Sri Lanka

Kukule Ganga Hydroelectric Power Project

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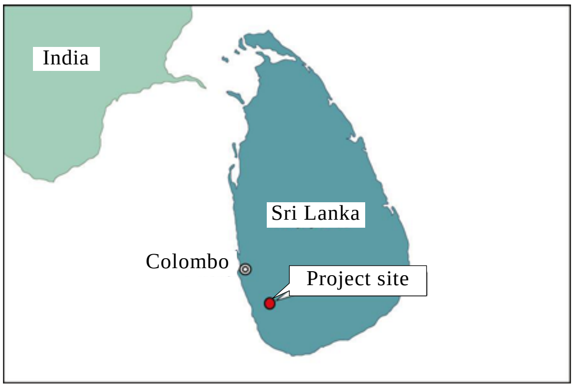
Field Survey: November 2007

1. Project Profile and Japan's ODA Loan



Map of the project area

Regulation pond gate of the Kukule Ganga Hydroelectric Power Plant

1.1 Background

Sri Lanka is poor in fuel resources such as coal, oil and natural gas, but is blessed with a number of sites suitable for hydroelectric power generation, which is economically efficient. The government has been supplying affordable energy to the people of Sri Lanka and the domestic industry by actively implementing hydroelectric power development projects. However, in the beginning of the 1990s, as a result of economic expansion and development, the demand for electricity in Sri Lanka increased by more than 8% on average, and the balance between the supply and demand of electricity became tight in the second half of the decade; thus it has been anticipated that Sri Lanka could be hit by a critical supply-demand situation for electricity in any dry year.

This project is designed to alleviate the tight supply-demand situation for electricity by utilizing Sri Lanka's precious hydroelectric power resource to supply the affordable electrical power. In a preliminary feasibility study conducted in 1989 with funds provided by the United Nations Development Programme (UNDP), this project was conceived as a multi-purpose reservoir-type hydroelectric power plant with an output of 144 MW. After that, as a result of the feasibility study conducted with funds provided by the World Bank in 1992, a lower output inflow-type hydroelectric power plant equipped with a regulation pond was planned, because a reservoir-type hydroelectric power plant requires a large-scale resident relocation.

1.2 Objective

The objective of this project is to provide stable supply of electricity in Sri Lanka by constructing a run-of-river type hydroelectric power plant (35 MW × 2 units) equipped with a regulation pond in the Kukule Ganga(River) – a tributary of the Kalu Ganga(River) – which is a large rainfall zone (average precipitation of 3,750 mm per year) in Sri Lanka; thereby contributing to the alleviation of the tight supply-demand situation for electricity and to the socio-economic development of Sri Lanka.

1.3 Borrower / Executing Agency

The Government of the Democratic Socialist Republic of Sri Lanka / Ceylon Electricity Board (CEB)

1.4 Outline of Loan Agreement

Loan Amount / Loan Disbursed Amount	21,227 million yen / 19,415 million yen
Exchange of Notes / Loan Agreement	June 1994 / July 1997
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	 2.6% 30 years (10 years) Generally untied (Consulting service portion is partially untied)
Date of (Disbursement) Completion	June 2005
Main Contractors	Skanska International Civil Engineering A.B. (Sweden), VA Tech Transmission & Distribution GmbH & Co. KEG (Austria), VA Tech Hydro GmbH & Co. (Austria) (JV), Mitsui & Co., Ltd., Hazama Corporation, Kumagai Gumi Co., Ltd., Kajima Corporation (JV), etc.
Consulting Services	Electrowatt Engineering Services Ltd (Switzerland), Lahmeyer International GmbH (Germany), Nippon Koei Co., Ltd. (JV)
Feasibility Study (F/S), etc.	1992 (F/S): World Bank 1993 (D/D): World Bank

2. Evaluation Result (rating: A)

2.1 Relevance (rating: a)

2.1.1 Relevance at the time of appraisal

The fund allocation of Sri Lanka's electricity and energy sector accounted for approximately 8% of the Public Investment program(1993–1997), with electric transmission and distribution sectors accounted for the greatest share of that resource.

Since over 80% of Sri Lanka's power supply depends on hydroelectric power, providing a stable supply of electricity in dry years and dry seasons had been an issue. Moreover, the importance of promoting the development of power resources came to be recognized as a result of the expected growth in electricity demand based on the government's industrialization policy and regional electrification policy which set a goal of supplying electricity to all households by 2000.[1] Thus, at the time of appraisal, the project was judged to be highly relevant.

2.1.2 Relevance at the time of evaluation

The present administration, which came into power in 2005, has promoted economic growth through industrial development, but they recognize that power shortage is one of the serious bottleneck. The emphasis of the resource on the power sector in the National Infrastructure Development Programs (2006–2016) is 18%; it is the second largest proportion next to the transport sector. Since the supply-demand situation for electricity in Sri Lanka has not improved much from the situation at the time of appraisal, there is still a strong need to build up the country's power generation capacity. Consequently, there is an urgent need to secure its power generation capacity at an affordable price by developing the remaining hydroelectric power resource and utilizing coal-fired power plants.

