REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENERGY
THE PROVINCIAL GOVERNMENT OF IFUGAO

REPUBLIC OF THE PHILIPPINES
PREPARATORY SURVEY FOR MINI-HYDROPOWER DEVELOPMENT IN THE PHILIPPINES
(MINI HYDROPOWER PROJECT IN THE PROVINCE OF IFUGAO)
FINAL REPORT

MARCH, 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ELECTRIC POWER SERVICES CO., LTD.

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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Tokyo Electric Power Services Co., LTD.

The survey team held a series of discussion with the officials concerned of the Government of the Philippines, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the survey team.

March, 2013

Hidetoshi IRIGAKI
Industrial Development and Public Policy Department
Japan International Cooperation Agency

Summary

1. Country Profile

1-1 National Land and Natural Conditions

Located on the ocean route that links Japan to Southeast Asia, the Middle East and Europe, the Philippines is composed of 7,109 islands of various sizes. Its national land area is approximately 0.8 times the size of Japan, and its population of roughly 87 million is the second largest in the ASEAN region.

All of the Philippines belongs to the tropical rain forest zone, and temperatures nationwide reach a peak in May and hit a low in January. The rainy season and dry season differ according to each area: in Ifugao Province in the north of Luzon Island where the Project site is located, the dry season lasts from March to May and the rainy season is from August to October, however, there is no clear difference between the rainy and dry seasons and it is fairly rainy throughout the year. Annual rainfall around the Project site fluctuates from around 2,500 to 3,000 millimeters.

Rivers in Ifugao Province mainly originate out of mountains to the west and flow into Magat River, which is a tributary of Kagayan River, the largest in north Luzon. Rivers in the western areas are precipitous and have a mean river gradient of around 1/20, which makes them suitable for flow-in type hydropower development.

Lamut River, on which the Project site is situated, is also located in this western area.

1-2 Socioeconomic Conditions

Private consumption in the Philippines, supported by healthy remittances by overseas workers, is growing, and in 2010 the Philippines recorded an economic growth rate of 7.6% (IMF, World Economic Outlook Database) and GDP of US$199.6 billion (ditto). In 2011, due to the impact of the European credit crisis and so forth, economic growth slowed to 3.7% (ditto) and the GDP was US$213.1 billion (ditto), however, growth of 4.2% (ditto) is predicted for 2012, indicating that the country is enjoying firm economic growth. Per capita GDP in 2011 was US$2,223 (ditto).

Looking at the GDP share of each industry, primary industry accounts for 13% (Philippine National Statistical Coordination Board, 28 November 2012), secondary industry for 32% (ditto), and tertiary industry for 56% (ditto), and tertiary industry has been growing rapidly in recent years.

In terms of diplomacy, the basic policies are security, economic diplomacy and protection of overseas workers, and emphasis is placed on relations with Japan, the United States and China. Moreover, the Government of the Philippines lays emphasis on the following policies geared to realizing even more sustainable economic

growth based on promoting overseas direct investment via improvement of the business and investment environment: ① enhancement of industrial competitiveness, ② infrastructure development, and ③ promotion of employment. In order to address these policy issues, the government is striving to make improvements based on various policy, system and administration improvement items.

Under these circumstances, there is a lot of external direct investment from Japan to the Philippines, especially in the manufacturing sector.

In recent years, relations between the Philippines and Japan have deepened a lot, and the Japan-Philippines joint statement on the comprehensive promotion of the "strategic partnership" was announced on the occasion of President Aquino's visit to Japan, thereby further strengthening ties between the two countries.

2. Background to the Project

2-1 Overall Goals

Having meager fossil fuel resources, the Philippines is promoting the diversification of energy sources, however, it still relies on imported fossil fuels to generate half of its generated electrical energy, and it is desirable to switch to further domestic and renewable energies from the viewpoints of energy security and reduction of greenhouse gas emissions. Hydropower accounts for 21% of all power supply in the Philippines and ranks with geothermal energy as a renewable energy and important source of power supply, and its further utilization is anticipated.

The primary sources of renewable energy in the Philippines are geothermal energy and hydropower; in particular, the country has abundant hydropower potential amounting to 13,100 MW (of which 3,400 MW is already developed). Combined potential for mini hydropower development (projects no larger than 10 MW) is 1,880 MW, an promising sites for this are located all over the country. Accordingly, it is anticipated that this can contribute to the stabilization of power supply in rural areas especially.

In October 2008, the Government of the Philippines enforced the Renewable Energy Act of 2008, R.A. 9513 (hereinafter referred to as the "RE Act") - the first comprehensive legislation on renewable energy in Southeast Asia. This Act has the objectives of, ① improving the self-sufficiency of energy supply, ② strengthening the capacity of central and local governments via development of renewable energy, and ③ balancing economic growth with environmental protection. Furthermore, the Government of the Philippines in June 2011 announced the National Renewable Energy Program with the goal of increasing the amount of power generated from renewable energy by three times (to approximately 16,200 MW) over the 2010 level by 2030. Because the Philippines relies on imported fossil fuels to cover 40% of its power generation requirement, implementation of the Project can be expected to promote the utilization of renewable energy based on

domestic water resources, and thereby contribute to energy security and reduction of greenhouse gas emissions.

Ifugao Province, where the Project site is located, has abundant water resources and numerous sites of large head drop, making it one of the most suitable areas in the Philippines for mini hydropower development. Since industry in this province is dominated by agriculture in mountain corridors and the electrification rate is roughly 65% of households (compared to the national average of 80%), the issues that confront the province concern the diversification of energy supply sources and extension of power. Moreover, prior to enactment of the RE Program, Ifugao Province in 2007 enacted the Mini Hydro Electric Power Plant Development Program Ordinance geared to ① expanding the province's development budget, ② reducing electricity tariffs in the province, and ③ securing funds for preserving the rice terraces, and it is encouraging hydropower development in the province.

The Project will contribute to achieving the goals of the RE Act, the National Renewable Energy Program and the Mini Hydro Electric Power Plant Development Program Ordinance of Ifugao Province.

2-2 Current Conditions and Problems in the Sector

In the Philippines, although there has been active mini-hydropower development following enactment of the RE Act, because development has conventionally focused on large-scale hydropower development, appropriate technologies concerning mini hydropower development have failed to take root. As a result, the average operating rate of exiting flow-in type mini hydropower plants (10 MW or less) is 38%, which is far lower than the corresponding rate of 76% in Japanese mini hydropower plants of the same scale. In future, it will be necessary to conduct appropriate development upon giving full consideration to the rooting of mini-hydropower technologies, mitigation of environmental impacts on local communities and ecosystems, flood control based on units of rivers and securing of water supply for irrigation purposes and so on.

