Kenya

Ex-Post Evaluation of Japanese ODA Loan

"Sondu-Miriu Hydropower Project I, II"

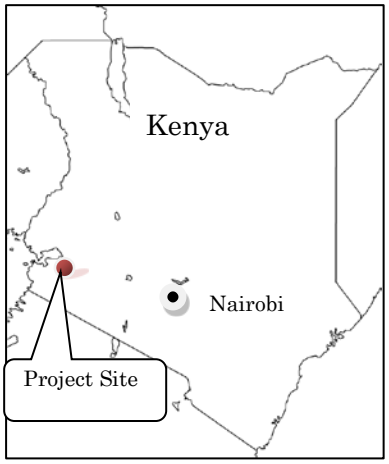
External Evaluator: Takeshi Daimon, Waseda University

0. Summary

This project is consistent with Kenya's policy of promoting efficient and sustainable supply and demand of energy, local and national needs for electricity supply, and Japanese aid policy at that time, so the relevance is high. There is no major operational problem with the constructed power plant, and in general, the target goals for annual power generation, operational ratio, etc. have been achieved; thus, the effectiveness is also high. There is no serious negative impact on the natural environment; further, there are no severe problems involving relocation and pollution and related effects on health. The project cost slightly exceeded the plan, and the project period significantly exceeded the plan—there was a delay of more than five years in the signing of Loan Agreement (L/A)—owing to which the efficiency is low. There is no major problem in the structure, finance, technique, or current status of operation and maintenance; hence, the sustainability of the project is high.

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

1. Project Description



Project Location

Sondu-Miriu Hydropower Plant

1.1 Background

Under the long Moi Presidency (1978–2002), Kenya's policy base became unstable in the early 1990s, when the country was faced with an anti-corruption and pro-democracy movement. Further, the delay in implementation of the structural adjustment programs since the 1980s worsened its relations with the World Bank and IMF. In November 1991, at the Paris Conference for Aid for Africa, Kenya was criticized for the delay in democratization and structural adjustment, and the decision to stop new

assistance for Kenya was made; subsequently, there was a substantive decrease in aid for the country until the late 1990s when there was improvement in governance and stabilization of the macro economy. During this period, there was an increase in demand for electricity; however, no new power stations were constructed. Hence, the supply gap increased, and there were frequent planned outages of electricity, which were obstacles for the country's economic activities.

Hydropower (tapping roughly from the central and western river systems) contributes to nearly half of Kenya's electricity supply. The power stations in the country are connected to a single grid, extending from the northwest (facing Uganda) to Mombasa (the second largest commercial city) via Nairobi, the capital city. Kenya Electricity Generating Company Limited (KenGen) deals with power generation, and Kenya Power and Lighting Company Limited (KPLC) deals with transmission and distribution. The grid is also connected to the adjacent nations Uganda and Tanzania.

Western Kenya, includes Kisumu where this project is located, is known to be a major agricultural area; about 30% of the national population resides in Western Kenya. However, there is a shortage of electricity infrastructure, and this is a major obstacle for economic activities in the region. The area is also known to be very poor, with 54% of people living under the poverty line (1994 survey), much higher than the national average of 40% (1994) or the corresponding value of 26% for Nairobi (1994). Addressing the issues of electricity shortage and the creation of employment in western Kenya was expected to provide a solid basis for activating economic activities.

1.2 Project Outline

To meet the growing demand for electricity in western Kenya and the whole country by installing 60MW (30MW×2) hydroelectric power plant in the Nyando and Rachuonyo Districts, thereby contributing to the sustainable economic growth of the country.

Loan Approved Amount/ Disbursed Amount	Phase I: 6,933 /6,933million yen Phase II: 10,554 /10,554 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	Phase I: March 1997/July 2004 Phase II: February 2004/July 2009
Terms and Conditions	Phase I:2.3%, 30 (10) years, General Untied Phase II: 0.75%, 40(10) years, Bilateral Tied
Borrower/Executing Agency	KenGen / KenGen
Final Disbursement Date	Phase I: July 3, 2007 Phase II: July 15, 2009 (II)
Main Contractors (Over 1 billion yen)	[Civil Works] Konoike (Japan) /VEIDE KKE ASA (Norway) / MURRAY AND ROBERTS (South Africa) (Phase I)

	Taiesi (Japan) / Konoike (Japan) (Phase II) [Turbine] IHI (Japan) [Power Generator] Mitsui-Toshiba Consortium (Japan) [Transmission & Substation] Kinden (Japan)
Main Consultant (Over 100 million yen)	Nippon Koei (Japan)
Feasibility Studies etc.	F/S (JICA 1983, "Pre-Study on Sondu River Multipurpose Development Plan" for the power plant and irrigation plan along the Sondu River; JICA 1983–1985 "Sondu River Hydropwer Plan" for the power and irrigation plan including this project.)
Related Projects (if any)	Yen Loan "Sondu-Miriu Hydropower Project (E/S)" (L/A signed in October 1989), World Bank "Energy Sector Reform and Power Development Project" (C/A signed in April 1998).

2. Outline of the Evaluation Study

2.1 External Evaluator

Takeshi Daimon, Waseda University

2.2 Duration of the Evaluation Study

Duration of the Study: December 2011–October 2012

Duration of the Field Study: March 24, 2012–April 4, 2012; June 16, 2012–June 22, 2012

