurants, retail stores and money-changing establishments. A majority of the responses indicated that, as a result, there has been an improvement in household incomes.

Lighting device installed in a kitchen

In other results, there are villages where a minority called the Pnong people live in mountainous areas of Mondul Kiri Province, and construction is currently underway that will extend power transmission/distribution lines to these villages. For example, construction of power lines from the city to Putang Village and Laoka Village, located four to five kilometers from the city, was begun in 2011, and the power supply to contracted households began in May 2012. Construction has also been planned to bring power to Keo Seima District in 2012, where large numbers of minorities live, and electrification of minority villages is taking place little by little.

According to observations of family households, the use of consumer electrical appliances by general households are now widespread among the general households, and surveys of beneficiaries indicate that when the numbers of appliances owned prior to the implementation of the Project and currently owned were compared, the percentage of lighting devices increased from 39% to 100%, while mobile phones had increased from 64% to 100%, TVs from 35% to 97%, and water pumps from 35% to 84%. The number of households owning rice cookers had increased from 13% to 70%, and those with refrigerators had grown from 6% to 26% (see Figure 5). Because purchases of household appliances are governed by the economic strength of individual families, even though the outcome of the Project is not the sole factor behind the increase in the possession of household appliances, the Project can be considered to be contributing to the propagation of household appliances that alleviate the burden of housework for women, such as water pumps and rice cookers. Additionally, as seen in Figure 6, 97% of respondents said that the burden of women's housework has been alleviated, and the electrification of households can be considered to have brought about changes in women's housework.

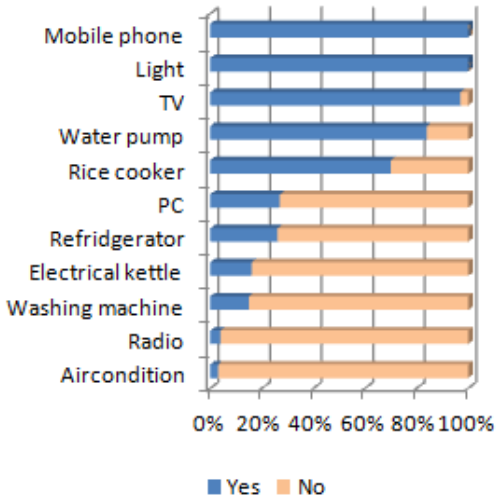


Figure 5: Appliances currently owned
(results of recipient study)

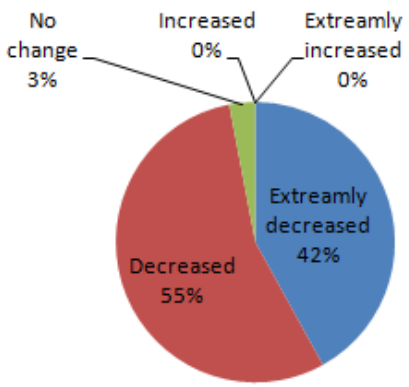


Figure 6: Increases/decreases of women's housework
(results of recipient study)

As described above, the improvement in the power situation in Sen Monorom City as a result of implementation of the Project has helped to improve the living environment for residents and to improve the quality of public services.

3.3.2 Other Impacts

① Impacts on the Natural Environment

The Project primarily involves power generation using hydropower, which is a form of renewable energy and has little impact on the environment.

There is a waterfall in O'Mleng that is a tourist draw, and the design has taken the environment and scenery into consideration in ways such as burying water pipes and hiding intake weirs in locations that will not be visible to tourists from the general activity range. Also at the stage of construction, environment was taken into consideration so as not to give impact to water quality and volume of the river.

After starting operation of the facility, in the dry season, which is the tourist season, the operation of hydropower facilities is limited during 9:00 in the morning to 4:00 in the afternoon, in order to keep the way to discharge water to the waterfall so as not to interfere with the scenery. In the field study that was conducted, it was confirmed that the sufficient volume of water flows at the waterfall even for the dry season, and that the power generation facility, which is located upstream, was not affecting it. Additionally, No negative impact has been given to the ecological system in the downstream area and neighbor residents.