Moreover, at the time of this ex-post evaluation, one of the principal measures of electric power policy includes energy security and effective utilization of domestic resources. Therefore, this project, which utilized water energy, is consistent with the policy.[2] Furthermore, since the reliance on high-cost diesel power generation significantly tightened the electric power sector's finances, it seems that the importance of hydroelectric power generation projects designed to provide low-cost power generation is believed to have increased.[3] Hence the high level of relevance of this project was also maintained at the time of ex-post evaluation.

In view of all the above factors, the implementation of this project was consistent with power sector policy and the like at the time of both appraisal and ex-post evaluation, and so the implementation of this project is highly relevant.

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[1] The rainy season rain fall pattern? in the Kalu River system is different from that in the river system where electric power development projects were implemented in the past. So at the time of appraisal, development of electric power in the Kalu River system was deemed effective for stabilizing the power supply in dry years. However, since the power generating capacity of this project is small, its overall effectiveness is miniscule (see Figure 1 below).

[2] National Energy Policy and Strategies of Sri Lanka, Ministry of Power and Energy, October 2006

[3] The Long-term Generation Expansion Plan (CEB, December 2005) and the Ten-year Horizon Development Plan (2007–2016, discussion paper) both plan to make optimum use of this project, as well as launch in 2008 a F/S on a new hydroelectric power generation project.

2.2 Efficiency (rating: b)

2.2.1 Outputs

In this project, a 70 MW run-of-river hydro-electric power plant with a regulating pond and 132kV transmission lines to hook up to an existing power grid were constructed, practically as planned. After hiring a consultant, CEB devoted about a year conducting a technical review of the basic design on the basis of which it made several changes to optimize the plan.[4] These changes are all judged to be valid both technically and economically. Additionally, after the start of construction, since the bedrock for the pond site turned out to be deeper than anticipated, the design of the protective wall to be built on the right bank of the dam was changed.

An access road about 20 km long and housing facilities at five locations were built to facilitate the construction work. The access road was designed to serve as rural road for local community after the project is completed.

Top floor of the underground power plant

Lower floor of the underground power plant (under construction)

2.2.2 Project period

The period for project implementation far exceeded the planned period, and the power plant went into operation in September 2003, or 44 months after the planned date set at the time of appraisal. Upon a change of administration, the new government (not CEB) revoked the consultant procurement method agreed upon by the previous government and JBIC. It took about 21 months for JBIC and the new government to reach an agreement and begin implementing the procurement process. In addition, the revision of the detailed design delayed the implementation period another 10 months or so. Moreover, the delay

[4] In order to reduce the amount of civil engineering works, CEB curtailed the cavity volume for the underground power plant by about 30%. The plan was changed so that the tunnel for use in construction could be used as a surge tank without modification. As a result of a bedrock test and adit drilling, the geological condition was found to be better than originally thought, so the circular concrete lining for headrace and discharge channels was kept at a minimum. In addition, the original plan contains unnecessary items for a mid-scale inflow-type power plant, and the electric machinery and equipment used were also narrowed down.

in the procurement of electrical equipment such as a power generator led to a delay of about 13 months in the implementation of the project.[5]

2.2.3 Project cost

The volume of construction work was decreased by the change of the plan, on the other hand, because of a rise in prices and additional construction for the left bank of the dam, construction cost increased. However, as a result of downsizing of the equipment to the appropriate scale and competitive bidding, the cost for electrical equipment was dramatically reduced from the originally plan. (Also, the costs related to tax, land acquisition and compensation were kept lower than planned.) As a result, the total project cost was 22,173 million yen, or 85% of the originally estimated cost of 26,244 million yen.

Table 1: Planned and Actual Project Costs

(Unit: million yen)

Item	Plan			Actual		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
Preparatory work	0	1,012	1,012	0	1,047	1,047
Civil engineering works	6,614	1,945	8,559	8,148	2,563	10,711
Hydraulic power, electrical equipment	5,821	506	6,327	4,064	367	4,431
Consulting services	1,568	504	2,072	1,987	59	2,046
Management, tax, land acquisition, compensation	0	4,561	4,561	0	2,481	2,481
Physical contingency	1,319	937	2,256	0	0	0
Interest rate during construction	1,457	0	1,457	1,457	0	1,457
Total	16,779	9,465	26,244	15,656	6,517	22,173

Source: CEB Project Completion Report

From the foregoing discussion, it can be seen that, while the outputs and costs of the project were as originally planned, the project period far exceeded that planned. Consequently, the project is judged to be moderately efficient.

[5] Procurement of electrical equipment was delayed for over two years due to the fact that (i) a longer than expected time was required to reach an agreement on bid evaluation and (ii) the bidding for switchgear had to be repeated because there were no qualified bidders in the first bidding. More than half of the two-year delay was reclaimed in the construction phase by adjusting the construction technique to fit the progress of the civil engineering works.