2.3 Constraints during the Evaluation Study (if any)

None

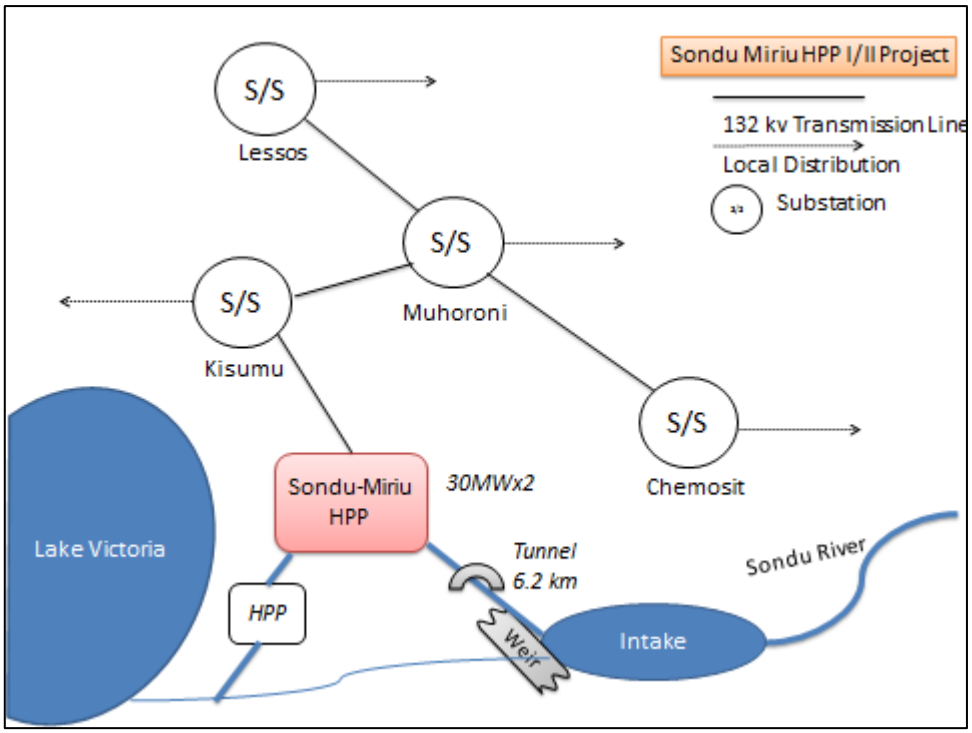


Figure 1 Project Overview

Source: Evaluator

Notes: 1) Local distribution, except for systems for supplying electricity for the weir, is outside the scope of the project.

2) Water used for electricity generation flows back into the Sondu River through a hydropower plant, to be constructed (separate from this project.)

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of Kenya

At the time when this project was extended, Kenya's "National Development Plan" (1994–1996) listed the electricity sector as an important sector. The National Power Development Plan (NPDP) (1994–2013), which was part of the national plan, envisioned a 10-year program of expanding power generating facilities, and the 5 Year Least Cost Development Program (LCDP) (1994–1998, 1999–2019) listed this project as a priority investment. Further, the Economic Recovery Project (2003), published after the extension of Phase I of this project, continued to recognize this project as having the highest priority. When Phase II was extended, Kenya drafted a Poverty Reduction Strategy Paper (PRSP) (2001–2004) recognizing this project as a high priority project because it was expected to deliver a "secure supply of energy in order to promote economic growth."

Vision 2030, a long-term national plan drafted in 2007, continues to emphasize the necessity of establishing a system of efficient and sustainable supply and consumption of energy in order to realize

[1]A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[2]③: High, ② Fair, ① Low

the long-term economic development of Kenya. In addition, the National Energy Policy, drafted in May 2012, continues to emphasize the necessity of investing in expanding power generating capacity to secure a stable supply of electricity. The policy presents a plan to decrease the dependence on hydropower from 47.8% as of 2011 to 5% by 2030 because it is difficult to increase the hydropower contribution in the future because of relocation and environmental issues.

3.1.2 Relevance with the Development Needs of Kenya

As of the appraisal of this project, western Kenya—where Kisumu, the project site is located—is home to about one third of the national population. It is endowed with fertile land and a favorable climate, and is a major agricultural area that produces consumption products such as maize and rice as well as cash crops such as tea, coffee, and sugar. However, the inadequate electricity infrastructure was a major obstacle for further economic activities. In addition, the electricity demand in Kenya grew more than 5% annually, and supply was not able to meet the demand, resulting in planned blackouts and purchases of electricity from Uganda. Because the excess demand was not met by the outdated power stations existing in the country, the construction of new power plants became inevitable.

This project was expected to contribute to narrowing the gap in electricity supply and facilitate the supply of electricity in western Kenya by aiding the construction of a power plant in Kisumu, and thus contribute to the economic activities in the region.

Table 1 Forecast and Actual Electricity Demand

Unit：MW

	Nairobi		Western Kenya		Kenya
	Original Forecast	Actual/Re-forecast	Original Forecast	Actual/Re-forecast	Actual/Re-forecast
1997	392	n/a	76	n/a	n/a
2000	441	n/a	84	n/a	n/a
2005	593	481	114	178	920
2010	804	623	156	233	1,194
2015	1,085	1,241*	211	476*	2,386*
2020	n/a	2,214*	n/a	904*	4,519*
2025	n/a	3,726*	n/a	1,753*	8,102*
2030	n/a	5,996*	n/a	3,283*	14,273*

Source：KPLC Annual Report (Actual), LCDP (1998, 2011)
Note：* Re-forecast at the post-evaluation

As of 2010, the peak demand in the country is 1,194 MW, while the effective capacity[3] is 1,412 MW; hydropower contributes 735 MW (including this project of 60 MW); thermal power, 182 MW; geothermal power, is 143 MW; wind, 5 MW; and others, 347 MW to the effective capacity)[4]. The supply gap is solved for now. However, Kenya showed an annual economic growth of more than 5%[5] from 2005 to 2010, and if this trend continues, the demand in the period 2015–2030 would range

[3]The effective capacity refers to all installed and operational capacity except for non-operational facilities.
[4]According to KPLC data (2010).
[5]5.8%(2005), 6.4%（2006）, 7.1%（2007）, 1.7%（2008）, 2.6%（2009）, 5.6%（2010）, 4.6%（2011）, Statistics Office

from 2 to 10 times the 2010 level (Table1). This demand cannot be met with existing power-generation facilities. In order to mitigate the current gap, Kenya purchases about 30 GWh annually from Uganda (and 1 GWh from Tanzania).

Table 2 Trade of Electricity with Uganda and Tanzania

Unit : GWh

		2004	2005	2006	2007	2008	2009	2010
Uganda	Import	105.6	14.6	12.7	24.7	28.6	37.1	29.9
	Export	19.9	23.9	73.5	46.4	26.6	26.3	30.3
Tanzania	Import	0.3	0.4	0.4	1.0	1.2	1.1	0.9
	Export	n/a	n/a	n/a	n/a	n/a	0.5	0.8

Source：Kenya National Energy Policy (2012) (Fiscal Year)

Therefore, the development needs for electricity in Kenya, particularly the needs for power generation and infrastructure expansion in western Kenya, remain high.

3.1.3 Relevance with Japan's ODA Policy

The Country Assistance Policy for Kenya[6] (Ministry of Foreign Affairs, 1998) states that as Kenya "fills in the shortage of electricity supply from neighboring countries, which is important in industrial activities," it is important "to support the development of energy resources." The Country Assistance Plan (drafted in August 2000) also recognizes "the development of energy resources" as a pivotal assistance area "to alleviate shortage of supply in electricity, indispensable for industrial activities, as far as it pays considerations for coexistence with environment and relationship with community members." In addition, Kenya's Overseas Economic Cooperation Implementation Policies (2002–2004) emphasize the need to support the development of "infrastructure for economic growth" and recognize the importance of support for the economic and social infrastructures.

