【Ex-Post Monitoring of Completed ODA Loan Project】

Sri Lanka

"Samanalawewa Hydroelectric Power Plant (I) (II) (III) and
Samanalawewa Hydroelectric Project (Reservoir Remedial Works)"

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1. Project Description

Project Location

Samanalawewa Dam

1.1 Project Objectives

The objective of this project was to address the shortage of electricity supply in Sri Lanka by constructing a reservoir-type hydroelectric power plant with a maximum output of 120 MW in the upstream of Walawe River, approximately 160 km southeast of Colombo, thereby contributing to the economic development and improvement of the welfare of the country.

1.2 Outline of the Loan Agreement

Loan Approved Amount/ Disbursed Amount	1st Phase: 14,500 million yen/14,500million yen 2nd phase: 13,920 million yen/13,920 million yen 3rd phase: 3,264 million yen/3,264 million yen (Remedial works): 5,282 million yen/3,134 million yen
Loan Agreement Signing Date/ Final Disbursement Date	1st Phase: July 1986/September 1992 2nd phase: July 1987/April 1994 3rd phase: January 1991/March 1995 (Remedial works) : July 1995/March 2005

Ex-post Evaluation	2006
Executing Agency	Ceylon Electricity Board (CEB)
Main Contractor (Over 1 billion yen)	Joint venture of Kumagai Corporation (Japan), Hazama Corporation (Japan), and Kajima Corporation (Japan)
Main Consultant (Over 100 million yen)	Nippon Koei Co., Ltd. (Japan)

1.3 Background of Ex-post Monitoring

Along with the steady economic growth of the country, the electricity sales in Sri Lanka grew rapidly by 8.2% per year on average from 1980 to 1985, and the demand for electricity was predicted to further increase. As a measure to cope with such increase in demand, the Government of Sri Lanka (GOSL) planned to operate large-scale coal-fired power plants, which estimated a huge delay in actual construction. The gap between electricity demand and supply was then anticipated to become severe in the first half of the 1990s. This project was planned with the aim of alleviating the disproportionate supply-demand situation for electricity.

This project was co-financed by Japanese ODA loan and loans provided by the U.K. The Japanese ODA loan was extended to the construction of diversion tunnels, dam, hydraulic turbine and penstock, and construction management cost, while U.K Portion was extended to the construction of intake and waterway, power generating mechanical plant and design cost. During the construction of the dam in 1988, a highly permeable section was found in the ground of the right bank, and CEB modified the project plan to add cut-off work (curtain grouting), etc., to which the remaining amount of the third phase of the Japanese ODA loan was disbursed. After the completion of the construction, when the water-filling test was conducted in the reservoir in 1992, a large amount of water leakage occurred from the right bank into downstream areas. The GOSL set up an "International Panel" to examine potential countermeasures to address this problem. As a result, it was decided to implement the wet blanketing method2 (remedial work) as a countermeasure. For the remedial work, Japanese ODA loan was disbursed starting from 1995.

The overall rating in the ex-post evaluation conducted in 2006 for this project was "D" (dissatisfactory) mainly for the following reasons:

- The actual project period exceeded the plan due to the additional work against water leakage, which resulted in the rating "B" for the project efficiency.
- The actual annual power generation was lower than planned, mainly due to the decrease of water discharge for electricity generation that mainly comes from the decrease in rainfall and the increase in discharge of irrigation water, which resulted in the rating "B" for the project effectiveness.
- Water leakage from the right bank into downstream areas rapidly increased although the main cause was not detected when the field survey for the ex-post evaluation was conducted. Challenges were admitted for securing safety on a long-term basis, and the project sustainability was rated as "C".

Observing that the water leakage decreased as the reservoir water level lowered, the ex-post evaluator concluded to draw a recommendation to CEB. That is "*Continue observing the amount of leakage, water quality, reservoir water level and the groundwater level at the right bank while maintaining the low water level and at the same time consider taking measures as necessary based on the study undertaken by experts and the results of additional surveys, measurements and analyses to be conducted when necessary*."

Therefore, this project was selected for ex-post monitoring and reviewed under each criterion, particularly to assess the project sustainability, and to reconfirm the project effectiveness and impact, with the findings from the field survey and other research activities with a final conclusion being drawn.

2. Outline of the Monitoring Study

2.1 Duration of Monitoring Study

Duration of the Study: January-September 2012

Duration of the Field Study: July 4-16, 2012

2.2 Constraints during the Monitoring Study

Not applicable.

