Ex-Post Project Evaluation 2016: Package Ⅲ-2 (India, Sri Lanka)

September 2017

JAPAN INTERNATIONAL COOPERATION AGENCY

IC NET CO.LTD.

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India

FY2016 Ex-Post Evaluation of Japanese ODA Loan

"Maharashtra Transmission System Project"

External Evaluators: Akane Totani and Ryujiro Sasao, IC Net Limited

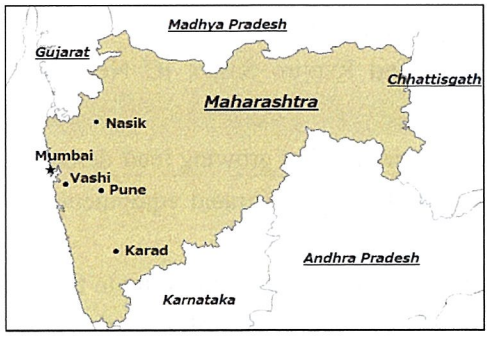
0. Summary

The project aims to ensure a stable power supply and meet the fast growing load demand by augmenting facilities at 110 substations and replacing old and deteriorated equipment at 95 substations in the State of Maharashtra.

Since the augmentation of transmission and transformation facilities corresponding to the rapid increase of power demand has been regarded as a priority at the time of both the project appraisal and the ex-post evaluation, this project has been highly relevant to the development plan and development needs of India. Also, Japan's Country Assistance Program for India at the time of the project appraisal mentions clearly that Japan would assist the development of power grid in order to create stable and efficient power supply. Thus, it can be said that this project is relevant to the Japan's ODA policy. As for the efficiency of the project, outputs of the project including the additional scope (replacement of equipment), which were approved during the project implementation period taking the necessity, urgency and the status of budget implementation into consideration, were achieved as planned. Although the project cost was within the budget, the project period exceeded the plan because of the delay in selecting consultants and suppliers (contractors) and the addition of the scope. Therefore, the efficiency of the project is fair. As for the effectiveness of the project, it was confirmed that the target operation and effect indicators such as availability factor of the transformers and transformer capacity, which were set at the time of the project appraisal, were met in 2014, which is two years after the project completion. As for the impacts of the project, although the contributions made by the project are still limited, it has been found that economic development has been enhanced, business activities of Japanese companies have expanded, and the living conditions in the State of Maharashtra have improved. Therefore, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, financial aspects and the status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

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

1. Project Description



Project Location

Substation Equipment Augmented by the Project (Shirwal Substation, Karad Zone)

1.1 Background

Since the late 1990s, India has been suffering from a serious shortage of electric power supply, caused by the rapid economic growth. In spite of the government's intensive promotion of new power development, it witnessed a shortage of about 8% in the total requirement and 12% in the peak demand in 2005. Regional disparities in electric power supply and demand have also been exacerbated and the shortage was the most serious in the western and northern areas of India. Especially in the State of Maharashtra (whose capital is Mumbai), which is located in the western part of India and has the country's largest economy, electric power demand has increased remarkably and the annual average rate of increase of about 7% for 2001–2005 is expected to continue. To meet the current demand, as well as the future growth in demand, Maharashtra State Electricity Transmission Company Limited (MSETCL) prepared and implemented its investment plan to augment its transmission capacity; however, in many substations in the state, the power load had almost approached their maximum capacity.

1.2 Project Outline

The objective of this project is to ensure a stable power supply and to meet the fast-growing demand load by strengthening intra-state transmission systems in the State of Maharashtra which is a western state in India, thereby contributing to local economic development and improvement in the standard of living of the state's citizens.

Loan Approved Amount/ Disbursed Amount	16,749 million yen / 12,070 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	August 2007 / September 2007
Terms and Conditions	Interest Rate: 0.75% (Main portion), 0.01% (Consulting portion) Repayment Period: 15 years (Grace Period: 5 years) Conditions for Procurement: General untied
Borrower/ Executing Agency	The President of India / Maharashtra State Electricity Transmission Company Limited
Project Completion	March 2015
Main Contractors (Over 1 billion yen)	Vijay Electricals Limited (India), Bharat Bijlee Limited (India), Voltamp Transformers Limited (India), Transformer and Rectifiers Limited (India)
Main Consultants (Over 100 million yen)	Nippon Koei Co., Ltd. (Japan)/ Tokyo Electric Power Company Holdings (Japan), Incorporated (Japan)/ Japan and Insight Development Consulting Group (IDCG) (India) (JV)
Feasibility Studies, etc.	Feasibility study conducted by the Executing Agency (March 2007)
Related Projects	【Technical Cooperation】 Master plan study on pumped storage hydroelectric power development in Maharashtra State (1994–1998) 【Japanese ODA Loan】 Rural Electrification Project (March 2006), Power System Improvement and Small Hydro Project (January 1991), Ghatgar Pumped Storage Project (December 1988), Ujjani Hydroelectric Project (November 1985), Paithan Hydroelectric Project (August 1978) 【Other Organizations】 ・ Asia Development Bank (ADB): Maharashtra Solar Park and Green Grid Development Investment Program (2012), Power Grid Transmission III (2004), Power Finance Corporation (1999) ・ World Bank: Organizational Transformation and Public Private Partnership: Maharashtra State Electricity Transmission Company Limited (2006–2010), Maharashtra Power Project 2 (1992–1998), Maharashtra Power Project (1989–1998) ・ KfW[1]: Shivajinagar Sakri Solar Power (2001)

[1] Kreditanstalt für Wiederaufbau (a German government-owned development bank)

2. Outline of the Evaluation Study

2.1 External Evaluators

Akane Totani, IC Net Limited

Ryujiro Sasao, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September 2016–October 2017

Duration of the Field Study: January 30–February 14, 2017, April 4–11, 2017

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of India

At the time of the project appraisal, the Government of India, in the 10th Five-Year Plan (2002–2007), aimed to complete new power development of about 41,110 MW, as well as the augmentation of the nationwide high-voltage transmission networks. This would ensure efficient power transmission across the country from the northern, north-eastern and eastern parts of the country, where many sources of electric power are concentrated to the metropolitan areas in the west, north, and south of the country, and increase intra-state transmission by 30,000 MW by 2012. In the next plan, the 11th Five-Year Plan (2007–2012), further augmentation of inter-state and intra-state transmission system for more stable electric power supply, as well as new power development of 78,577 MW, was planned.

The importance of stable electric power supply in the country has not changed at the time of the ex-post evaluation of the project. In the 12th Five-Year Plan (2012–2017), new power generation for meeting the future electric power demand and augmentation of the existing transmission and distribution facilities have been given priority. The Draft National Electricity Plan, released in 2016, plans to invest for the new power generation and transmission projects such as expanding power generation capacity including re-examination of the composition of power sources, and strengthening inter-regional transmission links in response to the continuously increasing power demand. Considering that the project aims to realize stable electric power supply corresponding to the demand growth, it is fair to say that from the time of the project appraisal to its ex-post evaluation, the project has been consistent with the development plan of the Indian government.

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

[3] ③: High, ②: Fair, ①: Low

3.1.2 Consistency with the Development Needs of India

The State of Maharashtra is located in the western part of India. It has the country's largest economy and a high growth rate. According to the documents provided by the Japan International Cooperation Agency (JICA), the peak power demand increased from 12,535 MW in 2001 to 16,069 MW in 2005 and the annual average growth rate of about 7% is expected to continue. Although the length of the intra-state transmission grid was 35,626 km overall and the number of substations was 473 as of March 2007, according to the same document as above) it was found that in many substations and transmission lines in the transmission system, the power load had almost approached their maximum capacity. In Maharashtra, electric power is mainly consumed in the western coastal areas such as Mumbai which is the state capital, while the main supply sources are located in the eastern areas with some of the shortfall being met by import of electricity from other states. Therefore, augmentation of the transmission and distribution system in the western part of the state is an urgent requirement.

According to the Load Generation Balance Report for the years 2008 and 2016, prepared by the Central Electricity Authority (CEA), it was found that a peak demand of electric power in the State of Maharashtra has continuously increased from 18,441 MW in 2007 to 20,973 MW in 2015. It is worth noting that the increase happened even after the implementation of the project. On the other hand, power shortage was severe at the time of the project appraisal and the state had an electricity deficit of 18.3% in 2007. However, because of the increase in power supply brought about by the entry of new private companies into the power generation business beginning around 2010, and the progress in the augmentation of the transmission and distribution system, power shortage in the state has been alleviated. Maharashtra enjoyed an electricity surplus of 7.4% at the time of the ex-post evaluation of the project.

Thus, it is clear that electric power demand in the state has increased continuously, from the time of the project appraisal to the time of the ex-post evaluation of the project. Especially at the time of project appraisal, when the deficit was very large, it can be said that the priority for expansion of a transmission and distribution system such as this project was high. It was also found, in the ex-post evaluation, that the needs have been met to some degree owing to MSETCL's continuous efforts including their self-investment to augment electric substation equipment; however, the project is still important for stable power supply. Hence, it can be said that the project is consistent with the developmental needs of India.

3.1.3 Consistency with Japan's ODA Policy

In Japan's Country Assistance Program for India at the time of project appraisal (May 2006), assistance for the electric power sector was categorized as a priority area for promotion of economic growth. It was also clearly mentioned that Japan would assist in the development of the power grid in order to create a stable and efficient power supply, as well as development of power sources and human resource development. In Medium-Term Strategy for Overseas Economic Cooperation Operations (2005), assistance for poverty reduction and infrastructure development for sustainable growth were set as overall priority areas, and development of

economic infrastructure was prioritized, especially in the assistance earmarked for India. In Country Assistance Strategy for India (2006), electric power sector was regarded as a priority sector for providing Japanese ODA loan, and it was decided to provide necessary support for strengthening the transmission grid as stable power supply and distribution grid was important for economic revitalization and poverty reduction. Thus, it can be said that the project is consistent with Japan's ODA policy at the time of project appraisal.

This project has been highly relevant to the development plan and development needs of India, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2. Efficiency (Rating: ②)

3.2.1 Project Outputs

(1) Augmentation of substation facilities (transformers and peripheral equipment)

Under the project, substation facilities such as transformers and peripheral equipment were augmented at 110 substations in four zones (Vashi, Pune, Karad, and Nasik) in the western part of Maharashtra state. The number of targeted substations were the same as at the time of project appraisal. However, because MSETCL had already performed augmentation works to meet the large and urgent needs at 12 substations[4] prior to the project's start, these were replaced by other substations. The list of peripheral equipment provided during the project along with transformers, shown in Table 2, has also not changed since the time of the project appraisal. The images below show the transformer and the control panel (peripheral equipment) provided through the project.

Table 1: Number of Targeted Substations and Transformers Provided by the Project

Zone	No. of Substations	No. of Transformers
Vashi	19	27
Pune	28	48
Karad	20	50
Nasik	43	55
Total	110	180

Source: Document provided by the executing agency

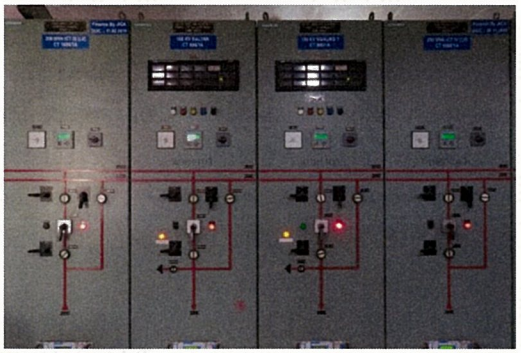
Table 2: Contents of Substation Facilities Augmented by the Project

Transformers	220/33kV 50MVA、220/22kV 50MVA、132/33kV 50MVA、220/132kV 200MVA、220/132-110kV 200MVA、220/132-110kV 100MVA、220/132-100kV 200MVA、220/132-100kV 100MVA、220/132kV 100MVA、132-110/33kV 50MVA、132-110/22kV 50MVA
Peripheral Equipment	Current Transformer, Lightning Arrester, Isolator, Circuit Breaker, Control Panel, Power Control Cable, Fire-Fighting Equipment, etc.

Source: Document provided by JICA

[4] Three substations in Vashi, three in Pune, five in Karad, and one in Nasik

Transformer
(Lonawala Substation, Pune Zone)

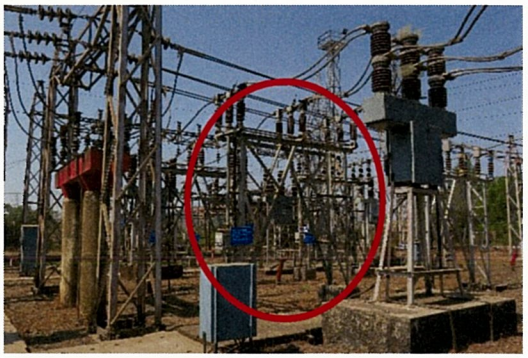


Control Panel
(Kalwa Substation, Vashi Zone)

(2) Replacement of related equipment (additional scope)

After the approval on adding the project scope in March 2011, equipment that had deteriorated was replaced at the 95 substations in four zones (this includes 52 substations, which were also targeted by the original project scope). Selection of targeted substations and equipment to be replaced, as per the additional scope, was done according to the results of analysis in MSETCL's Life Extension Scheme.[5] As the need to replace peripheral equipment is as urgent as the need to augment substation facilities, it can be said that the judgment to include the replacement of equipment as an additional project scope is appropriate in terms of improving efficiency in not only target substations but also in the whole transmission system in the targeted zones. The list of equipment to be replaced, as per the additional scope, includes station transformer, circuit breaker, lighting arrestor, isolator, current transformer, potential transformer, control & relay panel, power & control cable, battery set, battery charger, and alternating current (AC) distribution box. The following images show a circuit breaker and isolator replaced by the project.

Circuit Breaker
(Takali Substation, Nasik Zone)



Isolator
(Lonawala Substation, Pune Zone)

[5] One of the schemes in MSETCL's investment plan to replace deteriorated substation facilities and transmission lines in order to avoid failure and electric outage

(3) Consulting services

In the project, compared to the 48 M/M (24 M/M for Japanese consultants and 24 M/M for local consultants) planned in the project appraisal, 35 man-months (M/M) were actually provided for consulting services. The breakdown of the M/M is as shown in Table 3. Because time was required for procurement, the period for which the consulting service was actually provided was March 2009 to March 2011, although the original plan had scheduled it from August 2008 to September 2010.

Table 3: Consulting Services (Unit: Man-Month)

Items of Works	Planned	Actual
Introduction of Total Quality Management (TQM)	8.0	9.5
Plan and Coordination of Training Program in Japan[6]	4.0	1.5
Project Supervision	12.0	12.0
Project Supervision (Local Consultant)	17.0	6.0
Capacity Building Support (Local Consultant)	7.0	6.0

Source: Documents provided by the executing agency and JICA

Japanese consultants were assigned as nearly planned; however, it was found that M/M for the local consultant on project supervision was far less than planned. It occurred because the frequency of travels of the Japanese consultants from Japan had been less than planned, and this led to the revision of the assigned M/M for the local consultants. In addition, it was already agreed at the time of the project appraisal to exclude the review of detailed design and assistance for tendering in the terms of reference (TOR) for consultant services, because it was found that the executing agency was capable enough and had the relevant knowhow and experience.

[6] In the project, a two-week training course was conducted three times in Japan for MSETCL technicians of the head office and the zone offices.

3.2.2 Project Inputs

3.2.2.1 Project Cost

Table 4 shows the comparison between the planned and actual project costs. It is found that the total project cost, including additional scope, was 65% of the planned amount and that the Japanese ODA loan component was 72% of the planned amount. It can be said that the project cost was within the budget. As indicated in 3.2.1, the project outputs including additional scope were appropriate, and it is fair to say that the project cost matches the project outputs. The main reason for the imbalance between planned and actual project costs is the appreciation of the Japanese yen. Compared with the exchange rate at the time of project appraisal and the average IMF rate during the project period, it was found that the exchange rate of Japanese yen against Indian rupee appreciated by 32%. The fact that the actual bid amount for procuring transformers and peripheral equipment was lower than the planned amount estimated at the time of the project appraisal was another reason for the actual project cost falling below the estimated amount.

Table 4: Planned and Actual Project Cost

	Planned	Actual	Planned/Actual
Total Project Cost	20,712 million yen	13,393 million yen	64.7%
Japanese ODA Loan	16,749 million yen	12,070 million yen	72.1%

Source: Documents provided by the executing agency and JICA

3.2.2.2 Project Period

The project period exceeded the plan. While the planned period at the time of the project appraisal was 3 years and a month (37 months), starting from September 2007 (signing of Loan Agreement (L/A)) and ending in September 2010[7], the actual period including additional scope approved in March 2011 was 6 years and a month (73 months), starting from September 2007 (signing of L/A) and ending in September 2013. For comparing the planned and actual project periods, the planned period was revised taking into account necessary period for additional scope. The actual project period, including the additional scope, was 91 months (September 2007–March 2015) and exceeds the planned period (73 months) by 125%. The main reasons for the actual project period exceeding the planned period were as follows:

1) The executing agency did not have enough experience in procuring consultants, so it required much time to prepare the documents for inviting proposals from consultants. In addition, following the usual procurement process in India, it took a certain amount of time to prepare the shortlist. As a result, 7 months of delay occurred at the "procuring consultants" stage.
2) Because the bidding took longer owing to the large number of bid packages, 2 months of delay[8] occurred at the stage of preparation for bidding.

[7] The project completion was defined as commissioning of all the substations, completion of all the activities for human resource development are implemented, and completion of consulting services.

[8] While the planed period was 15 months from October 2007 to December 2008, the actual one was 17 months from February 2008 to June 2009.

3) Because the transformers and equipment were delivered and installed during the monsoon period and the erection works were delayed owing to outage problems, installation works at some substations could not be completed as per the original schedule.
4) In March 2011, consent to replace the related equipment as an additional scope of the project was obtained from JICA. Although the planned period for the additional scope was 30 months, from April 2011 to September 2013, the actual period was 49 months because of the delay in the preparation for bidding.

Table 5: Comparison of Original and Actual Schedule

Process	Original	Actual
Selection of Consultant	Oct. 2007–Jul. 2008	Jan. 2008–Feb. 2009
Consulting Services	Aug. 2008–Sep. 2010	Mar. 2009–Mar. 2011
Selection of Supplier (Contractor)	Oct. 2007–Dec. 2008	Feb. 2008–Jun. 2009
(Additional Scope)	Apr. 2011–	Nov. 2011–Jun. 2012
Delivery of Equipment	Jan. 2009–Mar. 2010	Apr. 2009–Jan. 2011
(Additional Scope)	–Mar. 2013	Feb. 2012–Nov. 2013
Erection / Installation of Equipment	Jan. 2009–Mar. 2010	Sep. 2009–Mar. 2011
(Additional Scope)	–Mar. 2013	Mar. 2012–Mar. 2014
Commissioning	Mar. 2010	Feb. 2012
(Additional Scope)	Mar. 2013	Sep. 2014
Project Completion	Sep. 2010	Mar. 2012
(Additional Scope)	Sep. 2013	Mar. 2015

Source: Document provided by JICA
Note: In the document provided by JICA, it is assumed that all the construction works of the additional scope are done by March 2013. However, similar to the original scope, project completion is regarded as September 2013 which is six months after the completion of the installation.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

3.2.3.1 Financial Internal Rate of Return (FIRR)

It was concluded that, at the time of the project appraisal, a calculation for the FIRR was not possible because no immediate benefit from the project can be expected in the transmission sector.

3.2.3.2 Economic Internal Rate of Return (EIRR)

In the project appraisal, the EIRR was calculated based on economic costs which consist of the project cost excluding cost escalation, taxes and duties, connection cost to the distribution network, operation and maintenance (O&M) cost (which is equivalent to 3% of the initial investment cost), cost of power purchase, and economic benefit is brought by the increased power supply including consumer surplus. In the recalculation of the EIRR in the ex-post evaluation of the project, the same figures are taken for the initial investment cost for installation of distribution network, connection cost and power purchase cost. As the electric outage rarely happens except during inspection and maintenance in the target zones, the consumer surplus accrued by switching to electricity utilization from other energy sources during the power outage is excluded from the economic benefit.