Originally, the appraisal of Phase II of this project started in October 1998, and was expected to be extended within the same fiscal year. However, the possibility emerged that Kenya would be a candidate country eligible for the enhanced debt reduction scheme, which prevented the Government of Japan from extending the loan for this phase; however, finally, since the Government of Kenya expressed its intention to not take the benefit of the debt relief program, the Government of Japan made a pledge in September 1999. Nevertheless, as the Phase I work started, local parliamentarians, NGOs, and local people raised environmental concerns about this project, which was also taken up by the Japanese Diet, and the extension of Phase II was postponed until February 2004.

Therefore, this project has been highly relevant with the country's development plan and its development needs, as well as Japan's ODA policy; therefore, its relevance is high.

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of Kenya.

[6]"Country Assistance Policy for Major Countries" (Annual Report on Implementation of Japanese Official Development Assistance for Major Countries.)

3.2 Effectiveness[7] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

The operation and effect indicators for this project overall meet the targets for the maximum output (30 MW × 2), total electricity generated and operating rate, as well as planned outage hours (Table 3).[8] Further, the inflow into the reservoir is stable. KPLC does not measure the end-users' electricity generated.

Table 3 Operation and Effect Indicators

	Target (2012)	Actual			
		2008	2009	2010	2011
Net Electric Energy Production (GWh)	330.6	333.15	340.46	364.31	290.43
Maximum Output (MW)	60	60	60	60	60
Planned Outage Hours (Days/Year)	14	14.84	12.50	33.75	7.19
Unplanned Outage Hours (Days/Year)	2	46.08	23.54	2.71	4.88
Capacity Factor (%)	59.1	63.38	64.78	69.31	82.66
Hydro Utilization Factor (%)[9]	n/a	69.01	67.94	72.67	84.08
Annual Total Volume of Inflow to the Reservoir (mil. m^3)	n/a	957	1,140	1,103	980

Source: KenGen

Note: Fiscal year runs from July till June, but FY 2011 includes data from July 2011 until February 2012.

The inflow and maximum output with seasonality is described in Chart 2 below. In the dry season (January to April), there is little inflow and low output, while during the 8 months of the rainy season, the monthly generation is about 40 GWh (or about 320 GWh in 8 months), which is 97% of the annual generation (about 330 GWh).

KenGen purchases about 360 GWh (July 2011 to May 2012) annually from a UK generator rental company (Aggreko)[10] in order to cope with the seasonally unstable supply of electricity and to meet emergency electricity demand.

There are various hydroelectric power stations at different water systems in the country, which make

[7]Sub-rating for effectiveness is to be decided after considering the impact

[8]Unplanned Outage Hours have been decreasing since 2008 but have not achieved the target as of the ex-post evaluation.

[9]Hydro Utilization Factor = (net electric energy)/ (possible power generation in a given year) × 100(%)

[10]Aggreko installs emergency power plants in Kenya with generating capacities of 30MW and 60MW.

it possible for other plants to fill in the electricity supply gaps, should there be a shortage of water in the Sondu River and a resulting outage of the Sondu-Miriu power plant. Similarly, the Sondu-Miriu plant could fill in the gaps of other power plants if they happen to experience supply shortage.

These measures could rectify the seasonality of electricity generation, which is a challenge for hydroelectric power stations.

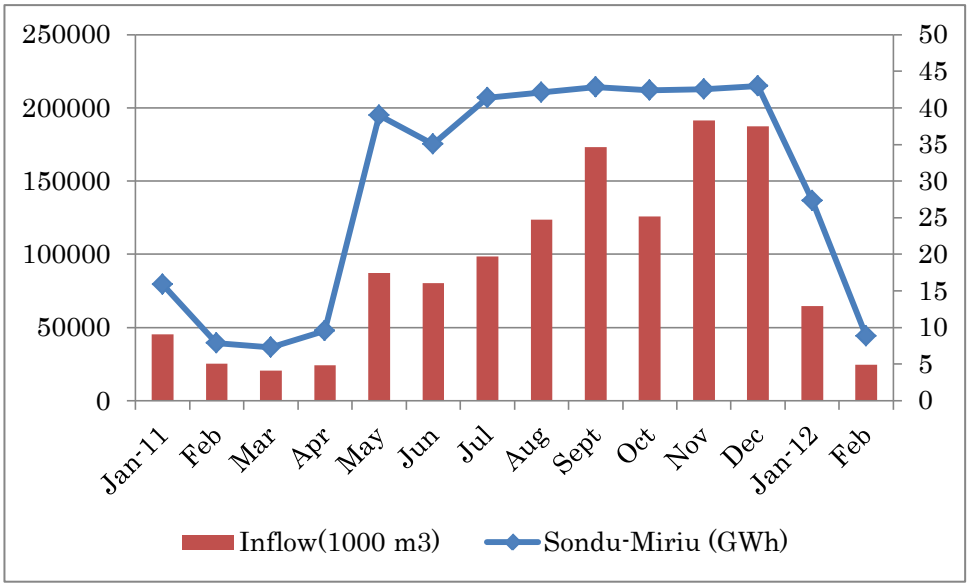

Figure 2 Inflow of water to the reservoir (monthly average) and power generation (monthly)

Source：KenGen

3.2.2 Qualitative Effects

None.

3.3 Impact

3.3.1 Intended Impacts

This project was expected “to alleviate supply gap of electricity,” “to provide stable supply of electricity in western Kenya,” and “to save foreign currency for oil imports by using alternative water resources.”

Considering the supply-demand gap, as shown in Table 1, the peak demand in the whole country as of 2010 was 1,194 MW, while the effective power generated was 1,412 MW; thus, it can be said that the project has contributed to narrowing the gap. The project has indeed contributed to the supply of electricity in western Kenya, where the electrification rate[11]was reduced from 18% in 2005 to 15% in

[11]Number of KPLC subscribers/number of households.

2011[12], and there remains a significant gap between this region and other big cities such as Nairobi.

Table 4 Electrification Rate

Unit: %

	2005	2006	2007	2008	2009	2010	2011
Western Kenya	18	18	17	17	16	15	15
Nairobi	51	52	51	52	53	54	53
Kenya	7.1	4.6	10.6	5.1	2.1	3.5	8.9

Source：KPLC Annual Reports
Note: in fiscal years

Regarding the "saving of foreign currency for oil imports by using alternative water resources," a thermal power plant[13] of the same capacity costs two billion Kenyan Shilling (about two billion Yen)[14]annually for fule, which is equivalent to the savings by this project, suggesting that it would recover the project cost (about 28.7 billion Yen) in about 15 years by a back-of-the-envelope calculation.