O'Romis Waterfall has become a tourist site.
Photo: April 2012

② Land Acquisition and Resettlement

No residents have been relocated, and there has been no opposition to the construction. With respect to the acquisition of sites, most of the construction sites have comprised forest land owned by the government, so there were no problems in implementing the Project, and refurbishment of sites, including the removal of trash prior to construction, has been carried out appropriately before implementing the Project.

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

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

Table 9 shows the outputs with respect to the Project. Changes occurred in the planning and

actual results for the following two items:

- The number of hydropower plant sites was reduced by one (the Prek Dakduer Hydropower Station).
- Power output was increased at the remaining two locations (O'Mleng and O'Romis) to assure the output specified in the planning.

Table 9: Project outputs (planned and actual)

Item	Planned	Actual
Japan side:		
1 Power generation planning		
1) Output of small-scale hydropower stations: Total a) O'Moleng Hydropower Plant b) O'Romis Hydropower Plant c) Prek Dakduer Hydropower Station	370 kW 130 kW 130 kW 110 kW	370 kW **185 kW** **185 kW** **Deleted**
2) Diesel power plant output Diesel power plants	250 kW	**300 kW**
2 Transmission line planning		
1) Medium-voltage transmission lines	Voltage: 22 kV, Extension: 33 km	Voltage: 22 kV, Extension: 33 km
2) Low-voltage transmission lines	Voltage: 400/230V, Extension: 33 km	Voltage: 400/230V, Extension: 33 km
3 Civil engineering equipment		
1) O'Moleng Hydropower Plant equipment	Pressure pipe Inner diameter 0.6－1.0 m Extension 416m	Pressure pipe Inner diameter 0.6－1.0 m Extension 416m
2) O'Romis Hydropower Plant equipment	Conduit Width 1.0 m Depth 1.2 m Extension 1,024m	Conduit Width 1.0 m Depth 1.2 m Extension 1,024m
3) Prek Dakduer Hydropower Plant equipment	Pressure pipe Inner diameter 0.6－1.0 m Extension 536m	**Deleted**
4 Hydropower generation devices		
1) O'Mleng Hydropower Plant equipment a) Hydraulic turbine Maximum water volume used Maximum output b) Generator Rated capacity Maximum rated output	 1.02 m^3/s 144 kW 180 kVA 130 kW	 **1.45 m^3/s** **200 kW** **250 kVA** **185 kW**
2) O'Romis Hydropower Plant equipment a) Hydraulic turbine Maximum water volume used Maximum output b) Generator Rated capacity Maximum rated output	 0.75 m^3/s 144 kW 180 kVA 130 kW	 **1.05 m^3/s** **200 kW** **250 kVA** **185 kW**
3) Prek Dakduer Hydropower Plant equipment a) Hydraulic turbine Maximum water volume used Maximum output b) Generator Rated capacity Maximum rated output	 1.10 m^3/s 120 kW 150 kVA 110 kW	 **Deleted**
5 Diesel generator Rated output	 250 kW	 **300 kW**
6 Administration building	189 m^2	189 m^2

7 Equipment Dolly for working at heights Pickup truck	 1 1	 1 1
Cambodia side:		
Land acquisition and lease fee Improvement and repair of existing roads, and maintenance costs Costs for removal of existing power equipment Construction cost for transmission lines to general customers Construction costs for indoor lines Cost of training local staff Cost of preparing to start operation	15 ha 20 km 1 set 1200 households 1200 households 1 set 1 set	15 ha 20 km 1 set 1200 households 1200 households (Construction for 1180 households completed in 2009 and for 1200 households in 2010) 1 set 1 set

The background behind the changes noted above, and the reasons, are described below.