In Ifugao Province, where the Project site is located, approximately 70% of workers are engaged in primary industry, 9% are engaged in secondary industry, and 21% are engaged in tertiary industry. Ifugao Province is famous for rice terraces which spread extensively over mountain slopes and were registered as World Heritage by UNESCO in 1995. However, in recent years, the rice terraces have become devastated due to the impacts of globalization. Although the responsibility for conserving the rice terraces of Ifugao has been transferred from the central government to the provincial government, hardly any financial support has been forthcoming and the provincial government must independently secure the funds required to conserve the rice terraces. According to the latest estimate by Ifugao Province, between 30~50 million pesos (60~100 million yen) is required to conserve the rice terraces every year, however, since this is equivalent to between 25~45% of the annual development budget of the province (approximately 116 million pesos in 2011), it is virtually

impossible for the provincial government to keep paying for maintenance of the rice terraces out of its own budget.

Concerning international assistance for preservation of the Ifugao rice terraces, GSEP (Global Sustainable Electricity Partnership, international NGO and the former "e8") in January 2010 developed Ambangal mini hydropower plant (200 kW) in Kiangan District, Ifugao Province and established the Rice Terraces Conservation Fund (RTCF) based on revenue from the sale of power generated by that plant; however, the funds generated by this program only account for roughly 10% of the amount required to preserve the rice terraces.

Against this background, the Philippine Department of Energy (DOE) requested the Government of Japan to provide grant aid for construction of Likud mini hydropower generation plant in 2012.

3. Outline of the Study Findings and Contents of the Project

In order to contribute to the implementation of the Likud mini hydropower project, which aims to realize stable power supply in Ifugao Province and expansion of the rice terraces conservation fund, the Project intends to construct mini hydropower equipment (maximum output 820 kW) and transmission equipment (13.2 kV), and to implement a soft component geared to establishing the setup for the smooth operation and maintenance of the plant and equipment and appropriate management of the rice terraces conservation fund. Moreover, in tandem with the construction of power generating equipment, the local citizens strongly desire the rehabilitation of existing irrigation channels that are currently out of order, and since the said rehabilitation work is relatively simple and has negligible impact on the hydropower utility, it has been decided to add this to the Project activity.

The Project components are as indicated below.

3-1 Mini Hydropower Equipment and Power Distribution Equipment

Table-1 Project Feature of Generation and Distribution Facilities

Item		Content	Remark
Project Location	Location	Barangay Haliap, Municipality of Asipulo, Province of Ifugao	
	Coordination	Intake Weir: N 16° 44' 24.70" E 121° 05' 30.61" Powerstation: N 16° 43' 56.01" E 121° 06' 08.95"	

	River		Lamut River	
	Catchment Area		44.0 km^2	
	Discharge Gauging Data		Hapao Gauging Station	Municipality of Hungduan, Barangay Hapao , TEPSCO observation
Project Feature	Type of Generation		Run-of-River	
	Plant Discharge		2.00 m^3/s	
	Firm Discharge		1.36 m^3/s	85% Discharge
	Intake Water Level		EL. 600.0 m	
	Tail Water Level		EL. 541.0 m	
	Gross Head		59.0 m	
	Effective Head		51.8 m	
	Plant Capacity		820 kW	
	Firm Capacity		564 kW	85% Discharge
Item			Content	Remark
Generation Feature	Annual Generated Energy		6,206.2 MWh	at the average discharge duration
	Annual Effective Energy (Generating end)		5,585.5 MWh	Ditto, suspended ration: 90%, un-consideration of output limitation during the night
	Annual Effective Energy (Generating end)	January	434.7 MWh	Estimation in the drought year Consideration of output limitation during the night from 22:00 to 6:00: 410kW of limited output from 6:00 to 22:00: no-limitation of output Suspended ration regarding the powerhouse: 5% regarding the distribution: 5%
		February	304.9 MWh	
		March	191.7 MWh	
		April	200.0 MWh	
		May	378.6 MWh	
		June	410.5 MWh	
		July	381.6 MWh	
		August	422.1 MWh	
		September	396.6 MWh	
		October	452.6 MWh	
		November	438.9 MWh	
		December	439.0 MWh	
		Total	4,451.1 MWh	
Civil Structure	Intake Weir		H 4.5m, W 22.0m	Reinforcement of existing irrigation weir
	Inlet		H 1.5m, W 1.6m	
	Settling Basin		H 3.5m, W 6.5m, L 13.7m	
	Headrace		H 1.7m, W 2.0m, L 1,844.4m	Open & closed channel, flume, etc
	Headtank		H 4.0m, W 6.2m, L 14.1m	
	Spillway		H 1.6m, W 1.6m, L 152.6m	Buried type
	Penstock		D 0.85m, L 148.7m	Buried type, spiral steel pipe, Procurement in Manila
	Powerstation		H 5.0m, W 9.4m, L 14.0m	
	Powerhouse Access Road		W 4.0m, L 200.0m	

Specifications of Electrical/ Mechanical and Transformation Equipments	Turbine	Horizontal Shaft Francis Turbine x2 420 kW、1200 rpm	Procurement from Japanese small-medium industry
	Generator	3 Phase Synchronous Generator x2 460 kVA	Ditto
	Control Device	Water Level Controller Governor Excitation System Auto Synchronizer Protection Relay Individual Operation Detector	Ditto
	Main Transformer	1 Phase 333 kVA x 3 Voltage 440/13.2kV	NEA Standard
	Switchgear	3 Phase Load Breaker Switch Voltage 24kV	Ditto
Specifications of Distribution Equipments	Distribution Line	3 Phase 4 Wire, 13.2kVA Newly construction: 2.93km Repayment: 9.31km	NEA Standard P/S ~ No. 89 pole (Haliap Bridge) No. 89 pole ~ Existing line
	Distribution Pole	Steel pole	Ditto
	Watt Hour Metter, etc	Voltage Transformer Current Transformer Watt Hour Meter	Ditto

3-2 Repair of Existing Irrigation facilities

Table 2 shows the contents of repairs for existing irrigation facilities.

Table 2 Contents of Repairs to Existing Irrigation Facilities

Item	Contents	Remarks
Irrigated area targeted for repair	2.43ha	
Irrigation flow	0.01 m^3/s	Water diversion from the settling basin
Channel repairs	Length 700m, inner width 0.3m	Installed in tandem with the power plant headrace channel

3-3 Soft Component

The soft component of the Project will be implemented with the purpose of, 1) establishing the operation and maintenance setup for the mini hydropower plant, and 2) realizing the appropriate administration of the rice terraces conservation fund. Table 3 gives a summary of the activities.