Therefore, the intended overall impact is realized.

3.3.2 Other Impacts

3.3.2.1 Beneficiary Survey

This post-evaluation study includes a beneficiary survey. The target areas include those affected by the project, including the inlet, Sondu River downstream maintenance areas' left and right banks, the outlet channel, power station, transmission line, and base camp (facilities for staff), along with 200 sample households that have been randomly selected.

The electrification data show that out of 200 sample households, 23 (11.5%) have contracts with KPLC, which serve them with electricity, and the non-contractors replied that they have not signed the contracte with KPLC because of the lack of electricity supply to their community (50 households), high electricity bills (where the community is served) (111 households), and other reasons (5 households).

Further, many of the households recognized the employment and business during construction, and the new infrastructure (power station and related facilities) as major positive impacts; the noise and pollution during construction, and the loss of employment[15] after the construction was completed were recognized as major negative impacts. Overall the rate of satisfaction with the project shows that 140 households (70%) are "very much satisfied" or "satisfied," far exceeding 55 households (27.5%) who replied "unsatisfied" or "very much unsatisfied."

[12]However, the population in western Kenya increased by 16% from 4.13 million (in 2000) to 4.8 million (in 2010); hence, the number of people with access to electricity itself has increased.
[13]Calculated (by KenGen) by comparing Kipevu Thermal Power Plant of 73.5 MW, adjusted to the 60 MW capacity.
[14]Exchange Rate (1 Ksh = ~1 JPY) as of March 2012.
[15]Strictly speaking, from an evaluation point of view, this is not defined as "negative impact from the project" because the situation has simply returned to the pre-project status (of no employment).

Table 5 Positive or negative impact from this project

Unit: households

Nature of Impact (Positive/Negative)	During Construction	After Completion
Positive：Employment & Business	177	0
Positive：Infrastructure	1	176
Positive：Other Social Benefits	1	3
Positive：None	20	21
Negative：Loss of Employment Opportunity	1	171
Negative：Pollution（Noise & Dust）	176	0
Negative：Other Social Costs	9	17
Negative：None	14	12

Source: Beneficiary Survey

Table 6 Level of satisfaction with this project

Unit: households

Very much satisfied	42
Satisfied	98
Unsatisfied	45
Very much unsatisfied	10

Source: Beneficiary Survey

A major reason for satisfaction is the economic benefits such as employment creation (132 households), while a major reason for dissatisfaction is the non-economic costs such as worsening of the environment during construction (45 households).

Box 1 Technical Committee

(1) Background

After Phase I of the project had begun, local people and NGOs had raised concerns regarding for socioenvironmental issues; these concerns were also taken into consideration by the Japanese Diet, which resulted in the delaying of the decision to start Phase II. Faced with the situation, a "stakeholder meeting" (in which 300 people participated) was held in order to assess the current situation of the project and to hear opinions from local people and NGOs; the outcome was an agreement to establish a Technical Committee in order to discuss their daily requests. The committee was in place until 2008, when this project was completed.

(2) Mechanism

The Technical Committee consisted of 31 members, including members of parliament (4), members of local councils (6), professionals (6), community representatives (6, elected by voting), Non-Governmental Organizations (NGOs) (6) (Nyakach Community Development Association, Climate Network Africa, local NGOs), Government of Kenya (2), KenGen (1) (chair), and observers from KenGen (6), JICA (2), and consultants (2).

As a rule, the committee meetings were held quarterly, reporting its activities at the "stakeholder meeting" that were conducted annually in principle. Sub-committee meetings were held monthly in principle with the following themes: "land compensation and relocation," "employment and economic opportunity,"

"environment," and "health, safety, and security." Any issues raised between the executing agency and the stakeholders were coordinated, solved, and monitored through these sub-committees.

However, the committee "is not an enforcing agency that can enforce decisions, but can only study, monitor and make recommendations about the concerns and problems raised by stakeholders" (Technical Committee Guideline); hence, the limitation is that the decisions made by the committee are not legally binding for KenGen.

(3) Contributions of the Technical Committee（From the Beneficiary Survey）

The beneficiary survey reveals the relatively low level of recognition of the committee[16] where people are nearly equally "aware of" (105 households) and "unaware of" (91 households) it. Among those who recognized the committee, 86 households (81.9%) replied that they were either "unsatisfied" or "very much unsatisfied," far exceeding the 18 households (16.6%) who replied that they were either "satisfied" or "very much satisfied." The reasons for satisfaction included "opinions and interests were reflected" (9 households), "problems were solved" (10 households), while the reasons for dissatisfaction included "opinions and interests were not reflected" (17 households), "problems were not solved" (49 households), and "participatory, democratic and transparent process was not available" (27 households).

These results suggest that overall people are satisfied with the project, while they are not aware of the Technical Committee, and unfavorable opinions dominated even among those who recognized the committee because the problems raised were not solved (49 households)[17] etc. However, it is also true that based on requests from local people and NGOs, additional surveys (on fishery and livery standards, etc.) were recommended and conducted by the committee. This suggests that the committee's monitoring of the impacts on fishery and health damages caused by dust, etc. have decreased public concerns. However, it is most likely that these actual contributions by the committee were not fully shared with the local people in general.

3.3.2.2 Impacts on the natural environment（Delegated Issue 1 for the Technical Committee）

（1） Amount and Quality of Water in the Sondu River (maintenance section)

At the appraisal, the water outflow into the Sondu River was planned to be 0.5 m^3/s (constant), but by request from the Technical Committee, a consultant conducted a survey and recommended a modification of the outflow rate to 3.0 m^3/s (constant). The recommendation is not a legally binding target of effort, but post-project monitoring data of the water level shows that the water outflow can be below the target of effort depending on rainfall, and the monthly average remains more than 3.0 m^3/s[18] throughout the dry and rainy seasons.

[16]Households with land compensation (implemented in 1999, 2005, and 2007) replied that they were "aware of" (43 households) and "unaware of" (64 households) the committee.

[17]Those "problems raised but not solved" are too many to be generalized, but as pointed out in section "3.3.2.1 Beneficiary Survey", high electricity rates and loss in employment after the projects are considered among them.

