Indonesia

Ex-Post Evaluation of ODA Loan Project "Renun Hydroelectric Power and Associated Transmission Line Project"

External Evaluator : Masami Sugimoto
(SHINKO Overseas Management Consulting, Inc.)
Field Survey : Feb. 2009 - Jun. 2009

1. Project Profile and Japanese ODA Loan

Map of Project Area

Renun Hydroelectric Power Plant
Located at Lakeside Toba

1.1 Background

Sumatra Island is located at the west end of the West Great Sunda Islands of Indonesia. The shape of the island is vertically long extending from northwest to southeast, reaching about 1,750km in length and 450km in width at the broadest. The island which is the second biggest in Indonesia and the sixth biggest in the world occupies total area of about 433,800km^2, 1.15 times as big as the territory of whole Japan having total population of approximately 45,000 people. Being located at a strategic position in east-west maritime transportation, the island is rich in numbers of ancient dynasties among which the Sriwijaya Dynasty is most well-known for its domination widely extended up to the territories of Southeast Asia over the Strait of Malacca. The capital city of North Sumatra Province where the Project site is located is Medan, the forth biggest city in Indonesia after Jakarta, Surabaya and Bandung having its population of about 2.25 million people. Although agriculture consistently dominates the regional industry, food, rubber processing and chemical industries were also developing actively, which was

strongly promoting rapid growth of power demand. The 6th Five-year National Development Plan (REPELITA VI) under which the Project was formulated aimed at stable power development. At the same time, utilization of potential hydropower resources coupled with construction of coal-fired thermal power plants mainly to supply base-load electricity demand was an urgent issue in that framework.

1.2 Objective

The objective of this project is to construct 82MW hydroelectric power plant and associated transmission lines at the region of Lake Toba in the North Sumatra Province of Sumatra Island aiming to meet the growing power demand to be supplied by the PLN's Regional Distribution Office II (Wilayah North Sumatra), and thereby contributing to the region's economic development and improvement of the people's standard of living.

1.3 Borrower/Executing Agency : The Government of Indonesia / PT. PLN (Persero)

1.4 Outline of the Loan Agreement

Approved Amount/Disbursed Amount	(I)5,460 million yen (II)15,668 million yen (III) 5,479 million yen (Total) 26,607 million yen / (I) 5,439 million yen (II)15,642 million yen (III) 3,219 million yen (Total) 24,300 million yen
End Notes Exchange Date/Loan Agreement Signing Date	(I) June 1991 (II) June 1993 (III) July 1994 / (I) September 1991 (II) November 1993 (III) November 1994
Terms and Conditions	Interest Rate: (I) (II) (III) 2.6% Repayment Period: 30 years (Grace Period: 10 years) Procurement: (I) Compound (II, III) General Untied
Final Disbursement Date	(I) (II) (III) December 2005
Main Contractor (over 1 billion yen)	HYUNDAI CORPORATION (South Korea), JINRO (Indonesia), MBRC (Indonesia), PT. MARTA KARYA (Indonesia), PT. AUSTRODWIPA (Indonesia), VA TECH ELIN GMBH

	(Austria), SAKAI IRON WORKS Co. Ltd (Japan)
Main Consultant (over 100 million yen)	NIPPON KOEI Co., Ltd. (Japan)
Feasibility Studies, etc.	Feasibility Study: Renun Hydroelectric Power Development(JICA, 1985) Engineering Service: Renun Hydroelectric Power Project (JBIC, 1985) Special Assistance for Project Implementation (JBIC, 2003)
Related Projects	N/A

2. Evaluation Results (Rating: A)

2.1 Relevance (Rating: a)

2.1.1 Relevance at Appraisal

Under the objectives of the energy sector to reduce its oil dependency by means of raising the share of alternative energy resources and new energy source development, the 6th Five Year National Development Plan (REPELITA VI, 1994~1998) was taking major policies enforcing (1) increase in supply of energy resources and their effective use, (2) infrastructure and facility development and (3) institutional strengthening of the energy sector. Expecting improvement of electrification (from 37% in 1993 to 60% in 1998) and economic growth of 6% mark, the power demand was anticipated to grow at 13% during the period. It also targeted average annual rate of conversion at 20% from diesel-based self generation to the PLN-grid connection and reduction of the ratio of oil thermal generation from 17.5% to 9.9% during the plan period in the framework of getting rid of oil dependency and improving efficiency. The trends of power demand, peak load and installed generation capacity of PLN throughout Indonesia forecasted at the time of Appraisal are shown in the next table.

Table 1：Supply-Demand Forecast

	1993	1998	2003
PLN Power Demand	38,962GWh	88,285GWh	137,484GWh

Peak Load	7,448MW	17,291MW	27,018MW
Installed Generation Capacity	12,605MW (Hydropower, 2,315MW)	20,128MW (Hydropower, 3,193MW)	24,951MW (Hydropower, 6,952MW)

Source: Appraisal Documents
Note: (1993) Actual performance (provisional) at the time of Appraisal, (1998, 2003) Forecast and planned total capacity to be installed

The average rate of power sales growth in the north Sumatra region (PLN Region II then) was 17.4% per annum from 1992 to 2003. Total power demand was 11,005GWh (11,888GWh) and peak load was 2,343MW (2,581MW)[1]. In the PLN Region II, the construction of Salurlla and Sibayak geothermal power stations that was planned to be implemented in 1999~2001 under private participation was delaying, and Asahan Hydroelectric Power Plant (III) had no prospect of start. Under such conditions, it was an urgent need to start this Project to cope with the critical condition with only 4% power supply reserve against the peak load, otherwise the growing power demand would be hardly met with the existing capacity of supply. Or, even if the power development was implemented as planned, the tight supply-demand condition would necessitate expansion of the power supply reserve. The power supply structure in North Sumatra was biased with too much dependence on oil thermal and diesel generation (1,543MW (98.5%) out of 1,567MW in 1998), therefore additional construction of hydroelectric power stations was eagerly expected to be established in order to attain balanced as well as stable power supply.