3. Monitoring Results

3.1 Effectiveness

3.1.1 Quantitative Effects

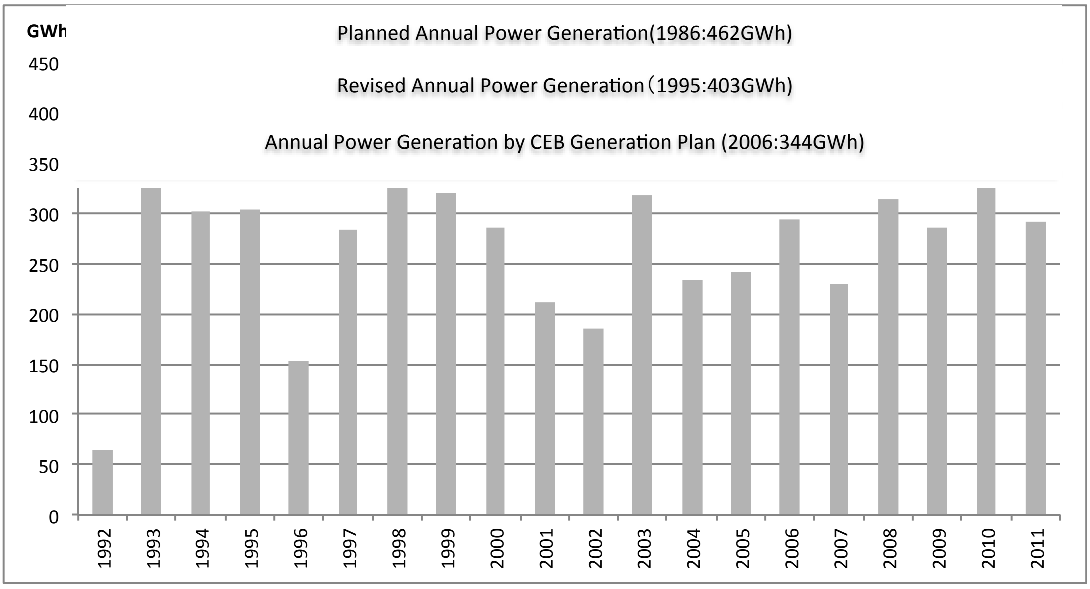
3.1.1.1 Results from Operation and Effect Indicators

(1) Net Electricity Energy Production

Table 1 shows the operation and effect indicators of the project: net electricity energy production and maximum output from 2006 to 2011. The average of annual electricity energy production through to 2011 reached 298 GWh, which is higher than the average at the time of ex-post evaluation in 2006 (271 GWh). It was however lower than the design energy of 462 GWh, revised energy of 403 GWh, and mid-term annual generation forecast by CEB of 344 GWh.

Table 1: Net Electricity Energy Production and Maximum Output of Samanalawewa Dam (2006-2011)

	2006	2007	2008	2009	2010	2011	1996-2011 Average
Net Electricity energy production (GWh)	294.5	229.3	312.8	285.4	375.4	292.2	298
Maximum Output (MW)	Over 120	Over 120	128	128	130	128	Over 120



Source: Developed from CEB data.

Figure 1: Comparison of Designed Energy and Actual Power Generation at Samanalawewa Hydroelectric Power Plant

The ex-post evaluation made analyses on the major reasons that caused the power generation to be lower than planned. Those were annual rainfall into the catchment area and water inflow into the dam reservoir decreased and the discharge volume of irrigation water increased.

In this ex-post monitoring, the data of monthly water inflow and rainfall from 2006 to 2011 were newly collected and added to the ones obtained at the ex-post evaluation, which are shown as Figure 2 and Figure 3.

The planned average inflow volume to the reservoir was estimated at 17.9 m3/s per year, based on the actual volume of 18.5 m3/s measured from 1959 to 1979[1]. Average volume of water inflow from 1996 to 2011 is lower every month than that from 1959 to 1979 as shown in Figure 2, and the annual average from 1996 to 2011 remained at 14.2 m3/s, which is 79 percent of the designed figure. It was estimated that the smaller volume of water inflow into the reservoir has reduced 90 GWh annually from the total power generation.

The lower water inflow was caused by the decrease in rainfall as shown in Figure 3. Annual rainfall from 1996 to 2011 is 1,940 mm on average, which is approximately 83 percent of that of 1959 to 1979:

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[1] For both average volume of water inflow and annual rainfall, the measured amount from 1959 to 1979 and planned amount at the time of project planning were referred in the Ex-Post Evaluation.

2,320 mm.

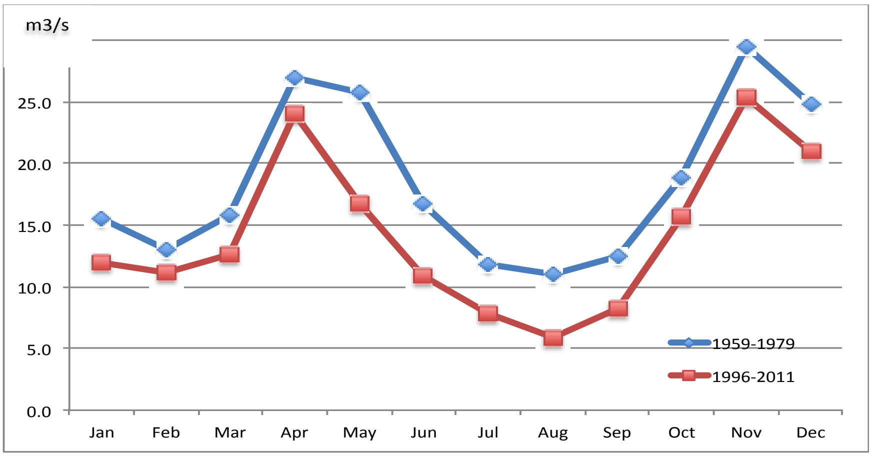


Figure 2 Comparison of Water Inflow before and after the Project (Monthly Average)