Bidding on the Project was carried out in October 2006, but the lowest bid price significantly exceeded the planned price of 967 million yen, at 1,123 million yen. Subsequent price negotiations were not successful. Because of this, when consultants examined the reasons for the failed negotiations, the following were cited: (1) a construction rush in the capital city of Phnom Penh had caused an increase in construction machinery procurement costs; (2) increased demand for labor in urban areas had caused an increase in rural-area allowances for workers and technicians; (3) the prices of fuel, construction materials and other items had risen; and (4) exchange rates were fluctuating. It was found that these factors had caused significant increases in civil engineering construction costs. Also, because the scope of the increase was more than could be absorbed through competition between contractors, the implementing agency in Cambodia had made requests that involved design changes. A design policy was formulated such that, when design changes were made, the changes would not result in a smaller range of electrification, but rather would maintain the same level of power supply capability as in the basic design.

As a result, as shown in Table 9 above, it was decided to eliminate one of the hydropower plants, and to increase the power output at the remaining two locations in order to ensure the level of output specified in the planning. It was confirmed that this change did not deviate from the initial objectives of the Project, and the change was approved. However, changing the design increased the output of diesel power generation by 50 kw which incurs fuel cost (no fuel cost incurred by hydropower generation), as well as fuel prices were higher than those at the time of planning, making it necessary to add in a higher power tariff rates (about 6% higher than at the time when the Project was planned).

The changes to the Project design described above had almost no impact on indicators involving efficiency, and a rationalization plan was formulated that would reduce project

costs while at the same time maintaining the electrification range and power supply capability. The changes made were judged to have been appropriate.

3.4.2 Project Inputs

3.4.2.1 Project Cost

As for the cost provided by the Japanese government for the Project, the E/N limit was 1,066 million yen while the actual cost amounted to 1,059 million yen. Therefore, the cost at the Japanese side was lower than planned (99%).

Moreover, the amount to be borne by the Cambodian government was estimated at US$ 190,000 (approximately 21 million yen), and according to explanations made by the Cambodian side, disbursements were made as planned. It has not been possible, however, to confirm precise figures.

3.4.2.2 Project Period

The Project was planned to span a period of 22 months, but the actual implementation period was longer than planned by 132%, running 29 months, from June 2006 through November 2008.

The reason for the overrun was that, as described above, bidding conducted in October 2006 failed, and new bidding was conducted in April 2007 after changes were made to the design. Thus, the planned start of construction was delayed by around six months.

In light of the above, although the project cost was within the plan, the project period was exceeded, therefore efficiency of the project is fair.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

Through the soft component of the Project, conducted up until November 2008, a governing body for the Project and a Project Management Advisory Committee were established, and systems were established for the operation of the Project. Specifically, support was provided for establishing EUMP, and guidance in the operation and maintenance of power facilities was provided to 31 personnel (three managers dispatched from the Ministry of Industry, Mines and Energy (MIME), and 28 others from the local area). With respect to obtaining approvals for the electrical operation and tariff rate structure, guidance was provided through the soft component, and applications were submitted for approval of power contractors and for tariff rates. Approval was obtained from the Electricity Authority of Cambodia (EAC) in October 2008, and systems were constructed so that power supply could begin rapidly after the construction was completed.

Subsequently, EUMP's systems were strengthened as a result of the technical cooperation project "The Project of Operation and Maintenance of the Rural Electrification on Micro-hydropower in Mondul Kiri Province" that was implemented starting from December 2008, and the next two years were spent strengthening the organization, technology and systems. Moreover, EUMP was originally planned to be run as an independent organization, but on June 8, 2010 control was transferred to Electricité du Cambodia (EDC), a large-scale government corporation, and it became the Mondul Kiri branch of EDC. Most of the EUMP personnel continued to work as employees of EDC and were transferred to the new system. At that point, the EDC Keo Seima Division in Mondul Kiri Province, in which electricity had been introduced as a result of the transmission lines from Vietnam, was added to the Mondul Kiri branch of EDC, making the organization larger than originally planned (a total of 44 people).