Power plant control console (above ground)

Site inspection after a fire

2.3 Effectiveness (rating: a)

2.3.1 Operation of power plants

The Hydroelectric Power Plant is operated by remote control from a control room located in an administrative office building above the ground. In accordance with directions issued from the System Control Centre in Colombo, the power plant generates electricity mainly between 6:30 to 9:30 in the evening at the peak hours. From the year 2004 to 2006, when precipitation was normal, each generator achieved its planned power generation by operating for about 12 hours per day. But in 2007, when there was less precipitation than usual, the power generation for the year was only 85% of the planned power generation. The average annual power generation from 2004 to 2007 was 306 GWh, or 97% of the planned power generation. Additionally, in the rainy season, since the capacity of the pond is limited, when the river flow rate exceeds the level of it needs at the peak output hours, the power plant is unable to use up the river flow rate. Until now, about 10% of the river flow was discharged without being used.

In 2005 and 2006, unplanned outage hours increased as a result of breakdown and failure of electric machines. In 2005, a fire broke out near Generator No. 2, forcing it to cease operation for one month. However, since the fire broke out during the dry season, it did not have any noticeable impact on the plant’s power output. An investigation revealed that heat stored by a plastic cover caused the accident. The problem was resolved by changing the design of the parts. In addition, the clogging of the water supply pipe in the waterproof seals of Generator No.1 occurred frequently from 2004 to 2006 was resolved by replacing the pertinent parts and making the necessary adjustments.

Table 2: Operation Performance of the Kukule Ganga Hydroelectric Power Plant

	2003 Oct–Dec	2004	2005	2006	2007
Maximum output (MW)	80	80	80	75	75
Annual power generation (GWh)	79	318	317	319	270
Annual operating hours (2 units total: hours)	2,098	8,865	8,797	9,003	7,665
Unplanned outage (2 units total: hours)	125	141	513	435	70

Note: The planned annual power generation was 317 GWh at the time of appraisal
Source: Questionnaire results from CEB

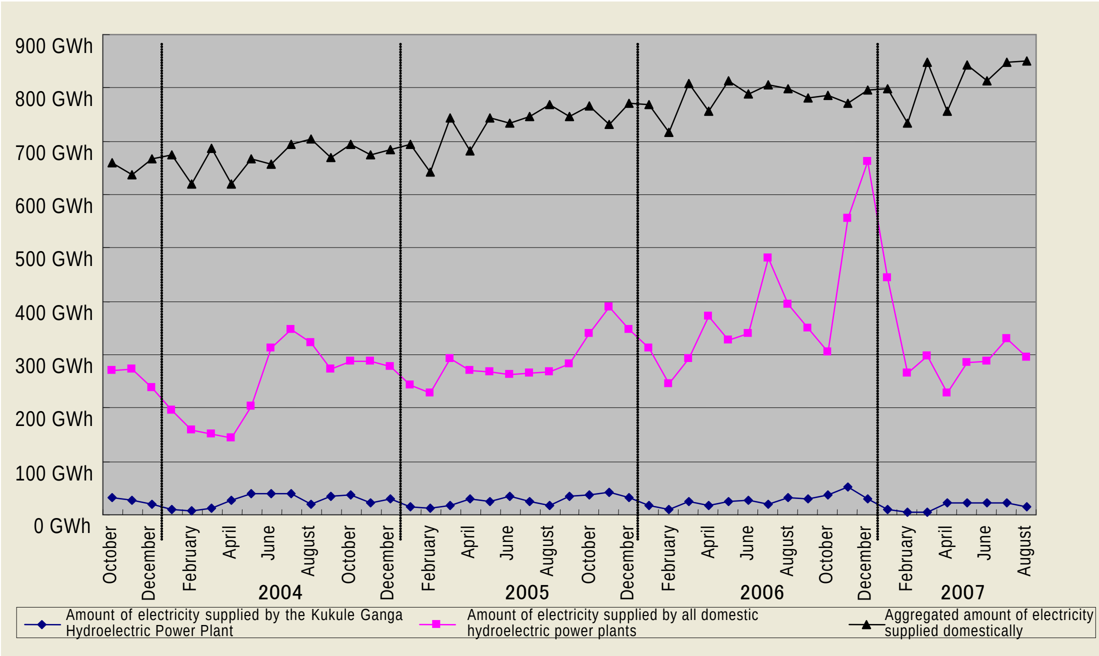
The rated output of the power plant is 70 MW, but the power plant is capable of producing a maximum of 80 MW of electricity. Until 2005, the power plant had been generating 80 MW of electricity per year not to waste the river flow as much as possible, but for the sake of safety, since the outbreak of the fire near Generator No. 2 in 2005, the power plant has been operating at 75 MW capacity or lower. Although there are external factors that are of concern, such as changes in precipitation, since it is producing enough electricity, the power plant can be said to be operating at a satisfactory level.

2.3.2 Contribution to stable power supply

Electricity produced by the Kukule Ganga Hydroelectric Power Plant is being supplied to all parts of Sri Lanka through a national power grid.[6] In 2006, the power plant supplied about 4.0% of the total amount of electricity supplied in Sri Lanka at peak hours, and about 3.4% of the amount of electricity supplied per annum.[7] Thus, the project is contributing to the provision of the stable supply of electricity mainly at peak hours.[8]

[6] Except for some areas in northern Sri Lanka where the power grid has been disrupted by a civil war.
[7] The load factor of the power plant from 2003 to 2006 (actual amount of electricity generated / amount of electricity generated at the time of rated operation) is about 83% at peak hours (6:30 p.m.–9:30 p.m.), and about 41% at other hours.
[8] Two power plants completed under other projects (combined output: 300 MW, one of which was built with an ODA loan) completed in 2002–2003 are also contributing to the stable supply of electricity in Sri Lanka.