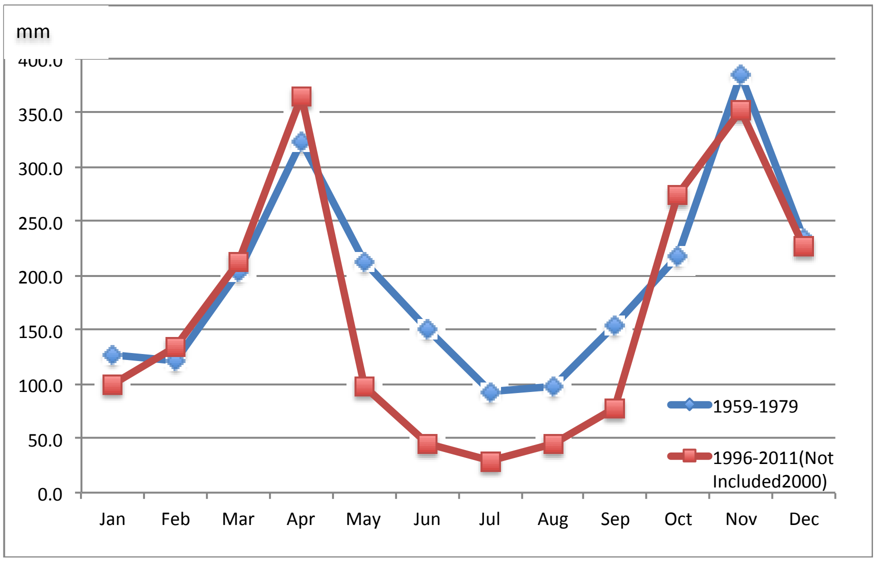


Figure 3 Comparison of Rainfall before and after the Project[2] (Monthly Average)

From the Samanalawewa Dam, irrigation water is discharged to the Kaltota Agricultural District downstream without going through the power station. The water leakage from the right bank and water discharge through the dam are spent for irrigation, and the actual average volume of discharged water from 1996 to 2011 is 92 million m^3 annually (2.9 m^3/s), which far exceeds the original plan: 50 million m^3. It was roughly estimated that this difference has caused a reduction in power generation by 40 GWh per year.

(2) Maximum Output

Maximum output had been recorded around 120 MW since 2006 to 2011 (see Table 1), although their duration of peak generation was short. And it can be said that the output was utilized to cope with the peak electricity demand.

[2] Rainfall data of February 2000 was missing and it was not taken into account in the Figure.

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

The data from 1992 to 2004 obtained at the ex-post evaluation were found to be unreliable[3], and collecting the necessary information and data during the said period was not possible in this study although data from 2005 to 2011 was available. Due to incomplete collection of such data, the ex-post monitoring did not undertake a recalculation of FIRR and EIRR.

The EIRR calculations up to the ex-post evaluation were based upon the cost required for a thermal power plant at same scale which drew superiority in cost for hydroelectric power station.

Operation cost per electricity generation unit by hydroelectric power generation facilities stays lower than that of diesel thermal power generation facilities in Sri Lanka, and it is inferred that hydropower generation still has advantages in prices against thermal power generation.

3.1.2 Qualitative Effects

Not applicable.

Although the electricity energy production has not reached the planned target due to a decrease is waterfall and other factors, the average power generation from 2006 to 2011 exceeded the average up to the ex-post evaluation (2006). In terms of enhanced electricity energy production and moderate operation cost, the project is still found effective at the time of ex-post monitoring.

3.2 Impact

3.2.1 Intended Impact

3.2.1.1 Stable Electricity Supply

Table 2 shows major electrical indicators of Sri Lanka from 1986 to 2011. Increase in demand for electricity in the country during the said period was prominent, and the annual electricity energy production and peak demand of 2011 rose to approximately 4.3 times and 4 times greater than that of 1986 respectively. The annual average electricity energy production of Samanalawewa was 298 GWh up to 2011, which shared 2.8 percent of total energy production of the country (10,714 GWh). Peak electricity capacity of Samanalawewa is 120 MW, which had a share of 5.5 percent of the peak demand nationwide in 2011. Although the share of the Samanalawewa Power Station was on decrease as the total annual electricity production and peak demand in Sri Lanka keeps increasing, it is confirmed that the Samanalawewa Power Plant has contributed to stable electricity supply of the country.

Table 2 Electrical Indicators Nationwide

	1986 (Project commencement)	2004	2011 (Ex-Post Monitoring)

[3] In this study actual data of O&M cost from 2005 up to present were collected, which are 10 times more than that up to 2004. The ex-post monitoring team revealed that the operation cost in 1992 was not taken into account, for instance. O&M cost was found to be an estimate, not actual data, with parameters such as electricity production.