According to interviews with employees, an extremely large percentage of the regional staff hired when EUMP was newly established remained with the organization. Furthermore, employees were highly satisfied with the work in which they were engaged, of promoting the region, and there is good teamwork among employees. According to the project planning for the EDC Mondul Kiri branch, further expansions are planned, such as the extension of the power transmission/distribution network to villages where large numbers of minorities live, at a distance from the city, as well as the acquisition of large-scale consumers. In order to maintain the current operation and maintenance systems, which are working well, it will be important to continue expanding the Project while giving consideration to the appropriate personnel scale and human resource cultivation.

3.5.2 Technical Aspects of Operation and Maintenance

As part of the soft component, manuals for civil engineering facility maintenance and power generation facility maintenance were prepared, and technical aspects relating to civil engineering facilities and electrical facilities were strengthened by means of OJT. Training was also conducted using the actual equipment, with workers operating and stopping the power plant, carrying out other operations, and confirming the plant circumstances. In this training, emphasis was placed on improving employees' skills and knowledge of electricity. Other endeavors included training in inspection records, as well as hands-on training throughout the test operation period.

Following the completion of the soft component, further strengthening of technical aspects was carried on by means of the relevant technical cooperation project, with four periodic inspections being conducted during a two-year period, and operation adjustments were made in two seasons, the rainy season and the dry season, with technology transfer being carried out by means of OJT. As a result, when the relevant technical cooperation project had ended,

employees were able to handle parallel operation of the hydropower plant and diesel plant, to start and stop the plants, to handle accidents, and to take care of other operation tasks that came up. In terms of operation and maintenance of civil engineering structures, employees were also able to discover irregularities during patrols and carry out minor repairs. Additionally, an appropriate loss rate of 10 to 12% per month for the power transmission/distribution system is currently being maintained, following the yearly decrease trend of 19.12% in 2009, 15.45% in 2010, and 9.68% in 2011. Note that loss of the power transmission/distribution system is caused by technical problems, but not by theft.

Employees have been measuring the flow rate and water level, which are fundamental to hydropower generation, have been conducting periodic inspections of various equipment, and have been carrying out daily patrols, by following the instructions in the maintenance manual. Also, when data provided by the EDC Mondul Kiri branch was confirmed, it was found that output categorized by power generation source, production volume, loss rates and other data were being updated monthly, and that the technical prowess of the employees has been maintained at the same level as when the relevant technical cooperation project ended.

Thus, as described above, personnel with the necessary technologies for maintaining the facilities constructed through the Project have been appropriately cultivated through the soft component and relevant technical cooperation project, and no problems have been observed. In interviews conducted at the EDC Mondul Kiri branch, employees had undergone comprehensive technical instruction with the aim of a firm grounding of technology from Japanese experts, and many of the employees voiced confidence that they could continue maintaining the power generation facilities in the future.

3.5.3 Financial Aspects of Operation and Maintenance

As described in Section 3.5.1 above, an independent organization EUMP was newly established through the soft component of the Project, and this organization will run the electricity part of the business. Plans were formulated to strengthen business management aspects necessary in order to manage the electricity business, along with strengthening financing aspects. Specifically, a business operation manual was prepared, employees were trained in order to boost their office skills, improvements were made to the day-to-day work, and accounting systems were put in place so that electricity fees could be collected and cash flow control could be carried out. Essentially, an infrastructure was put in place during this time for running the electrical business. Also, to give employees a chance to experience the actual collection of electricity tariff rates and to manage disbursements, onsite tests were conducted several times, and training was carried out to increase employees' proficiency at reading the meters of power users in the city, creating invoices, and collecting tariffs.

Subsequently, financing aspects were strengthened by continuing on from the relevant

technical cooperation project and creating a system through which employees on the Cambodian side could handle financial control on their own while working with the Engineering Department overseeing operation of the power generation facility, and that system is currently being maintained. Moreover, after EUMP came under the control of EDC and became the Mondul Kiri branch of EDC (June 2010), the same finance control system as that used by the EDC headquarters was promptly introduced.