Table 6: EIRR (Project Appraisal/Ex-Post Evaluation)

	Project Appraisal (2007)	Ex-Post Evaluation (2017)
EIRR (%)	23.0	27.9
Project Life	30 years from the project completion	
Cost	Investment cost, connection cost, operation & maintenance (O&M) cost, power purchase cost	
Benefit	Economic benefit brought by increased power sales and savings (including consumer surplus)	Economic benefit brought by increased power sales (excluding consumer surplus)

Source: Documents provided by JICA for project appraisal; calculated by the external evaluators based on the information provided by the executing agency for the ex-post evaluation

Although the project cost was within the budget, the project period exceeded the plan. Therefore, efficiency of the project is fair.

3.3. Effectiveness[9] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

In the evaluation of effectiveness, much emphasis is put on the operation and effect indicators that were set at the time of the project appraisal such as the "availability factor of the transformers" (in percentage) and "transformer capacity" (in MVA). For the comparison between target and actual, the figures relating to 2014[10], that is, two years after project completion, were treated as the actual effect.

The actual availability factor of the transformers almost coincides with the target value. It shows that the substation facilities augmented by the project have been properly brought into use. The actual figures on transformer capacity exceeded the target as a whole, although the target capacities for 132 kV and 100 kV transformers were not met. This is because some target substations were replaced, as mentioned in 3.2.1, and transformers with 132 kV and 100 kV capacity were replaced by the transformers with the other kV classes.

Table 7: Operation and Effect Indicators

	Baseline	Target	Actual	
	2006	2012	2012	2014
	Baseline Year	2 Years after Completion	Completion Year	2 Years after Completion
Availability Factor of the Transformers (%)	81.9	62.0	56.8	61.0
Transformer Capacity (MVA)				
220 kV	4,566	7,970	8,153	8,153
132 kV	2,279	4,700	4,502	4,502
110 kV	300	600	714	714
100 kV	400	950	908.5	908.5

Source: Documents provided by the executing agency and JICA
Note: The availability factor of the transformers is calculated as "maximal load (MW) / (rating capacity (MVA)× power factor". It shows whether the transformer is appropriately operated at around the target availability factor that is set leaving room for margin. The transformer capacity indicates the capacity according to the voltage class.

[9] Sub-rating for Effectiveness is to be put with consideration of Impact.

[10] The operation and effect indicators were not revised at the time of adding the scope. Since the additional scope aims to exchange the old and deteriorated relevant equipment, it can be said that there are no effects on the indicators which were originally set at first. Thus, comparison of target and actual figures of indicators is done regarding 2012, when the augmentation of transformers in the original scope was completed, as completion year.

For reference, the availability rate of the transformers based on operating time was 98.82% in 2006 and 99.73% in 2014 (two years after project completion). It also shows that the substation facilities augmented by the project are being operated to the fullest extent.

Table 8: Availability Rate of the Transformers

	2006	2012	2014
Availability Rate of the Transformers (%)	98.82	99.71	99.73

Source: Document provided by the executing agency
Note: The availability rate of the transformers indicates the proportion of actual operating hours of transformers out of 24 hours and 365 days.

Thus, it can be judged that the target operation and effect indicators, which were set at the time of the project appraisal, were achieved, and that the project could elicit the expected effects.

3.3.2 Qualitative Effects (Other Effects)

The stability of electric power supply, as a result of the augmentation of substation facilities and capacity building of the relevant people in the executing agency and developed through the consulting services in the project, were analyzed as the qualitative effects of the project. Investment promotion and improvement of living conditions in the State of Maharashtra, which were also seen as qualitative effects of the project at the time of the project appraisal, were regarded as impacts of the project.

(1) Outline of the beneficiary survey

In the ex-post evaluation, manifestations of qualitative effects (situation of power supply) and impact (improvement in living conditions) were examined through a beneficiary survey of residents living in the vicinity of the target substations, private companies, and public institutions, which received power supply directly from the target substations or even from any distribution companies in the substation area, conducted at seven substations (two substations each were selected from Nasik, Pune, and Karad; one from Vashi). At each substation area, three surveyors were assigned to conduct a questionnaire survey in the different target areas, which were already trisected, and 113 residents, 22 private companies, and 10 public institutions were randomly selected according to the equidistant spacing method. Finally, valid responses could be collected from 101 residents, 22 private companies, and 10 public institutions that have been living, working, and/or running a business in the area before the project was implemented.[11]

[11] The 101 residents include 74 men and 27 women. With regard to their age, 5 are in their 20s, 32 in 30s, 34 in 40s, 17 in 50s, and 12 in 60s or above, and 1 unknown. The breakdown by zone is as follows.

	Residents	Private Company	Public Institution
Vashi Zone	16	7	0
Nasik Zone	25	7	0
Pune Zone	32	3	2
Karad Zone	28	5	8
Total	101	22	10

Note: 2 substations each from Nasik, Pune and Karad zones and 1 substations from Vashi zone

(2) Improvement in electric power supply

The beneficiary survey asked the respondents a question on the degree of satisfaction regarding the electric power supply after project completion, with four scales: "very satisfied," "satisfied," "somewhat satisfied," and "not satisfied." Among the respondents, 24% of the residents and 16% of the private companies and public institutions chose the "very satisfied" and 76% of the residents and 84% of private companies and public institutions chose "satisfied" (none chose "somewhat satisfied" or "not satisfied"). Decreases in the frequency of outage and voltage stability were given as reasons for their satisfaction.

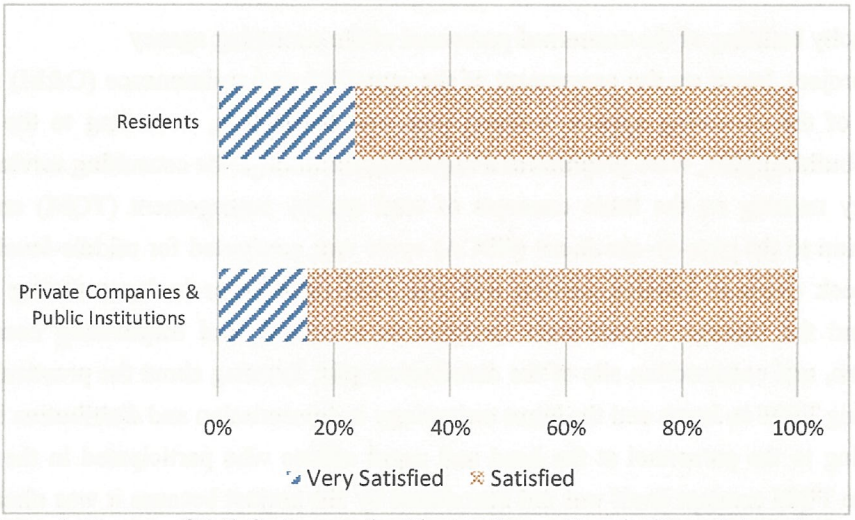


Figure 1: Degree of Satisfaction on the Electric Power Supply (Beneficiary Survey)

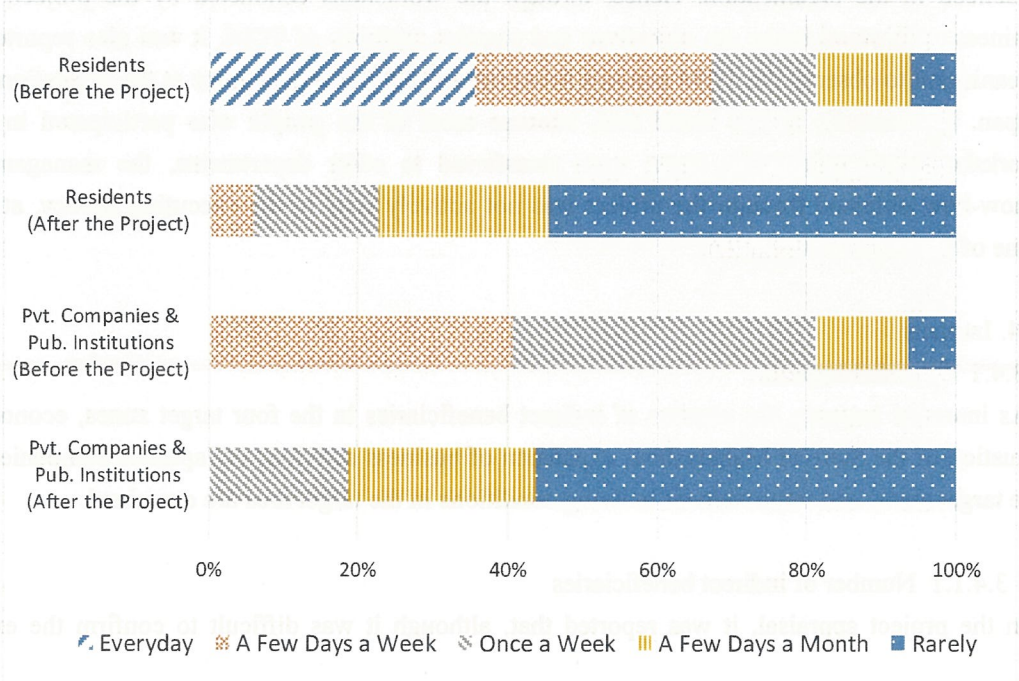


Figure 2: Frequency of Outage (Beneficiary Survey)

The survey also asked a question on the frequency of outage before and after project completion with five scales: "every day," "a few days a week," "once a week," "a few days a month," and "rarely." As shown in Figure 2, it was found that the frequency of outage was drastically reduced after project completion, although the situation before the project for residents and private companies as well as public institutions was quite different. The augmentation of substation facilities by the project makes it possible to provide constant power supply by operating other transformers at the time of regular inspection and maintenance, or when the transformer malfunctions.

(3) Capacity building of the concerned personnel of the executing agency

In the project, based on the assessment of the operation and maintenance (O&M) system and capacity of the executing agency, training plan and curriculum, according to the needs and capacity-building plan, were prepared and implemented through the consulting services. Initially, in-country training on the basic concepts of total quality management (TQM) and practical introduction to the plan-do-check-act (PDCA) cycle was conducted for middle-level managers. A two-week overseas training session was also held three times in Japan during the project period and the trainees visited such facilities as a central load dispatching control center, substations, and construction site of the distribution grid, learning about the practical aspects of introducing TQM in Japan and the latest technology in transmission and distribution systems.

According to the personnel at the head and zonal offices who participated in the training in Japan, the TQM concept itself was not introduced by the project because it was already used in the work of the executing agency. However, in reality, the TQM concept was not being properly practiced in the organization. Hence, through the workshops conducted by the project, the trainees understood better the objectives and practice methods of TQM. It was also reportedly meaningful to observe the TQM concept being intensively put into practice at the substations in Japan. By contrast, it was found that, because most of the people who participated in the workshops and training in Japan were transferred to other departments, the management know-how obtained through the project was not actively used at the executing agency, at the time of the ex-post evaluation.

3.4. Impacts

3.4.1 Intended Impacts

As intended impacts, the number of indirect beneficiaries in the four target zones, economic situation of the State of Maharashtra, expansion of business activities of Japanese companies in the target areas, and improvement in living conditions in the target area are examined.

3.4.1.1 Number of indirect beneficiaries

In the project appraisal, it was reported that, although it was difficult to confirm the exact

number of direct beneficiaries of the project,[12] 61.64 million people in the four target areas could benefit from the indirect impacts of the project. In the ex-post evaluation, it was found that the population of the four target areas (indirect beneficiaries) was estimated as 85.48 million, based on the results of the census in 2011. Thus, the number of indirect beneficiaries of the project has increased by 39%, compared with the number finalized during the project appraisal, which shows the magnitude of the indirect impacts of the project.

Table 9: Estimated Population in the Four Target Areas in 2014

Vashi Zone	32,018,607
Pune Zone	16,840,867
Karad Zone	13,863,755
Nasik Zone	22,760,586
Total	85,483,815

Source: Document provided by the executing agency

3.4.1.2 Economic situation of the State of Maharashtra

The table below shows the economic situation in the State of Maharashtra, the target area of the project.

Table 10: Economic Situation of the State of Maharashtra

	2010	2011	2012	2013	2014	2015
Population (in thousands)	111,645	113,179	114,697			
Gross State Domestic Product (GSDP, million rupee)						
(at Constant (2011-2012) Prices)	-	-	-	14,418,430	15,248,460	16,470,450
(at Current Prices)	10,683,270	11,995,480	13,237,680	15,101,320	17,921,220	19,691,840
Annual Growth Rates of Real GSDP	-	-	6.6%	6.2%	5.8%	8.0%
Sectoral (Agriculture)	-	-	-1.9%	12.6%	-16.0%	-2.7%
Sectoral (Industry)	-	-	5.4%	1.2%	6.8%	5.9%
Sectoral (Services)	-	-	8.2%	7.0%	10.0%	10.8%
Net State Domestic Product (State Income, NSDP, million rupee)	9,824,520	10,827,510	11,967,540	14,500,030	15,720,370	-
State Income per Capita (rupee)	87,686	95,339	103,991	125,146	134,081	-
No. of Companies in Industrial Sector	27,892	28,215	28,949	29,123	-	-
(Percentage to Whole India)	13.2%	13.0%	13.0%	13.0%	-	-
Labor Force in Industrial Sector (in 100 thousands)	12.03	13.21	12.33	13.12	-	-
(Percentage to Whole India)	12.2%	12.7%	12.3%	12.6%	-	-
Profit in Industrial Sector (million rupee)	918,680	784,880	1,016,400	1,195,370	-	-
(Percentage to Whole India)	23.6%	17.4%	22.9%	26.3%	-	-

Source: Economic Survey of Maharashtra 2011–12, 2012–13, 2013–14, 2014–15, 2015–16

As shown in Table 10, it was found that the gross state domestic product (GSDP) and the GSDP growth rates of the service sectors and industry, in addition to the state income per capita, increased after the completion of the project in 2012, and that the economic development in the State of Maharashtra was led by the service sectors and industry. In general, it is reasonable to say that the increase of electric power supply and its use are the contributing factors for the regional economic development. However, because the project scope focuses only on the

[12] This is because the executing agency of the project simply supplies electric power to the distribution companies, which directly distribute electric power to the customers (beneficiaries).

augmentation of substation facilities—a component of the entire electric system—and the direct beneficiaries of the project are part of the indirect beneficiaries shown in 3.4.1.1, the impact of the project on the economic development in the State of Maharashtra is limited. By contrast, as the rapid economic development of the state continues, as described above, the significance of the project—which contributed toward securing a stable electric power supply in the western coastal areas of the state with their rapidly growing power demand—for the state's development is quite high.

3.4.1.3 Expansion of business activities of Japanese companies in the target area

At the time of the project appraisal, 67 Japanese companies already had business activities in the State of Maharashtra (project target area) (as of June 2006). Thus, it was expected that they would also benefit from the project's objective of ensuring stable electric power supply. According to the list of Japanese companies operating in India (2016), at the time of the ex-post evaluation (as of 2016), the number of Japanese companies operating in Maharashtra was 205, which is almost three times as many as the number at the time of project appraisal. Table 11 indicates that the number of hubs of Japanese companies in India increased fourfold in the eight years since 2008. However, it was also found that both the number of hubs in 2016 and the growth rate since 2008 in the western region, including the State of Maharashtra, was lower than what it was in the northern, north-eastern, and southern regions. According to the interview with the concerned people, this is because the high electricity tariff in the State of Maharashtra is an obstacle for the promotion of investments in the state. On the other hand, it was confirmed that the stability of electric power supply in the state, compared with that of other states, could be a promoting factor for the Japanese companies to make investment decisions. According to the list of Japanese companies operating in India (2017), as of October 2016, the number of Japanese companies located in the target areas of the project is as follows: 5 companies, with 5 hubs in Vashi; 158 companies, with 192 hubs in Pune; 1 company, with 1 hub in Karad; and 14 companies, with 17 hubs in Nasik. It is fair to say that the stable power supply realized by the project indirectly contributes to the business expansion of the Japanese companies.

Table 11: List of Hubs of Japanese Companies by Region in India[13] (2008–2016)

	2008	2009	2010	2011	2012	2013	2014	2015	2016
North/North-East	305	369	410	474	613	707	1,246	1,490	1,585
East	39	65	93	95	109	144	336	369	385
West	208	268	246	265	365	519	994	1,128	1,163
Maharashtra	174	219	198	218	277	395	625	712	709
South	286	347	487	588	717	1,133	1,305	1,430	1,457
Total (Hubs)	838	1,049	1,236	1,422	1,804	2,503	3,881	4,417	4,590

Source: Embassy of Japan in India and JETRO, *The List of Japanese Companies Operating in India* (2017)

[13] The hubs were of the following types: 1) representative office and branch office of the Japanese company, which is not locally incorporated; 2) locally incorporated head office, central branch, production plant, branch office, business office, local office, etc., of the Japanese company (fully affiliated company or a joint venture) ; and 3) companies set up by Japanese nationals in India.

3.4.1.4 Improvement of Living Conditions in the target area

In the ex-post evaluation, the beneficiary survey[14] was conducted to compare the living conditions in the target areas of the project before and after the project implementation. On a whole, living conditions in the target areas were improved in several aspects after the project implementation. However, it cannot be said that the changes indicated in Figure 3 have been brought about only by the stable electric power supply resulting from this project. The changes could also be influenced by the economic conditions of the respondents' households or of the target areas. According to Figure 3, most of the respondents chose "very improved" or "improved" in availability of lighting, TV and radio, convenience with the use of home electric appliances (because of fewer outages), and frequency of breakdown of home electric appliances (because of stable electric voltage). As for the burden of housework and time management, compared to the above-mentioned items, more respondents chose "very improved", while a certain number of the respondents chose "not changed". Notably, more than half of the respondents choose "very improved" in securing a block of time and fixing working time (because reduction and/or change in working hours is resolved due to the stability of the power supply).

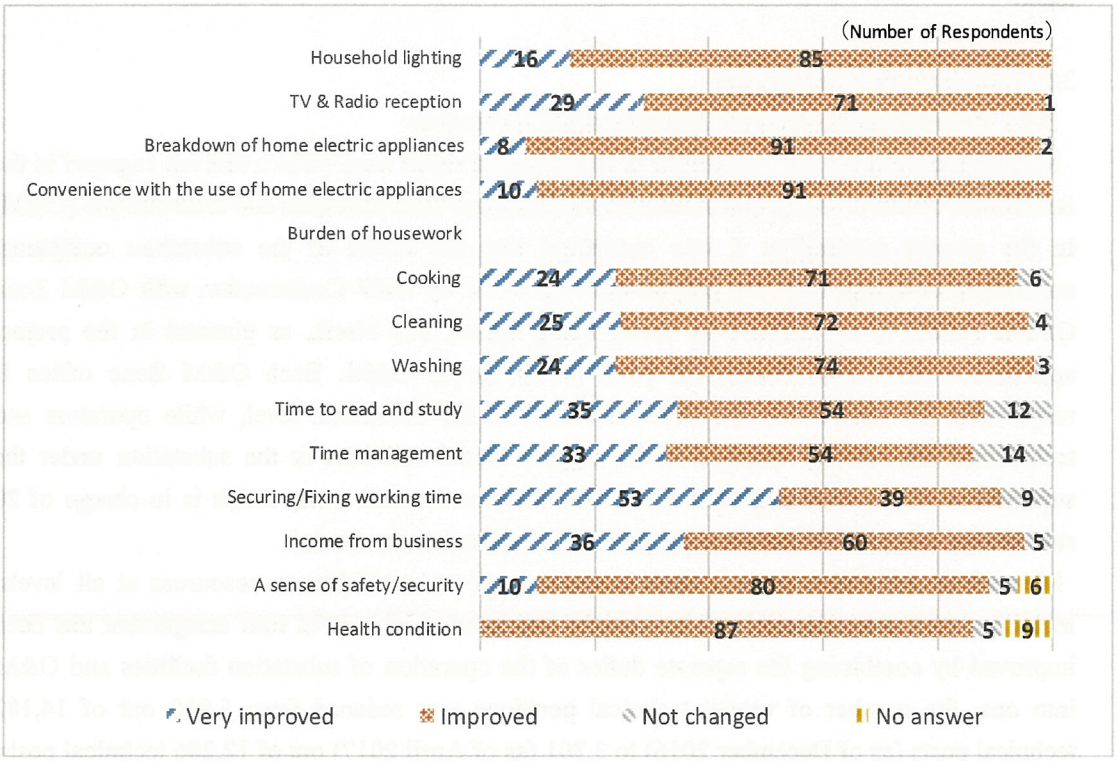


Figure 3: Changes in the Living Conditions in the Target Areas (Beneficiary Survey)

[14] Same as the survey described in 3.3.2

3.4.2 Other Positive and Negative Impacts

3.4.2.1 Impacts on the Natural Environment

In the project appraisal, it was expected that there would be minimum negative impacts on the natural environment. In the ex-post evaluation, according to the interviews with the concerned personnel of the executing agency and technical officers at the target substations, as well as the beneficiary survey[15], it was confirmed that there were no impacts on the natural environment because of the projects' augmentation of substation facilities and replacement of related equipment.

