Nepal

Kulekhani Disaster Prevention Project(2)

Field Survey: July 2003

1. Project Profile and Japan's ODA Loan

Project Location


Erosion-Control Dam No. 5

1.1 Background

Nepal relies primarily on hydroelectric power, and in 1994 Nepal's total electricity generation facility capacity was 295.1 MW, of which 252.7 MW (approx. 86%) was supplied by hydroelectric power. Growth in electricity demand in Nepal was high, at an average of 13% annually, which caused a supply-demand gap of 20 MW at peak usage[1], and this was handled in Kathmandu by implementing planned blackouts. However, even if all of the electricity-related projects planned in 1994 were implemented, resolving the supply-demand gap would have been difficult. The forecast was that peak usage will be 341 MW in 2010, and the electricity supply-demand gap will expand to 738 Gwh. Since this forecast was based on the stable operation of Power plants in operation in 1994, measures were considered necessary for adequate operation and maintenance to ensure normal operation of power plant facilities.

Given this, Kulekhani Hydroelectric Power Plant (Power Plant 1, 60 MW; Power Plant 2, 32 MW), which benefited from this project, was constructed with development assistance from JBIC. It is the largest power plant in Nepal, supplying approximately 12% (as of 2003) of Nepal's electric power and supplying approximately 40% (as of 1994) at peak usage times. Moreover, this plant holds an important position in the provision of stable electric power supply in Nepal because whereas the majority of hydroelectric power plants in Nepal are flow-through type and their output declines in the dry season, this plant is the only reservoir-type hydroelectric plant in the country.

However, due to the topographic features of the region, this plant is subject to damage from natural disasters. A flood disaster occurred at both Kulekhani plants due to heavy rains in 1984 and 1986, and in response the Japanese Government granted a loan totaling 18.965 billion yen for Disaster Prevention Project (I). However, during the implementation of Disaster Prevention Project (I) (July 1993), another large flood occurred due to heavy rains with precipitation of 80 mm/hour and 540 mm/day, causing massive damage to steel penstock and head works and halting power generation. In response, grant aid

[1] The time when demand for electricity is at its maximum.

and part of the loan for Disaster Prevention Project (I) were used to implement emergency restoration work (permanently burying the steel penstock that had been washed away by the flow of earth and rocks as well as temporary restoration work for the head works of Mandu River), and in December 1993, power generation was resumed. As a result of the engineering service for the full-scale restoration and the disaster countermeasures implemented at this time for the power plant and the dam, it became clear that heavy damage would be incurred if another flood on the scale of the 1993 flood occurred within 10 years, and so further disaster prevention measures became necessary.

1.2 Objective

The objectives are to ensure safe and efficient operation of Kulekhani Hydroelectric Power Plants 1 and 2 by implementing full-scale disaster prevention works, and through this, to contribute to the stable supply of electric power in Nepal.

1.3 Output

(1) Improvement of dam’s water intake pipe (Construction of sloping intake)
(2) Protection work of Mandu head works
(3) Construction of erosion-control dams at the mouth of the Kulekhani River where it flows into the dam reservoir and on the upper Kulekhani River
(4) Installation of a warning device for dam discharges and construction of a telemetering system which monitors the water level of the reservoir of the Power plant
(5) Purchase of a vehicle for operation and maintenance use
(6) Construction of an access road for operation and maintenance between the dam and Power Plant 1
(7) Emergency restoration work
(8) Consulting service
* See the “Project Site Map” on the next page for details