[18]As shown in the chart, the monthly average water outflow is 5.1 m^3/s (March 2009), 6.3 m^3/s (February 2011), 9.9 m^3/s(February 2012). During the site visit (March 2012), outflow was at a rate of 1.4 m^3/s, but this could be indicative of an instantaneous data point during the dry season.

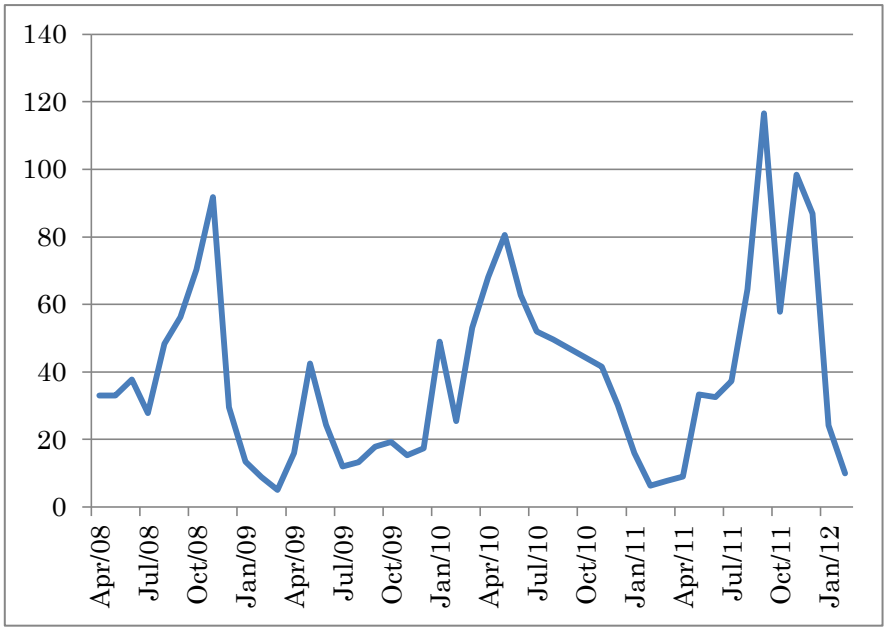

Figure 3 Water Outflow at Sondu River Maintenance Section（m3/s）

Source：KenGen

Water quality is measured at upstream and downstream sections, and indicates a high level of coliform[19], as described by the WHO standards for drinking water[20]. However, there is a seasonal fluctuation in water flow as well as the power required for purification, and there is seasonality in coliform levels, so it is impossible to identify causality between this project and the quality of water. Further, as part of its Corporate Social Responsibility (CSR) activities (Box2), KenGen installed public wells and a treated water system at the downstream area, and there is no report that untreated river water has been used for drinking.

（2） Impact on the Ecosystem

According to a survey on Sondu-Miriu River Fishes[21] conducted in 2010 by request from the Technical Committee, the number of fishes has increased from 2003 to 2010 as measured by "electrofishing"[22]above reservoir, down reservoir (maintenance section), and downstream sections. The diversity has increased from 19 species in 2003 to 25 in 2010.

[19]Measured by Total Coliform (TC) and Fecal Coliform (FC).
[20]WHO standards require the zero level of TC/FC for drinking water. The Sondu River shows a significantly high level of TC/FC exceeding 10,000 c.f.u./100 ml depending upon the timing of measurement.
[21]Owiti, Kapyio, and Bosire (2010), "The Sondu-Miriu River Fishes & Fisheries, Species Diversity, Abundance and Distribution by 2010"
[22]A widely used scientific way to determine the abundance and diversity of fishes, by stunning fishes with electricity.

Table 7 Abundance of Fish

Unit：g

	Above reservoir	Down reservoir	Downstream
2003	1,831	2,392	19,878
2010	4,583	10,666	22,004

Source：Owiti et al (2010)
Note：Total number of fishes (per measure)

The fact that the abundance and diversity of fishes have increased from 2003 to 2007, while the actual decrease of catch by local fishermen can be attributed to causes other than the reservoir (such as illegal fishing), suggests that the project has no significant negative impact on the ecosystem.

3.3.2.3 Impact on Affected Areas （Delegated Issue 2 for the Technical Committee）

(1) Land Acquisition and Resettlement

From January to May 1999, before the Technical Committee was established, land compensation[23] was made for 649 households of 213.2 ha, and about 91 million KSh was paid. The value of land was assessed at the market rate. Those who lost land at the base camp area were paid an additional 22.5%, while for others, 15% was added to the market rate.

In addition, the schools and church near the power station were provided "land for land" and "building for building" compensation, and by January 2001, they were newly constructed near their original locations (Box2). In March 2003, a boat owner above the reservoir intake was given cash for compensation. These compensation amounts were finally agreed upon among stakeholders, based on a hearing of their wishes and claims by the Technical Committee.

Compensation for the 1,714 landowning households[24] affected by the installation of the transmission line[25] was made in 2005 and 2007, totaling 137 million KSh.

(2) Pollution and Health Effects During Construction

Since 2001, KenGen annually conducts a "socioeconomic survey" in order to compare and assess the impacts of the project in the affected and non-affected areas. The 11th survey was completed in August 2011, when 2,773 people were interviewed.

The results showed that 30–50% of the local people have experienced effects of the dust,[26] but more than 70% of them responded that they suffered no health impacts in both the affected and non-affected areas; less than 20–30% of the local residents replied that they suffered from eye and respiratory diseases. During the same period, 40% of the respondents in the non-affected area replied that they suffered from eye diseases, implying that the rate of disease does not depend on whether the location is affected or non-affected by the project. Further, 30–50% of the local people experienced the

[23]The number of actual relocations among those who received land compensation is not recorded. KenGen reports that most of the residents remained in their terrain as the area is not densely populated or at best relocated to the nearest neighborhood.
[24]No data about the area (in ha) of land compensated for the transmission line are not available because the compensation was made for the violation of superficies without any land confiscation.
[25]Transmission line from the power station and a distribution line from the power station to the intake weir.
[26]Measures such as water sprinkling were taken.

effects of noise, but about 60% of the people living in the affected areas replied that they suffered no health impact; only about 40% of the residents of the affected areas experienced health problems such as insomnia. Moreover, 40% of the people in the non-affected area reported having the same problem, suggesting that the rate of the health impact does not depend on whether the location is affected or non-affected by the project.

This project has largely achieved its objectives; therefore, its effectiveness is high.