Installed Capacity (MW)	1,065	2,280 (2.1 times)	3,141 (2.9 times)
Annual Electricity Energy Production (GWh)	2,652	8,159 (3.1 times)	10,741 (4.3 times)
Peak Electricity Demand (MW)	540	1,563 (2.9 times)	2,163 (4.0 times)
Household Electrification Rate (%)	17	71 (4.2 times)	91 (5.4 times)

Source: CEB Statistics

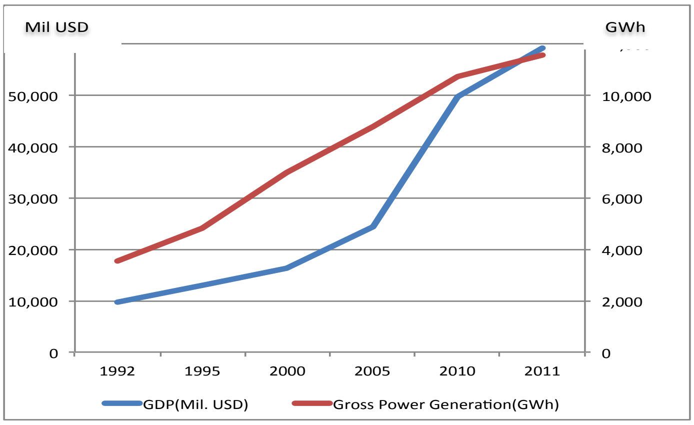
Note: Figures in parentheses are comparison with those of 1986.

3.2.1.2 Increase in Electricity Energy Consumption and Contribution to Economic Growth

GDP at constant prices, real economic growth rate, GDP per capita at constant prices, and per capita growth are shown in Table 3. Since the Samanalawewa Power Station started operation in 1992, GDP has shown steady growth although it dropped when a severe recession occurred in 2001 caused by complexity of long-time civil war, terrorism, poor crops due to severe drought and power failures and by global financial crisis in 2008 that was caused by economic downturn precipitated by the Lehman Brothers bankruptcy. GDP per capita also increased greatly from 557 USD in 1992 to 2,835 USD reflecting the same tendency as GDP. Figure 4 gives an implication that the electricity energy production increased steadily, as the country's economy grew, to which the Project made a contribution.

Table 3 GDP and Real Economic Growth Rate

	1992	1995	2000	2005	2010	2011
GDP (Mil. USD)	9,703	13,030	16,331	24,406	49,568	59,172
GDP Growth Rate (%)	-	5.6	5.0	4.0	6.4	8.3
GDP Per Capita (USD)	556.8	718.4	854.9	1242.4	2,400.0	2,835.4
Average Growth Rate (%)	-	4.3	4.0	3.4	5.3	7.1



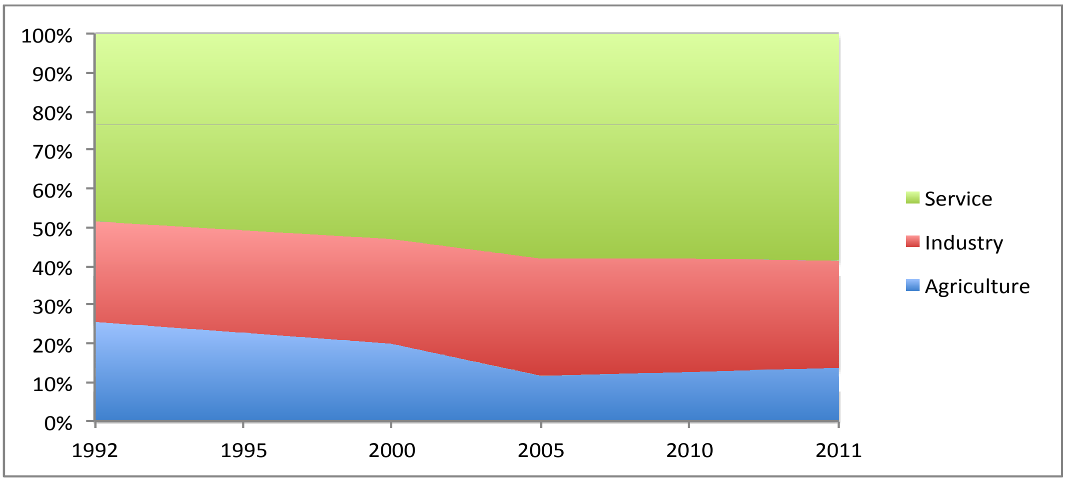
Source: World Bank, World Indicators, 2012, and CEB data.

Figure 4 GDP Growth and Gross Power Generation

Table 4 shows the industrial sector and service sector grew rapidly compared to the agricultural sector up to 2005. Although the share of industrial sector has been at a standstill since 2005, outputs from these two sectors keeps growing. Further development of the two sectors requires stable electricity supply, and the Project meets such immediate needs for the country's economic growth and thus has had a positive impact on the country's economic development.