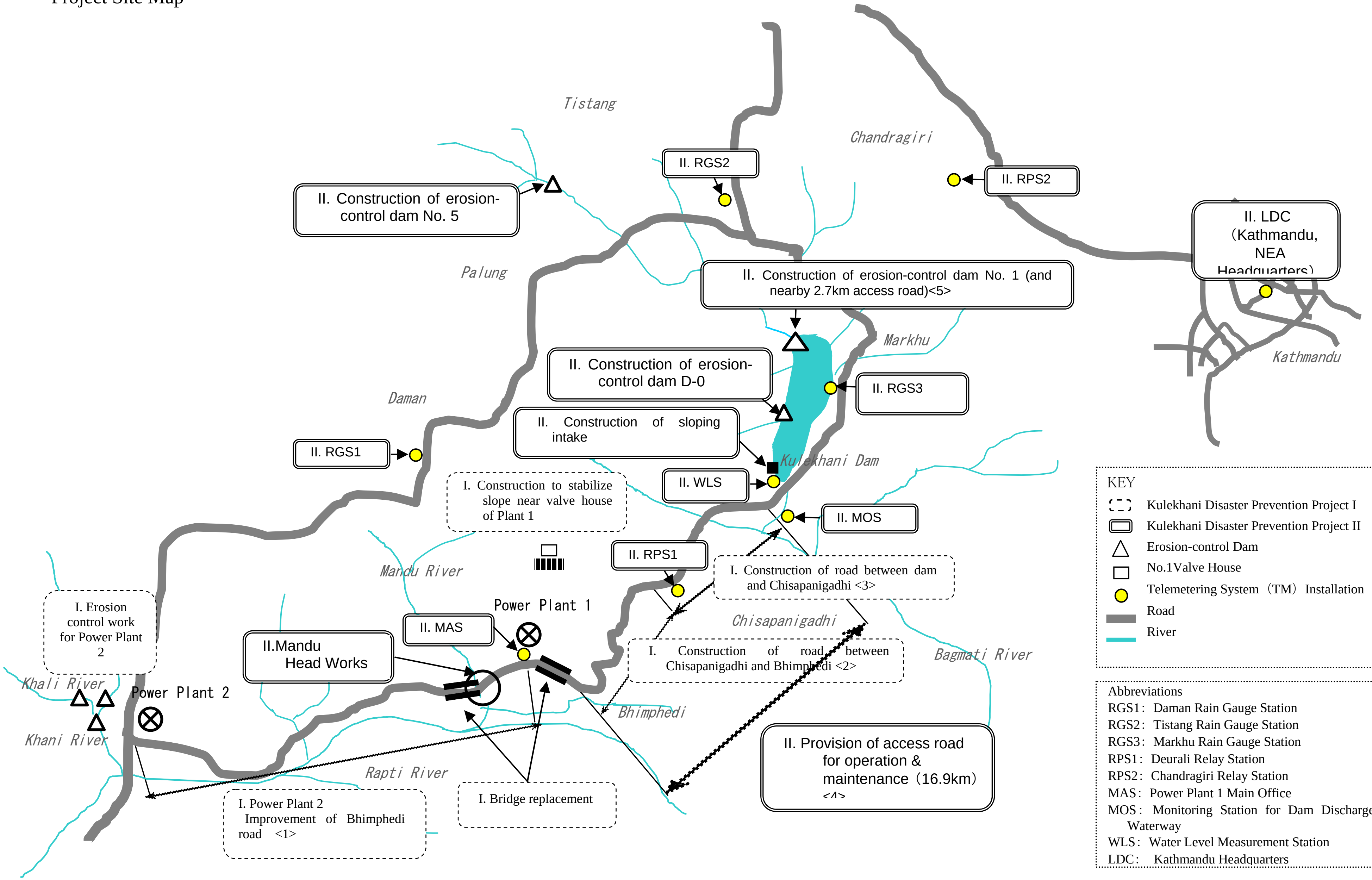
1.4 Borrower/Executing Agency

Borrower: The Kingdom of Nepal
Executing Agency: Nepal Electric Authority (NEA）

1.5 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	3,484 million yen / 2,466 million yen
Exchange of Notes/Loan Agreement	April 1996 / May 1996
Terms and Conditions -Interest Rate -Repayment Period (Grace Period)	 1.0% 30 years（10 years） General Untied
Final Disbursement Date	July 2001

Project Site Map



KEY
- Kulekhani Disaster Prevention Project I
- Kulekhani Disaster Prevention Project II
- Erosion-control Dam
- No.1Valve House
- Telemetering System（TM）Installation
- Road
- River

Abbreviations
- RGS1: Daman Rain Gauge Station
- RGS2: Tistang Rain Gauge Station
- RGS3: Markhu Rain Gauge Station
- RPS1: Deurali Relay Station
- RPS2: Chandragiri Relay Station
- MAS: Power Plant 1 Main Office
- MOS: Monitoring Station for Dam Discharge Waterway
- WLS: Water Level Measurement Station
- LDC: Kathmandu Headquarters

2. Results and Evaluation

2.1 Relevance

Demand for electric power in Nepal increased by an annual average of 13% from 1981 to 1991, and at the time of this project planning as well, it was increasing by approximately 9%, creating a situation in which supply could not keep up with demand. Thereupon, the Nepalese Government placed high priority in its Eighth 5-Year Plan (1992-1997) on development of electricity sources, agricultural development, and tourism development, with the stated policy goals of 1) sustainable economic development, 2) alleviation of poverty, and 3) correction of regional gaps. (In this plan, the electricity sector accounted for 21% of the budget for development expenditures.) Given this, the Kulekhani Hydroelectric Power Plant, which accounted for approximately 31% of the domestic power generation facility capacity, was in a vital position, but it became difficult to continue sustainable operations due to flooding. Consequently, it can be said that this disaster prevention project was highly relevant because it devised measures so that this power plant could safely supply electricity.

Moreover, the relevance of Project (II) is recognizable because, since funds for improvement and construction of access roads that were initially planned in Project (I) were used for emergency restoration work following the large flood (1993), it was necessary to construct the unfinished portions of road, to implement lasting measures for the facilities of the power plant, and to provide an environment that can withstand flooding.

At the time of evaluation, this project, which protects the power plant from natural disasters and supports the stable supply of electricity, remained highly relevant 1) because Nepal's 5-year Plan (2002-2005) [2] aims at increasing the electrification rate and the 5-year plan lists as important the boosting of the domestic electricity supply and the increase of the electrification rate in rural areas, and 2) because the Kulekhani Hydroelectric Power Plant accounts for approximately 16% (FY2002) of Nepal's electric facility capacity and for 20% at peak demand[3], and it supplies 50% to 60% of Kathmandu's electric power.

2.2 Efficiency

2.1.1 Output

Output at the time of the appraisal had been implemented almost according to plan. Emergency restoration work[4] was not necessary since no particular disasters occurred. At the time of appraisal,

[2] His Majesty's Government National Planning Commission Kathmandu, Nepal, May 2003
[3] "Peak demand" refers to the demand for electric power when demand is at its maximum
[4] Using the lessons learned in Project (I), restoration expense was appropriated for disasters that might occur during

two items were added: 1) construction of erosion-control dam No. 1 (and accompanying that, construction of the access road) and 2) a radio system (added as part of the telemetering system). The construction of erosion-control dam No. 1 was implemented because it was judged necessary for boosting erosion control, and according to the executing agency, it was mentioned as an important item at planning time. The radio system was added after it was judged necessary to increase the efficiency of communication among nine points[5] including the dam site and the power plants, etc., and to ensure a communication tool in times of disaster[6].