3.4.2.2 Land Acquisition and Resettlement

In the ex-post evaluation, through the interviews on the occurrence of land acquisition and resettlement t with the concerned personnel of the executing agency and residents living in the areas surrounding the target substations, it was confirmed that no land expansion or displacement of the existing sub-stations occurred. Thus, there was no land acquisition and resettlement caused by the implementation of the project.

This project has largely achieved its objectives. Therefore, the effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

MSETCL consists of the head office in Mumbai and seven zone offices that are engaged in the installation of transmission and substation facilities and their operation and maintenance (O&M). In the ex-post evaluation, it was confirmed that the O&M of the substation equipment augmented or replaced by the project has been done by EHV Construction with O&M Zone Offices (O&M Zone Offices) in Vashi, Pune, Karad, and Nasik, as planned in the project appraisal without any changes of posts in charge of O&M. Each O&M Zone office is responsible for supervising the O&M activities at the substation level, while operators and technicians are actually engaged in the regular O&M activities at the substation under the supervision of the chief engineer. The O&M division in each zone, which is in charge of 20 substations, can provide technical support to the substations as needed.

Meanwhile, MSETCL faces a chronic shortage of technical human resources at all levels, including the O&M division and substations. Because efficiency in staff assignment has been improved by combining the separate duties of the operation of substation facilities and O&M into one, the number of vacant technical positions was reduced from 5,880 out of 14,182 technical posts (as of December 2016) to 3,301 (as of April 2017) out of 12,286 technical posts. Although staff shortages still exist, it was confirmed that the substation facilities have been properly operated and maintained with the requisite minimum number of personnel at the substation levels, so it is not currently such a serious problem.

[15] Same as the survey described in 3.3.2

Thus, it was found that the O&M has been appropriately performed at the substations with clear demarcation of responsibilities and roles among the concerned departments, as well as in the system of command and communication. Therefore, it can be said that a proper O&M system has been established. However, it is still necessary to take immediate and necessary measures for filling the vacant technical posts.

3.5.2 Technical Aspects of Operation and Maintenance

As of December 2016, MSETCL had 10,143 employees, including 8,528 technical staff members. The technical levels of the departments and staff in charge of O&M are kept at the proper level: a bachelor's degree or higher in electronic engineering is an eligibility requirement for the technical staff, and necessary knowledge and techniques are updated through training for newly appointed personnel and a series of regular technical training courses[16] provided by the head office and zone offices.

At each substation, a manual for the O&M of the substation equipment is prepared and regular inspection and maintenance are properly conducted according to the common rules established by the head office. The records are also appropriately kept at the substations. However, in the ex-post evaluation, it was found that the contents and quality of the operation manuals are not standardized but vary from one zone and substation to another. The substations that can get more input from the O&M division possess and use a more practical and detailed manual, while the manual that the other substations possess does not provide any concrete procedures. However, interviews revealed that even the substations with a simple operations manual conduct regular inspection and maintenance as well as the other substations do, and no failures of transformers and related equipment or accidents happened.

Thus, it can be judged that the technical level of personnel at the zone and substation levels are high enough to operate and maintain properly the substation facilities introduced by the project.

3.5.3 Financial Aspects of Operation and Maintenance

Table 12 shows the financial status of MSETCL in the last three years. Because MSETCL is a public corporation for transmission, its source of revenue is not the fare collection from the customers but the commission charges from the State Transmission Utility (STU). As shown in the table below, in the last three years, the total income exceeded the total expenditure, and the net profit was stable with around 17,000 million rupee before the fiscal year (FY) 2015 when adjustment of depreciation was posted. It is fair to say that the sustainability of revenues and the financial status of MSETCL are secured. The recording of depreciation in FY2015, which made the net profit negative, was temporary and not expected to occur in the subsequent years.

[16] According to an interview, technical training courses are held several times a year at the head office and the zone offices of MSETCL in addition to on-the job training at the substation provided by the zone offices.

Table 12: Financing Status of MSETCL (FY2013–FY2015) (Unit: Million Rupee)

Item	FY2013	FY2014	FY2015
Total Income	54,957	54,320	35,700
Total Expenditure	29,424	27,920	29,020
Profit before Tax	25,532	26,400	6,670
Depreciation due to FRP	-	-	46,540
Net Profit (after Tax)	17,031	17,640	-42,560

Source: Documents provided by the executing agency
Note: Depreciation due to Financial Restructuring Plan (FRP) in FY2015 is the difference in the depreciation between FY2005 and FY2015, which was caused by the increased value of asset of MSETCL according to the FRP scheme of the Maharashtra State Government in 2016.

Table 13: Balance Sheet of MSETCL (Unit: Million Rupee)

Item	FY2014	FY2015
Asset	197,227	209,170
Current Asset	31,668	37,294
Non-Current Asset	165,559	171,876
Accounting Capital	67,228	84,866
Debt	129,999	124,304
Current Debt	25,329	23,415
Non-Current Debt	104,670	100,889

Source: Documents provided by the executing agency

Table 13 shows the balance sheet of MSETCL in the last two years. According to the figures in FY2015, it was confirmed that MSETCL had current ratio of 159%[17]. The capital adequacy ratio of 41%[18] also meets the generally desirable level.

As for the budget for O&M, 2,922 million rupee in FY2016 and 3,128 million rupee in FY2015 were secured in the four target zones. The O&M budget is allocated not to the substation levels but the O&M division that supervises the substations based on the plan and request submitted by each substation. Interviews with the concerned personnel confirmed that the annual O&M budget per substation is around 2–3 million rupee and an emergency budget is separately allocated to the O&M division in each zone. According to the personnel at the O&M division and substations, a sufficient O&M budget is allocated for proper operation and maintenance of substation facilities.

3.5.4 Current Status of Operation and Maintenance

The site survey of the ex-post evaluation has confirmed that the substation facilities introduced by the project have been appropriately operated and maintained. Specifications of the equipment are based on MSETCL's standards, and the availability of spare parts is secured.

The frequency of regular maintenance at the substation is annual, semiannual, quarterly, monthly, or daily, depending on the type of equipment. Especially for the transformers and the peripheral equipment, the engineers of the inspection division perform a routine operation check once a week; the schedule depends on the zone. So far, no serious failure has been reported. In

[17] Current ratio is calculated by dividing current asset by current debt.
[18] Capital adequacy ratio is calculated by dividing accounting capital by total asset.

case of trouble, the maintenance team of the O&M division in each zone is responsible for addressing the issues and, if necessary, the neighboring substations can provide technical support.

Thus, it has been confirmed that the equipment introduced by the project are properly operated and maintained through regular inspection. By the time of the ex-post evaluation, no failure and fixing of equipment have been reported. An emergency response procedure is also clearly set. It is fair to say that a proper O&M system has been established.

No major problems have been observed in the institutional, technical, financial aspects and status of the operation and maintenance system. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project aims to ensure a stable power supply and meet the fast growing load demand by augmenting facilities at 110 substations and replacing old and deteriorated equipment at 95 substations in the State of Maharashtra.

Since the augmentation of transmission and transformation facilities corresponding to the rapid increase of power demand has been regarded as a priority at the time of both the project appraisal and the ex-post evaluation, this project has been highly relevant to the development plan and development needs of India. Also, Japan's Country Assistance Program for India at the time of the project appraisal mentions clearly that Japan would assist the development of power grid in order to create stable and efficient power supply. Thus, it can be said that this project is relevant to the Japan's ODA policy. As for the efficiency of the project, outputs of the project including the additional scope (replacement of equipment), which were approved during the project implementation period taking the necessity, urgency and the status of budget implementation into consideration, were achieved as planned. Although the project cost was within the budget, the project period exceeded the plan because of the delay in selecting consultants and suppliers (contractors) and the addition of the scope. Therefore, the efficiency of the project is fair. As for the effectiveness of the project, it was confirmed that the target operation and effect indicators such as availability factor of the transformers and transformer capacity, which were set at the time of the project appraisal, were met in 2014, which is two years after the project completion. As for the impacts of the project, although the contributions made by the project are still limited, it has been found that economic development has been enhanced, business activities of Japanese companies have expanded, and the living conditions in the State of Maharashtra have improved. Therefore, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, financial aspects and the status of the operation and maintenance system. Therefore, the sustainability of the project effects 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

To actively use the management method such as TQM and PDCA cycle acquired through the project, it is desirable to establish the information sharing and implementing mechanism for the concerned departments to play central roles to share and instill the outputs of management method within the organization, even in case that most of the personnel who participated in the workshops under the consulting services of this project and training in Japan were transferred to the other departments.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

None

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	Augmentation of substation facilities (110 substations) - 180 transformers - Current Transformer, Lightning Arrester, Isolator, Circuit Breaker, Control Panel, Power Control Cable, Fire-Fighting Equipment (including erection works) Consulting services	As planned As planned
		(Additional scope) Replacement of related equipment (95 substations) station transformer, circuit breaker, lighting arrestor, isolator, current transformer, potential transformer, control & relay panel, power & control cable, battery set, battery charger, alternating current (AC) distribution box (including erection works)
2. Project Period	Sep. 2007–Sep. 2010 (37 months)	Sep. 2007–Mar. 2015 (91 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 13,975 million yen 6,737 million yen (2,504 million Rupee) 20,712 million yen 16,749 million yen 1 Rupee＝2.69 yen (As of May 2007)	 12,070 million yen 1,323 million yen (723 million Rupee) 13,393 million yen 12,070 million yen 1 Rupee＝1.83 yen (Average of IMF Rate between 2008 and 2014)
4. Final Disbursement	November 2014	

India

FY2016 Ex-Post Evaluation of Japanese ODA Loan Project

"Purulia Pumped Storage Project (I) (II) (III)"

External Evaluators: Yumiko Onishi and Ryujiro Sasao, IC Net Limited

0. Summary

In the 1990s, India achieved high economic growth and power demand was increasing along with it. As was the case across India, meeting the peak-time power shortage was an issue in the State of West Bengal. Given such situation, this project was expected to mitigate the shortage in peak-time electricity by constructing a pumped storage with an output of 900 MW and related transmission and substation facilities in Purulia District of West Bengal. From the time of the project appraisal to the ex-post evaluation, the power sector has always held an important position in the development policies of the Government of India and the Government of West Bengal. As in the case at the time of the appraisal, the peak-time power demand is ever increasing at the time of the ex-post evaluation. Therefore, it is necessary to strengthen the power supply capacity hereafter as well. The project objective is consistent with Japan's ODA policy and the relevance of the project is high. Outputs were implemented mostly as planned. With regard to the project cost, because of the fluctuation of the exchange rate during the implementation period, the project was implemented with about 60% of the planned cost. On the other hand, the project period exceeded the plan by 52 months because of the delay in obtaining forest clearance. As a result, the efficiency of the project is fair. Regarding the effectiveness of the project, the operation and effect indicators set at the time of the appraisal have been mostly achieved. A certain degree of impacts is also seen in reducing peak-time power shortage in West Bengal, improving the operational efficiency of coal fired thermal power plants, revitalizing industries through increased power supply, and improving the lives of people. No negative impact has been seen with regard to the natural environment, and the effectiveness and impact of the project are high. No particular problems have been seen in institutional, technical and financial aspects and the current status of the project's operation and maintenance; therefore, the sustainability of the project is high.

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

1. Project Description

Project Location

Purulia Lower Reservoir

1.1 Background

India achieved high economic growth at an annual average of 6–7% in the 1990s, and power demand, which supported the country's economic activities, was increasing along with it. However, shortage of peak-time power supply became a roadblock for industrial development and improving the standard of living. Thus, mitigating the power shortage was an urgent issue across India. Particularly in the State of West Bengal, reducing the gap between peak-time supply and demand was an issue. In the state, the estimated peak-time demand was 2,237 MW in fiscal year (FY) 1992 against the peak-time supply of 2,180 MW, causing power shortage. In the same fiscal year, the estimated electricity requirement was 6,525 GWh but the electricity sold by the West Bengal State Electricity Board was 6,189 GWh. Given such situation, scheduled power cuts were enforced mostly during peak time for two hours a day and affected the lives of the people in the state significantly. In addition, the state's energy mix was not balanced because 95% or more of the state's electricity was supplied by thermal power. This was due to slow development of hydropower while the north-western part of the state was rich in coal.

1.2 Project Outline

The objective of this project is to improve peak-time power supply gap and operational efficiency of coal fired thermal power plants by constructing a pumped storage with the capacity of 900 MW (225 MW x 4 units) with related transmission and substation facilities in Purulia District located about 300 km north-west of Kolkata, in the State of West Bengal, in eastern India, thereby contributing to the improvement of people's lives and economic development of the region.

Loan Approved Amount/ Disbursed Amount	I 20,520 million yen / 20,388 million yen II 23,578 million yen / 23,534 million yen III 17,963 million yen / 13,316 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	I December 1994 / February 1995 II March 2004 / March 2004 III March 2006 / March 2006
Terms and Conditions	Interest Rate 2.6% (I), 1.3% (II and III) Repayment Period 30 years (Grace Period 10 years) Conditions for Procurement General untied
Borrower / Executing Agency	The President of India / West Bengal State Electricity Distribution Company Limited[1]
Project Completion	February 2008
Main Contractor(s) (Over 1 billion yen)	Mitsui & Co., Ltd. (Japan), Mitsubishi Heavy Industries, Ltd. (Japan), Taisei Corporation (Japan), TM T&D Corporation (Japan) / Marubeni Corporation (Japan) (JV), KEC International Ltd. (India), Jyoti Structures Ltd. (India) / Kalpataru Power Transmission Ltd. (India) (JV)
Main Consultant(s) (Over 100 million yen)	Water and Power Consultancy Services (India) Limited (India) / Electric Power Development Co., Ltd (Japan)
Feasibility Studies, etc.	Overseas Economic Cooperation Fund (OECF) provided an Engineering Service (E/S) Loan in 1988.
Related Projects	Japanese ODA Loan ・ Purulia Pumped Storage Project (E/S) (February 1988) ・ Ghatghar Pumped Storage Project (December 1988) ・ Bakreswar Thermal Power Station Construction Project (I) (II) (January 1994, December 1997) ・ Bakreswar Thermal Power Station Unit 3 Extension Project (I) (II) (February 1995, March 1999) ・ Srisailam Left Bank Power Station Project (I) (II) (III) (February 1988, February 1995, December 1997) ・ Bakreswar Thermal Power Station Units Extension Project (March 2003) Asian Development Bank (ADB) ・ Power Sector Reform Project (2003) Department for International Development (DFID) ・ West Bengal Public Sector Enterprise Reform Programme (2004)

[1] The executing agency was originally the West Bengal State Electricity Board. Because of the unbundling in 2007, the project was handed over to West Bengal State Electricity Distribution Company Limited.

2. Outline of the Evaluation Study

2.1 External Evaluators

Yumiko Onishi and Ryujiro Sasao, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September 2016 – October 2017

Duration of the Field Study: January 17–25, 2017 and April 10–14, 2017

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of India

At the time of the Tranche I appraisal in 1995, the Eighth Five-Year Plan (April 1992–March 1997) of the Government of India allocated 18% of the Indian rupees (INR) 4,341 billion public work investment budget to the power sector (budget allocation to the energy sector as whole including the power sector was 26%). Similarly, in the Five-Year Plan of West Bengal, the power sector had a share of about 30% out of the INR 93.3 billion public work investment budget of the state government. At the time of the Tranche II and III appraisals, the priority for the power sector was high and the project was consistent with the development plans of the Government of India and the West Bengal State government.

As explained in the later section "3.1.2 Consistency with the Development Needs of India," at the time of the ex-post evaluation, the gap between peak-time demand and supply has been reduced in West Bengal. However, the Twelfth Five-Year Plan (April 2012–March 2017) still regards the development of new power sources including those for peak load as an important matter. According to West Bengal State Electricity Distribution Co. Ltd (WBSEDCL), the executing agency, the target for the power sector in West Bengal is as follows.

- Twenty-four-hour Power supplies
- Provide access to stable power to all households within 2017
- Developing agricultural feeder to promote agriculture
- Developing adequate power generation to cater for future industrial load growth.

In addition, because this project as a pumped storage contributed to reducing the gap between peak-time demand and supply as originally expected, the State of West Bengal plans to build a new pumped storage with the capacity of 1,000 MW to meet the future peak-time demand. As

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

[3] ③: High, ②: Fair, ①: Low

can be seen, the project is consistent with the development plans of the Government of India and the West Bengal State government at the time of the ex-post evaluation.

3.1.2 Consistency with the Development Needs of India

In West Bengal, both power supply capacity and electricity at peak hours were inadequate because of shortage of power generation facilities, low operational efficiency of thermal power plants, low capacity of coal fired thermal power plants for peak time, and high transmission and distribution losses, all of which were prevalent before the Tranche I appraisal. To solve these issues, it was necessary to secure a balanced energy mix through developing hydropower while reducing the peak-time power supply gap by constructing pumped storage, which corresponds to the peak-time power supply.

Table 1: Power Supply and Demand in West Bengal State

	2009	2010	2011	2012	2013	2014	2015
Peak demand (MW)	5,850	6,162	6,592	6,832	7,180	7,600	7,876
Annual growth rate of peak demand	13.0%	5.3%	7.0%	3.4%	5.1%	5.9%	3.6%
Peak availability (MW)	5,840	6,112	6,532	6,734	7,120	7,540	7,713
Gap between peak-time demand and availability (MW)	▲10	▲50	▲60	▲98	▲60	▲60	▲163
Percentage of gap between peak-time demand and availability	▲0.2%	▲0.8%	▲0.9%	▲1.4%	▲0.8%	▲0.8%	▲2.1%
Electricity requirement (GWh)	33,750	36,481	38,679	44,151	44,935	48,429	49,238
Electricity availability (GWh)	29,415	33,052	33,996	43,762	44,718	48,192	49,055
Annual growth rate of electricity requirement	7.7%	8.1%	6.0%	6.8%	1.8%	7.8%	1.7%
Gap between electricity requirement	▲4,335	▲3,429	▲4,683	▲390	▲217	▲237	▲183

and availability (GWh)							
Percentage of gap between electricity requirement and availability	▲14.7%	▲10.4%	▲13.8%	▲0.9%	▲0.5%	▲0.5%	▲0.4%

Source: Data from FY 2009 to 2011 are from the WBSEDCL Annual Statistics Report and those for FY 2012 onwards are from the Central Electricity Authority.

Table 1 shows the data related to electricity supply and demand for West Bengal from 2009. While peak-time supply capacity has been strengthened, the demand has kept increasing in recent years. Similarly, electricity requirement is also increasing. While power was being purchased from the central government and other state governments to respond to the situation, the average gap between peak-time supply and demand in term of installed capacity from 2009 to 2015 was minus 1%, and the power shortage has been almost resolved. The gap between electricity requirement and availability was minus 14.7% in 2009, but it decreased to minus 0.4% in 2015. Thus, the gap is decreasing. According to WBSEDCL's estimate, the future peak-time demand will continue to grow and it will reach 9,690 MW by 2026. The project meets the peak-time electricity requirement and has been consistent with the development needs of West Bengal from the time of the appraisal to the ex-post evaluation (See "3.4 Impacts" for details).

3.1.3 Consistency with Japan's ODA Policy

At the time of the Tranche I appraisal, development of economic infrastructure was one of the important areas for Japan's ODA policy for India. Particularly, it focused on supporting infrastructure development, mostly power and transport, which was a priority for the Five-Year Plan of India[4]. Thereafter, during the appraisals of the Tranche II and III in 2004 and 2006, development of economic infrastructure was an important area for JICA's Medium-Term Strategy for Overseas Economic Cooperation Operations at the time for India, and the project was consistent with Japan's ODA policy.

As described above, the project has been highly relevant to the development plan and needs of both India and West Bengal, as well as Japan's ODA policy. Therefore, its relevance is high.