Table 3 Contents of the Soft Component

Objective	Implementation Timing	Contents of Soft Component
Establishing the operation and maintenance setup for the mini hydropower plant	Immediately after the start of works	Learning of basic knowledge concerning the mini-hydropower plant
	During the headrace concrete works	Practical training of technology for building civil engineering structures on the works site
	Immediately after implementation of the above	Practical training of operation and maintenance in the existing Ambangal mini-hydropower plant
	During the test with flowing water	Practical training at Likud power plant Final screening of operation and maintenance staff members
Appropriate administration of the rice terraces conservation fund	Immediately after the start of works	Analysis of problems in the current rice terrace conservation fund operating guidelines in joint work with officials of the provincial government
	During the busiest phase of the works	Support for revision of the existing guidelines
	During the equipment test period	Approval of the approved guidelines and support for public relations activities concerning fund utilization

4. Project Works Period and Outline of Project Cost

4-1 Project Works Period

Table 4 shows the works period that will be required to implement the Project.

Table 4 Project Works Period

Implementation Contents	Implementation Period	Implementation Months
Implementation design	May~July, 2013	3 months
Tender-related work	July~October, 2013	4 months
Facilities construction and equipment procurement period	November 2013 ~ February 2015	16 months

4-2 Outline of Project Cost

Table 5 shows the outline of project cost.

Table 5 Outline of Project Cost

Total Project Cost	Non-disclosed up to Approval of the Execution and procurement Contractor Agreements
Burden of Japan	Ditto
Burden of the host country	0.46 million yen

(Note) 1.0Php＝￥2.03

5. Project Evaluation

5-1 Relevance

For the Philippines, which rely on imported fossil fuels to provide half of its power requirement, implementation of the Project is expected to promote the utilization of water resources-based renewable energy, contribute to improving energy security and help mitigate greenhouse gas emissions. Moreover, since this mini hydropower activity geared to promoting utilization of renewable energy is also compatible with the energy policy of the Philippines, the Project is deemed to be relevant.

Moreover, in the Project, it is planned to utilize the profits acquired from power sales for conserving the World Heritage rice terraces of Ifugao via the RTCF. Doing so will also make a contribution to preserving tourism resources and will thus also be significant in terms of promoting environmental conservation and local economic development.

At the same time, through adding to the experience of Japanese mini hydropower equipment makers, which possess technical capability but are having difficulty making overseas advances, the Project will contribute to a new growth strategy that is based on the promotion of technical dissemination and overseas extension.

5-2 Effectiveness

The anticipated outputs of Project implementation are as follows.

(1) Quantitative effects

Table 6 Quantitative Effect Indicators

Indicator	Reference Value (as of 2012)	Target Value (as of 2018) [3 years after Project completion]
Generated electrical energy at the generating end (MWh/year)	0	4,451
Contribution to CO_2 emissions reduction (tCO_2/year) (generating end)	0	2,167

(2) Qualitative Effects

The following qualitative effects can be anticipated from implementation of the Project.

Qualitative Effects: The profit which will be secured from electricity sales of Likud Mini-Hydropower plant, will contribute to conservation of Ifugao tourism resources including rice terraces of World Heritage