Figure 1: Changes in the Amount of Electricity Supplied (nationwide, domestic hydroelectric power generation, and the amount generated under this project)



Source: Questionnaire results from CEB

Since 2000, electricity consumption in Sri Lanka has increased at an annual rate of 7%. However, the four power plants originally scheduled to be completed by 2000 (combined output of 675 MW), including the Kukule Ganga Hydroelectric Power Plant, were not completed until after 2002, so CEB attempted to make up for the shortage through emergency electric power purchases from the private sector using mobile diesel power generators capable of supplying 100–300 MW of electricity. However, in 2001 and 2002, because of the high cost of emergency electric power purchase, CEB was not able to make up for the entire shortage through emergency purchases. Consequently, the executing agency was forced to carry out planned outages equivalent to 4–8% of electricity demand. The agency continued to make emergency electric power purchases even after September 2003 when the Kukule Ganga Hydroelectric Power Plant began generating electricity. If the power plant had commenced generating electricity in March 2000, as was originally scheduled in the project, it is believed that some of the emergency purchases and planned outages of 2000 to 2003 could have been avoided. According to some calculations, it is believed that the executing agency could have cut down on the cost of power purchase by about 5.3 billion rupees (7 billion yen, or equivalent to about 30% of the total cost of the project) had the project been completed as originally planned.[9]

[9] This was calculated by using the amount of electricity that would have been generated had the project been completed as planned and by using the original cost of power generation for emergency power purchase in each year.

Table 3: Comparison of the Amount of Electricity Generated by the Kukule Ganga Hydroelectric Power Plant and the Amount of Emergency Power Purchases and Planned Outages

(Unit: GWh)

	2000	2001	2002	2003	2004	2005	2006	2007
Net energy sent at KG Hydro Power Station (planned)	76	317	317	317	317	317	317	317
(actual)	0	0	0	79	318	317	319	270
Emergency power purchased	485	471	939	442	0	0	0	0
Load shed (planned outage)	0	289	525	0	0	0	0	0
Gross units sold	6,686	6,520	6,810	7,612	8,043	8,769	9,388	9,814

Source: Questionnaire results from CEB

2.3.3 Economic analysis

The financial internal rate of return (FIRR) and the economic internal rate of return (EIRR) calculated on the basis of the conditions given below at the time of appraisal were 7.3% and 11.7%, respectively. When the FIRR and EIRR were recalculated for this evaluation based on the same conditions, they were 11.4% and 15.5%, respectively. Major causes for the rates exceeding which at the appraisal are increased benefit due to sudden rise in fuel cost for diesel-fired power generation as well as the resultant rise in the selling price of electric power and the cost of alternative energy.

Table 4: Preconditions of Economic Analysis

Cost: Cost of constructing the power plant, operation and maintenance expenses
Benefit: FIRR: Income from power selling (price of power selling × amount of power generated)
EIRR: Cost of constructing alternative electric generation facilities, cost of alternative generation
Project Life: 50 years

Note: Electricity generated by the Kukule Ganga Hydroelectric Power Plant is sold through the same grid as electricity generated by other power plants, and its selling price was set at the same level as the average selling price charged by CEB. In the economic analysis, it was assumed that if the project had not been implemented, the hydroelectric power plant would have been substituted by a diesel-fired power plant until 2011 and by a coal-fired power plant after 2012.

In summary, it can be said that this project has generally expressed effects as originally planned, and so is highly effective.

2.4 Impact

2.4.1 Impact on industrial development

In Sri Lanka, the industrial sector experienced a temporary decline in economic activities as a result of the economic slowdown in advanced countries in 2001 and 2002 and a change of administration in Sri Lanka. However, since then, backed by the development of the service sector, the economy has continued to grow at an annual rate of 6–8%. Additionally, foreign direct investment, which was valued at 1.5 billion dollars in 2001 and is expected to reach 5.5 billion by 2007, is contributing to industrial growth in Sri Lanka. However, for Sri Lankan industry, instability of electrical power supply continues to be considered one of the most serious issues facing Sri Lanka even it is not the greatest constraint.[10]

As noted above, this project is believed to contribute to the stable supply of electricity and support industrial development indirectly. However, considering the amount of electricity generated by the Kukule Ganga Hydroelectric Power Plant accounts for only 5% of the amount of electricity supplied nationwide, the impact of this project to the industrial development is limited.

2.4.2 Impact on improvement in people's standards of living through electrification

The household electrification ratio, which stood at approximately 35% at the time of appraisal (1994), rose to approximately 78% in 2006. Although the amount of electricity supplied under this project accounts for lower than 5% of the total amount of electricity supplied in Sri Lanka, this project is believed to be contributing to the raising of the electrification ratio indirectly.