[4] From the website of the Ministry of Foreign Affairs of Japan, "Country-wise Development Assistance (1991–1998)."

3.2 Efficiency (Rating:②)

3.2.1 Project Outputs

Table 2 shows the planned and actual outputs of the project.

Table 2: Planned and Actual Outputs

Plan	Actual
① Upper dam and reservoir: rockfill dam, dam height 71 m, dike length 1,505 m, total storage capacity 16.5 million m^3	As planned
② Lower dam and reservoir: rockfill dam, dam height 95 m, dike length 310 m, storage capacity 16 million m^3	As planned
③Penstock: 2 lanes, length 256.57 m, inner diameter 7.7 m	As planned
④ Power station: underground width 22.5 x length 157.0 x height 47.7 m, output 900 MW (225 MWx4 units)	As planned
⑤Switchyard (no details)	Switchyard: above ground, GIS floor area 45 x 152 m
⑥ Transmission: 2 routes Power station – Durgapur Substation: 400 kV, double circuit lines, length 160 km Power station – Arambagh Substation: 400 kV, double circuit lines, length 150 km	Power station – Durgapur Substation: 400 kV, double circuit lines, length 185 km Power station – Arambagh Substation: 400 kV, double circuit lines, length 209 km
⑦ Substations: 2 locations Durgapur Substation: 400 kV, Shunt reactor 4 x 50 MVAR Arambagh Substation: 400 kV, Shunt reactor 4 x 50 MVAR	As planned
⑧ Consulting services: 78 M/M (detailed design)	851 M/M (detailed design, bidding assistance, construction management)

Source: Documents provided by JICA and WBSEDCL

The infrastructure component of the project has been implemented almost as planned. The change from the plan is the length of transmission lines. This change is a result of adjustment at the time of the detailed design based on the situation on the ground.

With regard to consulting services, at the time of the Tranche I appraisal, 78 man/month (M/M) was planned only for detailed design. However, at the time of the Tranche II appraisal, the number of personnel was being reduced as part of the unbundling of the executing agency (see "3.5 Sustainability" for details). Thus, construction management was included in the consulting services although the executing agency had planned to be responsible for it. Therefore, the consulting services amounted to 851 M/M.

At the time of the Tranche III appraisal, as part of assistance for institutional strengthening, the following items were added to the project's scope: a) strengthening of Availability Based Tariff (ABT) system on power trading business among states, b) promotion of Total Quality

Management (TQM), and c) development of a transmission system database. Nevertheless, citing the unbundling of the executing agency was nearing, the additional items were not implemented using the funds from the Japanese ODA Loan. Eventually, a section was set up within WBSEDCL after unbundling and the necessary mechanism for promoting ABT was established. TQM was implemented as part of the routine work of the consulting services mentioned above. The executing agency also took up TQM activities on its own (see "3.5 Sustainability" for details). A database for the transmission system has not been developed by the time of the ex-post evaluation; however, according to WBSEDCL, it is being prepared. The addition of the items above to the scope for institutional strengthening should have been considered carefully in the Tranche III appraisal. However, it was reasonable to exclude them from the project considering the changes surrounding the project.

3.2.2 Project Inputs

3.2.2.1 Project Cost

Table 3 compares the planned project cost from the Tranche I appraisal with the actual one. As shown in the table, the project cost was within the planned amount. Sixty-five percent of the Japanese ODA Loan was used for a dam and other main civil works and procurement of equipment including hydropower related facilities. The funds from the executing agency were spent for tax, land acquisition, and administrative cost.

Table 3: Planned and Actual Project Cost

	Plan	Actual	Actual against Plan
Total project cost	JPY 107,150 million	JPY 60,256 million	56%
Japanese ODA Loan	JPY 88,027 million	JPY 57,238 million	65%

Source: Documents provided by JICA and WBSEDCL

The major reason that the actual project cost was far below the planned one was the substantial fluctuation in the exchange rate during the project period. Between 1995 and 1998, INR 1 was equivalent to around JPY 3, but it became less than JPY 2.5 around 2003 when the project implementation was in full swing. Further, it became less than JPY 2 from 2009. It is difficult to foresee at the time of project planning any fluctuation of the exchange rate; thus, it is fair to say that the project cost was estimated properly. Other reasons that the project cost was reduced include the following: the project was recognized as a Mega Project of the Government of India and received some tax exemptions; and some of the contractors' bidding prices were below the estimated prices.

3.2.2.2 Project Period

According to the Tranche I and II appraisals, the completion of this project was defined as beginning of commercial operation of all four units. As the institutional strengthening component was added in the Tranche III appraisal, project completion was then defined as the completion of the activities related to the component. However, as described earlier, institutional strengthening was not implemented in the project. Therefore, as defined originally, start of commercial operation means project completion. At the time of the Tranche I appraisal, the planned project period was 105 months between the Loan Agreement (L/A) scheduled in July 1994 and March 2003.

The actual L/A was in February 1995, and Unit 1 to 4 became commercially operational in January 2008, February 2008, November 2007 and October 2007 respectively. The project completion was February 2008, making the project period 157 months (i.e., 150% of the plan). It means that there was a delay of 52 months from the original plan. The biggest reason is that it took time for processing of acquiring forest land (forest clearance) needed for construction of various project facilities. Out of total 373 ha of the forest land required for the project, 233 ha was provided based on the clearance from the Ministry of Environment and Forest. However, no clearance was given for the remaining 140 ha until 2002. Forest clearance is administered by the Ministry of Environment and Forest and it would have been difficult for the executing agency to avoid delays arising out of this process. While awaiting forest clearance, the project tried to reduce the delay by proceeding with the bidding process and part of the preparatory civil works. The main civil work was scheduled to take 75 months, but it actually took 60 months. The project also tried to reduce the project period even after obtaining the clearance.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Table 4 shows the internal rate of return (IRR) of the project calculated at the times of the appraisal and the ex-post evaluation along with assumptions. The IRR calculated at the time of the appraisal is from Tranche III. The IRR at the time of the ex-post evaluation was recalculated using the same assumptions as the ones used for the appraisal.

Table 4: IRR and Assumptions

	Financial IRR	Economic IRR
IRR	Appraisal: 5.3% Ex-post evaluation: 11.1%	Appraisal: 10.4% Ex-post evaluation: 9.1%
Cost	Project cost, operation and maintenance cost, cost of pumped-storage power generation	Project cost (excluding taxes), operation and maintenance cost, cost of pumped-storage power generation
Benefit	Revenue from sale of energy	Savings on purchasing alternative energy
Project life	25 years	

Financial Internal Rate of Return (FIRR)

The main reason that the FIRR became higher at the time of the ex-post evaluation was as follows: the cost applied for calculating FIRR was only about 40% of the amount estimated at the time of the appraisal both because the project cost was reduced by the exchange fluctuation, and because the amount of energy used for pumping water during off-peak hours was less than what was estimated. In addition, with regard to benefit, the sales tariff for electricity was INR 4.20/KWh at the time of the appraisal; however, it was INR 5.41/KWh (average of 2008–2016) at the time of the ex-post evaluation, contributing to the higher FIRR.

Economic Internal Rate of Return (EIRR)

For calculating EIRR, although taxes are excluded from the project cost, the calculation of cost is basically the same as in the case of FIRR. Thus, when recalculated at the time of the ex-post evaluation, the cost has become about 40% of the amount calculated at the time of the appraisal. Benefit is the saving from alternative energy purchase replaced by power generated by the Purulia Pumped Storage Power Station. For calculating the cost of alternative energy purchased, the actual power generated from the Purulia Pumped Storage Power Station was used until 2016. Thereafter, it was calculated using 1,515 GWh/year, which is the expected power generation from the project. EIRR has become slightly less than the estimate at the time of the appraisal because of less power generation than the plan and the tariff for power purchase has become INR 3.53/KWh (average of 2008–2016) instead of INR 4.20/KWh at the time of the appraisal.

Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness[5] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

Effectiveness has been evaluated with an emphasis on the operation and effect indicators that were established at the time of the Tranche II appraisal[6]. Table 5 shows the target and actual operation and effect indicators for the project. For the project, the target year is fixed as two years after the project completion; therefore, figures from 2010, which is two years after the project completion, were used for evaluating the level of achievement.

Table 5: Target and Actual Figures for Operation and Effect Indicators

	Target	Actual		
	2010	2008	2009	2010
	2 Years after Completion	Completion Year	1 Year after Completion	2 Years after Completion
Unplanned outage hours (hours/year)	258	5	73	892
Planned outage hours for inspection and repair (hours/year)	42	2	0	41
Comprehensive circulating efficiency (%)	75.5	77.9	78.0	77.7
Net electric energy production (GWh/year)	700	668	863	872
Maximum output (MW)	900	900	900	900

Source: Documents provided by JICA and questionnaire survey to the executing agency

The target for unplanned outage hours, one of the operation indicators, was fixed at a total of 258 hours including 168 hours of mechanical failure, 0 hours of human error, and 90 hours caused by other factors. The actual figure in 2010 is 892 hours, which is 3.5 times the target. The ones in 2011 and 2012 are also 355 hours and 672 hours respectively, significantly exceeding the target. This was caused by unexpected breakdown of generators and turbines and the significant amount of time that it took to repair them. According to WBSEDCL, all the unplanned outage hours were caused by mechanical failures. Planned outage hours for inspection and repair in 2010 were within the target. However, after 2010, because of overhaul, it has significantly exceeded the target at 198 hours in 2011 and 795 hours in 2013 (see Table 6). Comprehensive circulating efficiency, which is an indicator to determine the performance of the power plant, has been in line with the target.

[5] Sub-rating for Effectiveness is to be put with consideration of Impact.

[6] Operation and effect indicators were set at the time of the Tranche II appraisal since they were not set at the time of the Tranche I appraisal.

Table 6: Actual Outage Hours of Purulia Pumped Storage Power Plant

Unite: hours/year

	2011	2012	2013	2014	2015
Unplanned outage hours	355	627	5	108	405
Planned outage hours for inspection and repair	198	40	795	602	109

Source: WBSEDCL

At the time of the Tranche II appraisal in 2004, the Purulia Pumped Storage Power Plant was to be connected to the regional grid once its operation started. Therefore, the target for net electric energy production was fixed at 1,721.4 GWh/year. However, the national grid was introduced gradually in India, and the power plant was connected to the national grid by the time of the project completion. In India, the Central Electricity Authority (CEA) determines annually the amount of power to be generated by each power plant. Based on this generation plan and instructions from the Regional Load Despatch Center, the power plants generate power. The Purulia Pumped Storage Power Plant must also comply with the CEA's plan instead of generating power according to its own decision. Thus, it seemed appropriate to use the net electric energy production determined by the CEA for the Purulia Pumped Storage Power Plant, and compare actual figures with the target set by the CEA. As a result, the target was achieved in 2010. As shown in Table 7, the project met the target of net electric energy production since 2010 with the exception of 2015.

Table 7: Net Electric Energy Production of Purulia Pumped Storage Power Plant

Unit: GWh/year

	2010	2011	2012	2013	2014	2015
Target	700	700	700	700	1,200	1,200
Actual	872	759	791	778	1,408	1,048

Source: WBSEDCL

In addition, data on the capacity and availability factors of the Purulia Pumped Storage Power Plant were collected as reference indicators. Table 8 shows annual data for these indicators. The capacity factor has no baseline figure for comparison. Regarding the availability factor, the national average of hydropower plants published by the CEA in 2015 was 87.9%, and the Purulia Pumped Storage Power Plant has been maintaining it above the average in the past.

Table 8: Capacity Factor and Availability Factor[7]

Unit: %

	2008	2009	2010	2011	2012	2013	2014	2015
Capacity factor	39	50	51	44	46	45	82	61
Availability factor	97	100	99	93	93	91	92	77

Source: WBSEDCL

The project has achieved four out of the five operation and effect indicators. Particularly, the net electric energy production meets the instruction given by the CEA. Thus, it is fair to say the project is generating the expected effects.

3.3.2 Qualitative Effects (Other Effects)

It is fair to say that, based on their content, qualitative effects expected at the time of the appraisal are impacts. Therefore, they are evaluated as impacts in the following section.

3.4 Impacts

3.4.1 Intended Impacts

The intended impacts of the project were as follows: a) reducing peak-time power shortage in West Bengal; b) improving the operational efficiency of nearby coal-fired thermal power plants; c) revitalizing industries by increased power supply; and d) improving the lives of people[8].

a) Reducing peak-time power shortage in West Bengal

Power generated from the project is limited when it is seen against the total electricity availability in West Bengal State. However, as shown in Table 1 regarding the peak-time power demand supply situation of the state, there was 163 MW of peak-time power shortage in 2015. The project has the maximum output of 900 MW and holds about 12% of peak-time output for West Bengal in recent years. Accordingly, it can be said that the project's supply capacity holds an important position.

b) Improving the operational efficiency of nearby coal-fired thermal power plants

Regarding improvement of the operation efficiency for coal-fired thermal power plants, it was assumed to use the power generated from Units 4 and 5 of the Bakreswar Thermal Power Station, which was under construction at the time of the appraisal, for pumping water for the Purulia Pumped Storage Power Plant. However, in reality, the power from the Bakreswar Thermal Power Station is not directly supplied to the Purulia Pumped Storage Power Plant for

[7] WBSEDCL calculates the factors as follows: capacity factor (%) = annual net electric energy production / maximum electric energy production x 100; and availability factor (%) = number of days operated / 365 days x 100.

[8] At the time of the appraisal, it was "improving the lives of people through revitalization of industries." Because it is difficult to identify the direct contribution of the project to industrial revitalization, it has been changed to improving the lives of people through electrification.

pumping. The power is supplied through the grid; thus, it is not appropriate to take a specific thermal power plant's capacity factor and other data to explain the improvement in the operational efficiency resulted from the project. For reference, the recent average capacity factor of five thermal power plants belonging to the same regional grid with the project is compared to multiple thermal power plants that the executing agency was operating in 1992. The average of these multiple thermal power plants was 28.7% and there was a significant improvement as shown in Table 9.

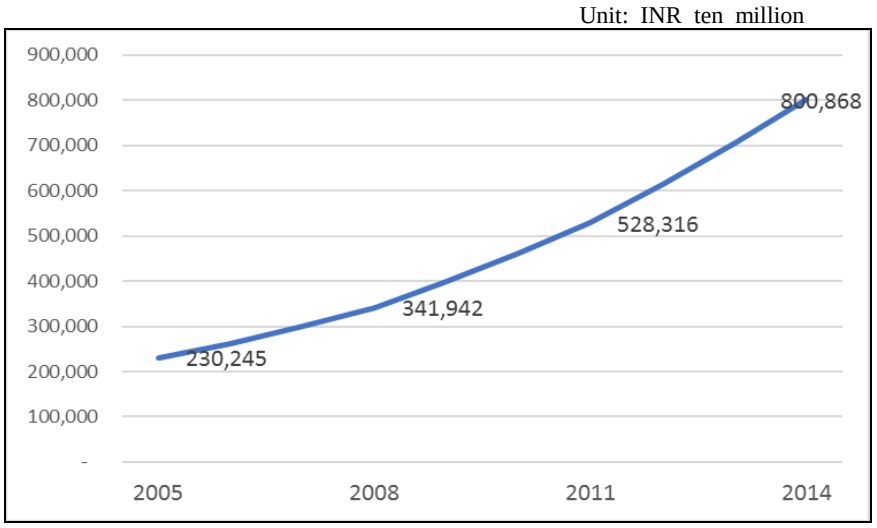
Table 9: Capacity Factor of Thermal Power Plants Belonging to the Same Grid as the Project

Thermal Power Plant	Average Capacity Factor (2007–2015)
Bakreswar	83%
Kolaghat	64%
Bandel	45%
Santaldih	58%
Sagardighi	67%

Source: WBSEDCL

c) Revitalizing industries through increased power supply

Figure 1 shows changes in GDP of West Bengal State between 2005 and 2014. Although it is difficult to specify the direct contribution from the project, it gives an indication that the state's economy has been growing in a stable manner.



Source: West Bengal State Government

Figure 1: Changes in GDP of West Bengal State

In addition, at the time of the ex-post evaluation, interviews with 10 business units[9] were conducted in the town of Baghmundi in Purulia District, the project site. All the business units interviewed felt that the power supply became stable from around 2004. Although it is not the direct impact from the project, because of electrification in the area and stable power supply, they also felt that becoming able to operate after the sunset was a major improvement. Moreover, there seemed to be a temporary boost in the local economy because many project-related people came from outside and spent money and the local residents were employed by the project during the implementation.

d) Improving the lives of people

It is difficult to specify the geographical areas benefited by the project because the power generated from the project is supplied to the national grid. In addition, it is difficult to determine the project's direct contribution to industrial revitalization. Therefore, in the ex-post evaluation, the changes in living standards of the local residents that arose from power generation (i.e., electrification) was surveyed. The Baghmundi area was electrified prior to the project and the project did not establish any distribution network in this area. By contrast, the rate of electrification in Purulia district increased from 64.2% in 2001 to 99.9% since 2012. To confirm the changes in living standards of the electrified households in the area, a rapid beneficiary survey was conducted covering the households electrified since 2007 in the project site[10]. In the area, there is a large Scheduled Tribe population and eight out of the ten households surveyed were below the poverty line. Therefore, although they are electrified, these households had only bulbs for lighting and none of them owned electric appliances such as TV and refrigerator. Under such circumstances, they felt the biggest impact of electrification has been the fact that children can study after the sunset. Some of the women felt that their income increased a little because they became able to do handiwork even after the sunset.

Figure 2: Settlement in the Project Site

Figure 3: Compensatory Afforestation Site

[9] Besides companies, it includes unregistered businesses and shops run by individuals.
[10] Households for the survey were selected from electrified houses with someone at home starting from the house located at the center of villages close to Baghmundi by moving away from the main road. Two households were selected in each of the five target villages.

3.4.2 Other Positive and Negative Impacts

a) Impacts on the Natural Environment

The project site is situated at the edge of Ayodha Hills, which is a habitat for some of the protected species in India including Indian Elephants. According to the survey conducted by the Indian Zoological Survey at the time of the project planning, the area was reportedly not an important habitat for the protected species.

The project was implemented after obtaining the environmental and forest clearances of the Government of India. To monitor the impact on the natural environment during the project implementation, the Environmental Monitoring Committee was established in 1996. Among the committee members were the state's Forest Department, Environment Department, Schedule Tribe Development Department, and Power Department. Until 2007, the year of the construction completion, the executing agency reported to the committee every six months the situation on noise, vibration, soil quality, air quality, water quality and flora and fauna of the target area. No particular problem was reported during the monitoring by the committee. According to WBSEDCL, until 2016, the committee conducted site surveys including during the operational phase when needed.

Regarding the forest land acquired from the state government for the construction of project facilities, it was obligatory to afforest an alternative area of the same size. By the site survey conducted at the time of the ex-post evaluation and through documents, it was confirmed that the Forest Department did compensatory afforestation in the same size of acquired land for 373 ha. Moreover, as part of environmental consideration, the Forest Department was to construct water holes for the wild animals, establish a corridor for migration between the upper and lower dams, develop fodder, and implement watershed management. According to the interview with the Forest Department, because the corridor between the upper and lower dams existed prior to the project, new one was not established; the Forest Department undertook other measures mentioned above. Fodder development and watershed management was implemented originally around 2001 by the Forest Department. Measures, such as soil conservation, that require maintenance were later taken up by other government schemes. Monitoring of siltation is conducted at intake point from the Kistbazaar River. Transmission lines established by the project are not passing through the protected area or the habitats of rare species; thus, no unintended negative impact on the environment was confirmed.

In a rapid beneficiary survey conducted at the time of the ex-post evaluation, the situation on air quality, water quality, waste, noise, vibration and odour during and after the project was investigated. The figure below shows the results on beneficiaries' views regarding the situation during the construction phase.