Box2 CSR Activities by KenGen

CSR activities by KenGen include efforts related to water supply, education, and environment. Water supply is provided to about 20,000 people in the downstream area of the Sondu River[27] through standpipes or as treated water and by establishing a rural water supply association, thus contributing to the supply of safe water. Initially, KenGen assumed the stand that water should be provided by self-help efforts by local communities, but following discussions and a recommendation by the Technical Committee, the water supply was funded entirely by KenGen. Water provided through water kiosks and standpipes is used for drinking or agricultural purposes, contributing to improving their standards of living by reducing the labor involved in fetching water and by providing safe water.[28] Water is provided for communities living downstream Sondu River (31 water kiosks and 3 standpipes) (photo, below left), and also for communities near the outlet channel (5 standpipes) (photo, below right). In addition, water is provided freely for local people within the base camp, which is open to the local community.

A Water Kiosk (Treated Water)

A Manual Standpipe Near the Outlet Channel

[27]KenGen web site.

[28]Before CSR, local people obtained water from rainwater and springs, fetched water from the Sondu River, or diverted water from the outlet channel from the power station; thus, obtaining water involved heavy labor, and unhealthy water was obtained.

As written in the main section, KenGen has constructed elementary and secondary schools as compensation in the affected areas (near the power station), and many local pupils attend these schools; as part of its CSR effort, KenGen provides scholarships for especially bright but economically disadvantaged children wishing to go to secondary schools and university.

In addition, KenGen nurses 50 varieties of trees and freely distributes them (annually about 50,000)[29], and landowners who received them planted them in collaboration with local people, making efforts to reduce the project-related negative impacts on the landscape. KenGen monitors the condition of the planted trees once or twice annually.

3.4 Efficiency (Rating: ①)

3.4.1 Project Outputs

The project has an increase or decrease of output if it is divided into phase I and II according to the loan agreement, but it has overall resulted in the intended power station as well as related facilities (sub-stations and transmission line) as an integrated project.

Table 8 Output Comparison

Item	Original	Actual	Difference
Phase（I） Civil Works (Lot I-1)			
1-1. River Works (Sondu River)	One set	One set	None
1-2. Intake Weir	One set	None	Carried over to Phase II
1-3. Tunnel	4.2-m dia. 6,194.5-m long	4.2-m dia. 6,194.5-m long	None
1-4. Serge Tank	14-m dia. × 36.8-m H	14-m dia. × 36.8-m H	None
1-5.Penstock	3.9-m dia. × 53ml long	None	Carried over to Phase II
1-6. Access Road	10.4-km long	10.4-km long	None
1-7. Staff Accommodation (base camp)	16 ha	25.4 ha	Expanded (+9.4 ha)
Phase（II） 1. Civil Works (Lot I-2)			
1-1.Tunnel（Added）	1,214.3-m long	1,214.3-m long	None
1-2.Power Station（Inside）	Engine room, outlet channel, switchyard	Engine room, outlet channel, switchyard	None
1-3.Outlet Channel	4,408 m + 711 m	3,954 m + 741m	Change in length
1-4.Power Station（Building）	24.5 m × 40 m × 2.2 m	24.5 m × 40 m × 32.2 m	None
1-5. Distribution Line（For Intake Weir）	11 kv	11 kv	None
1-6. Intake Weir	（None）	One set	Carried over from Phase I
2. **Civil Works** Lot II:			
2-1. Water Gates	Gates for intake, outlet, and tunnel	Gates for intake, outlet, and tunnel	None
2-2. Penstock	（None）	3.9-m dia. × 53-m long	Carried over from Phase I
3. **Civil Works** Lot III:			
3-1. Turbine Generator and related facilities	Generator (30 MW ×2)、132kv substation switchgear and related facilities Step-up transformer 11/132kV (33.7MVA x2)	Generator (30 MW ×2)、132 kv substation switchgear and related facilities Step-up transformer 11/132kV (33.7MVA x2)	None

[29]About 150,000 plants were nursed and distributed between 2008 and 2010.

Item	Original	Actual	Difference
4. **Civil Works** Lot IV:			
4-1. Installation of Transmission Line	132 kv-49 km	132 kv-49 km	None
4-2. Rehabilitation of sub-stations	132 kv switchgear and related facilities （Chemosit, Kisumu, Lessos, Muhoroni） 132/33kV transformer (Muhoroni)	132 kv switchgear and related facilities （Chemosit, Kisumu, Lessos, Muhoroni） 132/33kV transformer (Muhoroni)	None
（Common to two phases） Consulting Services			
2-1. E/S	D/D, Assistance for bidding, etc.	Additional services for assisitng the management activities of Technical Committee and additional (socioeconomic) studies	

Source：KenGen

As shown above, the intake weir and penstock were not completed in Phase I, and were carried over to Phase II. This is because unexpected geological conditions at the raceway raised the construction cost, which increased to beyond the permitted limit within Phase I. The base camp had to be expanded (+9.4 ha) since there were more staff than expected who needed accommodation, and this change was appropriate. Additional outputs for consulting services occurred because of the establishment of the Technical Committee and the resulting assistance for management work, as well as additional socioeconomic and fishery services, as recommended by the committee, and for implementing the project, these outputs were inevitable.

The Phase II included carry-over work from Phase I, and a slight increase of length of the outlet channel, but these changes are appropriate.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The projected cost of Phase I was planned to be 8,156 million JPY (of which the loan was 6,933 million JPY), but the actual cost was 9,088 million JPY, which is 111% of the planned cost. The projected cost of Phase II was planned to be 12,416 million JPY (of which the loan was 10,554 million JPY), but the actual cost was 15,179 million JPY, which is 122% of the plan cost. The overall cost was 21,504million JPY, which was 104% of the original cost of 20,572 million JPY, and thus, slightly higher than the original.

The difference in Phase I is attributable to the increased construction cost (about 1 billion JPY) attributed to the unexpected geological conditions, while in Phase II it is attributed to (a) price escalation (about 1.3 billion JPY), (b) carry over work from Phase I (about 0.9 billion JPY), (c) changes in design, (d) additional costs (about 0.6 billion JPY) to accelerate the Phase II work, and (e) additional work for Phase II contractors (about 0.2 billion JPY).