The financial status of the EDC headquarters is shown here. As indicated in Table 11 below, net profits had shown a deficit until 2008, but began showing a surplus starting from 2009, and management is currently sound. Support is being provided by the Asian Development Bank, the World Bank, France and other sources to improve the financial situation of the EDC headquarters, and efforts have been underway in particular to build financial systems that include unified control of customer data, and to improve figures such as fee collection rates in areas under the jurisdiction of the capital city of Phnom Penh and power transmission/distribution loss rates, among others.

Table 11: Financial situation of EDC headquarters (Phnom Penh) (Unit: US$)

	2008	2009	2010	2011
Sales	237,541,778.46	220,822,215.06	297,351,584.14	338,446,705.80
Operating profit (pre-depreciation profit)	2,879,104.32	27,523,044.08	52,865,700.71	44,605,354.52
Operating profit (pre-tax)	(1,800,290.88)	23,163,769.42	46,242,946.36	35,925,730.68
Net profit (after taxes)	(4,203,657.60)	18,401,019.88	37,925,058.86	28,465,430.12

Note: The above financial information covers only the jurisdiction of Phnom Penh.
Source: Data provided by EDC

Table 10 below shows a revenues and expenditures report for the Mondul Kiri branch of EDC. After EUMP became the Mondul Kiri branch of EDC, accounts settlements began being done based on the same financial control system as that used at EDC headquarters.

Table 10: EDC Mondul Kiri branch 2011 revenue and expenditure report

Item	Amount (riels)	Notes
A. Revenues	**3,107,143,745**	(Approximately US$ 722,592)
(1) Sales	3,058,247,845	
General households	1,605,180,200	The information at the left shows a breakdown of sales, with revenues from households making up 52%, or approximately half of all sales. Commercial businesses accounted for 22%, hotels for 15%, and government systems for 26%. Recently, revenues from antenna devices such as mobile telephones have been increasing.
Commerce	681,762,900	
Industry	68,919,700	
Government	192,812,000	
Hotels	460,609,900	
Private business	54,843,000	
Streetlights	16,317,000	
Previous-year	-22,196,855	

Item	Amount (riels)	Notes
adjustment		
(2) Other revenues	48,895,900	
B. Expenditures	**2,419,740,669**	(Approximately US$ 562,730)
C. Operating profit (pre-depreciation profit)	**687,403,076**	(Approximately US$ 159,861)
D. Depreciation	**2,813,113,764**	(Approximately US$ 654,213)
E. Net profit	**-2,125,710,688**	(Approximately US$ -494,351)

Note: The above revenues and expenditures report does not include revenues and expenditures for the EDC KEO SEIMA Division, which was consolidated following the transfer to EDC.

According to the above report on 2011 revenues and expenditures, operating profits (pre-depreciation profits), in which B. Expenditures are subtracted from A. Revenues, indicated a total of 687,403,076 riels (approximately US$ 159,861), indicating that operation at the Mondul Kiri branch of EDC has been running smoothly since the end of the relevant technical cooperation project. Because the Project facilities were provided through grant aid, accounting is different from that of ordinary companies, but the accounting method in which depreciation costs are not included in the accounting figures but reserve funds are set aside for large-scale renovations and water shortage countermeasures was approved through mutual agreement between Japan and Cambodia at the time that the relevant technical cooperation project was implemented and was continued until 2010. Starting from 2011, however, category D in the table, Depreciation costs, was added in keeping with EDC's financial control system, and reserve funds have been identified to cover funding costs necessary for large-scale renovations that will be necessary in the future. As a result, net profits show a deficit, taking depreciation costs into consideration.