Preparatory Survey Report

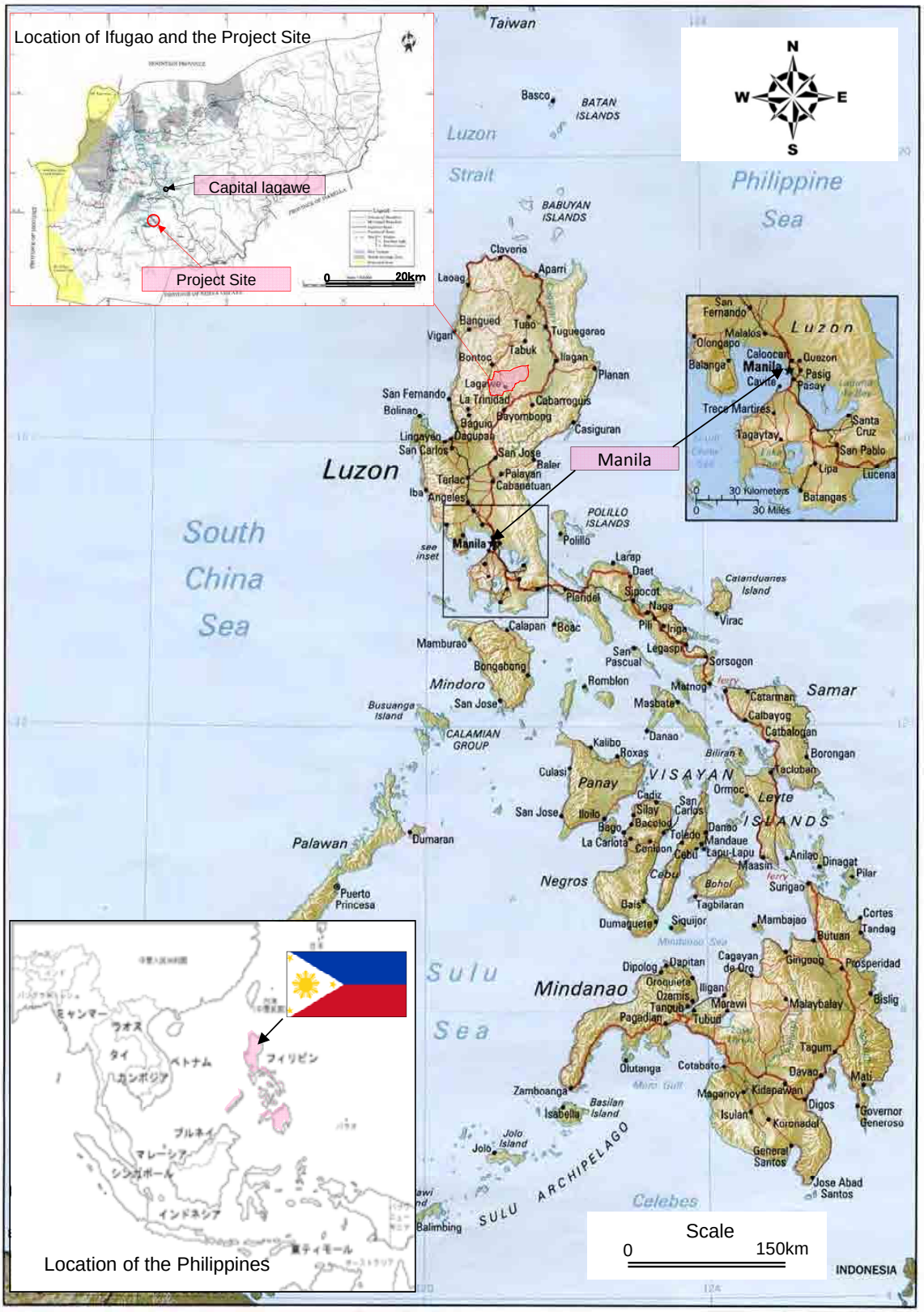
for

Preparatory Survey for Mini-Hydropower Development Project

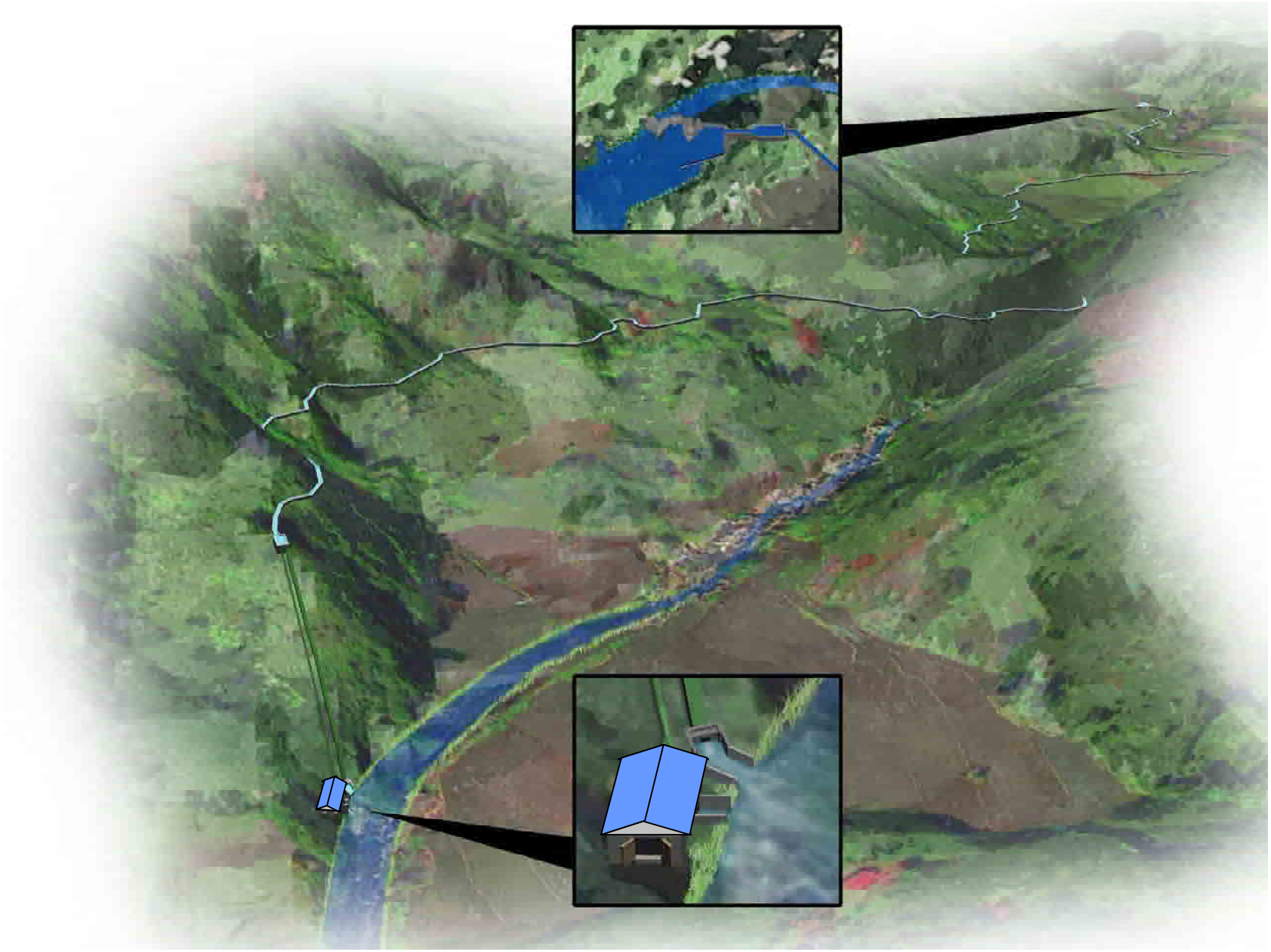
in the Philippines

(Mini-Hydropower Project in the Province of Ifugao)

Contents



Location Map



Perspective of the Project

Pictures of the Project Site

Photograph 1: The rice terraces of Ifugao Province were registered as World Heritage by UNESCO in 1995, however, the have become devastated in recent years because the provincial government cannot afford to properly maintain them.

Photograph 2: Ambangal mini hydropower plant, which was developed with the objective of generating funds for conserving the rice terraces. However, the funds generated by this program only account for roughly 10% of the amount required to preserve the rice terraces.

Photograph 3: Current conditions of irrigation water intake weir. Currently, the river water isn't acquired but simply flows over the weir. In the Project, it is planned to rehabilitate this weir (raising by approximately 0.3 m) with a view to in-taking a maximum of 2.0m^3/s of water.

Photograph 4: Current conditions of the water channel route. A concrete channel (width 2.0 m, height 1.7 m) will run for approximately 1.8 km from the intake weir to the head tank.

Pictures of the Project Site

Photograph 5: Rice paddies around a section of the water channel. The channel is arranged so that it runs along the paths that separate the paddies with a view to minimizing the impacts of land appropriation.

Photograph 6: Current conditions of the penstock installation route. Water will be guided approximately 150 m from the head tank to the power plant, and the head of approximately 52 m over this section will be utilized to generate maximum outpu of 820 kW.

Photograph 7: Current conditions of the power plant construction site. Water will be discharged in this area. There is a road and bridge downstream from here, and it is possible to transport equipment and materials onto the site.

Photograph 8: Existing 13.2 kV power distribution line. Since the existing distribution line (to which the power plant will be connected) uses a lot of wooden poles in poor condition, these will be replaced with steel poles in order to ensure stable supply. Also, 3-phase distribution lines will be used up to the new power plant.