Regulation pond of the Kukule Ganga Hydro Power Plant

2.4.3 Impact on the natural environment

The Environmental Impact Assessment (EIA) of this project was conducted by CEB before its appraisal. In the construction of the power plant, the civil engineering

[10] According to the Ceylon Chamber of Commerce, while electrical power supply is stable in Colombo, there are many power outages outside the capital. The latest economic and investment climate analyses reveal the following: "Industrial and service sectors are suffering from power shortages and lack of skilled labor force" (HSBC Global Research, Jan. 2008); "While electrical power supply is generally stable in Sri Lanka, there are electrical power shortages at peak hours during years of low precipitation. If the construction of power plants is delayed, the country will be faced with a serious power shortage in four years." (Invest Climate Statement, 2008, USA).

contractor implemented various strategies to alleviate air pollution resulting from construction work, to control waste, and carried on sufficient monitoring of air pollution, soil and water contamination and waste disposal, so that the impact on the environment was kept to a minimum.[11]

At present, monitoring is carried out only on the water quality of the river, and there have not been any reports of a serious impact on the environment caused by the power plant. Although local residents have pointed out possible increases in illegal timber cutting of trees associated with the construction of an approach road, such increases were not found in this ex-post evaluation.

2.4.4 Socio-economic impact at the vicinity of the power plant[12]

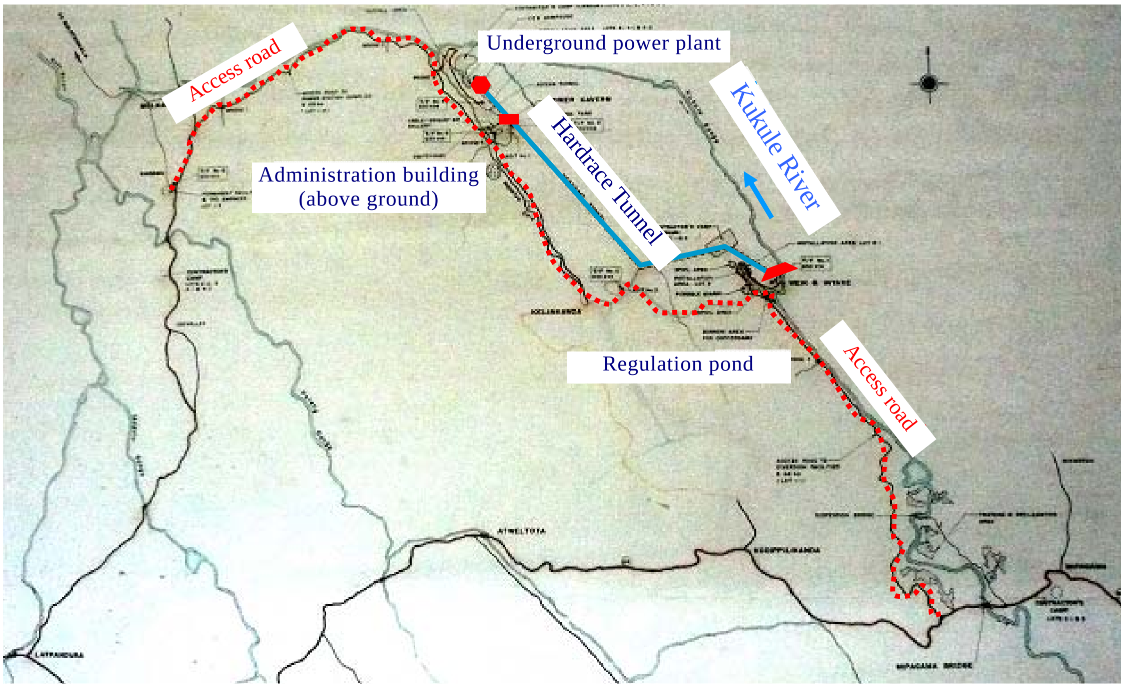
Many residents at the vicinity of the power plant are small-scale farmers that own about 0.5–1 ha of cultivated land. About half of those farmers earn their income mainly by growing tea and there are those who derive their income by working as hired labor or by producing rubber and the like. Only a few grow rice.

Under this project, approximately 2,000 households have lost all or part of their cultivated land and now rely on income they receive as hired labor. On the other hand, the 20 km or so long access road has dramatically improved traffic in the mountainous region; thus bringing about a host of favorable socio-economic impacts. To the question "How has your life have been changed by this project?" which was asked in a survey involving interviews of residents in areas surrounding the power plant, 74% of the households that lost their cultivated land and 90% of other households said, "Life has improved." This suggests that the project had a positive impact in the vicinity of the power plant.

[11] The environmental management on this project has been recognized as excellent by the World Bank.

[12] In addition to the evaluator's site inspection, JBIC conducted the following: (i) a group interview of residents undertaken by a local consultant who was commissioned (total of 111 residents participated); (ii) a household survey using questionnaires (80 households that lost their cultivated land and 20 households that did not lose their land); (iii) interviews of local government staff related with compensatory procedures; and (iv) a close investigation of compensation related records.