2.1.2 Relevance at Ex-Post Evaluation

The "Medium-Term National Development Plan (Rencana Pembangunan Jangka Waktu Menengah Nasional: RPJM-N) <2004-2009>," which announces the necessity of the development of the power sector for overall national development, puts continued emphasis on the development of alternative power resources including hydropower aiming for alleviating the dependency on oil as a main energy source. The growth of power demand has been also remarkable. The high rate of growth at 10% per annum in 1997 was once suspended by the economic crisis experienced in the same year, however, constant consumption with annual rate of 7.6% has been continuing afterwards.

[1] The region II was planned to be connected to the Region I (Aceh Province) then. The figures in parenthesis are the consolidated total of the two.

Table 2: Growth of PLN Power Salas

(Unit: TWh)

Region	2003	2004	2005	2006	2007	Annual Growth Rate
Sumatra	11.22	12.34	13.28	14.59	15.80	8.9%
Total Indonesia	90.54	100.10	107.03	112.61	121.25	7.6%

Source: RUPTL<Long-term Power Development Plan> 2009-2018

From the aspect of power development under the policy to alleviate oil dependency, hydroelectric power generation utilizing potential hydraulic resources is strengthened coupled with extended conversion to coal-fired thermal power generation for meeting base-load power demand. They occupy 39% and 11% respectively in total installed capacity, which turned to exceed the oil and gas fired generation that occupy 46%[2]. The potential capacity of hydroelectric power generation throughout Indonesia was estimated to be about 75,000MW ("Hydroelectric Power Potentiality Study," 1982), however, the total power volume developed up to the year 2008 amounts to 4,125MW, only 5.5% of the total potential.

PLN nominates areas whose peak-load demand can not be met with existing installed capacity of power generation as "Daerah Krisis (Critical Area)," and prioritize their power development in the Long-Term Power Development Plan (RUPTL, 2009~2018). North Sumatra (NAD, North Sumatra, Riau Provinces) where the Project is located is one of the 10 Critical Areas. Especially emphasis is placed on the power investment in NAD Province which was attacked by the great earthquake off the coast of Sumatra in 2004 and following Tsunami and the resultant damage on power facilities has not been fully recovered.

The power supply-demand conditions in the supply areas of the Renun Power Plant are critical. RUPTL forecasts the growth rate of peak load will reach at 73% for NAD and the highest 163% for Riau in coming 11 years. To cope with this expanding power demand, the estimated construction of needed power plants amounts to 57,442 MW (PLN, IPP inclusive) throughout Indonesia and 9,145MW (ditto) in Sumatra during the same period, among which hydroelectric power plant should occupy 4,740 MW, 3.8% (3,835MW, 10.9% for PLN only) in overall Indonesia and 893MW (262MW, 7.1% for PLN only) of the capacity totally required.

[2] Geothermal 4%. All the figures are taken from RUPTL

Table 3: Forecasted Power Demand of Respective Areas

Wilayah (Region)	Power Demand (GWh)			Peak Load (MW)		
	2008	2018	Growth Rate	2008	2018	Growth Rate
NAD (Note)	1,225	2,206	80%	239	413	73%
North Sumatra	6,382	15,213	138%	1,146	2,648	131%
Riau	2,316	6,347	174%	423	1,114	163%

Source: RUPTL2009-2018

Note: Nanggröe Aceh DarussalamProvince. NAD used to be called Aceh Special Province until 2002.

Thus, this project has been highly relevant with Indonesia's national policies and development needs at the times of both appraisal and ex-post evaluation.

2.2 Efficiency (Rating: b)

2.2.1 Output

This Project is to construct a run-of-river type hydroelectric power plant at the lakeside of Toba[3] utilizing the water resource available by transferring the water flow of Renun River which is currently flowing into the Indian Ocean to the lake. The construction works were divided into three phases each of which is separately financed by the yen loan.

Table 4: Phasing and Each Content of Project

Phase	Loan No.	Major Contents
I	IP-376	1. Consulting Services 2. Construction of Access Roads, and Base Camp
II	IP-407	Construction of Upstream and downstream head-race tunnels
III	IP-424	1. Construction of hydroelectric power plant 2. Construction of associated transmission lines

[3] A crater lake with the length of 84km from north to south, 24km from east to west. It is the greatest lake in Indonesia with the total area of 1,460km^2, which is twice as big as Lake Biwa of Japan. The depth of water is 903m at the deepest (No.8 in the world), and the altitude of the water surface is 906m above the sea level. The lake is well known as an international tourist resort having attractive spots of Prapat, a lakeside health resort, and Brastagi situated at the north plateau.

Actual project output of the power station and associated facilities is almost the same as planned with some additions in the following two areas.