2.2.2 Project Period

In the original plan, the loan agreement was to be signed in May 1996 and the project was to be completed in June 1998, but the project was actually completed in May 2001 due to the fact that before it started (1) there was a delay in the internal processing of the executing agency, and (2) contract negotiations were unsuccessful and bidding had to be redone.

2.2.3 Project Cost

The original project cost was 4,060 million yen (including loan portion of 3,484 million yen), and the actual cost was 2,635 million yen (including loan portion of 2,466 million yen). This difference was due to (1) efficient ordering through competitive bidding, etc., and (2) the fact that expenses were unnecessary for emergency restoration work which accounted for 16.5% of the total project cost.

2.3 Effectiveness

2.3.1 Disaster Prevention Effects

Through this project, the disaster prevention system of the Kulekhani Hydroelectric Power Plant was established, and the disaster prevention effects which were realized as a result are as follow.

(1) Construction to Prevent Intake Blockage (Improvement of Dam’s Water Intake and Construction

the implementation of the project

[5] Power Plant 1, waterway from reservoir, water intake of reservoir, Deurali, Chandragiri, Daman, Tistang, Markhu and Kathmandu

[6] Accompany the expansion of the above output, consulting service increased from the initially planned 1,316M/M to 2,512M/M (the increase in the local consultant portion from the planned 176M/M to an actual figure of 2,349M/M was particularly large). But the cost was within the planned because the cost increase of the expanded scope was offset by the cost decrease of the planned output.

[7] A sloping intake is an intake that can be raised according to the elevation of the sand in the reservoir to prevent the

of Sloping Intake[7])

Since at the Kulekhani Dam there is no way to drain the reservoir and remove the sand when the water intake and waterways are blocked with sand making restoration impossible, measures were devised to alleviate the risk so that water can be obtained even if the amount of sand in the reservoir increases

Sloping Intake

-Disaster Prevention Effects

- Through this construction and the erosion-control dam construction, the risk of blockage of the reservoir's water intake and waterways due to sand was alleviated, and the **life spans of the power plant and the reservoir were extended**.

Prior to project: 15 years→After project: 50 years
（an increase of approx. 3.3 times）

(2) Improvement and Construction of the Mandu Head Works and Water Intake

Since the power plant would be unable to take in water and power plant operation would stop if the head works leading to Power Plant 2 were buried under an avalanche due to flooding, construction was carried out to bury the head works to protect it from avalanches.

Entrance to the buried Mandu head works

-Disaster Prevention Effects

- The head works was damaged by an avalanche during major flooding in 1993 and power plant operation stopped, but although an avalanche occurred when heavy rain fell in 2002 following this project, there was no damage and power plant operation was not hindered.

power plant's water intake from being blocked by sand.

(3) Construction of Erosion-control Dam

Erosion-control dam No. 5, D-0, and No. 1 were constructed to reduce the amount of sand that accumulates in the reservoir.

Erosion-control Dam No. 5

-Disaster Prevention Effects

Reduction of annual sand inflow to the reservoir

1993 (year of flood): 4.8 million m^3 (6% of reservoir capacity)

↓

1996 to 2002: annual average of 0.29 million m^3 (a 94% reduction)

(4) Introduction Telemetering System

A telemetering system, together with a radio system, was introduced for automatically monitoring the reservoir’s water level at nine points, including the Kulekhani Dam, Power Plant 1, and Kathmandu.

Telemetering system installed at the monitoring station for the dam discharge waterway

-Disaster Prevention Effects

<u>Greater Efficiency of the Reservoir Water Level Monitoring System</u>

Prior to Project: Reservoir’s water level was confirmed respectively by telephone.

After the Project: The data of reservoir water level at multiple sites was collected automatically and monitored at sight.

<u>Assurance of Communication Means During Disasters</u>

Prior to Project: Stationary telephones were the main means of communication. During the disaster of 1993 telephones were out of service, and instructions to open/close the gates, etc., were delayed.

After the Project: Because of the introduction of radios, a system has been organized where communication is possible during power outages in disasters.

During the heavy rains (daily precipitation of 325 – 455 mm) that fell during July 22 - 24, 2002, the disaster prevention effects of this project were apparent. The rain at that time was a 100-year probability precipitation, of the same level as the 100-year probability rain hypothesized in the erosion-control plan of this project. Although a large avalanche occurred in the project area, it had no effect on the operation of Kulekhani Hydroelectric Power Plant. Among the disaster prevention measures of this project, it was the protection work of the Maudu head works that contributed to prevention of the avalanche from entering the head works, thus preventing the stoppage of Kulekhani Hydroelectric Power Plant's operation. This resulted from the fact that this project's disaster prevention facilities were designed using the lessons learned from the large flood of 1993.

2.3.2 Economic Internal Rate of Return（EIRR）

The economic internal rate of return (EIRR） was measured by comparing the case where this project (disaster prevention project) was implemented with the case where it was not implemented. At the planning time, it was calculated at 13.6% given the following conditions.

Project Life: 50 Years
Benefits: Extended life span for the Power plant (50 years) and extended life span for the reservoir (50 years)
Costs: Construction cost of this project, operation and maintenance expense, and reduction in the amount of power generated during the dry season[8].