Figure 2: Vicinity of the Kukule Ganga Hydroelectric Power Plant



2.4.4.1 Resident relocation and compensation

Although 51 households were subject to the relocation under this project, 42 agreed to relocate in exchange for monetary compensation and the remaining 9 households relocated to a district provided by CEB.[13] Those 9 households that relocated were all small-scale farmers who grew tea on the site selected for building the regulation pond. However, these 9 households have not been given alternative cultivated land. It seems conditions as hired labor.[14]

On the other hand, among the farmers who lost their lands to construct the pond or the access road, about 2,000 households mostly concentrated in the upper reaches of the pond, demanding compensation for the loss in farm products they have suffered.[15] In some

[13] According to local residents, in addition to this, there were about 40 households that were evacuated but received no compensation whatsoever or received inadequate compensation on the sites selected for building camps for construction work.

[14] Wells have been installed, but because the residents are unable to pay for the electricity to run the pumps, they are not in operation. Additionally, the residents are discontented because the houses are built so close to each other in the new residential district.

[15] Most residents did not possess legal ownership of their land, so they were not eligible for compensation under the normal procedures. Additionally, legal compensation normally requires a long time before payments are made. Residents affected by this project launched an organized protest against this situation. Consequently, in this project, before undertaking the legal procedure for paying compensation for land acquisition, CEB made ex-gratis payments to the affected residents. This was done to compensate for the loss of cultivated products regardless whether the residents concerned had ownership of the land or any land acquisition was involved. Additionally, farmers in some areas agreed with CEB that the benefits of the new access road were a quid pro quo for the loss of land, so that they did not demand compensation for the loss

areas, the residents and CEB have not yet reached the agreement on the details such as the scope of compensation to be given to residents, so about half of the households have not yet received compensation. Thanks to the convenience offered by the new access road, some of the farmers who lost their cultivated land have begun to commute to work outside of the project site. Their number remains small, however. It is believed that most farmers have increased their dependence on income they earn working as hired labor.

Practically no compensation for land acquisition has been given because the local government has not yet completed confirmation of land ownership and its appraised value. In some areas, the project has been completed with neither official land acquisition nor compensation.

Houses on a relocation site

Some residents have become more dissatisfied and distrustful because of delays in compensation payment. 70 percent of even those who have received compensation are dissatisfied with the amount they have been paid. Because it took many years from the calculation to the payment of the compensation, there are many recipients express dissatisfaction for the actual value of the compensation decreased significantly, considering the rise in prices during that period. Moreover, many residents do not know why compensation payment is being delayed.

The CEB procedure for compensation has continued to this day. One major reason why the compensation payment could not be completed prior to the completion of the project is that the close investigation of land ownership by the local government and the procedure for calculating the amount of compensation did not advance very fast because of personnel shortage, and so on. CEB has acknowledged that it had not made enough effort to promote these procedures. Moreover, this project is only the second project for CEB which granted compensation, suggesting that CEB did not have an adequate system or experience.[16] Even JBIC's local office had

Tea farm damaged by water from the regulation pond

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of agricultural products.

[16] In Sri Lanka, many hydroelectric power projects that require large-scale compensation were implemented,

not been able to fully grasp this situation during the implementation of the project.

2.4.4.2 Other socio-economic impacts

The construction work carried out under this project created short-term employment for many local residents. According to CEB, about 150 people were employed for four years. Since the project's completion, 10 local residents have been working at the power plant such as guards, janitors.

Before the project was implemented, the area around the power plant was an isolated area where there were no roads on which vehicles could go through. The construction of an access road increased traffic convenience, resulting in a host of social impacts, including those described below. In a survey of local residents, 97% of the respondents cited the enhanced traffic convenience as the main benefit of the project. The number of beneficiaries is estimated to be about 2,000 households.

- Public transpiration services such as buses have commenced. (photo)
- The marketing of such as tea advanced to provide farmers with an advantage in price competitiveness. (photo)
- Daily necessities are easily available at lower prices.
- Residents' access to administrative and social services has advanced.
- Social exchanges, including family visits, have increased.
- Due to the easier transportation of construction materials, many houses have been permanently rebuilt or improved by utilizing compensation money.
- Collecting of river gravel has begun.[17]

Although many villages in the vicinity of the power plant did not have electricity

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but most of these projects were implemented by organizations other than CEB that were placed in charge of construction, while CEB took charge of only the operation and maintenance of the power plants after they were completed. CEB was not involved in any of the compensation issues.

[17] About 30–40 contractors are collecting river gravel; legally or illegally, and about 1,500 local residents are believed to be engaged in this work.

before the project was implemented, electrification along the access road has been improved, and the majority of the residents pointed this out as one of the main benefit of the project. However, 150 households located along some parts of the road segment have not yet been electrified, and have expressed their dissatisfaction.[18] Electrification was carried outside the scope of this project.

Camps (lodgings for CEB, construction contractors, and consultants) were built at five locations for the project's implementation. After the project completion, CEB loaned out two of the camps to the national army. The two camps are now being used as a resort facility and a training center for the U.N. Security Force. The resort facility with a restaurant and a pool which was originally built as a camp for European and American contractors has the capacity to accommodate about 200 guests with 64 guest rooms. It attracts many domestic tourists and the rooms are nearly full during weekends and school vacations through the year. About 60 local residents are employed by the resort facility.