Table 9 Project Cost (Plan and Actual) Comparison

Phase I

	Original			Actual		
	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)
Civil Works	3,415	941	5,202	3,582	1,677	6,194
Contingency	342	98	526	0	0	0
Consulting Services	1,826	179	2,166	2,057	281	2,501
Land Appropriation Fee	0	64	122	0	232	339
Administrative Fee	0	74	140	0	33	54
Total	5,583	1,356	8,156	5,639	2,223	9,088

Source：KenGen

Note：Exchange Rate 1 KSh = 1.90JPY（Appraisal）；＝1.55 JPY（Post-Evaluation）（1996–2007 average）

Phase II

	Original			Actual		
	Foreign Currency (Mil. JPY)	Local Currency[30] (Mil. KSh)	Total (Mil. JPY)	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)
Civil Works	3,005	669	4,368	2,947	3,463	8,362
Hydromechanical Works	1,465	496	2,476	1,299	500	2,165
Generating Equipment	2,329	153	2,641	2,301	110	2,486
Transmission Line & Sub-Stations	1,178	104	1,390	957	254	1,379
Land Appropriation Fee	0	99	202	0	136	217
Administrative Fee	0	89	181	0	69	110
Consulting Services	0	0	0	318	90	449
Contingencies	864	144	1,158	11	0	11
Total	8,841	1,752	12,416	7,833	4,622	15,179

Source：KenGen

Note：Exchange Rate1 KSh ＝ 2.04 JPY（Appraisal）； ＝1.59 JPY（Post-Evaluation）（2004–2007 average）

3.4.2.2 Project Period

The original planned period was January 1997 to July 2002 (67 months) for Phase I, and January 1999 to December 2001 (36 months) for Phase II; the period for Phase II was revised to October 2000

[30]JICA Internal documents (appraisal documents) estimated local currency but it was expressed in KSh using the exchange rate at that time in order to be consistent in units of currency.

to June 2003 (33 months) at the time of appraisal for Phase II. The actual period was March 1997 to April 2004 (97 months) for Phase I with a 145% delay, while it was February 2004 to March 2010 (74 months)[31], with a 224% delay for Phase II. With the two phases combined, the original plan (100 months) and actual (171 months) differed by 171% with the delays. In brief, the actual period significantly exceeded the original plan.

Reasons for delays included the facts that (a) with the delay in the extension of Phase II[32], the executing agency had to stop work until the signing of the Phase II Loan Agreement because it was not possible to fund the project on their own; and (b) part of the civil work in Phase I was carried over to Phase II, requiring additional time. Other reasons included the additional time required for digging the raceway, as well as a delayed hand-over due to mechanical trouble with the turbine.

3.4.3 Results of Calculations of Internal Rates of Return (IRR) (for Reference)

The Financial Internal Rate of Return (FIRR) for the project was re-calculated to be 7.2%[33], which was lower than the original; the calculation was based on the same assumptions as the appraisal, with construction cost, operation and maintenance costs, and transmission cost taken as costs, while sales of electricity generated the benefits, with 50 years of project life.

The Economic Internal Rate of Return (EIRR) was also calculated as 9.2%, lower than the original; this calculation too was carried out under the same assumptions as the appraisal, with construction cost, operations and maintenance costs taken as costs, while the costs of construction and operations and maintenance of an alternative thermal power station, as well as fuel costs for the same power station were considered as benefits.

The decreases are attributable to the significant increase in construction costs from the original values.

Table 10 Internal Rates of Return

Unit：%

	Original (Phase I)	Original (Phase II)	Actual
FIRR	10.1	11.4	7.2
EIRR	14.1	13.4	9.2

The project cost slightly exceeded the planned value, while the project period significantly exceeded the planned duration; therefore, the efficiency of the project is low.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The Sondu-Miriu Hydroelectric Power Plant as completed by this project is operated and maintained

[31]As planned, the end of the project period is defined as the end of experimental operation and the OJT, and the completion of the consulting services.
[32]Loan Agreement was signed with 5 years of delay in the end.
[33]Re-calculated by KenGen staff, adjusted by the evaluator.

by KenGen, while the transmission lines and sub-stations are operated and maintained by KPLC. According to the original plan, Kenya Power Company (KPC), a subsidiary company of KPLC, was to assume the function of KPLC; however, as part of the World Bank-led reform of the electricity sector, the management of KPC was separated from KPLC and incorporated as a part of KenGen, to be specialized in power generation.

(1) KenGen

This is a publicly listed company, with a government-held share of 70%. This project (the Sondu-Miriu Power Plant and related facilities) does not outsource any operations and maintenance (O&M) activities, and is run and supported by full-time staff (8 employees from the engineer level with 15 years' experience); 20 employees from the skilled labor level with 20 years' experience).

(2) KPLC

This is a limited liability company, with a government-held share of 50.08%. The transmission line project is operated under the supervision of KPLC's transmission division, and does not outsource any O&M activities, but the construction of the transmission line was outsourced. The staffing for O&M for the transmission lines is run and supported by 8 engineers, 16 skilled workers, and 5 daily workers (all full-time except for the daily workers).

After the privatization of KPLC and the separation of electricity generation and transmission, KenGen and KPLC (whose head offices are adjacent to each other) have been coordinating closely; hence, there is no adjustment cost for coordination between the two agencies for the O&M.

3.5.2 Technical Aspects of Operation and Maintenance

KenGen and KPLC have fully skilled staff (for power plant, sub-stations, reservoir, transmission lines, and other related facilities), and daily training, OJT, and overseas training sessions are conducted in addition to the training by the manufacturer at the hand-over, allowing them to improve their skills; hence, no major problems have been experienced in the implementation of the project. The manuals are employed appropriately. Reduced unplanned outage hours and increased operating hours (Table 4) are evidence for the effective acquisition of techniques.

3.5.3 Financial Aspects of Operation and Maintenance

(1) KenGen

The 2009 drought damaged agricultural production and the supply of hydroelectric power, resulting in a 13% decrease in operational revenue in fiscal year 2010[34]; however, a quick recovery enabled maintaining a stable operational revenue and net profit. Further, financial conditions from Return on Assets (ROA) and self-financing ratio are good. KenGen mostly sells its product to KPLC, but it

[34]FY 2010 covers July 1, 2009, till June 30, 2010.

also sells electricity to Kenya Electricity Transmission Company (KETRACO), which was incorporated in 2008.

The wholesale pricing structure is based upon capacity charges and energy charges. The capacity charge is a fixed charge calculated from peak usage, while the energy charge is an additional variable charge, accounting for 85% and 8% of KenGen's revenue from the project (14,389million KSh as of FY2011). It is KenGen's management policy[35] to focus on the fixed charge.