Table 4 Structure of GDP (Unit: %)

Sector	1992	1995	2000	2005	2010	2011
Agriculture	23.5	20.6	17.8	11.8	12.8	13.7
Industry	23.3	23.8	24.4	30.2	29.4	27.8
Manufacturing	(14.0)	(14.1)	(15.1)	(19.5)	(18.0)	(17.2)
Service	44.1	45.2	47.3	58.0	57.8	58.5



Source: World Bank, World Indicators, 2012.

Figure 5 Structure of GDP

Therefore, it was confirmed in this ex-post monitoring that the Project still plays a crucial role in contributing to stable electricity supply in Sri Lanka, enhancement of economic growth and improvement of social welfare.

3.2.1.3 Impact on the Natural Environment

No serious impact on the flora around the dam reservoir was reported from the interview with CEB staff and local residents as of the ex-post evaluation in 2006.

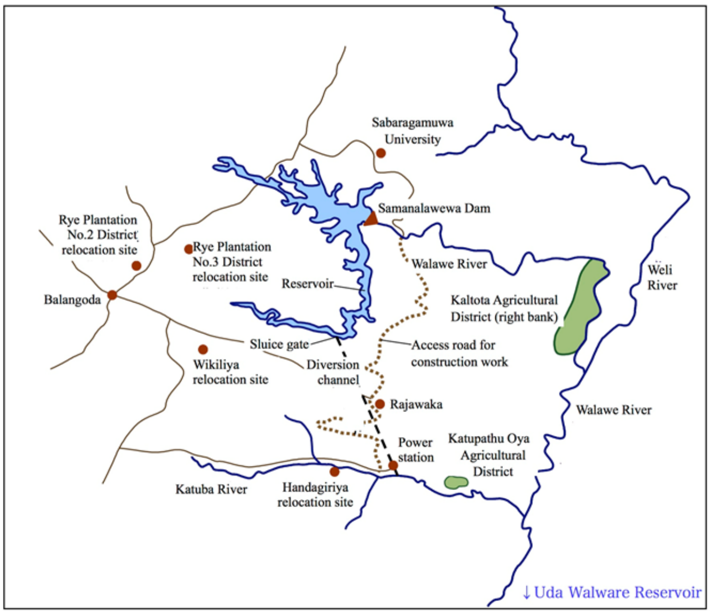
CEB obtained ISO14001 in December 2006, and the Samanalawewa Power Station has listed 672 items that might affect natural environment which accordingly are checked every two months. CEB selected and carefully monitored 102 out of 672 that were identified as the most critical items having impact on natural environment. CEB conducted monitoring on water quality at dam reservoir (one site), upstream (four sites), and downstream (two sites). Monitoring results up to 2011 indicated that all figures have stayed within the national environmental standards. CEB continues monitoring the flora every month as of December 2006 when CEB obtained ISO 14001, which has had no problems up to now.

3.2.1.4 Land Acquisition and Resettlement

It was Rathnapura District and the relevant Divisional Secretariat (DS) under the District that took initiatives in land acquisition and resettlement of the local residents, through which CEB made payment for compensation. Three DSs were involved as the project area was across three administrative boundaries. CEB has received periodic reporting from them about the progress of resettlement.

At least two households have not received relocation and compensation payment in the project area. Relocation and compensation payment was on progress for 49 households at Handagiriya site when the ex-post evaluation was conducted. As of July 2012, it was found 48 households already completed the process. In Imbulpe district, one household did not agree to resettle and will take further time for reconciliation although the objection was unknown. The remaining households are located beyond the maximum water level of the reservoir (Mean Sea Level: MSL 460m) and there was no impact on project continuation. The number of local residents who used boats to cross the reservoir decreased as they relocated to other places, and CEB implemented a boat service.

Brief interviews were conducted with resettled peoples in this ex-post monitoring. Many of them reported dissatisfaction for not being given the certificates of their land tenures. The details of the incidents were kept unknown as it had been nearly two decades since the resettlement started in the latter half of 1980s, and the DSs were not reached in this study. It was confirmed in this study that the resettlement procedure has not been completed yet.



Source: Ex-Post Evaluation Report.

Figure 6 Samanalawewa Dam Reservoir and Surrounding Area

3.2.1.5 Other Impacts

(1) Impact on Irrigation Works

CEB provides water from the Samanalawewa Dam downstream to the Kaltota Agricultural Area for irrigation works based on the request from the Department of Irrigation and in agreement with the Water

Management Board. The water coming from the leakage on the right bank of the Dam is regarded as part of the water outflow from the Dam. Some interviewees replied that their paddy yields have increased since the Samanalawewa Dam Reservoir started operation, along with the innovation of agricultural technology.

Picture 1 Kaltota Agricultural Area (overview, close-up view and canal)

The water outflow from the power station which bypasses the dam is used as irrigation water downstream in the Katupath Oya Agricultural Area. The ex-post evaluation mentioned that the increase in the water flow downstream contributed to the irrigation works in the basin of Walawe River, which is further downstream from the said agricultural areas. However, the Uda Walawe Power Station (Reservoir) is located 2 km downstream of the Katupath Oya Agricultural Area, where no irrigated area is identified in the satellite image. Therefore the contribution to the irrigation in other places than the said two agricultural areas was found to be limited.