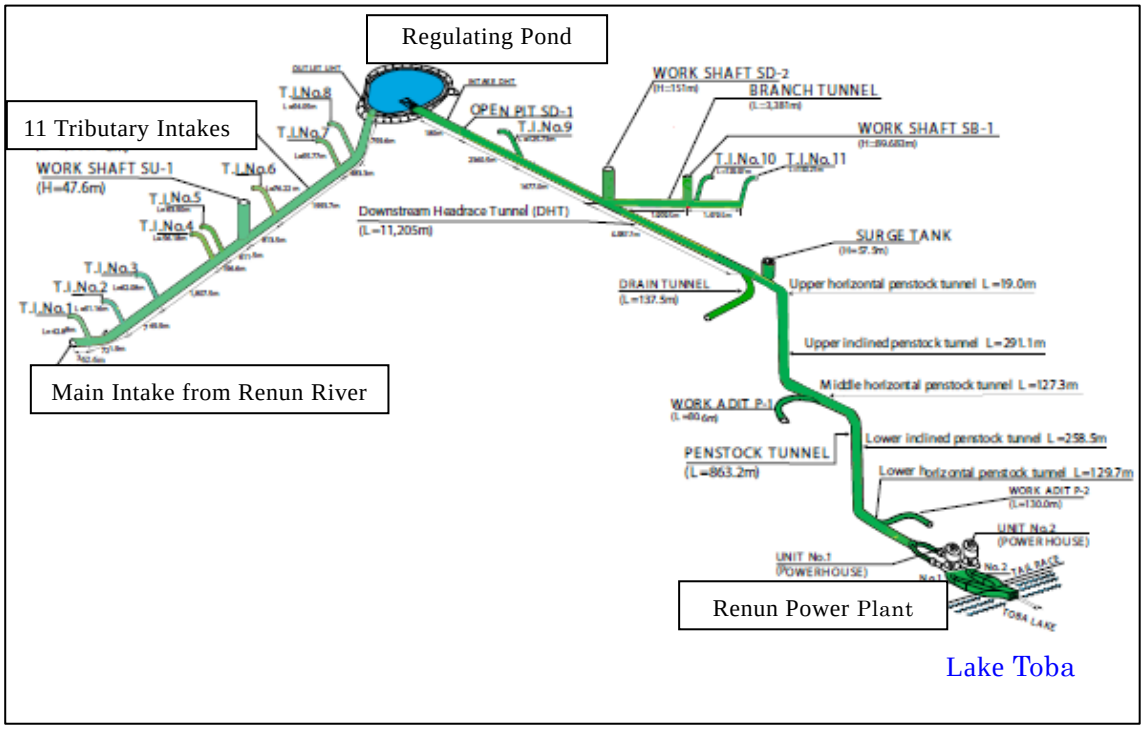
1. Addition of Irrigation Facilities

There are totally 2,000ha irrigation areas downstream the eleven tributaries of Renun River. In order to keep favorable coexistence between the hydropower generation and irrigation, facility development of irrigation was added to the original Project scope with totally 31.3 million yen investment.

2. Man-Month Addition of Consulting Service

As described below, the implementation period was obliged to be significantly extended from various causes being compared to the original schedule planned in Appraisal. The actual input volume of the supervision works of the consulting services was drastically increased.

Figure 1: Layout of Project



Substation

Regulating Pond

2.2.2 Project Period

Under the initial plan, the project period was from September 1991 to October 1999 (98 months), but the actual project period was from September 1991 to November 2006 (183 months) including a set of extension of the loan disbursement period, which turned out 86.7% longer than planned.

Table 5: Summary of Loan Disbursement Extension

IP No.	Original Expiry Date	Extended Expiry Date	
		First Extension	Second Extension
IP-376	October 29, 2000	December 29, 2001	December 30, 2005
IP-407	December 8, 2001	December 30, 2005	-
IP-424	December 15, 2001	December 30, 2005	-

Major causes and corresponding approximate months of delay are as follows.

1. The Phase I (IP-376) construction works for the access roads undertaken by a local contractor were delayed (6 months).
2. The Phase II (IP-407) construction works for the downstream headrace tunnel were significantly delayed due to (1) performance failure of an international contractor and (2) significantly prolonged excavation works for the headrace tunnel hindered by unexpected fault zone with sandy tuff layer (18 months).
3. After passing the fault zone above, large-scale groundwater discharge confronted the excavation works and badly affected the implementation (42 months).

4. The commissioning test of the turbine and generator was delayed from a technical trouble (12 months).

2.2.3 Project Cost

Planned project cost was 31,422 million yen (of which Japanese ODA loan was 26,607 million yen), and the total disbursed amount from the ODA loan was 24,300 million yen, 8.7% smaller than planned disbursement. Reliable actual project cost in total was unavailable because the amounts invested from the government and PLN budgets were not properly recorded in project accounting under imperfect project accounting system of PLN. In spite of the significant implementation delay as well as the added scope and input, the amount of ODA loan disbursement was saved within the plan. It is mainly due to the successful reduction of total payment through efficient procurement with reasonable prices through fair price competition under international and local competitive bidding, secondly due to the significant depreciation of Rupiah currency (about 80% depreciation against the rate at Appraisal) brought by the Asian currency crisis in 1997.

Although the project cost was held within the initial plan, the project period considerably exceeded the plan; therefore the evaluation for efficiency of this project is moderate.