Table 11 KenGen's Cash Flow and Balance Sheet

Unit：Mil. Ksh

	FY2008	FY2009	FY2010	FY2011
Operational Revenue	11,548	12,652	10,998	14,389
Operational Expenditure	△8,012	△8,247	△8,558	△10,014
Operational Profit	3,537	4,405	2,440	4,376
Interest and Non-Operational Revenue	340	907	786	1,273
Non-Operational Expenditure	△798	△756	△741	△1,997
Pre-Tax Net Profit	3,079	4,556	2,485	3,651
Tax Payment	2,818	△2,485	802	△1,571
Net Profit	5,897	2,071	3,286	2,080
ROA(%)	3.52	4.89	2.20	1.29
Self-Financing Rate (%)	74	97	60	42

Source：KenGen（Annual Report）

Note1：Positive sign in tax payment means tax credit.

Note2：ROA = Return on Assets

(2) KPLC

In general, operational profit and net profit are stable and financial conditions are stable.

Table 12 KPLC's Cash Flow

Unit：Mil. Ksh

	FY2008	FY 2009	FY 2010	FY 2011
Operational Revenue	40,801	65,208	73,166	69,728
Operational Expenditure	37,277	59,531	67,205	62,644
Operational Profit (Pre-Tax)	3,524	5,677	5,951	7,084
Tax Payment	△973	△1,557	△1,917	△2,035
Net Profit	2,551	4,119	4,035	5,049

Source：KPLC（Annual Report）

3.5.4 Current Status of Operation and Maintenance

KenGen conducts daily routine maintenance of the generators, turbines, intake weir, penstock, intake valve, outlet channel, etc., and they are in good condition. Spare parts are procured through OEM[36] without major problems. KPLC conducts daily routine maintenance of procured facilities (transmission line and sub-stations), and they are in good condition.

KenGen's offices are recognized by ISO90201:2000, which ensures client-driven output (electricity) quality, managerial system and a high level of environmental management system, objectively

[35]KenGen Annual Report (FY2011).

[36]Original Equipment Manufacturer

guaranteeing the sustainability of the project.

No major problems have been observed in the operation and maintenance system; thus, the sustainability of the project effort is high.

4. Conclusions, Lessons Learned, and Recommendations

4.1 Conclusions

This project is consistent with Kenyain the operation and maintenance system (electricity) qualityly sells its produccal and national needs for its electricity supply, and Japanese aid policy at that time, so the relevance is high. There is no major operational problem in the constructed power plant, and in general, the target goals for annual power generation, operational ratio, etc. have been achieved; thus, the effectiveness is also high. There are no serious negative impacts on the natural environment, relocation, or pollution and its related health effects. The project cost slightly exceeded the plan, and the project period significantly exceeded the planjor operational problem d national needs 4t to each other) ssion division, and does not outsourcthe efficiency is low. The project cost slightly exceeded the planned value, and the project period significantly exceeded the planned duration—there was a delay of more than five years in the signing of Loan Agreement (L/A) —owing to which the efficiency is low. There is no major problem in structure, finance, technique or the current status of operation and maintenance; hence, the sustainability is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

（1） Diversification and Stabilization of Power Sources

About 65% of the electricity generated in Kenya depends on hydroelectric power[37]. This creates a seasonal fluctuation in electricity generated between the dry and rainy seasons, even at the national level. The Government of Kenya also recognizes this structural issue[38] that hydropower is vulnerable to available water supplies and seasonal fluctuations as a “supply gap,” if not as serious as “supply gap; in order to cope with the rainy-dry seasonality, the Government of Kenya purchases electricity from a UK generator rental firm and fills in supply gaps from other hydropower stations using different river systems. However, these are only temporary measures and they will not be sufficient as medium- and long-term solutions; therefore, it is desirable to take fundamental measures to stabilize the seasonal supply gap, by diversifying electricity sources (e.g. geothermal, thermal, pump-up), as already planned by the Government of Kenya.

4.2.2 Recommendations to JICA

None.

[37]Share of total capacity. For actual generation, it is about 50%, adjusted for seasonality.
[38]As stated in the Kenya National Energy Policy (2012, under revision).

4.3 Lessons Learned

When the project implementation involves environmental issues and compensation related to resettlement, as in this project, the establishment of a consultative body that listens to requests and claims from local people, professionals, and NGOs (the “Technical Committee” as in this project or any other term such as “Town Meeting” would be fine), with persistent efforts to engage in a dialogue with the executing agency, would eventually contribute to winning support from the local people for the project; thus, it would contribute to realizing the efficient and effective implementation of the project, consistent with the realities of the local economy. In this case, however, it is important to closely share information with local people to avoid any perception gaps regarding the activities of the Technical Committee. The Technical Committee, while listening to the opinions of the local people, has made various recommendations to KenGen contributing to mitigating the negative impacts by its own efforts, and this should be recognized as an output available for the local people themselves.

Comparison of the Original and Actual Scope of the Project

Sondu-Miriu Hydropower Project I

Item	Original	Actual
1.Project Outputs	1. Civil Works (Lot I-1) River Works, Intake Weir, Tunnel, Serge Tank, Penstock, Access Road, Base Camp 2. Consulting Services	1. As planned, except for Intake Weir and Penstock, carried over to Phase II, and Base Camp, expanded 2. Additional Surveys
2.Project Period	January 1997 – July 2002 (67 months)	March 1997 – April 2004 (97 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 5,583million yen 2,573million yen (1,356million KSh) 8,156million yen 6,933million yen 1KSh = 1.90 yen (As of Appraisal)	 5,639million yen 3,449million yen (2,223million KSh) 9,088million yen 6,933million yen 1KSh = 1.55 yen (1996-2007 Average)

Sondu-Miriu Hydropower Project II

Item	Original	Actual
1.Project Outputs	1. Civil Works (Lot I-2) Tunnel (Added), Power Station (Inside), Outlet Channel, Power Station (Building), Distribution Line, Intake Weir 2. Civil Works Lot II Water Gates, Penstock 3. Civil Works Lot III Turbine Generator and related facilities 4. Civil Works Lot IV Installation of Transmission Line, Rebhabilitation of Sub-Stations 5. Consulting Services	1. As planned, except for Outlet Channel, expanded, and Intake Weir, carried over from Phase I 2. As plannned, excpt for Penstock, carried over from Phase I 3. As Planned 4. As planned 5. Additional Surveys
2.Project Period	October 2010 – June 2003 (36 months)	February 2004 – March 2010 (74 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 8,841million yen 3,575million yen (1,752million KSh) 12,416million yen 10,554million yen 1KSh = 2.04 yen (As of Appraisal)	 7,833million yen 7,346million yen (4,622million KSh) 15,719million yen 10,554million yen 1KSh = 1.59 yen (2004-2007 Average)