(2) Impact on Regional Development

According to the ex-post evaluation, a 23 km road was constructed as an access road for construction work and the road was used as a general road by the local residents in their daily lives. The road was operated and maintained by the Samanalawewa Power Station, and handed over to the Road Development Authority (RDA) in 2006. The chief engineer of the power station was of the opinion that the road condition had been improved and better managed since then. The traffic volume in 2012 was 50 vehicles per day on average.

Using the land where the temporary work station of the Project was located, a new university (Sabaragamuwa University) was established. The university increased the number of faculty and enrollment of students, and there are 170 staff members and 2,900 students enrolled as of the end of 2010. A youth training center which was built near the sluice gate of the headrace tunnel was also part of the work station. There are training programs implemented at the center that are still up and running. One temporary building for the construction period near by the access road to surge chamber was handed over to Department of Agriculture. This building was also used for training and research activities for them.

Picture 2 Access Road Sabaragamuwa University Youth Training Center

Therefore, it is confirmed that the Project has brought certain positive results to the stable power supply, social welfare, economic growth and regional development. There was significant progress made in paying compensation to the resettled local residents, however this has yet to be completed.

3.3 Sustainability

3.3.1 Structural Aspects of Operation and Maintenance

CEB is a fully government-owned public corporation under the supervision of the Ministry of Power and Energy and has 16,192 employees as of the end of 2011. Independent power producers (IPPs) have been established in some areas recently as power generation is no more a government monopoly as a result of the energy sector reform. The details and schedule of further implementation of sector reform have not been decided yet, and CEB will continue being engaged in power generation, transmission, and distribution.

The Samanalawewa Power Station belongs to the Generation Headquarters of CEB. There were 106 staff members working at the Power Station at the time of ex-post evaluation, and this increased to 122 as of July 2012. There has been however no change in the organizational structure, and the additional 16 members were allocated to vacant positions.

3.3.2 Technical Aspects of Operation and Maintenance

Technical staff members at the Samanalawewa Power Station have adequate educational background and years of experience. Training opportunities are provided to CEB staff annually in a systematic manner by CEB and the power station. External and internal training courses conducted at CEB are varied and offer over 20 programs, and internal program in particular, are well planned based on ISO9001 and CEB's mid-term vision. A wide range of the contents of the training includes emergency operations, public health and daily vehicle maintenance, etc.

3.3.3 Financial Aspects of Operation and Maintenance

According to the Financial Annual Report 2011, CEB had deficits in its current account of as much as 18 billion rupees in 2011. Overall, the financial structure of CEB is not in good shape. CEB's financial deterioration has not been resolved yet mainly because share of low-cost hydroelectric power generation is on a decrease, oil price hikes and the increase in payment to IPPs. The Public Utilities Commission of Sri Lanka (PUCSL) is now mandated to regulate the electricity sales price in Sri Lanka, and it was expected that CEB's financial structure should improve accordingly. However CEB falls into deficit whenever electricity energy production by hydroelectric power generation facilities is reduced due to droughts.

Although CEB often suffers from financial deficits, CEB makes a decision to allocate sufficient budget for the operation and maintenance of the power stations with a high level of priority because it immediately affects the electricity sales. Therefore, no problems have occurred so far in the operation and maintenance of the Samanalawewa Power Station due to shortages of finances.

3.3.4 Current Status of Operation and Maintenance

3.3.4.1 Region-wide Integral Operation

The Samanalawewa Power Station adjusts its power production according to the maintenance status of other major hydroelectric power generation facilities and water levels of their dams located in the Mahaweli system and Laxapana system, by the orders of the National System Control Center located in Colombo. However, no indicators were confirmed in this study that reflects such regional operation's influence. The natural environmental condition and operational status differs in each power station. For example, they allocate more water for irrigation works in the Mahaweli system, which limits the amount of water discharged for power generation. The volume of water stored differs by dams. With these variations taken into consideration, electricity energy production which can be better managed by water system and further contribute to the effective usage of water resources for the entire nation

3.3.4.2 Organizational Management

Following ISO9001, Samanalawewa Power Station was awarded with ISO14001 in December 2006, and has updated certifications periodically. It has enabled Samanalawewa Power Station to make prompt decisions by managing all the documents, sharing all information among staff and coping with critical issues by core members.

3.3.4.3 Procurement of Spare Parts

It was mentioned in the ex-post evaluation that it took longer time for CEB to procure spare parts for the equipment and facilities of the Samanalawewa Power Station. A spare parts manufacturer recently opened its office in India, which helped CEB procure needed parts quicker and problems were mitigated.