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Abbreviations

AMHPP	Ambangal Mini-Hydro Power Plant
B/C ratio	Benefit / Cost ratio
BBL	Barrel
BRTTF	Banaue Rice Terrace Task Force
CADC	Certificate of Ancestral Domain Claim
CALC	Certificate of Ancestral Land Claims
CAR	Cordillera Autonomous Region
CDM	Clean Development Mechanism
CIS	Communal Irrigation System
CNC	Certificate of Non-Coverage
CO2	Carbon Dioxide
COA	Commission of Audit
COC	Certificate of Compliance
D/L	Distribution Line
DBO	Department of Budget Office
DBO-CAR	Department of Budget Office-Cordillera Autonomous Region
DBP	Development Bank of the Philippines
D-CNC	Category D-Certificate of Non-Coverage
DENR	Department of Environmental and Natural Resources
DILG	Department of Interior and Local Government
DOE	Department of Energy
DPWH	Department of Public Work and Highway
e8	An international NPO which is composed of 10 of the world's leading electricity companies from G8 countries
EC	Electric Cooperative
ECC	Environmental Compliance Certificate
EDP	Environmental Development Project
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMB	Environmental Management Bureau
EPIRA	Electric Power Industry Reform Act
ERC	Energy Regulatory Commission
ESA	Energy Sales Agreement
FIRR	Financial Internal Rate of Return
FIT	Feed-In-Tariff
FPIC	Free Prior Informed Consent
GDP	Gross Domestic Product
HRMO	Human Resources Management Office
ICC	Indigenous Cultural Community
ICHO	Ifugao Cultural Heritage Office
ICOMOS	International Council of Monuments and Sites
IEE	Initial Environmental Examination
IFELCO	Ifugao Electric Cooperative
IKGS	International Keeping Good Sannna
IPRA	Indigenous Peoples Right Act
IRA	Internal Revenue Allotment
IRR	Implementing Rules and Regulations
IRTCHO	Ifugao Rice Terraces Cultural Heritage Office
ITC	Ifugao Terraces Commission
IUCN	International Union for the Conservation of Nature
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
kW	Kilo Watt
kWh	Kilo Watt Hour
LGU	Local Government Unit
LLCR	Loan Life Coverage Ratio
LMHPP	Likud Mini-Hydropower Plant
LTL	Long Term Loan
MEG	Monitoring and Evaluation Group

MH_h	Mega Watt hour
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPDO	Municipal Planning and Development Office
NAPOCOR	National Power Corporation
NCCA	National Commission on Culture and Arts
NCIP	National Commission on Indigenous People
NGCP	National Grid Corporation of the Philippines
NGO	Non Governmental Organization
NPC	National Power Corporation
NPV	Net Present Value
NSO	National Statistics Office
NUVELCO	Nueva Vizcaya Electric Cooperation
NWRB	National Water Resource Board
O&M	Operation and Maintenance
P/S	Power Station
PACCO	Provincial Accounting Office
PAENRO	Provincial Agriculture Environment Natural Resources Office
PBP	Pay Back Period
PD	Presidential Decree
PEO	Provincial Engineering Office
PGI	Provincial Government of Ifugao
PGO	Provincial Governor's Office
PHP	Peso
PLO	Provincial Legal Office
PPDO	Provincial Planning and Development Office
Pre-FS	Pre-Feasibility Study
PTO	Provincial Treasury Office
PV	Present Value
PVC	Polyvinyl Chloride
RA	Republic Act
RE	Renewable Energy
REMB	Renewable Energy Management Bureau
ROE	Return of Equity
ROI	Return on Investment
RPS	Renewable Portfolio Standard
S/S	Sub-Station
SB	Sanggunian Bayan
SITMO	Save the Ifugao Terraces Movement
SP	Sanggunian Panlalawigan
STL	Short Term Loan
T/L	Transmission Line
TEPCO	Tokyo Electric Power Company
TOR	Terms of Reference
TP	Tapping Point
TRANSCO	National Transmission Corporation
UNESCO	United Nations Educational, Scientific and Cultural Organization
WTI	West Texas Intermediate

Chapter 1 Background of the Project

1-1 Background

The Philippines has meager fossil fuel resources, however, the country depends approximately 65% of electricity source on fossil fuel (as of 2010, gross electricity capacity: 16,539MW, coal: 27%, oil: 20%, natural gas: 18%, hydropower: 21%, geothermal: 13%). In terms of energy security as well as reduction of greenhouse effect gas, domestic renewable energy is expected to substitute imported fossil fuel.

Currently total potential hydropower is estimated to be approximately 13,097MW. However, large-scale hydropower development requires vast initial investment as well as long-range collection period and this causes difficulties in funding and socio-environmental consideration especially in the Philippines where private initiative lead the deregulated power market sector. As a result, only approximately 25% (3,400MW) of total potential hydropower is utilized so far. Meanwhile, small-scale hydropower development have less impact on the country's whole energy balance, at the same time it causes fewer difficulties in such aspects. In addition, the country has rich small-scale (capacity less than or equal to 10MW) hydropower potential of approximately 1,900MW. Therefore, it is expected that the country aggressively develop small-scale hydropower

In October 2008, the Government of the Philippines enforced the Renewable Energy Act of 2008, R.A. 9513 (hereinafter referred to as the "RE Act") - the first comprehensive legislation on renewable energy in Southeast Asia. This Act has the objectives of improving the self-sufficiency of energy supply, strengthening the capacity of central and local governments via development of renewable energy, and balancing economic growth with environmental protection. Furthermore, the Government of the Philippines in June 2011 announced the National Renewable Energy Program with the goal of increasing the amount of power generated from renewable energy by three times (to approximately 16,200 MW) over the 2010 level by 2030.

Following enforcement of the RE Act, although hydropower development has become more active, the availability of appropriate technology for hydropower development has led to an indiscriminate rush of hydropower development by independent power producers (IPPs), including hurriedly established companies and foreign affiliates with no experience of hydropower development, without any overall planning. Accordingly, there is need to conduct appropriate development while giving full consideration to mitigation of environmental impacts on local communities and ecosystems, flood control in units of rivers, and securing of enough water for irrigation purposes and so on.

Ifugao Province, where the Project site is located, is famous for rice terraces which spread extensively over

mountain slopes and were registered as World Heritage by UNESCO in 1995. However, in recent years, the rice terraces have become devastated due to the impacts of globalization and the area was placed on the List of World Heritage in Danger[1] in 2001.

Although the responsibility for preserving the rice terraces of Ifugao has been transferred from the central government to the provincial government, hardly any financial support has been forthcoming and the provincial government must independently secure the funds required to preserve the rice terraces. Preservation of the rice terraces not only requires physical maintenance but can only be realized by guaranteeing the stable livelihoods of the residents who cultivate the land. According to the latest estimate by Ifugao Province, between 60~100 million yen is required to preserve the rice terraces every year, however, since this is equivalent to between 40~65% of the annual development budget of the province (approximately 155 million yen in 2009), it is virtually impossible for the provincial government to keep paying for maintenance of the rice terraces out of its development budget.
Furthermore, the main industry of Ifugao Province is agriculture centering on rice farming, however, due to the harsh cultivation conditions and low production levels, almost all of the rice harvest is used for private consumption and makes no contribution towards improving the provincial finances. Consequently, Ifugao Province must rely on external assistance in order to secure the funds required to preserve the rice terraces.