Resort facilities built on a former camp

A refurbished house along the access road

2.5 Sustainability (rating: a)

2.5.1 Executing agency

2.5.1.1 Operation and maintenance system

The Ceylon Electricity Board (CEB) is the executing agency of this project. The implementation and operation of the project are carried out by its power generation department. The Kukule Ganga Hydroelectric Power Plant employs 77 staff members: 5 engineers, 10 administrators and supervisors, and other 42 staffs (such as clerical workers, technicians and operation and maintenance personnel), and 20 safety control personnel. Although many of the employees are far from their home and family, this has not caused any operational problems.

There are no prospects of CEB splitting up or being privatized in the near future.[19] It is

[18] Some of the households without electricity that parted with their land without demanding compensation complained: "We parted with our land for the sake of Sri Lanka's electrical power supply, but we do not have electricity in our home."

[19] The structural reform of CEB involving the breakup of CEB, which was the objective of the Electricity

believed that the operation and maintenance system of the power plant will basically go unchanged even under the new Electricity Act that is currently being considered. Thus, no dramatic improvement in the operational efficiency of this project can be expected under the new Electricity Act.

2.5.1.2 Technical capacity of operation and maintenance

Most human resources involved in the implementation of this project are engaged in the implementation of many other projects today as members of CEB's construction force. Thus, there are hardly any members of CEB's construction force still working at the power plant. Also, virtually none of the personnel who received training in operating the power plant as part of the consulting services provided under this project are still working at the power plant. However, as CEB has a long track record of operating hydroelectric power plants, and the power plant has been operated in an appropriate manner, it is believed that there is nothing to worry about on the technical front. The operation and maintenance manual and records of accidents and breakdowns related to the operation and maintenance of the power plant are all stored appropriately.

According to the views of the chief engineer at the power plant, if the engineers currently working at the power plant were given an opportunity to participate in overseas training in improving the design of a computer-based control system, they would be able to continue operating the power plant more efficiently than now. In addition, it is believed that advanced training for young engineers would contribute to the sustainability of the operation of the power plant.

2.5.1.3 Financial status of operation and maintenance

Since low-cost hydroelectric power plant is very important for CEB, the agency gives top priority to obtaining the budget required for the operation and maintenance of hydroelectric power plants. Thus, nearly the entire amount CEB requests every year is approved. The budget for the operation and maintenance of the Kukule Ganga Hydroelectric Power Plant was 26.8 million rupees in FY2004, 34.6 million rupees in FY2005, and 34.4 million rupees in FY2006. Since 2000, the cost of supplying electricity has exceeded the selling price of electricity. Consequently, CEB has been cash-strapped since 2000.[20] However, since the budget for the power plant is secured preferentially if

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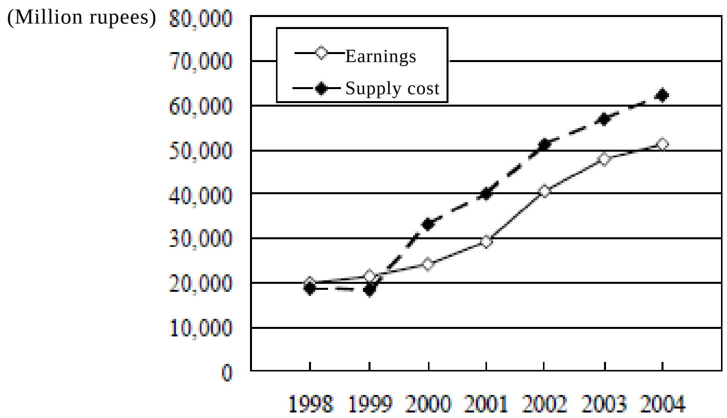
Reform Act that was passed in 2002 with the support of JBIC, the World Bank, and the Asian Development Bank, was discontinued after 2004, when the left-wing regime that participated in the current government opposed the reform. Under the Electricity Act currently being prepared by the Ministry of Power and Energy, the various departments of CEB will be restructured into strategic business units, and the Public Utilities Commission will strengthen regulations on the electric utility industry.

[20] Over the past 10 years, CEB has increased its earnings at a high rate of 15% per annum, while keeping

the lack of funding is seem to have effect on its operation, a budget shortfall that would have a detrimental impact on the operation of the power plant is believed unlikely going forward.

In order to ensure long-term sustainability of the financial basis of CEB, development of a structure for electric power under which it would be possible to obtain electricity at low cost by reducing reliance on expensive power purchasing schemes is urgently needed. To this end, it is important that the coal-fired power plants CEB is currently constructing or planning to construct be completed as planned.[21]

Figure 3: Changes in CEB's earnings from selling electricity and the cost of supplying electricity



Source: Final report of Sri Lanka's Electric Power Master Plan Survey, February 2006, Japan International Cooperation Agency

2.5.2 Operation and maintenance status

In the inspection conducted as part of the field survey, it was confirmed that the operation and maintenance of all facilities of the Kukule Ganga Hydroelectric Power Plant were conducted in appropriately. Power generators are subject to a two-week long overhaul every year, a two-day monthly maintenance, and weekly inspection. This work schedule is constantly adjusted to minimize unnecessary power discharge.