When the figures were recalculated during the latest evaluation using the same items as during the appraisal, the EIRR was 16.90% because total project cost was 65% of the originally planned cost and the reduction in the amount of power generated during the dry season was less than planned.

2.4 Impact

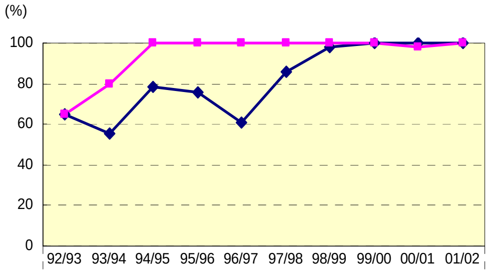
2.4.1 Contribution to Stable Supply of Electric Power

Ultimately, it was desired that this project contribute to the stable supply of electric power in Nepal.

Whereas the rate of operation of both power plants was approximately 80% on average in 1994 to 1997 prior to the project, a rate of operation of 99% is being maintained after the completion of the project (Figure 1). This is due to proper implementation of operation and maintenance for the power plants' facilities as well as the effects of disaster prevention measures installed by this project.

[8]The amount of reduction in power generated during the dry season in the event this project was not implemented was used in calculations

Figure 1 Rate of Operation of Kulekhani Hydroelectric Power Plant (KL)

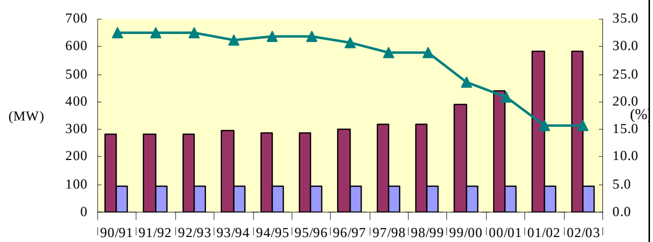


	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02
KL-1	65	55.43	78.20	75.51	60.91	85.57	98.28	99.86	99.82	99.81
KL-2	65	80	99.88	99.88	99.92	99.75	99.68	99.70	98.15	99.80

Source: Materials from executing agency

Kulekhani Hydroelectric Power Plant's share of facility capacity in Nepal had declined to 15.7% at the time of evaluation, compared to 32.5% in FY1990/1991 (Figure 2), but it still holds an important share. In addition, as shown in Figure 3, the amount of electricity supplied by Kulekhani Hydroelectric Power Plant is stable. From the above it can be said that the disaster prevention measures installed by this project not only stabilized the electric power supplied by Kulekhani Hydroelectric Power Plant, but also contributed to the stable electric power supply of Nepal.

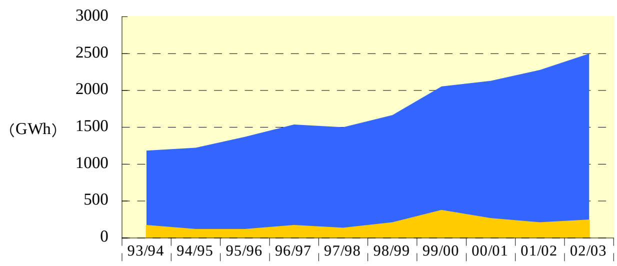
Figure 2 Kulekhani Hydroelectric Power Plant (KL) and KL's Share of Facility Capacity in Nepal



	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03
Facilities Capacity (MW)		283	283	295	288	288	300	319	319	390	440	585	585
KL (MW)	92	92	92	92	92	92	92	92	92	92	92	92	92
KL Share	32.5	32.5	32.5	31.2	31.9	31.9	30.7	28.8	28.8	23.6	20.9	15.7	15.7

Source: Materials from executing agency

Figure 3 Kulekhani Hydroelectric Power Plant (KL) and the Amount of Electric Power Supplied in Nepal



	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03
Nepal	1,030	1,117	1,262	1,369	1,373	1,475	1,701	1,868	2,066	2,261
KL (GWh)	160.2	108	110	168	122	196	363	258	212	244

Source: Materials from executing agency

2.4.2 Environmental and Social Impact

According to the executing agency, there were no reports of adverse effects on the natural environment during construction or after the completion. At the time of appraisal, acquisition of farm land, relocation of a school, and relocation of a temple were planned for the construction of erosion-control dams, but as a result of review of the project plan, it was decided that relocation was unnecessary except for the relocation of two families who lived near the construction site of erosion-control dam No. 5. The necessary measures were taken for the two families with their consent, including financial compensation. According to the executing agency, no complaints have been received to this day from the residents who were relocated.

2.4.3 Secondary Impact

（1）Increase in Safety of Area Residents Due to Dam Discharge Warning Device

The warning device installed at the Kulekhani Dam is used to warn residents who are bathing or doing laundry in the river when water is discharged into the spillway in order to adjust the water level in the reservoir. Because, following the completion of the project, the facility always sounds the warning device prior to discharge, the safety of the area residents is ensured, and they have had no accidents.

（2）Other

In the Makwanpur region where this project is located, there are 43 Village Development Committees (VDC; the smallest administrative unit in Nepal[9]). Among those, 7 VDCs (total population 43,387 persons; 7,932 households[10]) exist within the area of this disaster prevention project. In this evaluation, a site study was implemented in this region, and the site study confirmed the following secondary impacts.