2.3 Effectiveness (Rating: a)

2.3.1 Effectiveness Measurement with Operation and Effect Indicators

The following table 6 comparatively shows the targeted figures set at Appraisal and their actual performance.

Table 6: Operation & Effect Indicators: Target and Performance

Indicators (Unit)	Generator	Target at Appraisal	Performance 2007	Performance 2008
Operation Indicators				
Rate of Unplanned Outage	No. 1		0%	8%
(Note 2)	No. 2		0%	0%
Rate of Planned Outage	No. 1		5%	1%
(Inspection & Repair) (Note 2)	No. 2		2%	1%
Capacity Factor	No. 1	44%	27%	50%
(Note 3)	No. 2		63%	52%
Rate of Internal Plant Use		2.1%	1%	0%

Annual Operating Hours	No. 1		4,911 hours	4,860 hours
	No. 2		4,559 hours	5,882 hours
Maximum Water Use		22.1 ㎥/s		
Average Annual Water Intake		10.1 ㎥/s		
Effect Indicators				
Net Power Generation				
(GWh/year)	No. 1	313.5	97.6	179.6
	No. 2		228.0	186.2
Maximum Output（MW）	No. 1	82	41	41
	No. 2		38	41
Electrification Ratio (Sumatra Island)		54.8%	56.8%	

Source: Appraisal Document, PLN data, RUPTL

Note1 : No available data for blank columns.

Note 2: Rate of outage hours from inspection, repair and other unplanned causes against annual operating hours.

Note 3: Annual Energy Production / Maximum Power x Annual Hours

The power plant is operated in peak hours (from 5 until 10 p.m.) by the water released through the downstream headrace tunnel from the regulating pond (Capacity: approximately 567,000m^3) at a time after getting full storage collecting water through the upstream headrace tunnel. The water volume used for generation is not recorded, but can be estimated at 335,669 million M^3 in 2008 applying the rate of water usage 917,561M^3 / MWh.

Since the commencement of operation, the operational condition is satisfactory generating electricity more than the targeted volume.

2.3.2 Results of Economic and Financial Internal Rates of Return

Based on the consultant's project completion report which recalculates the Internal Rate of Return (IRR) under the same method with the one applied at Appraisal, update of Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) was attempted replacing the figures of following factors with updated operational performance until 2008. Since accurate amounts of the total project cost and its annual disbursement are not available as stated in section 2.2.3 above, figures used in the project completion report were utilized as they are.

Table 7: Assumption and Results of IRR Recalculation

		EIRR	FIRR
Project Life		50 years after project completion	
Benefit		Following benefits derived from incremental power generation of Renun and Asahan[4] Hydroelectric Power Plants 1. Least cost construction & annual operation & maintenance (O&M) cost of alternative power plant <Capacity Benefit> 2.Fuel cost of the above <Energy Benefit>	Incremental power sales revenue
Cost		1. Total economic project cost 2.Economic O&M cost	1.Total financial project cost 2. Financial O&M cost
Result	Appraisal	13.0%	4.4%
	Ex-post Evaluation	19.4%	5.8%

Both EIRR and FIRR are calculated higher than the rates at Appraisal. The reason would be as follows.

1. Fuel oil price (HSD) has gone up from US$ 23.0/barrel in 1990 which was applied at Appraisal to the level of US$ 105/barrel (cited in RUPTL), which pushed up the capacity benefit. (Upward factor for EIRR)
2. Actual volume of annual power generation of Renun Power Plant (365.8GWh in 2008) exceeds the planned volume at Appraisal (313.5GWh). (Upward factor for FIRR)

2.3.3 Qualitative Effect

(1) Electrification Ratio and Gross Regional Domestic Products (GRDP) of Sumatra Island

Although it is difficult to measure direct benefit derived from the Renun Power

[4] Assuming that the water level of Lake Toba will be lifted by the transferred water flow from Renun River as a result of the Project, generation of Ashan Power Plant which depends on the water from Lake Toba will be accordingly boosted. This incremental power generated is counted as benefit of EIRR calculation. However, the water level of Lake Toba is maintained high enough by abundant rainfall recently, therefore it is not the prevailing case under which the transferred water from Renun River can contribute 100% to the Ashan's generation increase. Therefore, it is rational to consider conservatively that the actual EIRR at ex-post evaluation is somewhat lower than the estimated result above. However, the extent is not reasonably estimated because the future volume of rainfall is unpredictable.

Plant because of its minor share shown in the following Table 8, the annual trend of "Electrification Ratio" and "GRDP" are presented in the following in Table 9 just for reference.

Table 8: Share of Renun Hydroelectric Power Plant

	Installed Capacity (MW)	Share of Renun Power Plant
North Sumatra Total	1,607.80	5.1%
Sumatra Total	9,145.00	0.9%
Hydroelectric Power Station Total in Sumatra	893.00	9.8%

Table 9: Annual Trend of Electrification Ratio and GRDP

	2004	2005	2006	2007
Trend of Electrification Rate (%)				
Sumatra Island	54.9	55.8	57.2	56.8
Total Indonesia	57.5	58.3	59.0	60.9
Trend of GRDP (trillion Rupiah)				
Sumatra Island	357	370	389	403
Total Indonesia	1,604	1,690	1,778	1,878

Source: RUPTL 2009-20018 (Electrification Ratio), BPS Statistics (GRDP)

Both of the indicators have been steadily improving, however the contribution of Renun Power Plant is minimal because of its little share.