3.3.4.4 Deterioration of Equipment

It has been approximately 20 years since the Samanalawewa Power Plant commenced operations in 1992. Equipment and facilities at the power station have deteriorated due to usage over time, out of which the following four are in critical condition:

(1) Breakdown of monitoring control systems of generators

Three out of four monitoring control systems of power generators have broken down, so power plant staff monitor and control the generators using the sole remaining one. If the remaining one should also break down, the generators could be operated manually without taking into account various indicators such as water temperature. The spare parts of the broken down equipment are no longer available, and repair work is not possible. It has turned out that it would cost 500 million rupees to replace all the relevant equipment of the monitoring control system. As of July 2012, they were examining alternatives with lower cost in the formed technical committee.

(2) Deterioration of Quality of Rock Material

The rock material of the dam, to a wider range, has oxidized and deteriorated as it experienced expansion and contraction due to exposure to sunlight, heat and cold. Most deteriorated rock became sandy, and it could not bear strength to sustain the structure. It is time to replace this, and selection of new rock material will require judicious technical examination, such as rock composition, in order not to repeat similar problems in the near future. As of July 2012, CEB was examining countermeasures with the University of Peradeniya.

(3) Breakdown of Programmable Logic Controller

The programmable logic controller, PLC, had been out of order for the gate system of the spillway. Taking into account the precipitation probability in Samanalawewa, only once in four to five years does CEB operate the gate system. They currently operate the dam at 5 m lower than the maximum level of the reservoir, which requires less need for operating the gate system. It was estimated to cost 20 to 30 million rupees to replace the PLC, which is affordable for CEB.

Picture 3 Monitoring Control System

Deteriorated bedrock

PLC

(4) Breakdown of Guard Valve

The guard valve is connected to the one which allows water discharge for irrigation. The power station keeps discharging water for irrigation throughout the year. They open and close the valve when they conduct periodic maintenance once or twice a year. As the valve is broken, CEB staff opens and closes it manually. As of July 2012, CEB was negotiating with the equipment suppliers on the replacement of equipment and prices.

Picture 4 Guard Valve

3.3.4.5 Water Leakage

(1) Background

Picture 5 Water Leakage Point

CEB conducted an initial survey in December 2006 with in which they tried to detect the cause of the sudden increase of water leakage. CEB agreed to take an immediate action in October 2007 in response to the recommendations drawn in the ex-post evaluation, with economic viability of the dam operation secured.

The amount of water leakage surged to 4.6m3/s in December 2006, which marked the high point. The amount of water leakage lowered in June 2007, and it was around 2.5 m3/s after 2008, although it is slightly above the average of 1.8m3/s for the ten years from 1996 to 2006.

(2) Safety Measures

CEB reconfirmed that the long-term structural safety of the dam would not be secured while it had water leakage. In order to lower the water pressure at the leakage point, they decided to lower the maximum level of water by 5m up to 455m. They revised the operation manual to cope with the water leakage, and built an early warning system for the downstream areas. CEB also supported the local administrative bodies to develop and implement a disaster drill in order to enhance their preparedness against disasters.

(3) Surveys to identify the cause of water leakage

There were two surveys in which countermeasures were examined and recommended to deal with the water leakage at the dam reservoir. Those were a doctoral dissertation by Dr. L.B.Kamal Laksiri (Project Director Bloadlands Hydropower project of CEB) and its follow-up survey, and another survey done by W.B. Atkins Co., Ltd. Table 5 shows the outlines of two surveys.

Table 5: Outlines of Surveys

	Dissertation of Dr. L.B. Kamal Laksiri	Survey of W.B. Atkins Co., Ltd
Period	2007 and follow-up survey (in progress)	2008-2009
Method	Comparison of water level between wells and reservoir	Analysis of water flow by using magnetism and electricity
Scope	All the monitoring wells on the right bank	Places without grout curtains and dislocation areas on the right bank
Identification of water leakage point	415 m MSL on the right bank	439m MSL on the right bank (places without grout curtains)
Further study	Location finding by Isotope	Large-scale survey
Recommended countermeasures	Extension of dry or wet blanket	Extension of grout curtains (project cost: high)

(4) Future Direction

CEB has not made any decision yet if it will conduct further surveys, develop and implement countermeasures. The Generating Department of CEB is torn into several ideas since water leakage is a complex mechanism and countermeasures are not yet proven. Some said that those countermeasures with lower cost should be tried first.

The Ministry of Power and Energy had paid keen attention to this issue, and the Minister ordered CEB to conduct a follow-up study in 2011 to detect the leakage point by using isotope based on the recommendations of Dr. Laksiri. A water ingress zone in the right bank was estimated to be located at about 415m MSL within about 100m distances along the right bank from the dam body. Furthermore, water ingresses into the right bank in above location, moved in different paths with different distance become coming to the outlet. They scheduled to conduct another survey to further identify the location.

At the time of ex-post evaluation, no problem was found for technical, organizational and financial sustainability of CEB. It was confirmed in this ex-post monitoring that they have continued and enhanced such sustainability to some extent: they have provided technical training opportunities systematically, and enhanced management by allocating required personnel and acquiring ISO9001 and ISO14001. Recurrent budget for the operation of the power station has been allocated with high priority. It was confirmed that sustainability was maintained or enhanced in terms of these three aspects.