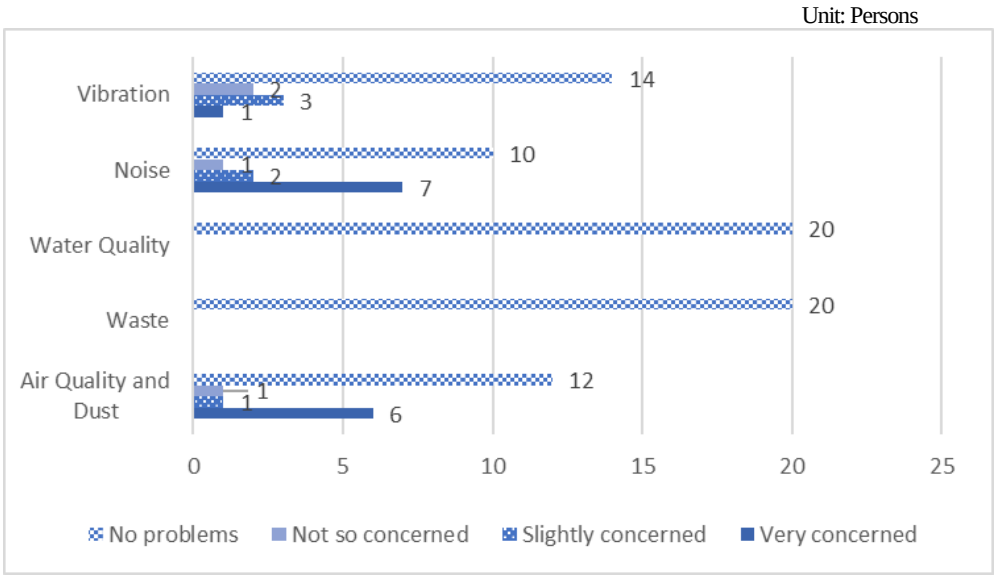


Figure 4: Beneficiaries' Views on Environment during the Construction Phase

There was a little variation in responses on the situation on vibration, noise and air quality and dust. Mainly the households close to the upper dam were concerned about noise and dust around the construction site and vibration caused by dynamite. No health-related issues arising out of noise and dust were reported. As all the respondents said 'there are no issues' for all these parameters after the project completion, it is fair to say there is no specific problem now. For filing complaints against the project, no specific system was established in the project. At the same time, in interviews with local residents, they stated that, if there were problems, they would be able to bring their concerns to the executing agency either directly or through local politicians and administrations.

b) Land Acquisition and Resettlement

For the project, in addition to the 373 ha of forest land, 24 ha of private land and 28 ha of government land were acquired, making the total of 425 ha. No resettlement occurred. The private land acquired from local residents had been used mainly as agriculture land. For acquisition of private land, compensation was paid to the affected households through district administration office by adding30% to the market price at that time in accordance with the Land Acquisition Act of India. In 2004, the executing agency conducted a survey on the affected households to check the situation on their livelihood. However, since 2004, no similar survey to monitor the situation was done. According to interviews with three of the affected households at the time of the ex-post evaluation, they opined that parting with the agriculture land posed a burden on the household income. However, they also seemed satisfied with the compensation given for the land.

c) Unintended Positive/Negative Impact

The upper and lower dams constructed by the project are discharging water to the existing Loharia dam downstream. According to WBSEDCL and the Irrigation Department, the completion of the Purulia upper and lower dams resulted in stable supply of irrigation water. Particularly, cropping areas during the dry season seem to have increased slightly. However, the changes in the volume of irrigation water and agricultural outputs before and after the project in the irrigated villages could not be confirmed quantitatively.

In addition, as the project was situated at the edge of Ayodha Hills, after the construction of the dams, local tourists using the project area as a gateway for Ayodha Hill tourism increased. Because of the increase in the number of visitors, stalls selling souvenirs and snacks were set up around the upper dam. However, according to residents in the area nearby, the people who run the stalls came from other areas. The dumping of garbage by visitors appeared to be damaging the landscape as well.

The project has largely achieved its objectives. Therefore, the effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

At the time of the Tranche I appraisal, the executing agency for the project was the West Bengal State Electricity Board (WBSEB), which was established in 1955 in accordance with the Electricity Supply Act of 1948. It was responsible for generation, transmission and distribution of power in the State under the West Bengal Power Department. Thermal power plants were already transferred to the West Bengal Power Development Corporation established in 1985. As part of the power sector reform implemented by the state government, West Bengal Rural Energy Development Corporation was established in 1998, and electrification and power distribution in the rural areas were being transferred to the corporation. In 2007, because of the unbundling, WBSEB was divided into West Bengal State Electricity Distribution Company Limited (WBSEDCL) and West Bengal Sate Electricity Transmission Corporation Ltd. The project was transferred to WBSEDCL.

According to the plan of the Tranche III appraisal prior to the unbundling, the Purulia Pumped Storage Power Plant was to be manned by 164 personnel for its operation and maintenance. Table 10 indicates the planned staffing, sanctioned posts and actual deployment at the time of the ex-post evaluation.

Table 10: Operation and Maintenance Staffing for the Project

	Plan (2006)	Sanctioned	Deployed
		(As of December 2016)	
Engineer	82	29	49
Technical staff	50	70	43
Professional staff (excluding engineers)	12	17	10
Non-technical staff	20	19	21
Total	164	135	123

Source: WBSEDCL

The number of operation and maintenance personnel planned at the time of the Tranche III appraisal was 164, which took the unbundling into consideration. This has included the personnel for maintenance as well. However, maintenance is actually outsourced, and the total number of personnel deployed indicated in Table 10 does not include the maintenance personnel. The number of outsourced personnel is approximately 34; if this is added to the deployed personnel, the actual staffing is almost in line with the plan. According to WBSEDCL, there was temporary shortage of staff immediately after the unbundling; however, currently, the institution as a whole faces no issues caused by the unbundling.

For operation and maintenance of the Purulia Pumped Storage, the necessary number of personnel is secured, and there is no problem on institutional aspects of operation and maintenance.

3.5.2 Technical Aspects of Operation and Maintenance

Table 11 shows the level of education required for personnel engaged in operation and maintenance of the project and the actual education level of deployed personnel. The personnel engaged in the operation and maintenance of the project have the required educational background.

Table 11: Educational Level of Operation and Maintenance Staff

	Required Education	Education of Deployed Staff
Engineer	Graduate Engineer	M-tech, Graduate Engineer
Other technical staff	Diploma, ITI	Graduate Engineer, Diploma, ITI
Professional staff (excluding engineers)	Chattered and Cost Accountancy, Personal & Business Management	Chattered and Cost Accountancy, Personal & Business Management
Non-technical staff	Graduate	Graduate, Inter Pass

Source: WBSEDCL
Note: Educational level indicated in each cell is listed in order of higher degree from left to right.

In the project, training for operation and maintenance of a power plant and related equipment was conducted during the implementation phase on the site and in Japan. Generally, in

WBSEDCL, regular training is conducted within the institution to maintain and improve the technical standards of the personnel for refresher training and introduction of new technologies. However, training on pumped-storage power generation is not conducted in WBSEDCL; thus, technical skills required for operation and maintenance of the project is acquired through on-the-job training and external training arranged as required. According to WBSEDCL, personnel engaged in the operation and maintenance of the Purulia Pumped Storage possess necessary technical skills and there are no issues with technical aspects.

Manuals on operation and maintenance are prepared for each machinery and equipment. Most of the manuals were prepared by the manufacturers at the time when the power station started operating. Because no need to revise the manuals has been seen, the same manuals have been in use so far. Inspections for generators, turbine and other main equipment are conducted following the schedule prescribed by the manufacturers and the inspection record is also maintained.

For TQM, which was part of the institutional strengthening mentioned in "3.2 Efficiency," the activities are carried out in WBSEDCL separately from the project. To improve the quality of electricity supplied to the consumers, Quality Customer Care Centers (QCCC) were established and 120 QCCC have so far been established across the state. In addition, a helpdesk has been set up in 500 customer care centers and award for good performing QCCC is initiated by holding regular competition among QCCC.

Personnel have necessary education and technical skills. Efforts are made to maintain and improve their technical standards, and there is no problem in technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

Table 12 shows the budget and expenditure (excluding expenses on personnel and administration) for the operation and maintenance of the Purulia Pumped Storage from 2013 to 2015. For the budget of the power plant, the required amount is first requested to the WBSEDCL headquarters and the budget for each fiscal year is distributed after the assessment by the headquarters. According to the power station personnel, sufficient budget has been provided so far and there has been no incident of budget shortage for operation and maintenance.

Table 12: Operation and Maintenance Budget and Expenditure of Purulia Pumped Storage

Unit: INR million

	2013	2014	2015
Budget	352	273	588
Expenditure	192	233	436

Source: WBSEDCL

Table 13 shows the financial statement of WBSEDCL from 2012 to 2015. It has been reporting profit in the last four years. In regards to the current ratio, it seems there is no issue in short-term repayment. Although the debt equity ratio officially reported by WBSEDCL is high, it is because long-term borrowing is also included in the debt when calculating the debt equity ratio. WBSEDCL is still taking up projects to improve the electrification rate for households and deliver stable power supply, and it seems the borrowings on these projects are high.

Table 13: Financial Statement of WBSEDCL

Units: INR million (current ratio and debt equity ratio are in real numbers)

	2012	2013	2014	2015
Total Assets	279,397	322,153	361,066	406,177
Share Capital	57,080	59,257	22,567	22,567
Fixed Assets	129,867	146,301	161,973	173,662
Non-Current Liabilities	130,656	151,304	161,648	174,255
Current Assets	90,583	133,077	133,519	179,862
Current Liabilities	91,660	111,592	127,158	145,719
Current Ratio	0.99	1.19	1.05	1.23
Debt Equity Ratio	6.23	7.10	7.53	8.18
Total Revenue	174,999	178,799	195,833	186,113
Expenses	173,915	178,503	195,533	185,761
Net Profit	817	191	198	216

Source: WBSEDCL Annual Report

There is a rating for domestic power corporations (performance rating) commissioned by the Indian Ministry of Power and conducted by a rating agency since 2013. WBSEDCL ranked high at fifth out of 39 corporations in the first overall rating in 2013. In the fourth overall rating of 2015, WBSEDCL ranked 15th out of 40 corporations. Although the ranking came down compared to 2013, the fact WBSEDCL's dependency on subsidy is very limited has been highly regarded in 2015. Detailed information on the amount of subsidy WBSEDCL receives could not have been collected. However, according to the Annual Report, it is clear that no subsidy was provided to supplement WBSEDCL revenue in FY 2014.

It seems that the budget for operation and maintenance of the Purulia Pumped Storage is provided sufficiently, and the executing agency's financial status is relatively good.

3.5.4 Current Status of Operation and Maintenance

As explained earlier, the regular inspections (daily, weekly and monthly) are conducted in accordance with the prescribed schedule. Although there was breakdown of generators in 2010 and there have been several breakdowns and other issues thereafter, necessary repairs have been done. According to WBSEDCL, although it takes time to procure some of the spare parts as they

need to be brought from Japan, there is no issue with securing the spare parts. At the time of the ex-post evaluation, the power station was functioning properly.

According to the plan at the time of the appraisal, overhaul was to be conducted once every 10 years; however, overhaul is actually required every five to seven years. In the project, based on the equipment conditions at the time of the inspection and the history of breakdown, overhauling was done in January 2014 for Unit 1, March 2015 for Unit 2, October 2016 for Unit 3, and January 2017 for Unit 4.

As can be seen, there is no issue with the current status of operation and maintenance of the project.

No major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the 1990s, India achieved high economic growth and power demand was increasing along with it. As was the case across India, meeting the peak-time power shortage was an issue in the State of West Bengal. Given such situation, this project was expected to mitigate the shortage in peak-time electricity by constructing a pumped storage with an output of 900 MW and related transmission and substation facilities in Purulia District of West Bengal. From the time of the project appraisal to the ex-post evaluation, the power sector has always held an important position in the development policies of the Government of India and the Government of West Bengal. As in the case at the time of the appraisal, the peak-time power demand is ever increasing at the time of the ex-post evaluation. Therefore, it is necessary to strengthen the power supply capacity hereafter as well. The project objective is consistent with Japan's ODA policy and the relevance of the project is high. Outputs were implemented mostly as planned. With regard to the project cost, because of the fluctuation of the exchange rate during the implementation period, the project was implemented with about 60% of the planned cost. On the other hand, the project period exceeded the plan by 52 months because of the delay in obtaining forest clearance. As a result, the efficiency of the project is fair. Regarding the effectiveness of the project, the operation and effect indicators set at the time of the appraisal have been mostly achieved. A certain degree of impacts is also seen in reducing peak-time power shortage in West Bengal, improving the operational efficiency of coal fired thermal power plants, revitalizing industries through increased power supply, and improving the lives of people. No negative impact has been seen with regard to the natural environment, and the effectiveness and impact of the project are high. No particular problems have been seen in

institutional, technical and financial aspects and the current status of the project's operation and maintenance; therefore, the sustainability of the project 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

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Revising Operation and Effect Indicators When the Environment Surrounding the Project Changes

In the project, operation and effect indicators and their targets, excluding the planned outage hours, were set at the time of the Tranche II appraisal. At the time of the Tranche III appraisal, although planned outage hours was added as an operation indicator, the target for net electric energy production remained the same as the Tranche II appraisal and was not revised. Moreover, until the time of the Tranche III appraisal, it was envisaged that the project was to be connected to the regional grid. However, the national grid was introduced and was in progress, and, at the time of the project completion, the net electric energy production fixed at the time of the appraisal was no longer appropriate as the target for the project. Operation and effect indicators are important information for confirming the level of achieving project objectives. Accordingly, for any project whose appraisal is conducted in several phases, it is advisable for JICA and the executing agency to check the operation and effect indicators and their details in every phase. This can help renew the understanding on any expected effect from the project among its stakeholders. In addition, when the environment surrounding the project changes, it is important to revise the operation and effect indicators and their targets when and if necessary, taking the changes into consideration.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs a. Upper dam and reservoir	Rockfill dam, dam height 71m, dike length 1,505 m, storage capacity 16.5 million m^3	As planned
b. Lower dam and reservoir	Rockfill dam, dam height 95m, dike length 310 m, storage capacity 16 million m^3	As planned
c. Penstock	2 lanes, length 256.57m, inner diameter 7.7 m	As planned
d. Power station	Underground width 22.5 x length 157.0 x height 47.7 m, output 900 MW (225 MWx4 units)	As planned
e. Switchyard	No details	Above ground, GIS floor area 45 x 152m
f. Transmission lines	2 routes Power station – Durgapur Substation: 400 kV, double circuit lines, length 160 km Power station – Arambagh Substation: 400kV, double circuit lines, length 150 km	2 routes Power station – Durgapur Substation: 400 kV, double circuit lines, length 185 km Power station – Arambagh Substation: 400 kV, double circuit lines, length 209 km
g. Substations	2 locations Durgapur substation: 400 kV, shunt reactor 4 x 50 MVAR Arambagh Substation: 400 kV, shunt reactor 4 x 50 MVAR	As planned
h. Consulting services	78 M/M (detailed design)	851 M/M (detailed design, bidding assistance, construction management)
2. Project Period	July 1994 – March 2003 (105 months)	February 1995 – February 2008 (157 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 69,815 million yen 37,335 million yen (11,112 million rupees) 107,150 million yen 88,027 million yen 1 rupee = 3.36 yen (As of April 1994)	 27,472 million yen 32,784 million yen (13,717 million rupees) 60,256 million yen 57,238 million yen 1 rupee = 2.39 yen (Average between January 1995 and December 2015)
4. Final Disbursement	January 2016	

Democratic Socialist Republic of Sri Lanka

FY2016 Ex-Post Evaluation of Japanese ODA Loan Project[1]

"Upper Kotmale Hydro Power Project (I) (II)"

External Evaluators: Yumiko Onishi and Ryujiro Sasao, IC Net Limited

0. Summary

In the late 1990s, Sri Lanka achieved high economic growth, and power demand was increasing at the rate of 7% annually. However, installed capacity in the country was not sufficient to meet the power demand and there was a severe shortage of electricity. Such a situation posed a serious challenge to socio-economic activities such as people's daily lives and investments. Given such a situation, this project was expected to contribute to the economic growth of the country through meeting the increasing power demand by constructing a 150 MW hydropower plant on the Kotmale River, a tributary of the Mahaweli River. In the development plan of the country, increasing power generation was considered important at the times of both the appraisal and the ex-post evaluation. As a development need, it is still necessary to strengthen the power supply capacity. Consistency with Japan's ODA policy is also confirmed and the relevance of the project is high. After the project started, intake from the tributaries has been cancelled in light of environmental consideration while other aspects of the project scope have been implemented almost as planned. The actual project cost was approximately within the budget; although, for the project period, there was a significant delay because of carefully dealing with resettlement. Therefore, the efficiency is evaluated as low. Regarding operation and effect indicators, the target has been mostly achieved for fixed indicators; however, the originally fixed target for planned and non-scheduled outage hours seems to be ambitious and the actual outage hours exceed the target significantly. There has been no specific negative impact on the natural environment from the project. For resettlement, careful consideration has resulted in huge improvements in the lives of affected people. Considering the above, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, and financial aspects, as well as the current status of the operation and maintenance system. Therefore, sustainability is also evaluated to be high.

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

[1] In the ex-post evaluation, opinions from Sri Lankan expert was sought in regard to the impacts of resettlement and rehabilitation program implemented in the project. Selection of the expert was done by external evaluator, and agreed by JICA.

1. Project Description

Project Location

Talawakelle Reservoir

1.1 Background

Sri Lanka achieved an average annual economic growth rate of 5% between 1996 and 2000, and power demand increased at an annual rate of 7% because of advancements in industrialization, spread of home appliances, and expansion of rural electrification. The amount of electricity sold in 1990 was 2,608 GWh and increased to 5,258 GWh in 2000. However, installed capacity was insufficient in meeting the power demand and the power supply was in serious shortage. After 1999, hydropower energy generation was limited because of annual droughts and loss of load probability, which is an indicator of the reliability of power supply, was 4.73 days/year in 1999 – a very large figure (around the same time, developed countries were formulating the supply plan to keep the figure less than 0.1). This kind of unstable power supply was a big hindrance to socio-economic activities such as daily life and investments.

1.2 Project Outline

The objective of this project is to meet the projected power demand increase by constructing a run-off the river hydropower plant (150 MW) on the Kotmale River, a tributary of the Mahaweli River (upstream of the existing Kotmale Dam), with adequate environmental and social impact mitigation, thereby contributing to the economic growth of Sri Lanka.

Loan Approved Amount/ Disbursed Amount	I II	33,265 million yen / 32,667 million yen 4,552 million yen / 4,548 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	I II	March 2002 / March 2002 March 2010 / March 2010
Terms and Conditions	I	Interest Rate 0.95% (Main portion)

		0.75%(Consulting portion) Repayment Period 40 years (Grace Period 10 years) Conditions for Procurement Tied (Special Yen Loan)
	II Interest Rate	0.20%(Main portion) 0.01%(Consulting portion) Repayment Period 40 years (Grace Period 10 years) Conditions for Procurement Tied (Special Terms of Economic Partnership (STEP))
Borrower / Executing Agency	The Government of Democratic Socialist Republic of Sri Lanka / Ceylon Electricity Board	
Project Completion	September 2012	
Main Contractor(s) (Over 1 billion yen)	Maeda Corporation (Japan), Nishimatsu Construction Co., Ltd. (Japan) / Maeda Corporation (Japan) (JV), Kurimoto, Ltd. (Japan), Mitsubishi Corporation (Japan), Kinden Corporation (Japan)	
Main Consultant(s) (Over 100 million yen)	Electric Power Development Co., Ltd (Japan)	
Feasibility Studies, etc.	Master Plan for Upper Kotmale Hydropower Project (JICA, November 1987)	
Related Projects	Japanese ODA Loan ・ Power Sector Restructuring Program (March 2003) ・ Samanalawewa Hydroelectric Project (Reservoir Remedial Works) (August 1995) ・ Kukule Ganga Hydroelectric Power Project (July 1994) ・ Upper Kotmale Hydroelectric Power Project (E/S) (March 1992) ・ Samanalawewa Hydroelectric Power Project (I) (II) (III) (September 1986, October 1987, March 1991) Technical cooperation ・ Master Plan Study on the Development of Power Generation and Transmission System in Sri Lanka (2004–2006) Asian Development Bank (ADB) ・ Power Sector Development Program (November 2002)	

2. Outline of the Evaluation Study

2.1 External Evaluators

Yumiko Onishi and Ryujiro Sasao, IC Net Limited

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: September 2016 – October 2017

Duration of the Field Study: December 4–21, 2016 and April 18–24, 2017

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

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Sri Lanka

At the time of the appraisal in 2002, in response to increasing power demand and shortages in supply, the Government of Sri Lanka listed the following as important issues for the power sector in the "Six Year Development Plan (1999–2004)": improved efficiency and reliability; expansion of generation capacity on par with demand (development of new sources); improved electrification rate, development of transmission and distribution facilities responding to aging facilities and expansion of power generation; and rationalizing tariff structure. Particularly, it prioritized promoting the development of a balanced energy mix and restructuring the power sector.