In these circumstances, the Provincial Government of Ifugao enacted the Mini Hydro Electric Power Plant Development Program Ordinance (Ordinance No. 2007-045) geared to expanding the provincial development budget, reducing power tariffs in the province and securing funds for preservation of the rice terraces in 2007 prior to enactment of the RE Act. Based on this, it has been promoting development of hydropower within the province.

Concerning international assistance for preservation of the Ifugao rice terraces, GSEP[2] (the former "e8," hereafter referred to as "e8" in this report) in January 2010 developed Ambangal mini hydropower plant (200 kW) and established the Rice Terraces Conservation Fund (RTCF) based on revenue from the sale of power generated by that plant; however, the funds generated by this program only account for roughly 10% of the amount required to preserve the rice terraces.

Against this background, the Philippine Department of Energy (DOE) requested the Government of Japan

[1] The site was removed from the list at the 36th Conference of the World Heritage Commission held in Russia in June 2012.

[2] Global Sustainable Electricity Partnership (the former "e8": An international NPO that is composed of 10 leading power companies from the G8 nations and has the objective of disseminating renewable energy. The Japanese representatives are Tokyo Electric Power Co. and Kansai Electric Power Co.).

to provide grant aid for construction of Likud mini hydropower generation plant with the goals of promoting regional electrification and preserving the rice terraces in Ifugao Province.

The Project will be conducted in accordance with the “Green Growth” policy by Government of Japan, which emphasizes on utilization of elaborated products, such as hydro turbines, fabricated by Japanese small, medium scale enterprise.

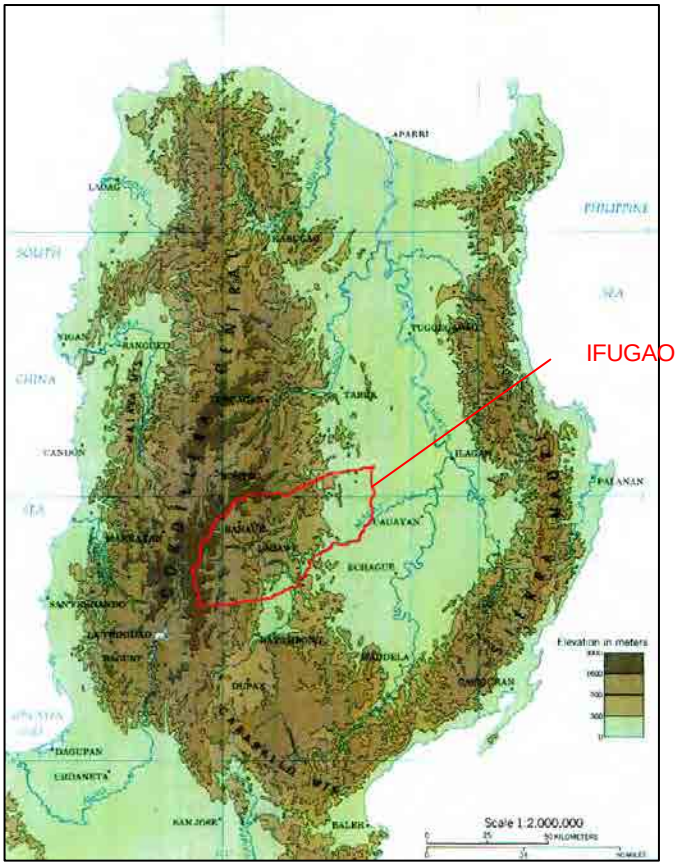
1-2 Natural Condition

1-2-1 Hydrological/Meteorological Characteristics around the Project Site

1-2-1-1 Topographical Characteristics

The topography of northern Luzon is shown in Fig. 1-1. Ifugao Province is located at the heart of northern Luzon. The western part of the province is dominated by a mountain range which forms part of the Cordillera Central. A series of 2,000 m Class Mountains run along the north-western provincial border while lowland with an elevation of around 300 m spreads in the eastern part of the province.

Many rivers in Ifugao Province originate in the western mountain ranges and flow into Magat River which is a tributary of Cagayan River, the largest river in northern Luzon. Rivers in the western part of the province generally have a steep gradient and the mean stream gradient is some 1 in 20. Such topography makes rivers in the western part of the province good candidates for the development of run-of-river type hydropower generation.