- Area residents who live near the erosion-control dams are collecting the sand that accumulates in the erosion-control dam[11] and are deriving supplementary income by selling the sand to construction materials dealers in Kathmandu[12].
- By using the roads provided by this project (including Phase I) (see <2> to <5> on page 3 “Project Site Map”), the area residents can now more easily transport their agricultural products to Kathmandu for sale[13].
- Due to the roads provided by this project (including Phase I), the route from Bhimphedi to Hetauda was improved and driving time was saved (see <1> to <4> on page 3 “Project Site

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[9] Village Development Committee (VDC)

[10] District Demographic Profile of Nepal, 2002

[11] The collection and sale of sand in the erosion-control dams is allowed in Nepal as a legal activity. Generally the collection of earth and sand by gravel dealers is subject to taxation. However, such activity as erosion-control dam No. 1 at the Kulekhani Reservoir is exempted from taxation because Nepal Electric Authority recognized from the project planning stage that collection of sand would extend the lifespan of the reservoir. Furthermore, this activity is permitted in rivers except in expressly prohibited areas, and it is not prohibited at the erosion-control dams in the Kulekhani reservoir basin.

[12] At residents’ hearings, it was stated that sales of sand accumulated at erosion-control dam No. 1 to dealers amounts to approximately 400,000 rupees per year, and sales of sand and rocks accumulated at erosion-cnotrol dam No. 5 amounts to approximately 1.6 million rupees (estimated) per year. However, it was unclear how many people are engaged in this work. According to the residents, mainly farmers during the off-season and residents who are not farmers are engaged in sand collection.

[13] This point is also mentioned as a secondary impact in the evaluation report of Kulekhani Disaster Prevention Project (I). This time, too, the same impact was confirmed in interviews with area residents (at three locations with approx. 15 persons).

Map") [14]. To be specific, the number of bus service (including truck buses) on this route was increased from 2 per day in 1990 to 8 per day at the time of evaluation, and the trip time was reduced from 4 hours to 1 hours.

2.5 Sustainability

2.5.1 Executing Agency

(1) Technical Capacity / Operation and Maintenance System

Nepal Electric Authority (NEA) employs 9,696 persons (2001/2002), and 70% of them are employed in power distribution and customer service, 13% are employed in power generation, and 8% are employed in power transmission. The operation and maintenance of this project's disaster prevention facilities are conducted together with the power plant work by the engineering works departments of Kulekhani Power Plant 1 and Power Plant 2. There has been almost no change in the organizational system of the power plants, with both power plants maintaining the number of their employees at 150 persons and 73 persons, respectively. The number of employees in the engineering works departments of the plants is 15 persons and 9 persons, respectively[15], and this current personnel placement is appropriate since the daily work involved in the disaster prevention project does not require a large workforce.

Moreover, in the daily operation and maintenance work for the disaster prevention facilities, no special technological skills are required. However, management of the facilities' monitoring and telemetering system does require semi-specialized technological skills, and the technological level of the employees is ensured through on-the-job training. Overall, operation and maintenance skills are at an adequate level. In this project, current quality and quantity of engineers are satisfactory because operation manuals are placed at each power plant, a system is in place in the event of a disaster or abnormal situation, almost all employees in charge of the disaster prevention project majored at university in civil engineering or mechanical engineering, and the number of employees has stabilized in recent years.

(2) Financial Status

Since the 2002/2003 financial statements of NEA were based on the forecasts of the executing agency, in order to analyze the financial status, first a comparative analysis had to be conducted on

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[14] Result of interview with Bhimphedi residents.

[15] The staffs at Kulekhani Power Plant 1 are in charge of operation and maintenance of the sloping intake, erosion-control dams, telemetering system, and inspection road connecting the dam and the power plant. Those at Kulekhani Power Plant 2 are in charge of operation and maintenance of the Mandu head works, water intake gate, outlet tunnel, and Rapti water intake, all of which were constructed by this project.

financial statement for 2000/2001 and 2001/2002, and then the forecast financial statements for 2002/2003 were analyzed.

First, sales for FY2001/2002 were 9,476.2 million rupees, a 16.1% increase over FY2000/2001. However, due to the rise in the cost percentage, etc., the operating profit was 2,427.3 million rupees, practically unchanged from FY2000/2001. Additionally, increase in depreciation expense and interest expense caused by the increase in fixed assets and borrowing due to investment in plant and equipment resulted in minus 1,209.4 million rupees as recurring profit.

Furthermore, the self-owned capital ratio declined by 3.2% to 33.4% compared to FY2000/2001.

Next, concerning the forecast financial statements for 2002/2003, sales are expected in increase 18.9% over 2001/2002, to 11,276.1 million rupees. Operating profit is also forecast to grow 85.6% to 4,505.8 million rupees. However, recurring profit is anticipated to increase by only 183.7 million rupees compared to 2001/2002 due to the large increase in interest expense. Finally, the self-owned capital ratio is forecast to decline to 31.4%, a drop of 2.0% compared to 2001/2002 because current net profit is negative, and in addition, fixed assets and borrowing increased just as in 2001/2002.

Given the above, NEA has adequate self-owned capital, but since it posted a deficit from 2000 to 2002, it needs to improve its profitability. In the ex-post monitoring survey, JBIC suggests more efficient collection of electricity fees and more efficient usage of personnel as a policy for improving profitability.