According to the Ceylon Electricity Board's (CEB) "Long Term Generation Plan (2015–2034)" effective at the time of the ex-post evaluation, Sri Lanka's economic growth and power demand have a direct correlation. The country's power demand has increased at the annual rate of 6% over the last 20 years. According to the Central Bank of Sri Lanka, the country's economic growth is estimated to grow at an annual rate of 8% between 2015 and 2018. In "Mahinda Chintana (Ten Year Development Framework 2006–2016)," the power sector is defined as a push factor for economic growth, and particularly, diversification of the power source, expansion of power generation, and promotion of rural electrification are emphasized. According to the "Long Term Generation Plan (2015–2034)," the total installed capacity in 2014 was 3,932 MW and is targeted to reach 5,623 MW by 2034. As can be seen, the project was implemented to meet the increasing power demand, and the country's development plan has been consistent from the time of the appraisal to the ex-post evaluation.

3.1.2 Consistency with the Development Needs of Sri Lanka

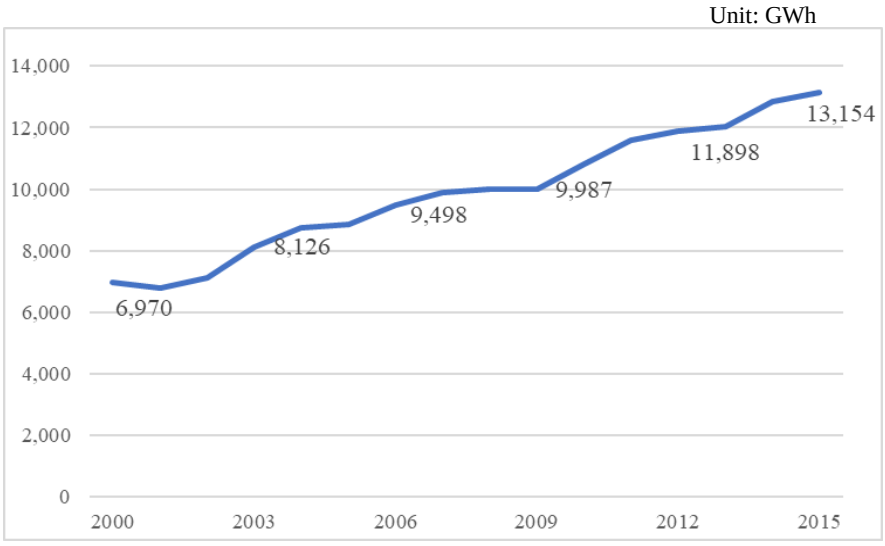
In the "Long Term Generation Plan (2002–2016)," which was in effect at the time of the

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

[3] ③: High, ②: Fair, ①: Low

appraisal, peak-time demand was expected to reach 2,346 MW in 2008 from 1,404 MW in 2000. Accordingly, it was planned to secure 2,909 MW of total installed capacity by 2008 (it was 1,777 MW in 2000). In the same plan, the increased capacity for hydropower was 220 MW, out of which 150 MW were to be met from the project. Another large project, a west coast coal-fired thermal power project, was being planned, and both of these projects were important for meeting power demand that was expected to rise after 2007. In 1999, Sri Lanka's energy mix was such that hydropower was the baseload with 67% of the total power generation. Even around that time, hydro-resources in the country were more or less fully developed, and the project was going to be the last largescale new hydropower project. Sri Lanka planned to change to a balanced energy mix mainly catered by thermal power by expanding the power generation facilities in order to secure a stable power supply that is not dependent on the weather. For a country that does not possess domestic fuel resources, developing hydropower to its maximum potential was essential. In 2015, the share of hydropower within the total electricity generation was 37% (1,377 MW) and after the project, largescale (100 MW or more) hydropower projects by the CEB had not been developed[4], and the share of hydropower is expected to be 18% by 2034.

As described earlier, Sri Lanka's power demand has been increasing at the annual rate of 6% over the last 20 years, and this trend is expected to continue after the time of ex-post evaluation. According to the "Long Term Generation Plan (2015–2034)," it is expected to reach 30,759 GWh by 2034. Figure 1 shows the electricity generation after 2000.

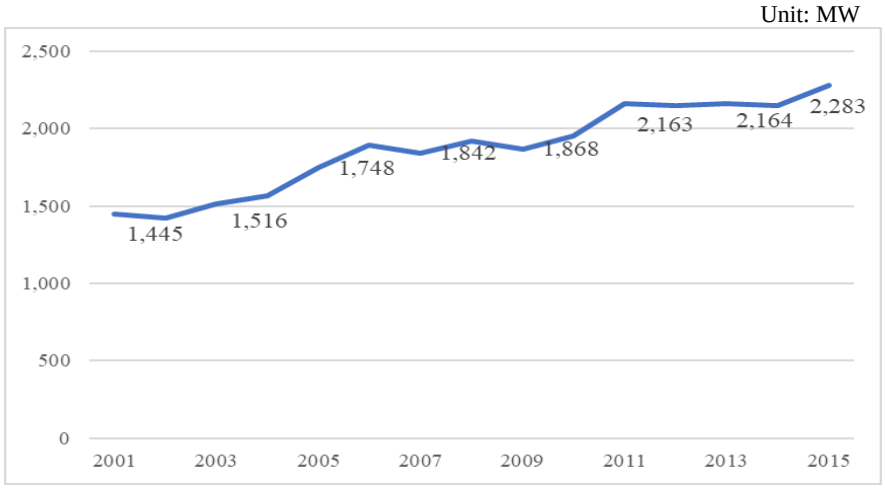


Source: Sri Lanka Sustainable Energy Authority

Figure 1: Changes in Electricity Generation

[4] It excludes the Uma Oya Multi-Purpose Project which is being implemented. The project, located in the Uma Oya river basin and implemented by the Ministry of Irrigation, has a generation capacity of 120 MW.

Figure 2 shows the changes in peak-time demand between 2001 and 2015. According to the "Long Term Generation Plan (2015–2034)," peak-time demand is estimated to increase hereafter at the annual rate of 5% and reach 4,805 MW by 2030.



Source: CEB

Figure 2: Changes in Peak-Time Power Demand

As can be seen from the time of the appraisal until the ex-post evaluation, a development need exists towards power demand.

3.1.3 Consistency with Japan's ODA Policy

In 2002, the following sectors were important for Japan's ODA policy for Sri Lanka.

- Development and improvement of economic infrastructures
- Development of mining industries
- Development of agriculture, forest and fisheries
- Human resource development
- Improvement of health and medical system

In JICA's "Country Assistance Strategy for Sri Lanka (2002)," which was under preparation at that time, "reform and support or development of economic infrastructure" was to be included in Japan's important areas for assistance to be consistent with mid- and long-term visions. As can be seen, the ODA policy toward Sri Lanka included the development and improvement of economic infrastructure at the time of the appraisal, and the project was consistent with the ODA policy at that time.

This project has been highly relevant to the country's development plan and development

needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

Outputs of the project were divided into five contract lots, and the following main works were planned for each of the lots:

- Lot 1 (preparatory works): access roads, development of resettlement sites, facilities for construction, and 33 kV transmission line
- Lot 2 (civil works): Talawakelle reservoir, tributary intake facilities, surge tank, penstock, underground power station, switchyard, and civil works for watershed environmental management
- Lot 3 (hydromechanical equipment): intake gate, flood gate, penstock, etc.
- Lot 4 (generation equipment): turbines (vertical axis, Francis), generators, main transformer, switchyard, etc.
- Lot 5 (transmission line): 220 kV, two circuits

In the project, Environmental Impact Assessment (EIA) was conducted in 1994. In the process of EIA approval, it became necessary to consider alternatives in details. Therefore, an EIA report was submitted again in 1996. Thereafter, the project started implementation after obtaining approval from the Government of Sri Lanka. However, after the project started, there was resistance from influential local people citing the impact on the natural environment. This resulted in cancellation of the construction of tributary intake points of Lot 2 in 2005. Because the environmental impact had been sufficiently considered before the project started and the changes were made considering the request from the project opponents, the changes were appropriate. Other contract lots were implemented mostly as planned (see "Comparison of the Original and Actual Scope of the Project" for details).

In addition, construction supervision and management consulting services were planned in the project. For consulting services as a whole, the man/month (M/M) for international consultants was 666 M/M and 843 M/M for local consultants. Construction supervision consulting services were implemented, but because the project period was prolonged, it actually became 812 M/M for international consultants and 1,434 M/M for local consultants. Because there was a plan to spin-off the CEB, management consulting services were originally expected to prepare a management framework for hydropower company newly established by spin-off and preparation of detailed plans for institution and finance among other things after the spin-off. At the time of the Phase II appraisal, because the CEB's unbundling was put on hold, management consulting services were changed to operation and maintenance consulting services. Training courses needed for CEB engineers to operate and maintain the project were conducted by the construction supervision consultants and contractors; however, for the maintenance

management plan, the CEB's existing plan was used. Thus, it was no longer necessary to hire consultants, and the consulting service related to this portion was not implemented. Table 1 shows the plan, the changes made, and the actual consulting services.

Table 1: Planned and Actual Consulting Services

	Phase I appraisal (plan)	Phase II appraisal (plan)	Actual
Terms of reference	Construction supervision, management consulting service	Construction supervision, operation and maintenance consulting service	Only construction supervision consulting service was implemented
International consultants	666 M/M	603 M/M	812 M/M
Local consultants	843 M/M	814 M/M	1,434 M/M

<Special Yen Loan>

Because the project was a Special Yen Loan, satisfaction level toward the scheme of the Government of Sri Lanka and the executing agency was surveyed. The Department of External Resources, under the Ministry of National Policies and Economic Affairs, and the borrower of the ODA Loan, recognized that concessional terms, particularly the low interest and long repayment period, were beneficial. On the other hand, both the Department of External Resources and CEB, the executing agency, pointed out the problems related to procurement based on rules for country of origin of goods and services. That is, according to the Department of External Resources and CEB, by applying rules for country of origin of goods and services, the bidders are restricted; as a result, competition becomes less. For the bidding, it was desirable to have a minimum of three bidders; however, in the project, some of the contract lots had three bidders at the time of pre-qualification, but in some cases, only two made the bids. In itself, a Special Yen Loan scheme can be attractive to the central government while it seems that the executing agency, who is the actual user of the scheme, have some concerns.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost at the time of the appraisal was JPY 41,836 million (out of which JPY 23,329 million was foreign currency and Sri Lankan rupees (SLR) 12,807 million was local

currency). Out of the total project cost, the ODA Loan was JPY 33,265 million. However, after the project started, there was a shortage of project funds (the reason is explained later) and an additional loan (Phase II) of JPY 4,552 million was provided in 2010. At the time of the ex-post evaluation, the actual total project cost became JPY 42,561 million[5] (out of which JPY 23,138 million was foreign currency and SLR 22,247 million was local currency) and the disbursed amount of the ODA Loan was JPY 37,215 million. The total project cost exceeded the planned cost by 2%, and the ODA Loan exceeded the planned one by 12%. The ODA Loan was used for Lots 1-5 and consulting services. The project cost for civil works has increased 33% from the planned amount. The increase in this portion of the project cost is mainly due to the soaring price of equipment and materials[6] which exceeded the price escalation beyond what was estimated because of the delay in project implementation. Although an additional ODA Loan was provided because of fund shortages, the Government of Sri Lanka agreed to contribute part of the additional fund and the effort of the government was evident.

Table 2: Planned and Actual Project Cost

Total Project Cost (Plan)	Actual	Actual Against Plan
JPY 41,836 million	JPY 42,561 million	102%

3.2.2.2 Project Period

The original project period was planned for 82 months from March 2002 (the signing of the Loan Agreement) to December 2008, which was the beginning of commercial operation. Commercial operation started in July 2012 for Unit 2 and September 2012 for Unit 1. As a result, the actual project period was 127 months from March 2002 to September 2012, which exceeded the plan (Table 3).

Table 3: Plan and Actual Project Period

Plan	Actual	Actual against Plan
82 months	127 months	155%

Among the reasons for the prolonged project period were as follows: revision to the project plan after starting because of resistance from influential local people; delays in the procurement process for consulting services and contractors; and delays in land acquisition and resettlement process. The delay related to the resettlement process was 24 months, making it the biggest cause. In the project, various considerations were taken and negotiations took place in view of

[5] However, because the land acquisition cost for 30 ha has not been paid at the time of the ex-post evaluation, the cost was added on the actual project cost by using the average land acquisition cost per ha paid previously.
[6] The fuel (diesel) price, which was SLR 30/liter in 2002, became SLR 115 in 2012 (source: Ceylon Petroleum Corporation).

the social environment which included the fact that many of the project affected people (PAP) were tea plantation workers who belong to lower and poor social classes. Communities were resettled as a whole, to the extent possible, and households which ran businesses (those who owned residence-cum-shop properties) stayed back in the original location. From the planning stage of resettlement, careful considerations were given. As a result, the project brought a positive impact to the lives of PAP and they were satisfied. Considering such facts, the delay related to the process was inevitable (see column at the end of the report for process and impact of the resettlement).

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Table 4 shows the Internal Rate of Return (IRR) calculated for the project at the times of the appraisal and the ex-post evaluation along with its assumptions. The figures from the time of the appraisal is from the Phase II appraisal when net electric energy production was revised. Re-calculation at the time of the ex-post evaluation was done using the same assumptions from the appraisal.

Table 4: IRR and Assumptions

	Financial IRR	Economic IRR
IRR	Appraisal: 7.3% Ex-post evaluation: 7.8%	Appraisal: 11.0% Ex-post evaluation: 20.8%
Cost	Project cost, operation and maintenance cost	Project cost (excluding taxes), operation and maintenance cost, re-investment
Benefit	Revenue from sale of energy	Alternative thermal power (gas turbine) construction and operation and maintenance costs
Project life	50 years	

Financial Internal Rate of Return (FIRR)

For FIRR, the same assumptions from the time of the appraisal were used while actual values were used for the cost and benefit from 2012 to 2015. For estimated operation and maintenance cost after 2016, the average of 2014 and 2015 has been used. For benefit after 2016, the annual power production was fixed at 391 GWh and it was assumed that there will be no power tariff revision. The cost increased by 20% compared to the value estimated at the time of the appraisal; however, the power generation and sales tariff increased slightly on the benefit side as well, and the actual FIRR became approximately the same as that of the time of the appraisal.

Economic Internal Rate of Return (EIRR)

For EIRR, the same assumptions as those at the appraisal time were used; for the cost, actual

values were used up to 2015. Assumptions from the time of the appraisal were used for the construction, operation, and maintenance cost of alternative thermal power projects while actual price was applied for fuel to calculate the benefit. The re-calculated cost is the same as that of the appraisal time. However, on the benefit side, the fuel price of USD 0.1322/kWh at the time of the appraisal soared to USD 0.2359/kWh in 2015 and alternative thermal power stations' operation and maintenance cost saved by the project were estimated to be more. Thus, EIRR has become 20.8%, significantly exceeding the value of appraisal time.

As described above, the project cost exceeded the plan although by factors that were not in control of the project such as price escalation and resettlement process, and the project period significantly exceeded the plan. Therefore, the efficiency of the project is low.

3.3 Effectiveness[7] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

For effectiveness, weightage was given to operation and effect indicators fixed at the time of the Phase II appraisal. Table 5 shows the target and actual values of operation and effect indicators for the project. For the project, the target year is two years after the project completion. Therefore, for comparison with the actual achievement, the values from 2014, which is actually two years after the project completion, was used for evaluation. Hydro-utilization factor, planned and non-scheduled outage hours, and net electric energy production are indicators established at the time of the appraisal. Net electric energy production was originally 510 GWh/year; however, as a result of cancelling tributary intake facilities, gross generation output has been revised from 512 GWh/year to 409 GWh/year and the target has also been changed to 407 GWh/year. Although capacity factor and maximum output were not originally part of the indicators, they are standard indicators that show operation of power station. Therefore, they were added as additional indicators at the time of the ex-post evaluation. Target for capacity factor has been calculated based on the target figure of net electric energy production.

[7] Sub-rating for Effectiveness is to be put with consideration of Impact.

Table 5: Target and Actual Figures for Operation and Effect Indicators

	Target	Actual		
	2014	2012	2013	2014
	2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Hydro Utilization Factor (%)	97	64	139	89
Planned and Non-Scheduled Outage Hours (hours/year)	263	697	2,454	1,137
Net Electric Energy Production (GWh/year)	407	259	565	363
Capacity Factor (%)	31	31	43	28
Maximum Output (MW)	150	150	150	150

Source: Documents provided by JICA and questionnaire to the executing agency
Note: Hydro utilization factor (%) is calculated by net electric energy production / gross generation output (409 GWh) x 100. Therefore, when the net electric energy production is more than 409 GWh, it exceeds 100%. Capacity factor for 2012, which is the year power station started its operation, is calculated based on the actual number of operational days.

Indicators other than planned and non-scheduled outage hours have essentially achieved the target in their 2014 actual figures. The actual outage hours have significantly exceeded the fixed target of 263 hours (exceeded by 874 hours); however, the method used to arrive at the target at the time of the appraisal could not be confirmed. According to hearing from the CEB, the average annual outage hours of other hydropower stations operated by the CEB is 504 hours for each unit. Considering the situation, the target outage hours for the Upper Kotmale Power Station should have been 1,008 hours annually. If the target is replaced by 1,008 hours and compared with the actual, the outage hours exceeds the target by 129 hours. Because net electric energy production is almost achieving the target, the target for outage hours originally fixed may have been ambitious.

3.3.2 Qualitative Effects (Other Effects)

At the time of the appraisal, stable supply of power was defined as a qualitative effect of the project. According to the CEB, there have not been planned power cuts in recent years in Sri Lanka and it appears that the power is supplied stably.

3.4 Impacts

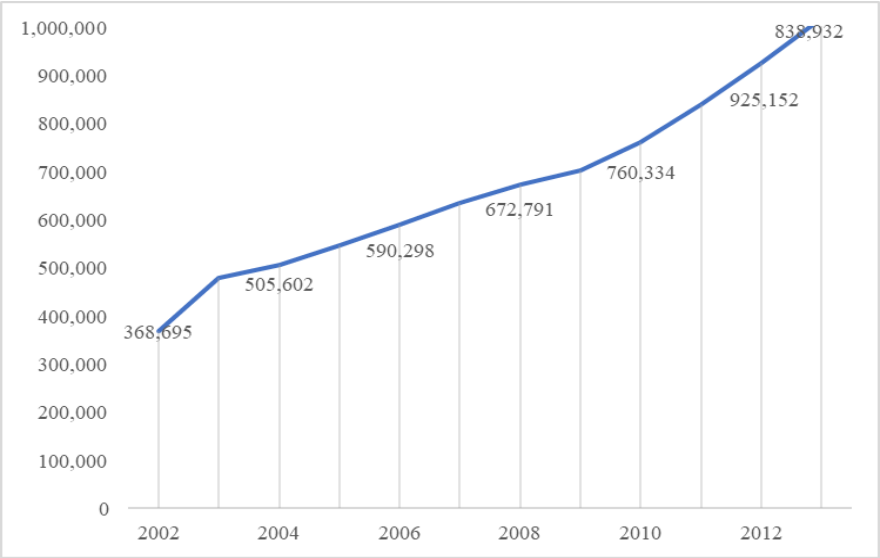
3.4.1 Intended Impacts

The intended impact for the project was contribution to the economic growth of Sri Lanka. In Talawakelle, Central Province, where the project site is located, interviews were conducted at the time of the ex-post evaluation. It was apparent from the interviews that the local economy had temporarily boomed because many construction-related people came from outside for the project and engaged local subcontractors for sourcing construction materials and other things. As can be seen, the project seems to have temporarily contributed to the local economy of

Talawakelle.

In the last five years (2011–2015), Sri Lanka saw an annual average economic growth of 6%[8]. As evident in its industrial output since 2002, it grew stably as shown in Figure 3.