(2) Effect on Oil Consumption Saving

The value of oil consumption saving is estimated US$ 85 million based on the actual generation performance of the power plant applying unit diesel price for generation cited in RUPTL 2009-2018.

Therefore, this project has largely produced the planned effects, and its effectiveness is high.

2. 4 Impact

2.4.1 Beneficiary Survey

Since the share of Renun Power Plant is minimal at 0.9% in its supply area (throughout Sumatra, and 5.1% in North Sumatra), no meaningful questionnaire survey is possible to the direct beneficiaries. On the other hand, benefit, as the side effect of the power station constructed, of the access roads created by the Project can be asked to the residents along the roads. The access roads were constructed during the period between October 1992 and March 1996 with the total length of about 20 km connecting the provincial road from Medan to Aceh to the district road Sidikarang-Dolok Sanggul. The beneficiary survey was conducted interviewing 180 residents living in six villages along the roads using questionnaires. The samples are voluntarily taken avoiding biased selection. The survey result is summarized in the Table 10 below.

There used to be only 25 households and 2 shops before the advent of the access roads, and the numbers have increased up to 630 households and 47 commercial shops up to the moment. Additionally, there appeared churches, mosques, clinics, gas stations, filling stations, markets, water supply facilities and so forth, each of which scarcely located in the area before.

Table 10: Result of Beneficiary Survey on Access Roads

Items of Inquiry and Comments	Ratio of Positive Answer
Relocated being attracted by the access roads	43.9%
Being benefited by the access roads	98.3%
Daily transportation has been improved	60.0%
Socialization and community communication has improved	74.2%
Enjoying benefit on children education	71.1%
Enjoying benefit on family health	96.7%

The newly constructed access roads under the Project attracted many people from other regions and have been contributing side effect of the power station activating the local economy. Although negative impact is being partly felt by the residents (for instance, traffic accidents <answered 22%>, air pollution <2%>, entry of unwelcome outsiders <4%>, deforestation <12%>), most of the people do not care on that.

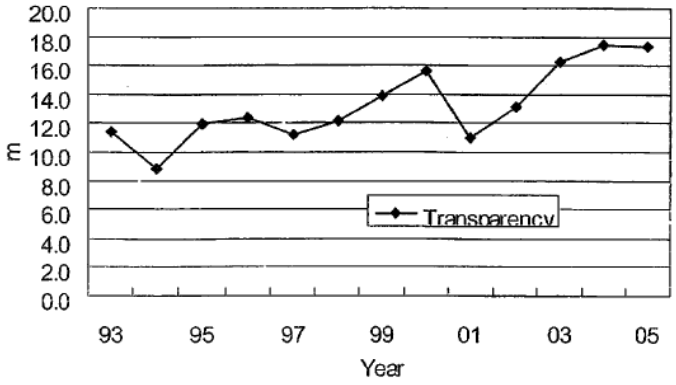
2.4.2 Impact on Natural Environment

(1) Water Quality of Lake Toba

It was a matter of concern at Appraisal whether the water quality of Lake Toba would be affected by the water inflow from Renun River which was partly transferred to the lake Toba from the Indian Ocean by the Project. Periodic transparency monitoring survey was conducted on the lake water near the power plant site until 2005[5], and no negative impact was shown as indicated in the following line graph. This survey was mainly for the water quality monitoring to detect contamination by the inflow of the earth and sand from the construction and was ceased after its completion. The field observation of the ex-post evaluation found no contamination or color change in lake water and witnessed its constant blue color. To alleviate influence on the lake water quality, a box culvert type headrace was installed to put generation water, which is 6 to 7℃ cooler than the lake water, down the lake bottom among other devices. Periodic monitoring of the lake water should be continued after the commencement of the plant operation also to confirm the effect of those remedial devices.

Surface of Lake Toba near Renun Power Plant

Figure 2: Trend of Transparency of Lake



(2) Other Items and Efforts for Environmental Conservation

Periodic environmental monitoring has been continuing after the Project completion for 12 checkpoints following the "Environmental Monitoring Plan," and no specific adverse environmental impacts have been reported. Several efforts are being attempted to minimize the Project's negative impacts on environment; such as PLN's afforestation in the Renun basin, regulation by the Ministry of Forest to control illegal deforestation by intruders entering through the access roads.

2.4.3 Impact on Social Environment

(1) Land Acquisition and Resident Relocation

[5] The consultant's project completion report (PCR).

The area of 773,000 m^2 for the preparatory works and 623,000 m^2 for the construction were acquired, and 832,000 m^2 was leased for construction works. Neither problem or dispute have been experienced. No resident relocation was executed.

(2) Issue of Water Sharing with Irrigation and Domestic Uses

The issue arisen during the project implementation raised by the local farmers through an environmental NGO in North Sumatra have been settled based on the result of the "Special Assistance for Project Implementation (SAPI) of JBIC (JICA at present)," conducted from May until September 2003, reaching agreement among the district government, PLN, residents and NGO that (a) people's water demand shall be prioritized after the commencement of the power plant operation, (2) the volume of water flow shall be jointly monitored and (3) the following committees and taskforce shall be organized to establish systems for joint control.