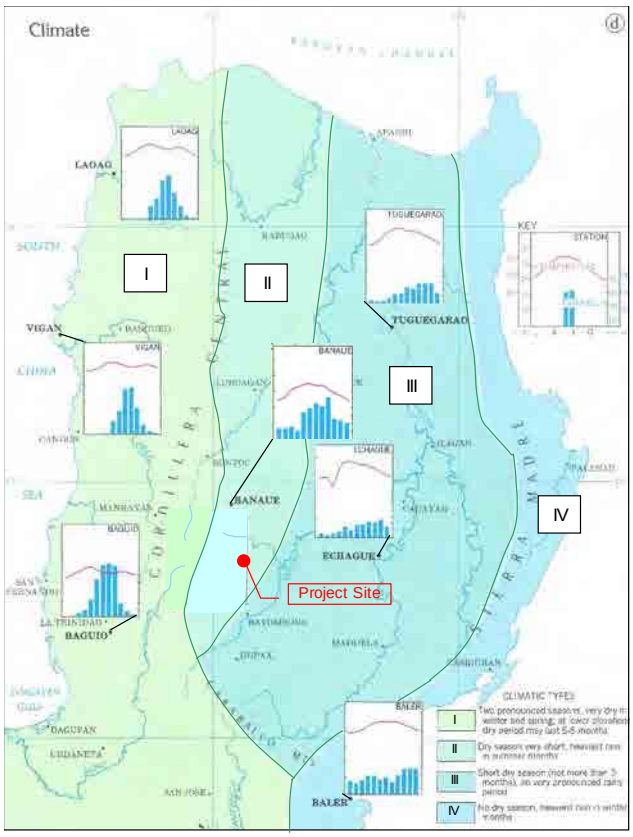


Source: Ethnographic Atlas of IFUGAO – Harold C. Conklin

Fig.1-1 Topographic Map of Northern Luzon

1-2-1-2 Meteorological Characteristics

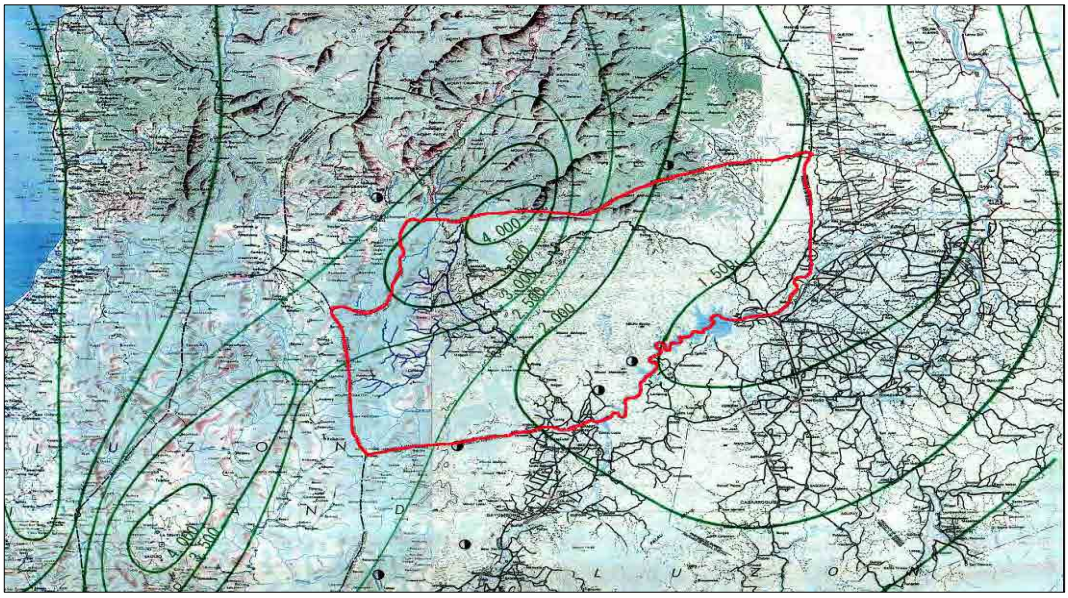
The meteorological characteristics of northern Luzon are shown in Fig. 1-2. The climate of the Philippines is largely classified into four types (Type I through Type IV) and all types are observed in northern Luzon. In the CAR, as the region is divided by the Cordillera Central, the local climate in the western part facing the South China Sea completely differs from the climate in the Cagayan catchment area facing the Pacific Ocean. Ifugao Province primarily belongs to the Type II and Type III zones. The western part of the province belongs to the Type II zone where there is no clear distinction between the dry season and the rainy season with a fair amount of rainfall recorded in the dry season. Meanwhile, the flat eastern lowland of the province belongs to Type III with a lower rainfall level than the western part.



Source: Ethnographic Atlas of IFUGAO – Harold C. Conklin

Fig. 1-2 Climate Classification in Northern Luzon

As shown in Fig. 1-3, the maximum annual rainfall is as high as some 4,000 mm in the western part of the province. The level of annual rainfall decreases towards the flat eastern lowland of the province where the figure is around 1,500 mm. In the western mountain range, the annual rainfall is generally around 3,000 mm and a fair amount of rainfall can be expected even in the dry season. The western part of the province is, therefore, suitable for run-of-river type power generation also from the viewpoint of the local climate.

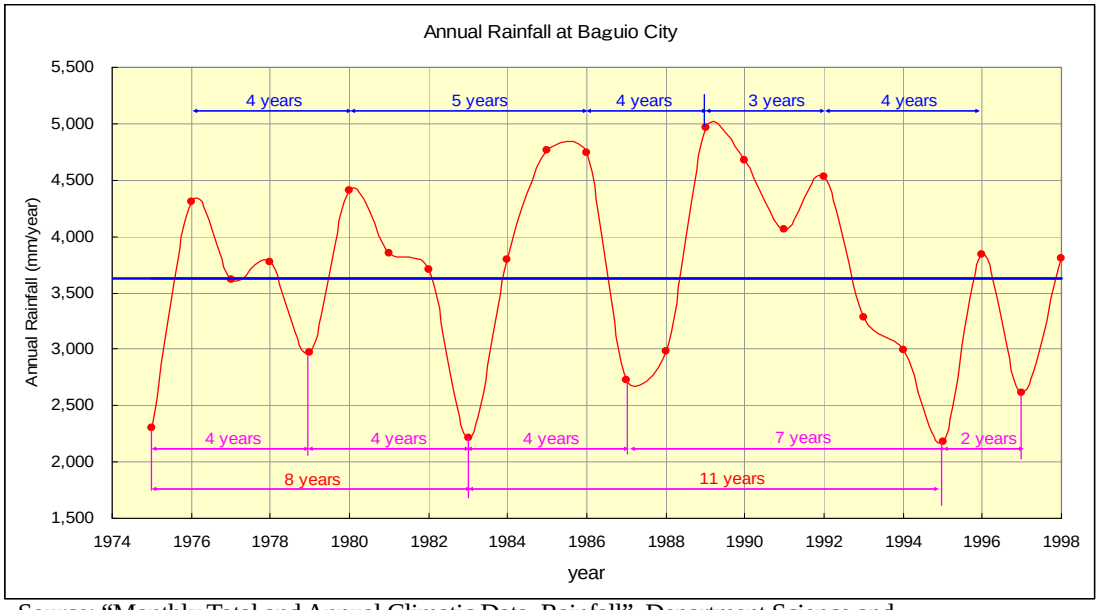


Source: Report for Study on Hydropower Potentials in Luzon Island, Main Report– JICA

Fig 1-3 Isotheral Map of Annual Rainfall

The planned Likud MHP site under the present study is located in the western part of the province and the local level of annual rainfall is 2,500 mm ~ 3,000 mm.

No long-term rainfall observation data exists for Ifugao Province. Fig. 1-4 shows the annual rainfall data for the city of Baguio in Benguet Province where the annual rainfall is understood to be similar to that of the western part of Ifugao Province where the project site is located. According to this data, the return period which are years from a dry year until next a dry year is some 4 ~ 5 years even though a severe drought occurs once every 8 ~ 11 years.



Source: "Monthly Total and Annual Climatic Data, Rainfall", Department Science and Technology PAGASA

Fig.1-4 Trend of Annual Rainfall in Baguio City, Benguet Province

1-2-1-3 Gauging Station near the Project Site

In the Philippines, the Department of Public Works and Highways (DPWH) and the National Water Resources Board (NWRB) conduct discharge observation even though many gauging stations were withdrawn in the early 1990's. In Ifugao Province, the Magat River Gauging Station used to be run by the NWRC. As the actual data from this station is quite old, covering the period from 1942 to 1967, and as the target catchment area was as large as 4,150 km^2, this data cannot be used for the planning of the Project with a catchment area of only 44.0 km^2.

Data which can be used for the Project is gauging data for Hapao River in the Hungduan Municipality (see Fig. 1-5) collected by the TEPSCO since November, 2003. The Hapao Gauging Station (GS) is situated some 18 km northwest of the project site and its catchment area of 45.0 km^2 is almost identical to the catchment area of 44.0 km^2 of the planned Likud MHP. Gauging operation at the Hapao GS was disrupted in 2010 as the staff gauge was damaged by flooding but operation resumed in February, 2011 with the repair of the staff gauge.