Table 1 Nepal Electric Authority Profit and Loss Statement (unit: million rupees)

Item	2000/2001	2001/2002	2002/2003
Sales	8,160.8	9,476.2	1,1276.1
Cost of Sales	4,480.7	5,440.7	5,130.6
Gross Profit on Sales	3,680.1	4,035.5	6,145.5
Other Profit	593.1	459.5	521.4
Sales Expense and General Administrative Expense	1,832.3	2067.7	2161.1
Operating Profit	2,440.9	2,427.3	4,505.8
Interest Expense	1,188.2	1,395.5	3,410.1
Depreciation Expense	1,119.3	1,420.1	1,830.6
Other Expenditures	426.9	821.1	290.8
Recurring Profit	-293.5	-1,209.4	-1,025.7
Gain from Prior Term Adjustment	291.6	492.0	370.0
Current Net Profit Before Taxes	-1.9	-717.4	-655.7

Corporate Tax, etc.	49.1	143.3	-
Current Net Profit After Taxes	-51.0	-860.7	-655.7

Source: Annual Report of Nepal Electric Authority 2002/2003
Note 1） Figures for FY2002/2003 are estimates.

Table 2 Nepal Electric Authority Balance Sheet (unit: million rupees)

Item	2000/2001	2001/2002	2002/2003注1)
Fixed Assets	61,261.2	63,929.0	65,050.6
Current Assets	6,434.5	7,332.2	9,003.0
Total Assets	67,695.7	71,261.2	74,053.6
Long-term Liabilities	36,707.5	41,474.5	45,011.0
Current Liabilities	6,113.8	5,948.1	5,735.9
Total Liabilities	42,821.3	47,422.6	50,746.9
Capital	24,874.4	23,838.6	23,306.7
Total Liabilities and Capital	67,695.7	71,261.2	74,053.6

Source: Annual Report of Nepal Electric Authority 2002/2003
Note 1） Figures for FY2002/2003 are estimates.

Meanwhile, the budget for the Kulekhani Disaster Prevention Project is secured as shown on Table 3. As seen on Table 4, this budget represented 2.59% in FY2001/2002 of NEA's total operation and maintenance expenses[16], and 4.06% in FY2002/2003. So, it is possible to cover the operation and maintenance expense in the budget of NEA. Also, given that the operation and maintenance expense for the Disaster Prevention Project increased by approximately 60% in FY2002/2003 over the previous year, it can be said the executing agency is aware of the importance of operation and maintenance of the disaster prevention facilities and is securing as large a budget as possible for that purpose.

Table 3 NEA Budget for Disaster Prevention Project（unit: million rupees）

Item	2001/2002（project completed）	2002/2003
Kulekhani Disaster Prevention Project II – Road Operation and Maintenance Expense	2.5	11.0
Portion Managed by Kulekhani Power Plant 1	26.1	32.8
Portion Managed by Kulekhani Power Plant 2	27.1	39.8
Total	55.7	83.6

Source: Materials from executing agency

Table 4 Percentage of Total Operation and Maintenance Expense Devoted to Disaster Prevention Project

[16] The sum of personnel expenses, facilities and materials expense, repair and maintenance expense, vehicle maintenance expense, and general administrative expense.

（unit: million rupees）

Item	2001/2002 (project completed)	2002/2003
Total NEA Operation and Maintenance Expense	2149.55	2057.77
(Disaster Prevention Project Operation and Maintenance Expense)	55.7	83.6
Disaster Prevention Project Operation and Maintenance Expense / Total NEA Operation and Maintenance Expense	2.59%	4.06%

Source: Material from the executing agency

Furthermore, according to the executing agency, since the budget for NEA's operation and maintenance expense adopts the zero base system[17], there are cases where the 100 percent of the requested budget is not approved, but basically the necessary budget is approved. Consequently, it is anticipated that the operation and maintenance budget for the facilities provided by this project will be secured henceforth.

2.5.2 Operation and Maintenance Status

The type of operation and maintenance work for the facilities constructed by this project and how well that work is being implemented are described as follows.

- Water Intake: Periodic monitoring and cleaning by the engineering works departments of each power plant
- Erosion-control Dams: Periodic monitoring and sand removal[18]
- Slopes and roads

-NEA staff conducts periodic inspections and mobilize local residents to clean before the start of the rainy season.

-When heavy precipitation is recorded, not only the staff in charge of operation and maintenance but also staff of the NEA Headquarters in Kathmandu conduct inspections of disaster prevention facilities and roads and monitor the conditions.

- Telemetering System: Monitored hourly every day and monitoring information at the 9 sites (see page 3, Project Site Map) is under centralized monitoring.

According to the results of the latest field survey and hearings at the executing agency, the operation and maintenance condition of the disaster prevention facilities constructed and improved by this project has no major problem. However, it is desirable to finish immediately the restoration

[17] A system wherein the budget assumed to be necessary for the following fiscal year is requested each year
[18] Collection of sand from the erosion-control dams by gravel dealers and area residents was expected as part of the operation and maintenance from the initial planning stage. The work of the executing agency is to monitor the sand accumulation with the expectation of sand collection by dealers and residents, and to remove sand itself when necessary.

work for the access road (constructed by this project between Kulekhani Power Plant 1 and the dam) that was damaged in the heavy rains in August 2001 and July 2002 following completion of the project. Currently, the road is passable using the detour built as a temporary measure, but in its current fragile condition it could be easily damaged again. If there is damage by further heavy rain in the future, roads including that to the dam may be cut off and facilities' operation and maintenance work may be hindered, increasing the likelihood of damage due to power failure. Also, if the residents' transportation routes are cut off, it may lead to difficulties for them in procuring supplies such as food and other necessities. Since the damage occurred, NEA has continuously worked to restore the road, but since their budget is limited, the work is unfinished. Given the importance of this power plant to Nepal, it is desirable to finish all of the restoration work as quickly as possible by arranging some budget measures in addition to the regular operation and maintenance budget.