At the same time, however, as of December 2011 the customer roster of the Mondul Kiri branch included 1,444 households (electrification ratio: 80.5%), and the tariff collection rate was being maintained at 97%. The background behind this is that, as at EDC headquarters, customer data and financial data are being appropriately controlled and updated at the branch, and in particular, customers who are late with their payments are dealt with promptly, which is an effective approach for avoiding the problem of large amounts of delayed payments accumulating. Moreover, data such as the amounts of power used by each customer are categorized by month and analyzed, making it possible to accurately forecast the amount of demand for power.

In light of these circumstances, in order to accommodate future improvements in power shortages[13] and the financial situation at the Mondul Kiri branch, EDC headquarters has decided to expand the amount of power supplied by importing power from Vietnam, and has refurbished power transmission lines using its own capital. After starting the transmission of

[13] As noted on page 8, the daily maximum amount of power supplied was 618 kW in 2011, which is close to the power generation capability of the Project, at 670 kW.

power from Vietnam, EDC headquarters has already succeeded in securing new contracts with quarrying plants and in concluding contracts with large-scale, high-revenue customers.

As indicated above, the EDC headquarters is taking prompt action as an organization with respect to two issues: the deficit in net profits posted by the Mondul Kiri branch, and the insufficient amount of power being supplied. In the future, as well, it is anticipated that the net profit will turn into surplus by support provided to help the Mondul Kiri branch in terms of financial and organizational aspects. Moreover, from the end of the Project to the current point in time, the Project outcomes have been continued, and operation and maintenance of materials, as well as injections of the capital necessary to expand the business, are being implemented on an ongoing basis. Thus, it is judged that there are no obstacles in terms of the financial situation.

3.5.4 Current Status of Operation and Maintenance

The relevant technical cooperation project was implemented during the approximately 2 years since the time that the Project described here was completed, and it has been confirmed that basic operations such as power generation, power transmission and the collection of electricity tariffs have been implemented appropriately.

With respect to plans for the affiliation with Vietnam, all aspects from planning to implementation have been carried out under the auspices of EDC, and Japanese experts have provided technical transfers through follow-up cooperation after the relevant technical cooperation project; thus, a system for a methodical affiliation has been appropriately constructed. Moreover, employees from the EDC Mondul Kiri branch visited Vietnam in April 2012 in order to help stabilize the affiliation with Vietnam, and talks were carried out with personnel at power companies and power generation facilities in Vietnam. In the course of those talks, interaction between personnel and between technologies was tried by means such as tours of Vietnam's hydropower generation facilities, and a system is being put in place by which corrective action could be taken promptly in the event that a problem occurs.

In light of the above, it was decided that system operation can be implemented in the future with no problems.

As indicated above, an organizational base for operation and maintenance of the Project had been put in place through the soft component, and subsequently, the prepared organization had been strengthened into an organization that actually functions by the technical cooperation project which was implemented following the soft component. Further, the organization has expanded its business receiving support by the follow-up cooperation. Thus, it has been judged that a system appropriate for operation and maintenance of the Project has been constructed. Also, now that the system is under the jurisdiction of EDC,

financial control aspects and human resource management aspects will be strengthened, enabling growth into an organizational system that offers greater stability.

No major problems have been observed in the structural, technical or financial aspects of the maintenance of the Project, therefore sustainability of the Project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the Project was to supply a stable supply of electric energy by constructing micro-hydropower plants and auxiliary facilities in Mondul Kiri Province. This objective has been highly relevant with the development plan of Cambodia and development needs both at the time of planning and at the time of ex-post evaluation, therefore its relevance is high. The hydroelectric power facilities that were constructed has been maintained in good operating condition, and the objectives of power supply and electrification, which are indicators of effectiveness, have been achieved as planned. As a result, electricity availability in the target area has been vastly improved, with increase in the number of restaurants, guesthouses and hotels. There have also been increases in the number of people moving into the area and in the number of tourists visiting Sen Monorom, and thus, the Project has contributed to lead the entire growth of regional economy through the development of local tourist industry. Additionally, improvements have been seen in the widespread use of consumer electronics by general households and in better public services, and thus there has been a positive impact on the living condition of rural people.