Equipment and facilities have deteriorated as it has been 20 years since they started to operate the power station. CEB had detected which equipment and facilities were broken down and examined countermeasures to implement. Although they confront challenges in budget, they should take appropriate actions in a timely manner.

The water leakage that has existed since the initial operation of the power plant station and saw a temporary increase in 2006 has continued up to present. It was confirmed in this ex-post monitoring that CEB has been making efforts to operate the power station with safety measures well taken, and to continue conducting studies to reach further solutions.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Samanalawewa Hydroelectric Power Plant presently supplies electricity in a stable manner, more than the average amount from 1992 to 2005 although it has not reached the planned level yet, and operates to cope with peak demand. Water inflow to the dam reservoir has increased comparing with pre ex-post evaluation times, and it provides water continuously to the irrigation system downstream. Facilities associated with the power plant that were constructed during the construction period have taken part in the area development. There was no new adverse impact on natural environment and social environment, with CEB’s monitoring efforts. Disputes over resettlement have not yet been resolved, although the land acquisition and resettlement saw a great progress and CEB was expected to continuously work on this.

The Samanalawewa Hydroelectric Power Plant had enhanced its management by obtaining ISO9001 and ISO 14001, allocation of technical personnel, and implementation of training programs. Although CEB was not in a favorable financial condition, the Power Station is allocated with sufficient budget for operation and maintenance. However, there were equipment and facilities that have deteriorated over 20 years of operation.

CEB saw an abrupt increase of water leakage that occurred in 2006, but had operated the Power Plant with special attention paid to safety. There were two surveys presently being conducted regarding the water leakage, which had not reached final conclusion on the leakage mechanism and countermeasures. Long-term structural safety should thus be further sought.

4.2 Recommendations

4.2.1 Recommendations to the local administrative bodies and CEB

(1) Rathnapura District and Divisional Secretariat Offices

It was recommended to continue working on the resettlement and CEB was required to monitor the activities and progress.

(2) CEB

It is desirable to examine alternatives that are technically and economically viable and take necessary actions to repair/replace deteriorated equipment and facilities.

With regard to the continuing water leakage on the right bank of the dam, no long-term safe solution is secured yet. It is thus recommended to review the survey outcomes up to present, continue necessary measurements, surveys and analyses, and examine concrete countermeasures.

4.2.2 Recommendations to JICA

It is recommended to correspond with CEB and monitor the progress of the survey and measures for leakage. Once if required, it is also recommended to take necessary action to the concerned organizations and personnel.

4.3 Lessons Learned

Not applicable.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Outputs		
[Hydroelectric power plant] Diversion tunnels (2) (JP) Dam (JP)	[Hydroelectric power plant] Length: 520 m and 545 m Height: 103.5 m, Length: 529 m Effective storage capacity: 254 million m3	[Hydroelectric power plant] Length: 482 m and 502 m Height: 100 m, Length 530 m Effective storage capacity: 218.2 million m3 Right bank cut-off works
Diversion tunnel (UK) Hydroelectric turbines (JP) Power generator (UK) Penstock (JP) Transmission line (other)	Length 5,150 m Turbine discharge: 42.0 m3/s 120MW (60MW X2) Length: 648 m 17 km (power station - Balangoda)	Length 5,159 m As planned As planned Length: 670 m 19 km (power station - Balangoda) 39 km (power station - Embilipitiya)
[Remedial Works] Main blanket (JP) Follow-up blanket (JP)	[Remedial Works] Input: 500,000 m3 Input: 500,000 m3	[Remedial Works] Input: 426,030 m3 Cancelled
(2) Project Period	[Hydroelectric power plant]	[Hydroelectric power plant]
[Hydroelectric power plant]	Sep 1986-Jul 1991 (59 months)	Sep 1986- Dec 1992 (76 months)
[Remedial Works]	[Remedial Works] Aug 1995–May 2001 (70 months)	[Remedial Works] Aug 1995–Jun 1999 (47 months)
(3) Project Cost		
[Hydroelectric power plant] Foreign Currency Local Currency Total Japanese ODA loan portion Exchange Rate	[Hydroelectric power plant] 43,139 million yen 17,037 million yen (2,433.8 million Rs) 60,176 million yen 28,420 million yen 1Rs= 7 yen (as of Apr 1986)	[Hydroelectric power plant] 48,112 million yen 22,217 million yen (5,660 million Rs) 70,329 million yen 31,684 million yen 1Rs= 3.93 yen (1986 - 1995)
[Remedial Works] Foreign Currency Local Currency Total Japanese ODA loan portion Exchange Rate	[Remedial Works] 5,061 million yen 1,153 million yen (568 million Rs) 6,214 million yen 5,282 million yen 1Rs= 2.03 yen (as of Feb 1995)	[Remedial Works] 2,359 million yen 905 million yen (453 million Rs) 3,264 million yen 3,134 million yen 1Rs= 2.00 yen (1996-1999)