In JBIC's ex-post monitoring survey [19], future measures were proposed by 2 hairpin curves[20] that had been damaged by landslides in 2001, but in the latest field study, it was confirmed as follows that the executing agency has appropriate measures toward the said proposals.

- Proposed: Clean the drainage ditch prior to the rainy season to ensure water flow capacity at the designed level

  Actual: It was decided to clean the mountain slope and the drainpipe along the road in December before the start of the dry season, and this is carried out every year.
- Proposed: From a long-term standpoint, measures should be devised to prevent small-scale landslides and falling rocks in advance by using spray-on concrete or protective mesh to stop falling rocks

  Actual: Trees were planted on the slope as a measure to reduce landslides, and the condition of the slope is being monitored carefully.
- Proposed: Install a holding tank where the roadside ditch and the concrete underground pipes meet, and further enlarge the diameter of the concrete underground pipes

  Actual: As a result of monitoring up until now, it was judged that immediate measures are unnecessary, so nothing has been implemented.

2.5.3 Other

For stable supply of electric power by the Kulekhani Power Plants, it is important that not only this disaster prevention project but also the operation and maintenance of the power plants themselves be carried out properly. The current operation and maintenance condition is favorable.

[19] To improve the profitability of the executing agency, JBIC proposed efficient collection of electricity fees and efficient usage of personnel, etc.
[20] Jurikhet Area (St.4+200) and Deorali Area (St. 7+200)

However, there is concern that the facilities are becoming antiquated since approximately 15 to 20 years have elapsed since they began operation (Power Plant 1 began operation in 1982, and Power Plant 2 began operation in 1987).

3. Feedback

3.1 Lessons Learned

None

3.2 Recommendations

-for the executing agency

The Kulekhani Hydroelectric Power Plant, which provided approximately 1/10 of Nepal’s electric power supply and is a place of extreme importance to the nation, is located in a harsh natural environment and so it is necessary to continue paying maximum attention to its operation and maintenance, including attention to budgetary measures for its operation and maintenance.

Comparison of Original and Actual Scope

Item	Planned	Actual Performance
Output		
(1) Improvement of Dam Intake (Lot 1)	Construction of sloping intake	As Planned
(2) Repair and Construction of Mandu Head Works and Water Intake (Lot 1)	1) Underground burial of Mandu head work, etc.	As planned, aside from reduction of earthwork of engineering works (47,000m^3→9,800m^3)
	2) Drainage tunnel construction	As planned, aside from reduction of earthwork of engineering works (23,000m^3→1,800m^3)
	3) Construction of intake gate shaft	As Planned
	4) Installation of perforated pipe	As Planned
	5) Repair of water intake	As Planned
(3) Construction of erosion-control dam (No.5) (Lot 1)	1) Construction of erosion-control dam	As Planned
(4) Erosion-control dam near river mouth of Darcotto (D-0) (Lot 1)	1) Construction of boulder dam	Construction of a consolidation check dam 5.0 meters high using wet stone-cutting method for small rocks
	2) Cutting through the causeway	Not implemented
	—	Other additional work (Lot 1) -Construction of erosion-control dam No. 1 and 2.7 km of access road
(5) Installation of Telemetering System (Lot 4)	Installation of telemetering system and water discharge alarm system	In addition, radio equipment was provided
(6) Provision of Roads (Lot 2)	1) New road construction (5.8 km) 2) Repair of existing roads (8.9 km)	1) and 2) total 16.9 km
(7) Purchase of Vehicles for Operation and Maintenance (Lot 3)	Bulldozer, loader, grinder, dump truck, crane, 4-wheel drive wagon, pick-up truck	As Planned
(8) Emergency Restoration Construction		Was unnecessary
(9) Consulting Service		
Total Overseas Domestic	- 1,316MM - 146MM - 1,176MM	- 2.512MM - 163MM - 2,349MM
Project Period		
1. Loan Agreement	January 1996	May 1996
2. Construction Preparation		
2.1 Engineering Service	October 1995－June 1998	June 1996 – May 2001
2.2 Bidding	October 1995－August 1996	May 1996－December 1999
3. Engineering Work		
3.1 Lot. 1	April – July 1996	November – December 1996
3.2 Lot No.2		
3.3 Lot No.3	August 1996 - March 1997	June 1997 – December 1998
3.4 Lot No.4	August 1996 – May 1997	July 1999 – June 2000
Project Cost		
Foreign Currency	3,484 million yen	2,322 million yen
Local Currency	576 million yen (Local currency: 341 million rupees)	358 million yen (Local currency: 218 million rupees)
Total		2,635 million yen

Item	Planned	Actual Performance
ODA Loan Portion Exchange Rate	4,060 million yen 3,484 million yen 1 rupee ＝ 1.69 yen	2,466 million yen (presented by executing agency: used conversion rate at time of expenditure）

Third Party Evaluator's Opinion on Kulekhani Disaster Prevention Project II

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Relevance

Nepal is one of the richest in water resources in South Asia. The water resources have tremendous potentials of contributing to Nepal's sustained development. This is the reason for each successive plan giving top priority on harnessing it for energy development. However, out of the total electricity generating capacity of 83000 MW, Nepal has been able to generate only 527.5 MK or 0.64 percent of potentials by the end of the Ninth Plan (1997-2002). The Kulekhani Plants (part I and II) generate 92-mw powers and thus their contribution still remains around 17 percent in total supplies. Upto 1994 these were the largest power supply plants meeting approximately 40 percent demands. More importantly, these are the only reservoir type big hydroelectric plants in Nepal with stable power supplies. The predomination of run-of-river type power plants are not only creating serious problems of supply gap during the dry season but also they are becoming instrumental to a greater extent in raising the electricity tariff rates every year. It is worth mentioning that now the electricity tariff rate in Nepal is the highest in South Asia. Therefore, from all these perspectives, the role of Kulekhani power plants is distinctive and crucial.