- "Water Management Committee" for settlement of water problems
- "Socialization Committee" for proper water sharing with irrigation
- "Special Taskforce" for regulating deforestation

Discussion with local farmers on the influence of Renun Power Plant on irrigation water

Actually, such arrangement was not practically executed, but no concern on the issue of water sharing has been revived again. The water intake facilities were designed such a way that Renun Power Plant is supplied for generation with residual water after securing a certain amount of water to meet the people's need. These facilities are effectively working and actually securing required water flow for the peoples use. Supported by such institutional and technical devices, the people's fear for anticipated water shortage has already been removed, and no protest or complaint has been claimed by the residents or NGO afterwards[6].

[6] The initial protest by local people and an NGO was raised before the commencement of water intake for generation, and it was against the fear for the future, which was partly attributed to insufficient explanation from the PLN side in a proper manner. However the people's concern was eventually wiped out later on by

To confirm the above state of affairs, the ex-post evaluation conducted a field interview survey to directly hear the prevailing voice of the people involved in parallel with the beneficiary survey for the access roads discussed in section 2.4.1 above. Total numbers of 180 households from 6 villages which draw irrigation water from the 11 tributaries of Renun River were taken as samples. The samples were taken voluntarily avoiding biased selection, and the interviews were carried out using questionnaires prepared in advance.

The survey result is summarized as follows.

Table 11: Result of Impact Survey

Comments		% Commented
Feel some impact from Renun Power Plant		82.8%
No impact, + do not know		17.2%
	Total	100.0%
Kinds of impact felt	Irrigation water has reduced	37.2%
	Power failure has been improved (Note 1)	20.0%
	Conflict on water has increased	17.8%
	Others	25.0%
	Total	100.0%
Possible remedies	Irrigation facility should be improved	46.1%
	Residents' water use should be prioritized (Note 2)	36.7%
	Others	17.2%
	Total	100.0%
Change in rice production	Reduced after completion of power plant	70.6%
	Others	29.4%
	Total	100.0%
Reason of rice production decrease	Lack of quality rice seeds	28.9%
	Insufficient fertilizer/pesticides	33.3%
	Insufficient agricultural technology	20.0%
	Shortage of water	17.8%
	Total	100.0%
Irrigation facility improvement under the Project is beneficial		75.6%
	Others	24.4%
	Total	100.0%

(Note 1) Since the electricity from Renun Power Plant is distributed throughout Sumatra Island, so almost nothing to do with power failure reduction.

(Note 2) Actually already done so by using residual water after the peoples' use.

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the practice of objective water flow monitoring, mutual close discussion on that issue, institutional preparatory arrangement and, most of all, by the realized fact that the plant operation has never exercised adverse influence on the local agriculture and people's living.

Some of the emotional comments insist reduction of agricultural (rice) production and water intake to the generation of Renun Power Plant as its major cause. However, objective facts revealed from the answers to other questions fail to support that argument. As a matter of fact, 82% of the respondents confess that the reduction of rice production is caused by other reasons than the water problem. The water problem itself is mostly affected by poor irrigation facilities, which is proved by the fact that the irrigation improvement implemented under the Project is much benefiting the agricultural production. It is an undeniable fact that the volume of irrigation water flow has been reduced after the water intake for the power generation, however, the influential bottleneck for sufficient water supply for the irrigation would not be the water intake in question but the defective irrigation facilities. It should be therefore concluded that it is not the case that the water intake from the 11 tributaries is exercising unfavorable influence on local agriculture through reduced water supply for irrigation. On the contrary, being coupled with effective practice of proper water sharing with people's living, the irrigation facility development added to the original scope of the Project and implemented in a part of the region has improved the water supply to the irrigation (partly used in daily domestic use), and is appreciated by the local people.

Irrigation Canal Improved under this Project
A young girl is doing washing-up after lunchtime

2.5 Sustainability (Rating: a)

2.5.1 Structural Aspects of Operation and Maintenance

Each power station is operated and maintained under the layered responsibility of the relevant institutions under PLN as shown below.

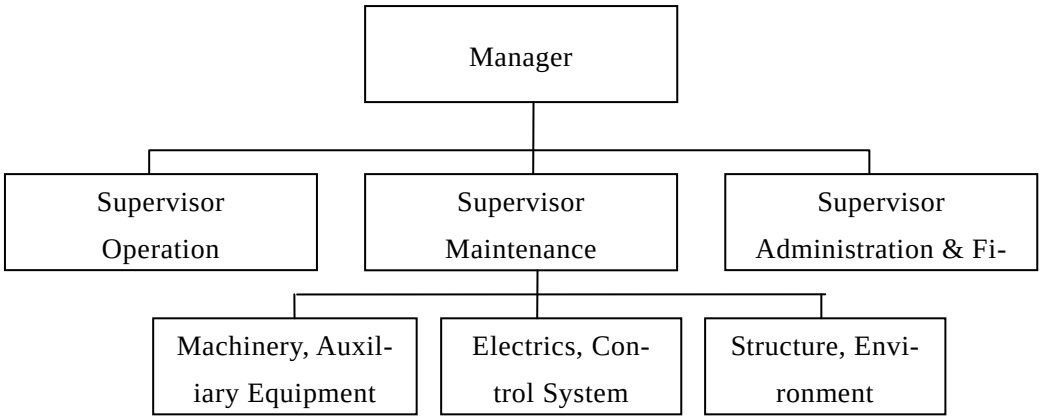
Table 12：Institutional Structure of Operation & Maintenance (O&M)

Institutional Structure of O&M
- Pembangkitan Sumatra Bagian Utara）

- Sektor Pembangkitan Pandan）
- Renun Power Station

The organization of the power plants of PLN are simply structured basically as illustrated in the figure below.