Unit: SLR million



Source: Central Bank of Sri Lanka

Figure 3: Industrial Output of Sri Lanka

The GDP share of Central Province in the last ten years has been changing at an annual average of 10%. At the same time, the demand for power is continuing to increase and the number of consumers, which was 2.80 million in 2002, reached 5.41 million in 2015. Sri Lanka's electrification rate was 61.0% in 2002 and 98.5% in 2015. When compared to the World Bank's 2012 data, it was 88.7% for Sri Lanka[9], while surrounding countries like India, Bangladesh, and Nepal were 78.7%, 59.6%, and 76.3%, respectively, making Sri Lanka's electrification rate higher than the other countries'. Power demand increased almost at the same rate with rigorous economic growth in recent years. Looking at peak-time demand and the project's generation capacity in 2015, the project is supplying about 7% of the peak-time demand. As can be seen, the project has contributed to the country's economic growth to a certain extent.

[8] Source: Asian Development Bank
[9] According to the data provided by CEB, it is 94%. For comparison, the same source has been used here.

3.4.2 Other Positive and Negative Impacts

a) Impacts on the Natural Environment

The project was classified as category A according to the "JBIC Guidelines for Confirmation of Environmental and Social Consideration" (October 1999) because it is a large-scale hydropower project. An environmental monitoring committee chaired by the Central Environmental Agency was established for the project and regular meetings were held to check the impact on the natural environment during project implementation. Environmental monitoring after the project completion has not been specifically carried out because it is not mandatory by Sri Lankan law. Currently, the risk of siltation in the reservoir is low; therefore, CEB is measuring the siltation level irregularly.

At the time of the appraisal, it was expected that five waterfalls in the Kotmale River basin would be affected by the project. However, as described earlier, because the water intake from the tributaries was cancelled after the project started, only St. Clair's Falls was affected. From the interviews conducted with the shops (tourism-related) overlooking the waterfall and with the local residents, it was apparent that the flow of the waterfall decreased compared to before the project was implemented. In reality, the annual average water flow of St. Clair's was 13.45 m^3/sec before the project implementation, and the CEB is releasing 1.31 m^3/sec of water everyday between 5:00 to 15:00 based on the government order. According to the businesses that run restaurants and tea shops catering to tourists in the nearby area, although the visitors who have been to the areas several times have pointed out the reduction of water in the waterfall, there has not been a decrease in footfalls. Space for viewing the waterfall was constructed by the project. In addition, beside a coffee shop and parking lots, an exhibition space was set up to display information about the project.

Figure 4: St. Clair's Falls

Moreover, because the large areas surrounding the project site were developed as tea plantations, there was no important ecosystem that needed to be conserved. Nevertheless, the International Union for Conservation of Nature studied the impact on the ecosystem at the project site and downstream of the Kotmale River in 2006. Based on the study report, the project was to translocate *Ravana Politissima*, an endemic species of snails from the submergence area. According to a post-survey by a local consulting firm, at two out of four sites where translocation was done, the survival conditions were not necessarily satisfactory. However, although the species was originally seen as unable to survive in the reservoir, a

submergence area, the survey confirmed its existence around the reservoir. The post-survey studied the flora and fauna of other areas, too, and no specific issues were reported.

At the time of environmental clearance for the project, the CEB was instructed to formulate and implement a watershed management plan. In the project, the watershed management plan was prepared in 2003 and afforestation, soil conservation, fire protection, and awareness activities were implemented. Many of the activities were implemented within the tea plantations located in the watershed. According to the interviews with the tea plantation management from that time, apart from physical activities like afforestation and fire protection, the awareness activities targeting the plantation workers received high appreciation because such activities have raised the workers' awareness towards the environment.

It was reported that during the construction period, the environmental monitoring unit comprising the CEB and contractors were measuring parameters like water quality, ground water level, air quality, and noise level every month. Although no specific grievance redressal system was established for complaints arising from the implementation of the project, according to the local residents, they were able to report the complaints to CEB or the Urban Council. According to the CEB, there were no specific problems reported by the environmental monitoring unit's measurement during the project implementation. At the time of the ex-post evaluation, a questionnaire survey was conducted for 21 households around the reservoir and power station. They were asked to rate the conditions during the construction regarding air pollution, waste, dust, water quality, noise, and vibration using four-grade scales. In the results, the responses for noise and vibration were mostly "very concerned" and "slightly concerned," as shown in Figure 5. Some of the households have filed complaints to the CEB because house walls were cracked from the dynamite used for the construction of project related facilities. CEB has assessed the damage to the houses and provided compensation for repairs.

Unit: People

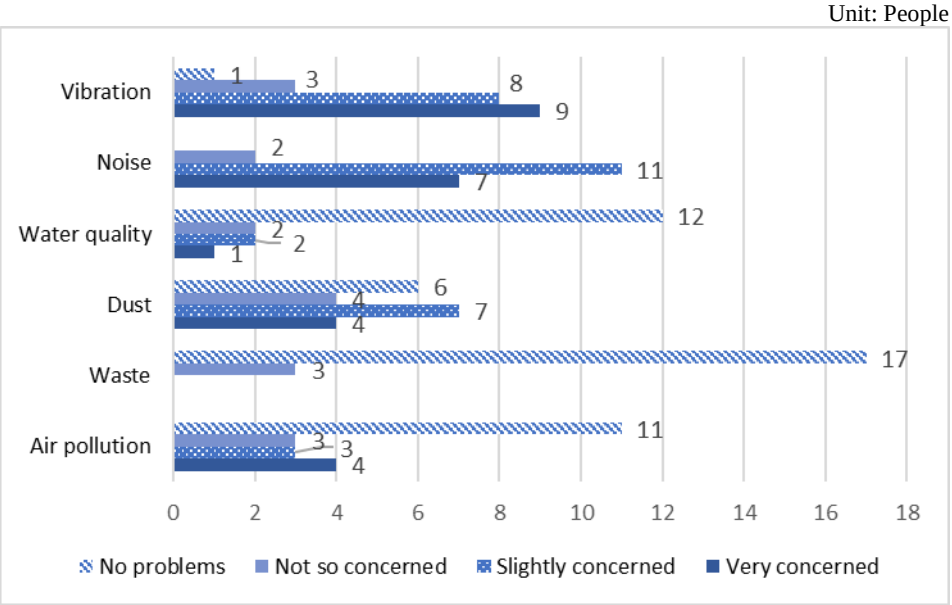


Figure 5: Opinion on Environment during the Construction

Regarding air pollution, waste, dust, water quality, noise, and vibration after the project completion, one household responded “slightly concerned” for waste and “not so concerned” for water quality. The remaining 20 households responded “no problems” to all the parameters. Therefore, it seems that there are currently no issues related to the environment.

As can be seen, no particular negative impact on the natural environment was confirmed.

b) Land Acquisition and Resettlement

In the project, 524 households were resettled[10] in order to make space for construction of the reservoir and widening of access roads. Land acquisition was originally planned for 155 ha but it became 99 ha. The land required for the project was reduced because a portion of the PAP (households who run business along the main road) returned to the original location after the project completion[11]. For the resettlement, a resettlement action plan including details of compensation and a support program was prepared. Women also participated in the resettlement planning process through the housing committee in each area. Out of the 117 women surveyed in the PAP survey conducted in the ex-post evaluation,[12] 92 (79%) felt that women’s opinions

[10] At the time of the appraisal, it was 457 households. The affected households have increased because those that preferred to relocate with the rest of the community and new households (whose members were newly married during the prolonged resettlement process) were added.

[11] Because they operated businesses in residence-cum-shop, it was important for them to remain close to the main road for their livelihood. Therefore, these households have temporarily relocated and returned to the same area after the area has been redeveloped.

[12] For the PAP survey, a questionnaire survey was conducted for 128 households. When the primary respondents were men, questions related to women were separately asked to the adult female of the same household. Resettled households were grouped by resettlement schemes, and based on the total number of houses in each scheme, sample size was decided. Sampling in each resettlement scheme was conducted by obtaining scheme-wise maps, by numbering the houses, and by generating random numbers with Microsoft Excel.

were reflected in the planning process. When PAP's level of satisfaction towards compensation was checked through the survey, 66% of the respondents felt it was sufficient (the remaining 18% responded "not sufficient" and 16% "can't say either").

The houses were provided in six different designs based on the size of the house before the resettlement. For PAP who were farming, either alternative land or cash compensation was given. As a system of grievance redressal related to the resettlement, a Grievance Redressal Committee was constituted with a divisional secretary, four religious leaders from the area, and teachers. About 100 complaints were reported to the committee during its five-year term. Complaints pertained to both individual households and the community. For example, there was a complaint that when those required resettlement were identified, they were temporary away from the target area and thus, they were not recognized as PAP. According to the nature of the complaints, some were resolved based on the discussion by the committee and in case more actions are required, the committee decided and the CEB was to take actions accordingly. If anyone was not satisfied with the decision of the committee, he/she could appeal to the court. According to two former committee members inquired at the time of the ex-post evaluation, all the cases were already resolved.

For improving the livelihood and living environment of the PAP after the resettlement, the project implemented support programs including the following: skill training (electric wire, welding, heavy machinery, computer, mushroom cultivation, and sewing); microfinance; support for home gardens such as provision of seedlings and tools; and medical camps[13]. Skill training courses were conducted once for each course and twice for a computer course. No post-training follow-up was done. For the skill training program, participants were selected from the PAP considering such factors as their age and experience. However, when PAP's awareness was checked at the time of the ex-post evaluation, 60% of the respondents were unaware of the program[14].

There has been no monitoring of the income level of project-affected households after the resettlement. The average annual household income before and after the resettlement was checked in the PAP survey, and the results showed that it changed from SLR 22,914 to SLR 32,242. However, considering the inflation rate between 2009, which was before the resettlement and the time of ex-post evaluation, no significant change is seen. On the other hand, housing and access to public services improved significantly. Other various impacts from the resettlement are described in the column at the end of the report. Compared to only 27% of the respondents lived in the permanent structures, all the households moved into the permanent structures after the resettlement (Figure 6). Particularly, the average floor area for a family in the line room provided by the tea plantation was 23 m^2, which changed to 58 m^2 after the

[13] Health check-ups and awareness programs on health and hygiene were conducted.
[14] Impacts of skill training program are described in the column at the end of the report. The reason PAP's awareness was low towards the program is not known.

resettlement. Regarding water supply, electricity, and cooking fuel, there was also a significant improvement because of the resettlement.

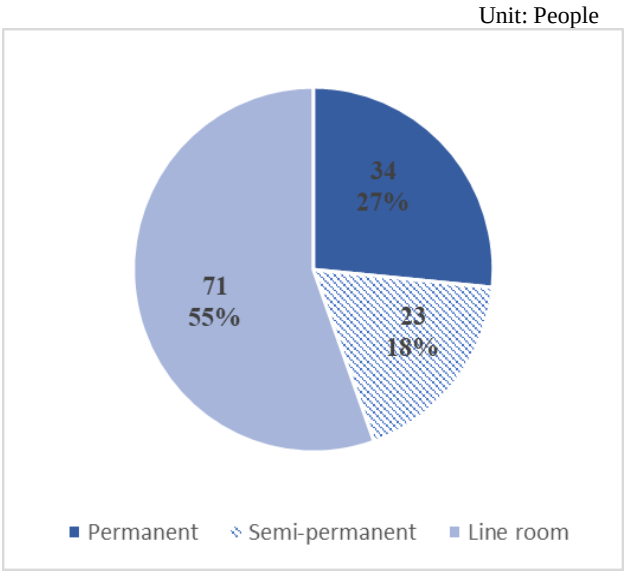


Figure 6: Housing before the Resettlement

Resettlement sites were provided as close as possible to the original location, within 1.5 to 2 km. Since many PAP had been residing in the center of the town, in the focus groups discussions conducted in the ex-post evaluation, they stated that the access has worsened.[15] Resettlement was made by keeping the community whole to the extent possible; however, there are cases where it was not possible and, based on the people's preference, resettlement happened by dividing the community. In the PAP survey, PAP were asked about their relationship with other people after the resettlement. In the results, 66% responded "same as before" while 27% said "weakened" and 7% "strengthened." In addition, the project has relocated Tamil School[16] to the center of Talawakelle. Before the relocation, the school was housed in an old tea factory and there were not even partitions for the classrooms. The new school has proper partitions and each classroom is equipped with lights, desks, and chairs. As the school infrastructure was upgraded, the number of students in the Tamil School has increased compared to earlier. According to the vice-principal of the school, he felt there are now more students who wish to be enrolled in the school and the academic performance of the students has also improved.

Out of the 128 households surveyed, 33 had experienced floods or landslides before the resettlement. For these 33 households, because housing structure was strengthened compared to before the resettlement, they cited that fear of disaster risk was reduced. Because careful

[15] Conducted in three resettlement schemes. In one of the schemes, about 15 people from a women's group participated; in the other two schemes, about 20 people who were present at the time of the visit participated.
[16] Public school teaching class 1 to 12. Mainly Tamil students are studying at the school.

considerations were given from the beginning such as PAP involvement in preparing the resettlement plan, the living environment for PAP seems to have improved significantly (see column at the end for details).

c) Unintended Positive/Negative Impact

Because many people belong to the poor section of society in the project area, it was expected that the project prioritize hiring local people. According to the CEB and the local residents, local people were given preference to be hired as unskilled labor for the construction site in the project. After the project completion, local residents were hired for some of the jobs at the power station such as security guards and drivers. Nevertheless, according to the interviews conducted around the power station, people voiced dissatisfaction that hiring of local residents was very limited.

The project has largely achieved its objectives. Therefore, the effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The project was implemented by the CEB, which is under the supervision of the Ministry of Power and Energy. The CEB was established as a power corporation in accordance with the CEB Act in 1969 by taking over the generation, transmission, and distribution projects of the government electricity department. At the time of the appraisal, restructuring of the CEB was under consideration as part of Sri Lanka's power sector reforms – the CEB was to be divided by its functions into generation, transmission, and distribution, and each unit was to be re-established as an independent company in accordance with the Company Act. However, because of opposition from the staff and for political reasons, restructuring was cancelled. At the end of 2014, the CEB possessed 69% of Sri Lanka's generation capacity. The CEB has divisions such as company strategy, generation, transmission, distribution, and asset management; the operation and maintenance of the Upper Kotmale Power Station is managed by Mahaweli Complex,[17] which is under the generation division. Against 42 personnel planned for operation and maintenance at the time of the appraisal, 43 personnel were posted at the time of the ex-post evaluation and institutional setup for operation and maintenance is established as planned.According to the power station officers, because the power station is new and there is less breakdown, operation can be managed by 43 personnel, but enhancement of staff strength is necessary in the future and the CEB is preparing to increase the number of personnel. Staff

[17] A division that manages seven hydropower stations in the Mahaweli River Basin.

turnover after the commercial operation started at the power station is low (2-3 personnel annually). Allowance for remote location posting is provided to the staff working at the power station and initiatives to retain the staff is also in place.

3.5.2 Technical Aspects of Operation and Maintenance

Trainings related to the technical skills needed for operation and maintenance of the power station was conducted during the project implementation period. Consultants and manufacturers have conducted trainings that are required for operation and maintenance of facilities and equipment of the projects. Currently, training courses including refresher and safety management courses are conducted in the CEB's own training facility. According to the CEB, personnel posted for operation and maintenance have the necessary educational background and technical training experience for each position, and the technical standards are appropriate. Their standards are at the level they can address issues related to operation and maintenance.

Manuals for operation and maintenance are also in place. According to the CEB, manuals on parts and systems were prepared and are used by the personnel. The current manuals were prepared by the manufacturers; therefore, they need to be revised in the future. In case of revision, based on the situation on the ground so far, parameters such as frequency for inspection will be considered for revision. Daily, monthly, annual, and special inspections are conducted in accordance with the guidelines. Inspection records are also kept. Therefore, there is no issue with technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

Table 6 shows operation and maintenance budget allocation and expenditure for the Upper Kotmale Power Station in the last four years. The year 2013 was just after the operation started in the power station, and, because it was still within the defect liability period, the contractors took care of maintenance. Thus, the expenditure was minimal. According to the CEB, the budget for operation and maintenance has been provided sufficiently so far and the budget is expected to be secured hereafter as well.

Table 6: Operation and Maintenance Budget and Expenditure for Upper Kotmale Power Station

Unit: SLR Million

	2013	2014	2015	2016
Budget	1,154	952	1,163	1,206
Expenditure	78	1,047	1,076	NA

Source: CEB

Table 7 shows the financial statements of the CEB for recent years. At the time of the ex-post evaluation, the CEB's fiscal year 2015 annual report was not published. Therefore, only the data

up to 2014 are included. The capital adequacy ratio was 27% in 2012 and improved to 30% and 49% thereafter. Similarly, the debt-equity ratio was 2.69 in 2012 but improved to 1.03 in 2014[18]. The current ratio for the CEB in 2013 and 2014 was 1.01 and 0.93, respectively. Because there is a stable revenue source from collection of electricity tariffs, there seems to be no particular issue.

Table 7: Financial Statement of CEB

Unit: SLR Million

	2012	2013	2014
Total Asset	727,728	749,438	769,660
Total Equity	197,300	226,729	380,022
Current Asset	101,295	93,435	76,492
Current Liabilities	137,356	92,698	82,309
Non-Current Liabilities	393,072	430,008	307,328
Total Revenue[19]	163,513	194,147	202,645
Direct Cost	▲222,419	▲165,508	▲210,850
Profit Before Tax	▲61,447	22,266	▲12,446

Source: CEB Annual Report

In 2013, due to the fact there was lots of rainfall, the balance has improved. In 2014 it was in deficit because of scarce rainfall in that year. On the other hand, according to the Ministry of Finance of Sri Lanka, the CEB's profit before tax (provisional) in 2015 was SLR 20,720 million and was in surplus. The electricity tariff, a revenue source for the CEB, is determined by the Public Utilities Commission. Most recently, the tariff was reduced in 2014.[20] However, according to the Finance Division of the CEB, the current tariff structure is not necessarily able to recover the cost. The average cost of electricity tariff in 2014 was SLR 18.50/kWh and the cost of supplying electricity was SLR 19.97/kWh. Provisional tariff and supply cost in 2015 is SLR 15.93/kWh and SLR 15.01/kWh, respectively. At the time of the project appraisal, the Government of Sri Lanka was providing SLR 0.5–1 billion to the CEB as subsidies. However, no regular subsidy is provided now except for special cases such as power shortages.

Moreover, power generation in Sri Lanka is still mainly hydropower. Therefore, power generation and the financial status of the CEB are dependent on the weather to a certain extent. Under such circumstances, the CEB is promoting development of renewable energy and liquid natural gas, which are relatively inexpensive to generate, to reduce the cost. As of March 2014, the CEB has already developed solar, wind, and biomass generation, and these facilities have a generation capacity of 135 MW.

As can be seen, the CEB has some issues in the financial aspect and has been working to

[18] In 2004, there was capital change of debt by the Government of Sri Lanka.
[19] Revenue from the electricity tariff. It does not include subsidies.
[20] It was due to the operationalization of a low-cost coal fired thermal power station (Norochcholai).

address them by such means as reducing generation cost through promoting renewable energy. Thus, there are no problems in financial aspects of operation and maintenance of the project.

3.5.4 Current Status of Operation and Maintenance

Maintenance of the Upper Kotmale Power Station is conducted in line with the prescribed schedule. The power station started operating in 2012, and no overhaul has been done so far. The power station is supposed to report certain parameters such as power generation, auxiliary power consumption, number of personnel, water released for St. Clair's Falls, and planned outage hours every month to Mahaweli Complex and the CEB's Central Control Room. Based on the report, the CEB headquarters is monitoring the situation in each power station.

According to the CEB, the facilities are functioning as originally expected; however, from the start of operations, noise and vibration of the turbine have been an issue. The problem of noise has been mostly resolved by such means as putting sound proof pads. For vibration, which extends to the civil structure and penstock, the CEB had Sri Lankan expert engineers conduct a survey to investigate the cause and find a solution. Moreover, by putting mats for absorbing vibration around the equipment inside the power station and putting a stiffener on penstock, measures suggested by the consultants who were engaged in construction supervision, the initially measured maximum level of vibration acceleration has reduced from 6.0 m/s^2 to 3.7 m/s^2in the power station. Impacts on staff physical health and operation of the power station arising from the vibration have not been reported so far.