However, the Kulekhani Power Plants have had the risk of serious disaster problems from unexpected heavy rains. The plants had to face severe disaster problems at first in 1984 and 1986 due to the same reason. As a result, the Kulekhani disaster prevention project phase I was launched immediately. But when it was about to complete, there was another large flood in July 1993. The flood created heavy damage to steel penstock and headwork and halted power generation. This happened at a time when Nepal was facing serious power shortage problem. Therefore, an emergency restoration program was executed and in Dec 1993 power generation was again restored. But two time severe damages to the power plants revealed that if some long-term measures were not taken to ensure the prevention of disaster, the stopgap arrangement could render the risk of similar damages in case of large flood within ten years. Therefore, the Kulekhani Disaster Prevention Project II was a necessity at that time.

From the medium to long perspective of electricity tariff rate and Nepal Electricity Authority's overall financial position also any risk of damage to the Kulekhani power plants could have been very distressing. In Nepal delay in project selection or implementation, immature or wrong power purchase agreements and management problems have increasingly made very adverse effect on electricity tariff rate and financial position of the NEA. For instance, in 1991/92 the average electricity tariff rate was Rs. 2.22. It reached Rs.7.02 in 2002/03 from Rs. 3.52 in 1996/97. Thus, the rate is increasing in a way that it is gradually becoming unaffordable to the people. The high rate is also adversely affecting the competitive strength of the industry and trade. The various conditions included in the private sector invested power projects like Khimti and Bhotekosi have led to escalate prices every year to a grater extent. After the closer analysis of the power purchase agreements between these projects and the NEA it is found that the prices paid by the NEA are always higher than the average prices fixed by the NEA for the consumers. For instance, in 2000 NEA purchased electricity from Khimti at the rate of Rs. 7.34 per KW where as at that time the rate charged by it to the consumers was Rs. 6.27 only. As a result, despite phenomenal rise in tariff rates, the NEA is confronting with the problem of big financial losses in recent years. In 2001/02 and 2002/03 it registered a net loss of Rs. 777.44 million and Rs. 655.7 Million respectively. This means that the cost of recently constructed projects have been too high to be compensated by profit earning relatively old power projects. This further reveals that, in the event of disruption in the power supplies from power projects like Kulekhani, the adverse effect could have been wide-ranging and long term in nature.

Impact

After quick assessment of the overall impact based on JBIC report, NEA documents and other primary sources, it is clear that the project has fulfilled its overall objectives. It has helped to stabilize the supply of power by minimizing the risk, at a time when the demand for electricity was rising at an annual rate above 13 percent. From the same token, it immensely contributed to contain the probable steep rise in the prices of electricity. The increase in the rate of operation of the plants from 80 percent previously to 99 percent after the completion of project also additionally contributed for this.

Despite project having management problems leading to delay in the completion of project by three years, this however, did not adversely affect the project cost. The competitive bidding and saving of entire funds allocated for emergency restoration made such a possibility. The project was started in 1996 and was completed in May 2001 despite the target of completing in June 1998. However, going by the information contained in the JBIC report and actual expenses reported in the income and expenditure account of the government, some discrepancy in the project cost is revealed. Based on the evaluation report, only 66 percent of the funds allocated were spent. This, in turn, enabled to raise the rate of return to 16.9 percent from 13.6 percent envisaged at the time of project formulation. This is based on the information that out of the total cost of $ 36.87 million (converted into Dollar at 1995/96 prices for comparison purposes) envisaged, only $24.35 million was spent. Based on the National Planning Commission documents and Ministry of Finance income and expenditure records, however, out of the total cost of US $ 31.03 million envisaged about $ 30.32 million was spent. One problem, thus, found is that there is no complete uniformity in the reporting of even the total expenses, needing enforcement of a system that could ensure that expenses are made through standard budgetary processes and recording. Nonetheless, even based on the budgetary documents some cost effectiveness is found particularly in view of long delay in the completion of the project. One additional area that requires enough care and attention is that the management system of project is significantly improved by means of measures to strengthen accountability system. The institutional and governance related problems are the ones that need enough attention in the course of project design and implementation in countries like Nepal.

No serious environmental problems have been created by the project. The over all social impact of the project also has been positive. Despite fears in the course of project design, neither the school nor the temple had to be moved from the project area. Likewise, only two families had to be resettled outside the project site. For them also adequate compensation was given. The construction or continued repairs and maintenance of road by the project have facilitated increased movement of vehicles. This has also provided incentive to the local people to collect sand from the project site for making additional or alternative incomes. This project has also paved the way for the initiation of the 42 MW third phase power project in the same area. However, from the sustainability point of view, there is a risk of scarcity of funds for repairs and maintenance especially due to continued deterioration in the financial position of the NEA. Therefore, further control of technical losses and measures to curb operating expenses in Kulekhani will be required.