Figure 3: Simplified Organizational Structure of Renun Power Plant



Numbers of engineers (staff) assigned to each division are 3 people for “Operation,” 2 people for “Maintenance (Machinery, Auxiliary Equipment), 3 people for “Maintenance (Electrics, Control System)” and 3 people for “Maintenance (Structure, Environment).”

2.5.2 Technical Aspects of Operation and Maintenance

Most of the staff assigned to the sections of operation and maintenance above has academic background of electrical or mechanical engineering at STM or other institutions of higher education. All follow technical training courses below specially prepared for the area of hydroelectric generation several times a year so as to continually upgrade their technical skills.

PLN makes much of staff education and training based on its internal regulation. The training is conducted systematically providing staff with such courses as below.

a. Freshman educational training
b. Professional training (Power generation, Transmission O&M, Distribution O&M, etc.)
c. Grade training (Managers, Strategic specialist, etc.)

d. Other supplementary training (Technical workshop, seminar, diffusion of knowledge, etc.)

Those training programs are carried out basically at PUSDIKLAT (Center of Education & Training) of PLN. Additionally courses especially focused on hydroelectric power generation are prepared in the training center in Padang, West Sumatra, and approximately 1,100 staff members were participated in more than 50 courses mainly on O&M and other technical training in 2008.

The engineers of Renun Power Plant are sufficiently trained following the special courses above. At the same time PLN applies a basic policy to assign staffs with enough experience in other power stations especially to new power plants. No technical problems or shortcomings were found considering well-prepared institutional arrangement and practices as well as the current good conditions of the facilities under operation.

2.5.3 Financial Aspects of Operation and Maintenance

Operation and maintenance budgets of power stations under direct management of PLN are formulated at each location based on their requirement for O&M activities and requested to the headquarters through relevant Sektors and Wilayah (regional office). The approved amount is provided from the recurrent budget of PLN headquarters. PLN's financial difficulty as shown below does not allow those budgetary requests to be fully met, however, no significant cash flow shortage for operation and maintenance is prevailing in the field. Also being supported by their significantly cheap cost of operation, Renun Power Plant is well operated and maintained without any significant financial obstacle.

Table 13: Trend of Financial Performance of PLN on Consolidated Basis

(Unit: billion Rupiah)

	2002	2003	2004	2005	2006	2007	2008
Power Sales	39,018	49,809	58,232	63,246	70,735	76,286	84,250
Government Subsidy	4,739	4,097	3,470	12,511	32,909	36,605	78,577
Total Operation Revenue	44,183	54,430	62,273	76,543	104,726	114,042	164,209
Fuel & Lubrication Cost	17,957	21,478	24,491	37,355	63,401	65,560	107,783
Total Operation Cost	52,345	55,876	59,710	76,024	105,228	111,505	160,598

Operation Profit	-8,162	-1,446	2,563	519	-502	2,537	3,611
Foreign Exchange Profit / Loss	2,725	1,009	-1,523	-699	1,763	-858	-9,296
Total Profit	-6,060	-3,558	-2,021	-4,921	-1,928	-5,645	-12,304

Source: Annual Report, PLN

PLN is chronically supported by a big amount of government subsidy and is hardly operating as a financially independent corporation, or rather it could be regarded as a direct government's business. That state of affairs is also implicitly represented by the attitude to categorize government subsidy as the company's operational revenue. The fundamental factor is a serious financial burden of fuel cost for generation. Especially in 2008, having been attacked by the soaring oil price, PLN received almost the same amount of gigantic government subsidy as the total power sales. PLN recorded a massive financial loss amounting to 12 trillion Rupiah in the same year incurring big foreign exchange loss caused by the significant depreciation of Rupiah currency, which could not be recovered even by the large scale government subsidy. That amount of PLN's loss occupied 83% of the entire amount of loss of all the state-owned companies incurred (23 companies, total 14.5 trillion Rupiah[7]).

Thus PLN as a company faces a significant financial problem and much effort should be made in operation and management to improve the situation, however, it is the condition that the Indonesian power sector is under full financial support by the government with massive subsidy. The financial issue of operation and maintenance in the field belongs to a different dimension, and PLN's financial problem does not exercise direct influence on the power plants' cash flow for effective operation and maintenance.

2.5.4 Current Status of Operation and Maintenance

1. Generation Facility

The generator No.1 was out of order (but it was making no problem for the overall operation of the power plant being fully shouldered by the No.2 generator) at the time of the first field visit in March 2009, however it returned normal having

[7] The company that suffered from the second biggest financial loss was Merpati Nusantara, state-owned airline company, whose amount of loss was 500 billion Rupiah which is only 5% of the PLN's. (KOMPAS <internet version>, May 14, 2009)

been properly repaired by the maker.

2. Sedimentation at Main Intake

The issue of mud sedimentation at the main intake is a burdensome problem for PLN and is being tackled by means of human-wave tactics mobilizing sizable amount of manpower to remove the mud, which has been taken up as a serious problem in some technical magazines. This problem had been already anticipated before the commencement of project implementation and a spillway to flush the mud back to the main river has been installed for this particular purpose with its operation manual. Therefore, there is no fear of much mud inflow into the head-race tunnel for generation (if happens, it will stuff up the intake gate and also bring serious sedimentation problem at the tunnel and regulating pond later) or clogging the gate of intake if the operation is properly handled by periodically opening spillway and flushing the muddy water. However it may naturally cause insufficient water supply for generation lifting the canal bed by the residual sediment at the main intake. PLN is doing effort following the above operational requirement, but the contained volume of mud in the river flow is significant and consequently the sedimentation is progressing much faster than anticipated. It is a cumbersome problem anyhow for PLN.