With respect to maintenance of the facility, the Project provided for the foundation of an operating and maintenance system, which was fortified through the technical cooperation project afterwards. Therefore, sustainability of the project effect is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) Efforts in electricity-saving education

It has been three and a half years since it became possible to supply electric energy on a 24-hour basis, and residents have become accustomed to the convenience of electricity. At the same time, however, some households are beginning to feel a sense of burden from increased monthly electricity charges as they use larger amounts of power, and are beginning to express dissatisfaction with the unit price of electricity, which is higher than that in other provinces, as well as distrust of the readings from electricity meters. Because the trend shows that power demand by individual residences will continue to increase, it will be necessary to carry out

education in ways to reduce electricity use, targeting general households, children, and other segments of the population. When conducting this education, in addition to guidance in ways to save electricity charges and to explain the calculation method of electricity charges, which EDC is currently conducting, it will be important to provide education in the meaning of using electricity carefully. In addition to prepare personnel who deal with questions and complaints of residents, it is required to summarize the opinions, consult for getting solutions, and also build a system to feed them back to the power services.

(2) Business expansion and personnel systems

It is envisioned that the Mondul Kiri branch of EDC will be expanding its business as the regional economy in Mondul Kiri Province develops. In order to continue the appropriate operation and maintenance systems and the technical capabilities that are now evident, it will be necessary to assign personnel in a manner appropriate to the business scale, and to educate them. In particular, because the area targeted by the branch is located in a mountainous region, the burden of maintenance and customer services after power transmission lines have been extended will be larger than that in urban areas. It is hoped that adjustments will be made in terms of business expansion and increases in personnel, taking this point into consideration.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Because there are extremely few engineers and managers in Cambodia who have experience in operation and maintenance technology and in business management technology pertaining to hydropower generation, the construction of organizational systems for operating and maintaining the power generation facilities has been incorporated from the outset as a part of the soft component of the Project, and activities are being carried out as a technical cooperation project to strengthen capabilities so that the organization will function autonomously immediately after the Project is completed (from the point when the power generation plant goes into operation). A noteworthy point is that personnel from the local area who have no experience in the power sector were hired to run the power generation facility, which needs high levels of technical prowess and management capabilities. Efforts to cultivate these human resources and to strengthen their capabilities are being carried out, which has produced smooth operation of the facilities and organization so far.

This success can be attributed to the shift from the soft component to the technical cooperation project having been appropriate. First, at the stage when the soft component was implemented, a number of issues were identified having to do with improving human resource

cultivation capabilities in the various divisions (Accounting, Power Generation, Power Transmission, etc.) of the hydropower plant, and the results of those evaluations were adequately shared between personnel from Cambodia and Japan, which led to the request for and implementation of the technical cooperation project.

Furthermore, the objective of both sides, which was to supply a stable electric energy through autonomous facility management by the newly established organization, was shared not only by upper-level personnel in the organization, but throughout the organization down to the end personnel level, and the fact that every employee was aware of the objective and aware of problems was an important factor in improving the efficiency and sustainability of the Project. In interviews with personnel, many people said that they become aware that the power supply to Sen Monorom City would begin immediately after the facility went into operation, and they were aware that if the facility stopped, the power supply would stop as well, which provided a sense of crisis. Also, Japanese experts provided technical guidance while still maintaining the autonomy of the staff, and many people said that this helped change their awareness with respect to their work. Additionally, the employees experienced for themselves the extent to which the power sector improves living conditions in Sen Monorom City, and being engaged in management of the sector was another factor in heightening their motivation with respect to their work. The construction of the facility through the grant aid project and human resource cultivation through the technical cooperation project functioned as expected from the outset, making this a case in which the advantages of both schemes were put to work.

This Project will definitely serve as a reference when constructing facilities that require a certain level of technological prowess in countries like Cambodia, where human resources with the necessary technical capabilities are in short supply.