No major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system. Although there is a problem with vibration in the power station, currently it does not pose an issue for the operation of the power station. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

In the late 1990s, Sri Lanka achieved high economic growth, and power demand was increasing at the rate of 7% annually. However, installed capacity in the country was not sufficient to meet the power demand and there was a severe shortage of electricity. Such a situation posed a serious challenge to socio-economic activities such as people's daily lives and investments. Given such a situation, this project was expected to contribute to the economic growth of the country through meeting the increasing power demand by constructing a 150 -MW hydropower plant on the Kotmale River, a tributary of the Mahaweli River. In the development plan of the country, increasing power generation was considered important at the times of both the appraisal and the ex-post evaluation. As a development need, it is still

necessary to strengthen the power supply capacity. Consistency with Japan's ODA policy is also confirmed and the relevance of the project is high. After the project started, intake from the tributaries has been cancelled in light of environmental consideration while other aspects of the project scope have been implemented almost as planned. The actual project cost was approximately within the budget; although, for the project period, there was a significant delay because of carefully dealing with resettlement. Therefore, the efficiency is evaluated as low. Regarding operation and effect indicators, the target has been mostly achieved for fixed indicators; however, the originally fixed target for planned outage hours seems to be ambitious and the actual outage hours exceed the target significantly. There has been no specific negative impact on the natural environment from the project. For resettlement, careful consideration has resulted in huge improvements in the lives of affected people. Considering the above, the effectiveness and impact of the project are high. No major problems have been observed in the institutional, technical, and financial aspects, as well as the current status of the operation and maintenance system. Therefore, sustainability is also evaluated to be high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

As described in the section on sustainability, the Upper Kotmale Power Station has a problem with vibration. The CEB and consultants have so far studied the cause and taken measures, but the problem has not been resolved. Because the long-term effect of the vibration cannot be ruled out in the future, it is advisable to continue to explore the solution together with the consultants while taking advice from external experts who specialized in vibration issues.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

<u>Formulation and Preparation of Resettlement Action Plan with Due Consideration to the Local Society</u>

Because many PAP were Tamil tea plantation workers who are socio-economically vulnerable, the resettlement plan was prepared and implemented carefully for this project. In the planning phase, housing committees comprising PAP were established, and a forum was made where the executing agency and PAP can have a direct dialogue and PAP can take part in plan preparation. For sharing information and exchanging views with the PAP, the project director and the resettlement officer of the executing agency were directly involved instead of using third parties such as NGOs. In this manner, they tried to build trust with the PAP. In addition, by avoiding

political involvement such as tea plantation trade unions, it has resulted in improving the self-confidence of the PAP (see the column at the end for details).

Resettlement in the project was implemented to provide a better housing environment than the one prior to the resettlement. The housing environment, particularly the housing infrastructure and access to public services, has benefitted PAP greatly after the resettlement. In addition, based on the process described earlier, because PAP were involved from the planning phase and able to reflect their views in the process, their satisfaction towards resettlement was high. By giving comprehensive consideration to the lives of PAP, it has resulted in positive impacts on awareness and action of PAP as well. This kind of measure can be applied to similar projects in and out of Sri Lanka.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs a) Preparatory works	Construction and renovation of access roads, development of resettlement sites (including houses), facilities for construction, 33-kV transmission line (41 km)	Construction and renovation of access roads, development of resettlement sites (including houses), facilities for construction, 33-kV transmission line (32 km)
b) Civil works	Constrcution of dam (Talawakelle reservoir and tributary intake facilities at 6 sites), headrace (12.5 km), tributary intake tunnel (9 km), surge tank (2 sites), underground penstock, underground power station, and switchyard and civil works for watershed environmental management	Constrcution of dam (Talawakelle reservoir), headrace (12.5 km), surge tank (2 sites), underground penstock, underground power station, and switchyard and civil works for watershed environmental management
c) Hydromechanical equipment	Intake gate, flood gate, penstock etc.	As planned
d) Generation equipment	Turbines (vertical axis, Francis), generators, main transformer, switchyard, etc.	As planned
e) Transmission line	220 kV, 2 circuits, 17.5 km, etc.	220 kV, 2 circuits, 15.5 km, etc.
f) Consulting service	1,509 M/M (construction supervision and management consulting service)	2,246 M/M (construction supervision consulting service)
2. Project Period	March 2002–December 2008 (82 months)	March 2002–September 2012 (127 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 23,329 million yen 18,507million yen (12,807 million rupees 41,836 million yen 33,265 million yen 1 rupee = 1.44 yen (As of February 2001)	 23,138 million yen 19,423 million yen (22,247 million rupees) 42,561 million yen 37,215 million yen 1 rupee = 0.94 yen (Average between January 2002 and December 2015)
4. Final Disbursement	October 2014	

JICA Evaluation Department

On Views of Expert

In this ex-post evaluation, in addition to performing evaluation based on the five DAC evaluation criteria by the external evaluator, the views of a Sri Lankan academic expert were sought in order to reflect more specialized and diverse views. The external evaluator selected the expert, and solicited cooperation from Dr. Dhammika Herath, the University of Peradeniya.

Dr. Herath is a sociologist specialized in peace and development studies and works as a senior lecturer at the University of Peradeniya. He is also affiliated with International Center for Ethnic Studies, a Sri Lankan think-tank, as a researcher and has been formulating and evaluating many projects on reconstruction of conflict affected areas, ethnic harmony, community livelihood and capacity development. He is also knowledgeable on issues related to land acquisition and resettlement in public works.

In the project, a large-scale resettlement took place. While the resettlement process, changes in living standard before and after the resettlement, and support provided for restoration of livelihood were surveyed, through the comparison of resettlement process which took place in accordance with the Sri Lankan law in this project and similar projects, the positive and negative impacts from diverse perspective were studied. Dr. Herath has provided advice as a local expert on the designing, implementing and compiling the results of the study and has given comment on the results of the study.

The summary of the study results and comments by Dr. Herath is attached as an appendix to the evaluation report.

End

Appendix

Column on Resettlement and Rehabilitation Program of Upper Kotmale Hydro Power Project

In addition to the standard ex-post evaluation, an effort was made to capture various impacts of resettlement and rehabilitation (R&R) that took place in the Upper Kotmale Hydro Power Project (UKHP). First, to understand the context, the R&R program of the UKHP was studied in detail while information on other development projects whose R&R program was cited as a success was collected and studied. Further, based on the household survey of project affected people (PAP) conducted in the ex-post evaluation and interviews with key informants such as project officials, NGO workers, and tea estate managers, tangible and intangible as well as positive and negative impacts of resettlement under the project have been summarized.

<R&R programs>

Based on suggestions by government officials and experts in the field to study their R&R programs, the Lunawa Environmental Improvement and Community Development Project (LEICDP)[21] and the Southern Highway Construction Project[22] were identified as projects for comparison with the UKHP. Together with the UKHP, these projects began in 2001, which coincided with the time that the National Involuntary Resettlement Policy (NIRP) was introduced in Sri Lanka. While the UKHP had 524 affected households, the LEICDP had about 900 and the Southern Highway Construction Project nearly 600. More than half of PAP in the UKHP were Tamil estate workers while the other two projects' PAP were mostly of the Sinhala population.

NIRP Introduced

Until 2001, resettlement of people displaced by development projects were covered under the Land Acquisition Act, National Environmental Act, and other acts of the country. However, these legal frameworks did not mention entitlements for PAP who had no legal title to the property. Then came the NIRP (2001), which aimed to minimize the adverse impact on PAP. The policy is in support of suitably compensating the PAP, including those without legal

[21] The project aimed to mitigate flood damage by improving urban drainage and canal systems. This is a Japanese ODA Loan project and aimed to improve the living conditions in the Lunawa Lake catchment area. The project started in December 2001 and was completed in April 2010.

[22] The project constructed 67 km of expressways between Kottawa and Kurundugahahetekma. It was also a Japanese ODA Loan project and part of the Southern Transport Development Project, co-financed with the Asian Development Bank to construct a 125-km expressway. The project was implemented from March 2001 to September 2013.

documents. People who had no legal title to the project affected land were also given consideration. As the NIRP recommends the consultation and participation of PAP in the resettlement process, the PAP were involved from the very beginning in planning and implementation of the R&R programs in the three projects. Further, the NIRP calls for rebuilding the lives of PAP and improving living conditions. Although the NIRP is only a policy and awaiting enactment, the UKHP, the LEICDP, and the Southern Highway Construction Project all took the NIRP seriously.

Participatory Planning

With some variation in structure, each project established its own mechanism to ensure that PAP had a stake in the planning process. In the UKHP, nine Housing Committees were formed in affected communities. They served as forums to represent all affected households and provide an occasion on which they can raise concerns and solve issues. Executive members were selected from the Housing Committee; they formed part of the Resettlement Committee where broader common issues were discussed under the chairmanship of the Divisional Secretary. Members of the Resettlement Committee also included the project authority, the Urban Council chairman, and local religious leaders.

Uplifting through Resettlement

The principle of the NIRP was to provide "land for land" and "house for house" in which loss of property due to the project is compensated with physical property. These three projects took a step further and provided housing infrastructures that were better than what the PAP had prior to the projects. In the UKHP, six different types of houses were designed, ensuring that the affected houses would get a minimum of the existing floor space when resettled. Table 1 shows the types of house designed by the project with affected floor space.

Table 1: Affected Floor Area and the Area Given by the Project on Relocation

Unit: ft^2

Type	Affected floor area	Floor area given by project
A	<400	**624**
B	401–600	**818**
C	601–800	**1003**
D	801–1000	**1308**
E	1001–1200	**1435**
F	1200–1500	**1530**
Special Types	>1500	**Custom design**

Photo 1: Type A House

<Impacts on Project Affected People>

Improved Housing-Related Infrastructure

The majority of PAP of the UKHP were "estate workers[23]." This meant that the majority were from socially and economically vulnerable classes of society. The estate workers traditionally lived in what are called "line rooms" – a row of small rooms in a single building[24]. Apart from increased floor space, moving into houses built on individual plots equipped with water supply, electricity, toilet, and separate spaces for bedrooms, kitchen, and living room was a definite change in their lifestyle. The following tables show the changes in housing amenities after the relocation based on the survey conducted for 128 affected households at the time of the ex-post evaluation.

Table 2: Source of Drinking Water

	Before relocation		After relocation	
	No.	%	No.	%
Pipe supply	67	52	128	100
Hand pump/tube	10	8	0	0
Open Well	14	11	0	0
Spring/River	37	29	0	0
Total	128	100	128	100

Table 3: Types of Toilet

	Before relocation		After relocation	
	No.	%	No.	%
Household flush	9	7	31	24
Household non-flush	78	61	97	76
Community latrine	37	29	0	0
No toilet	4	3	0	0
Total	128	100	128	100

Table 4: Source of Lighting

	Before relocation		After relocation	
	No.	%	No.	%
Electricity	91	71	128	100
Kerosene	37	29	0	0
Total	128	100	128	100

Table 5: Source of Cooking Fuel

	Before relocation		After relocation	
	No.	%	No.	%
Cylinder Gas	13	10	77	60
Firewood	114	89	47	37
Kerosene	1	1	4	3
Total	128	100	128	100

The household survey also revealed that 66% of the respondents felt the compensation given under the UKHP was sufficient (the remaining 18% felt it was insufficient and 16% felt it was neither). Focus group discussions in several resettlement colonies also indicated the PAP were highly satisfied with the facilities provided to them.

[23] Estate workers are one of the three classifications of population (urban/rural/estate) in the Sri Lankan census. The term generally refers to the resident laborers of plantations. However, there are families today none of whom work on the estate but continue to live in the line room on the plantation.

[24] A typical line room may consist of several rooms which often lack windows and therefore have no or little ventilation. Each room housing a family may have one or two separate rooms giving little privacy to the occupants.

Changes in Human Capital

Interviews with estate managers and other individuals knowledgeable of the sector revealed that the estate workers traditionally have depended on estate management. Since the estate workers are socially vulnerable, while they were protected by the trade unions active in the tea estates, their condition was also politically capitalized to secure voters by promising the improvement in basic infrastructure. The estate management and trade unions were often the estate workers' first point of contact with the outside world, and they often depended on these institutions to complete such procedures as birth registrations and banking.

Through participating in the resettlement process, the PAP experienced the process of discussing and negotiating with others around them as well as with the project authority. They were given chances to decide and take action on their own. This seems to have inculcated a sense of social confidence in them.

Secondly, improved infrastructure and subsequent improvement in living conditions have prompted lifestyle changes among the PAP. This has impacted the way PAP see themselves as well. Better living conditions meant that the people felt they needed to have a persona that matched their living conditions. A similar case was cited in the LEICDP in which the former project director recollected how women from some of the affected households even changed the way they dressed after resettlement. Before the resettlement, there was a lower sense of self-importance because the women had to be involved in additional chores such as fetching water from the common tap far from home, which gave them little opportunity to "dress up." Once they moved into a new home at the relocation site equipped with individual tap connections, they were released from such chores. Women have also aspired to live the way others do in such houses. Changes in such lifestyles have further prompted the change in people's psychology. Some of the PAP of the UKHP expressed that having their own space at the resettlement site gave them privacy, providing them mental peace which in turn resulted in less family discord. This aspect has been substantiated by some of the estate managers as well. One of the estate managers said that he has noticed visible differences in the attitudes of the workers who have been resettled by the project. Perhaps because of the change in mindset and fewer issues at home, it appeared the workers became more productive and were able to comprehend instructions much easier than before.

Shortfall in Income Restoration Program

Although the resettlement has brought about mostly positive changes, there has been some

shortcomings. Issues on the R&R program of the UKHP are mentioned here. To restore the livelihood of PAP at least equivalent to or better than pre-resettlement levels, several skill training and support programs (income restoration program) were implemented in the project. Skill training courses were selected based on the preference from the PAP and considering the employment opportunity in the project site (construction site). Nevertheless, when applications were called for courses such as welding and heavy machinery maintenance, there were fewer takers. The survey on affected households during the ex-post evaluation also revealed that the people were less aware of various courses provided under the project. Many of those who attended the courses also felt that there has been no particular impact on their income from the training courses they received.

Table 6: Whether the Respondents Knew About Income Restoration Programs

	No.	%
Was aware	51	40
Was not aware	77	60
Total	128	100

Table 7: Impact of Income Restoration Programs (Respondents Have Participated in One of the Programs)

	No.	%
Increased income	5	17
Better health due to awareness on health and nutrition	5	17
Started business using microfinance	2	7
No impact	18	60
Total	30	100

<Strategies behind UKHP Resettlement>

Displacement of people due to development projects has historically attracted much criticism. However, the UKHP and other projects implemented almost at the same time, such as LEICDP and the Southern Expressway Construction Project, have been able to persuade society that it is not always so. The positive impacts of resettlement under these projects were not easily achieved. While the participation of PAP from the planning stage was definitely a factor of its success, it was not simply the participation in planning but certain strategies that were employed that made it work better.

Direct Dialogue between Project Authority and PAP

It is a daunting task for the project authorities to identify, communicate, and negotiate with the PAP on a daily basis. In places where active local NGOs are found, such organizations can be brought on board to be the interface between the people and the project. In the UKHP, however, the project authority maintained that it is important to have direct dialogues with the PAP without involvement of NGOs. This way, people knew directly who they were dealing with and

there was no loss or misinterpretation of information due to having intermediaries between the two. It was important that people trust the project authority; therefore, the project authority made sure to be present at each housing committee meeting. This effort by the project authority is fondly remembered by PAP even today. In resettlement schemes, people remember the former project director and how they had direct access to him if ever needed.

The LEICDP took a similar strategy in this regard. An NGO was involved in the resettlement process but was taken on board as part of the project authority. NGO workers were identified as part of the project authority so that they did not become mere intermediaries between the project authority and PAP.

Keeping Vested Interest at Bay

As mentioned earlier, the estate workers' issues were often capitalized by trade unions and other interest groups. The estate workers often had strong bonds with particular trade unions. The project authority felt it was necessary to separate the PAP from the trade unions and other vested interest groups for the PAP to directly participate in resettlement process and to reflect their honest opinions to the R&R program. Therefore, the Housing Committee was exclusive to PAP, who were given chances to think and decide on their own without the involvement of external parties. This is also part of the reason there has been much benefit on the social capital front as a result of resettlement in the project.

Comment by Dr. Dhammika Herath (Social Development Expert) at the University of Peradeniya

The UKHP brings in a whole transformation in the PAP through drastic improvement in the quality of life and dwellings compared to the pre-displacement level. Almost every PAP previously lived in what is locally referred to as a "line-room." The UKHP has provided houses on individual plots equipped with water and sanitary facilities, which has led to a significant enhancement of the quality of life and dwellings as well as social status. In the succeeding sections, I present the weaknesses and strengths of the project.

There are several weaknesses regarding the quality of construction. Our respondents in a Tamil community complained of water leakages from the roof. Project authority promised to look after the houses for one year, after which PAP were expected to take care of the houses. Yet, PAP feel that a new house should remain in good condition for at least 20 years. Some respondents in a Tamil community complained of electric shocks due to erroneous wiring and we could observe that this had damaged some household equipment whereas some people avoided the use of electrical equipment. In my assessment, there are construction defects, which lower the level of satisfaction among the PAP. PAP should be able to address these shortcomings without having to invest significant resources. Although the construction defects affected only a minority of PAP, the contractors who built the houses should be held responsible for construction defects.

The UKHP imparted skills in welding, lathwork, electrical wiring, sawing, mushroom cultivation, etc. Nevertheless, not all those who received the training found employment in the same field. This is an area where the project could have done better to provide career guidance. Furthermore, although the project provided replacement lands for cultivation, some lands were unsuitable for cultivation due to unsuitable soil conditions and/or lack of water. This problem affected only a minority of farmers.

A significant complaint received from many PAP is access to the main road and increased distance to the town. Earlier, many people lived just a few minutes' walk from the town center. The resettlement has increased distance to the town by 15–30 minutes and enforced a walk up on a mountainous road. A reliable public transport service would have been able to address this complaint.

There is also the issue of lack of clarity about the management of the settlements and service delivery. While the project claims to have handed over the responsibility to the Urban Council (UC), the UC personnel said the handover is not yet complete. This has resulted in the UC not coming forward to perform some of the services such as maintenance of street lights in the resettlement schemes it is expected to provide. I cannot come to a conclusion on this.

Irrespective of the minor issues documented above, the UKHP is one of the rare cases where a resettlement has improved the quality of life in both absolute and relative terms. The most significant achievement of the UKHP is that every PAP received a replacement house, which is many times better than the previous house. The UKHP has not caused landlessness or homelessness.

The UKHP had paid attention to the sustainability of the livelihoods of the PAP, not merely to sustain the existing levels but in fact to enhance, and also granted scholarships to children to support their education from primary school up to university. The project provided replacement lands for lands that were cultivated before the project and where replacement lands were insufficient, the project also provided appropriate financial compensation. Such high compensations are less common if one compares the project with development-induced displacement and resettlement in Colombo, where beneficiaries of housing have to pay for the replacement houses they received from the urban development authority. For those who had shops, the project provided replacement buildings, larger and better than the previous buildings, close to the main road.

The UKHP also contributed to improving the resources for education among the PAP. The Tamil medium school, which previously had one dilapidated building, currently has six buildings provided by the project and more teachers. Some parents who could not afford to send their children to the towns of Hatton or Nuwaraeliya for better education now send their children to the local Tamil school. So, the number of children in the school has increased.

Overall, the UKHP did not damage the social capital stocks of the affected settlements. Displacement involved moving to new locations around 2 km away. People were thus able to keep their networks intact. Social trust and norms of reciprocity have not suffered.

One of the reasons for the significant achievements of this project is incorporation of effective participation of the PAP, who were initially resistant to the project but later accepted it when they were made part of the decision-making. The project developed a resettlement committee with

appointed and nominated members. There has been close interaction between the members of this committee and officials including the former project director. Furthermore, the project developed a strong grievance redress committee, which was able to address most of the grievances that were directed to it.

I conclude this evaluation with a positive picture: the resettled community currently has comparably nicer houses, clean water, good roads, similar or enhanced livelihoods, greater privacy, electricity, and other essential basic amenities. The quality of life has improved. The evaluation does find some areas the project could have done better, but this does not significantly change the positive conclusion.