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the cost of power transmission/distribution, management, and depreciation low. However, since its reliance on high-cost diesel power generation, fuel and power selling costs have increased significantly, so the cost of supplying electricity has far exceeded the revenue on electrical power supply since 2000.

[21] Construction of the first coal-fired power plant in Sri Lanka, with the goal of completion by 2012, has just been launched.

In this project, enough spare parts were procurred initially to cover a five-year period. Spare parts were procured as needed afterwards. Backlogs of large spare parts that are expensive and require a long time to procure are secured as needed. However, the procedure for procurring spare parts establsihed by the government is very strict, and procurement time is especially long when original spare parts have to be procurred under an optional agreement.

Spare turbine parts

A year ago, small cracks were found on the floor of the underground power plant. The cause of the cracks is now under investigation. The cracks are not expanding rapidly, so they do not pose an immediate danger.

The access road is scheduled to be placed under the jurisdiction of the Road Development Authority, albeit it at present it is still under the jurisdciton of CEB. The access road is not being properly maintained as evidenced by, for example, collapse of small inclines being left unattended. Thus, the jurisdiction over the access road needs to be transferred to the Road Development Authority without further delay.

To sum up, there are no outstanding issues regarding the capacity of the executing agency of this project and its operation and maintenance system. Thus, the conclusion of this ex-post evaluation is that the project can be expected to have high sustainability.

3. Conclusion, Lessons Learned and Recommendations

3.1 Conclusion

From the foregoing discussion, it can be concluded that this project is highly regarded.

3.2 Lessons Learned

(1) For power generation projects in the case where the supply-demand situation for electricity is very tight, it is necessary to be keenly aware that delays in project completion can lead to a huge cost, and so it is important to exert every effort to make sure the progress of a project is properly managed. In the case of this project, if it had been completed as originally planned, the cost of power purchase equivalent to 30% of the total project cost could have been saved.

(2) Access roads and camps built for construction work are secondary outputs. Since they have the potential to bring about important social and economic benefits in areas surrounding power plants, they should be planned and utilized in appropriately.

(3) In order to prevent delays in and inadequacies of compensation payment, an executing agency and donors need to monitor the process and progress of compensation payment carefully. At the time of appraisal, it is important to determine whether an executing agency has an adequate system and track record concerning the compensation process.

(4) For economically weak small-scale farmers, it is not necessarily enough to give monetary compensation to make up for the loss they suffer when projects are implemented. Thus, the content of compensation needs to be examined carefully to accommodate the socioeconomic conditions of the people to be compensated.

3.3 Recommendations

[For CEB]

(1) CEB should take the initiative in starting constructive dialogue so that an agreement on the outstanding compensation issue can be reached with all the people concerned. As the capacity of CEB and related government agencies is limited in manpower to be able to adequately process all matters related to compensation, and that the mutual trust between persons concerned has been lost, it is recommended that CEB seek assistance from outside the government. Furthermore, in addition to extending assistance to help stabilize the livelihood of relocated residents (granting of ownership of land and buildings, provision of cultivated land, development of water works), CEB should strive to promote regional development by cooperating with central and regional government organizations concerned.

(2) CEB should rapidly complete the electrification of the area surrounding the power plant.

(3) CEB should rapidly transfer its jurisdiction of the new road to Road Development Authority so that the road will be maintained appropriately.

(4) It is recommended that CEB should provide advanced training for engineers engaged in this project as well as provides training on the design and operation of the SCADA system in order to enhance operational efficiency of this project, and to improve the project's operational and administrative information system.

Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Outputs	Inflow type hydroelectric power plant with a regulation pond: 70MW (35 MW × 2 nits) (1) Water intake facility (2) Regulation pond (3) Headrace channel (4) Surge tank (5) Hydraulic steel pipe (6) Discharge channel (7) Power plant (8) Hydraulic turbine (9) Power generator (10) Transmission line	Nearly as planned (There are some changes in the design of the headrace channel, surge tank, hydraulic steel pipe, power plant, power generator.)
(2) Period	July 1994–March 2000 (69 months)	July 1994–November 2003 (112 months)
Consultant procurement	April 1994–December 1994	April 1994–September 1996
Preparatory engineering works	October 1994–October 1996	March 1997–September 2000
Civil engineering works	March 1995–December 1999	June 1998–November 2003
Electric machine engineering works	May 1995–January 2000	July 1998–November 2003
Transmission line works	January 1997–November 1999	October 1999–April 2003
Start of operation	March 2000	November 2003
(3) Project cost		
Foreign currency	16,779 million yen	15,656 million yen
Domestic currency	9,465 million yen (4,263 million rupees)	6,517 million yen (4,867 million rupees)
Total	26,244 million yen	22,173 million yen
ODA loan portion	21,227 million	19,415 million yen
Exchange rate	1 rupee = 2.23 yen (as of February 1994)	1 rupee = 1.34 yen (1997–2005 average)