The sediment at the regulating pond has to be dredged by making the pond entirely empty and it will take about one month suspending the power operation. The consultant's procedural manual for operation and maintenance instructs the dredging every 10 to 15 years showing its detailed procedure. However, the sedimentation is proceeding two or three times faster than forecasted, and the first dredging work is already budgeted and planned to be conducted in 2010.

This sedimentation problem is mainly caused by the sand mining jobs by local residents upstream the river. PLN has been discussing this issue with the district government and reached an agreement on March 6, 2009 to carry out joint monitoring and to request the government to take appropriate actions for the river basin management.

Sand Mining Site Upstream
Renun River
Muddy water from mining

Although a nuisance of the sedimentation issue is prevailing, it is being properly countered by PLN in cooperation with relevant agencies. No major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

3. Conclusion, Lessons Learned and Recommendations

3.1 Conclusion

This Project has been highly relevant in line with the Indonesia's national policy to cope with the country's growing power demand concurrently aiming at alleviation of oil dependency, and consistent with the development needs. Although the efficiency of the Project is moderate with significant delay in its implementation, the effectiveness is high supplying more electricity than planned with full operation to cope with prevailing insufficient power supply in Sumatra Island, concurrently contributing to activation of local economy and people's welfare as side effect by the access roads constructed under the Project. No major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

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

3.2 Lessons Learned

1. Project Implementation with Due Consideration for Environmental Conservation

Due consideration has been paid for natural environment (issue of water quality of Lake Toba) and social environment (issue of coexistence with local agriculture and people's living) to avoid or alleviate negative impacts of the Project. In this context, afforestation effort has been also taken by PLN itself. It is essential for any hydroelectric power plant projects to be prudently implemented with such environmental care.

2. Submission and Receipt of Accurate Project Completion Report (PCR)

The "Project Completion Report" which has been submitted to JICA is a completion report prepared by the consultant and lacks a number of items which are required by JICA in the loan agreement. JICA should remind implementing agencies to submit a right PCR in accordance with the agreement on the loan agreements.

3.3 Recommendations

1. Implementation of River Basin Management

Proper devices to tackle the problem of mud sedimentation at main and other intakes are being practiced by PLN. The sedimentation problem is mainly caused by the sand mining by local residents upstream the river, which necessitates proper river basin management especially on regulation to control illegal jobs by local residents under cooperation with the district government. The action has just got started reaching agreement among PLN, district government and the independent third party (North Sumatra University) on the river basin management based on the discussion to keep step with each other. PLN should urge the local governments to implement the agreement and should also act as a facilitator. The local governments are requested to actively respond and take necessary actions. [to PLN, Local Governments]

2. Water Transparency Monitoring of Lake Toba

The water transparency measurement and monitoring conducted during the consulting services up to 2005 (cf. section 2.4.2) should be resumed and continued by the Indonesian side. [to PLN and other relevant agencies]

3. Establishment and Proper Practice of Project Accounting

Revenue and expenditure regarding project implementation must be systematically recorded and managed in a proper project accounting system separately established out of a general accounting system. However, the proper management was not being practiced in this project. It is required to arrange a rational project accounting system and fix clear responsibility for record keeping during the establishment of the total management structure for project implementation. The state of practice is to be monitored under the JICA's mid-term review and other supervision schemes during the project implementation and to be remedied if inappropriate. [to PLN]

4. Issues of Operation & Maintenance Manuals

The operation & maintenance manual for the facilities constructed under the Project was prepared by the consultant, however it was not delivered to the Renun Power Station. In such a case that project implementation and operation are executed involving different agencies within PLN, effective communication and collaboration among them are essential for aiming for the achievement of maximal project effect. [to PLN]

Comparison of the Original and Actual Scope

Item	Original	Actual
1. Project Output	Water Intakes: 11 units Headrace Tunnels Upstream Tunnel: 8,800m Downstream Tunnel: 11,000m Regulating Pond Power Station Maximum output: 82MW Transmission Lines: 70.7km Substation Expansion: 2 units Consulting Service: 1,314M/M	Water Intakes: 11 units Headrace Tunnels Upstream Tunnel: 8,800m Downstream Tunnel: 11,200m Regulating Pond Power Station Maximum output: 82MW Transmission Lines: 70.7km Substation Expansion: 2 units Irrigation Facilities: Weir, Water Gates, Canals Rehabilitation Consulting Service: 2,333M/M
2. Project Period	September 1991 ~ October 1999 (98 months)	September 1991 ~ November 2006（183 months）
Project Cost Foreign Currency Local Currency Total Japanese ODA Portion Exchange Rate	 19,547 million yen 11,875 million yen 31,422 million yen 26,607 million yen (I) Rp.1= 0.046 yen (April 1991) (II) Rp.1= 0.059 yen (April 1993) (III) Rp.1= 0.050 yen (April 1994)	Amount of total project cost was not available at Ex-post Evaluation. 24,300 million Rp.1= 0.016 yen (Average rate March 1995 ~ August 2005)