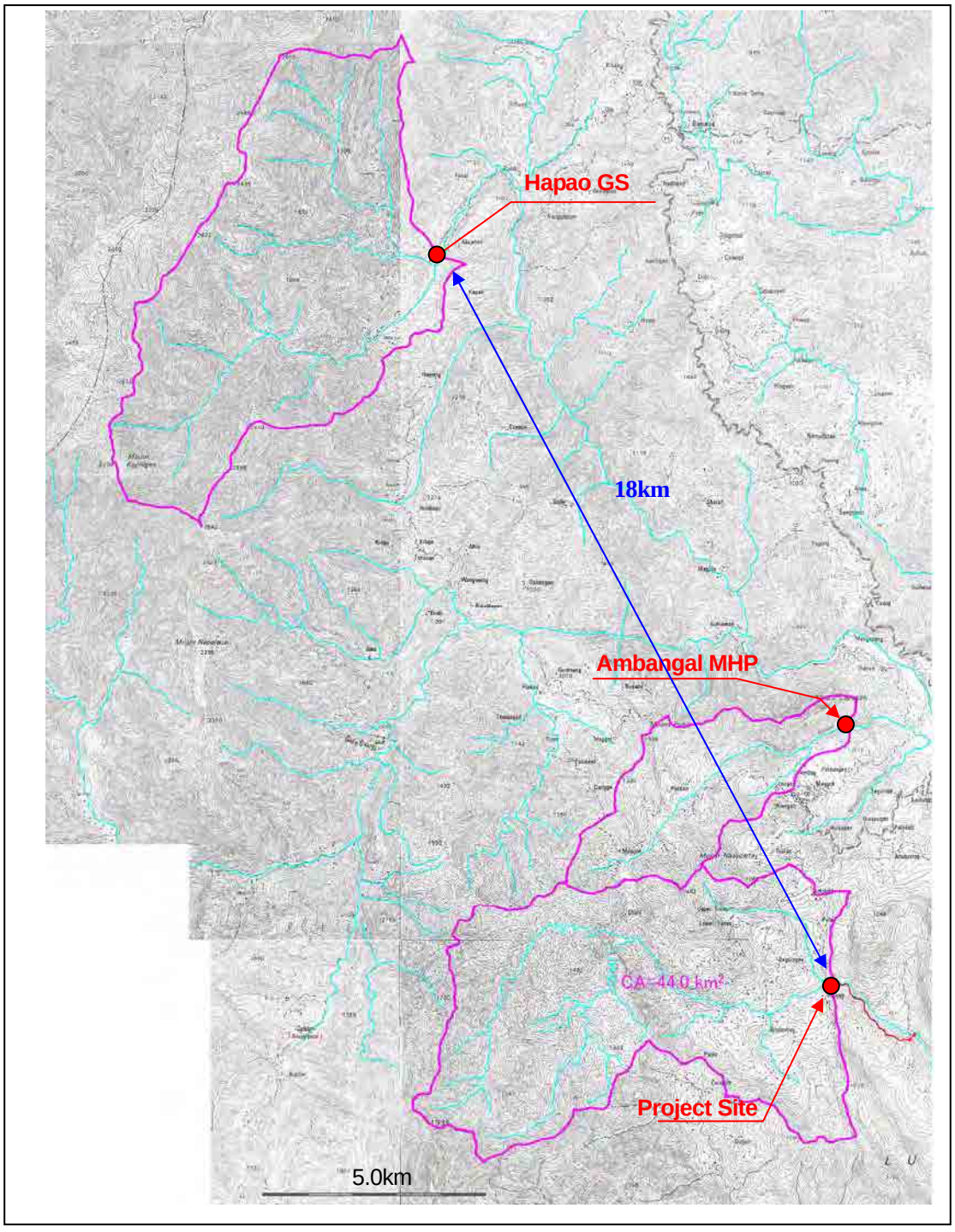


Fig.1-5 Location of Hapao Gauging Station

Observation records from the Hapao GS are shown in Fig. 1-6, Fig. 1-7 and Table 1-1.

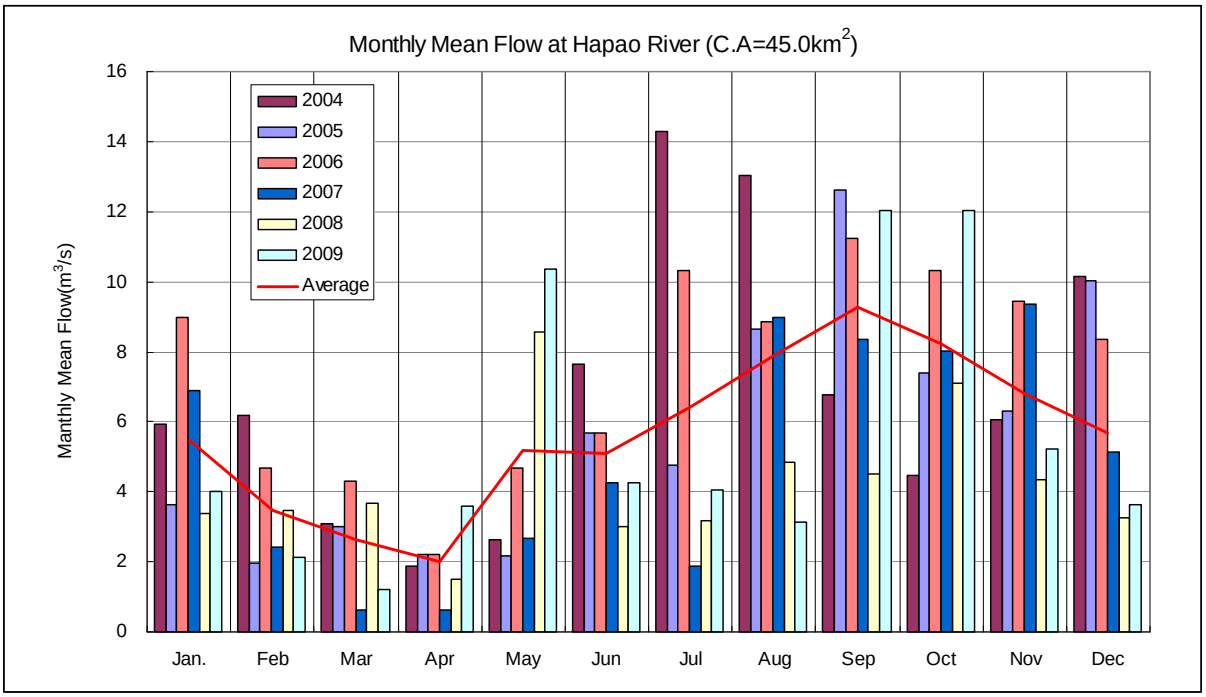
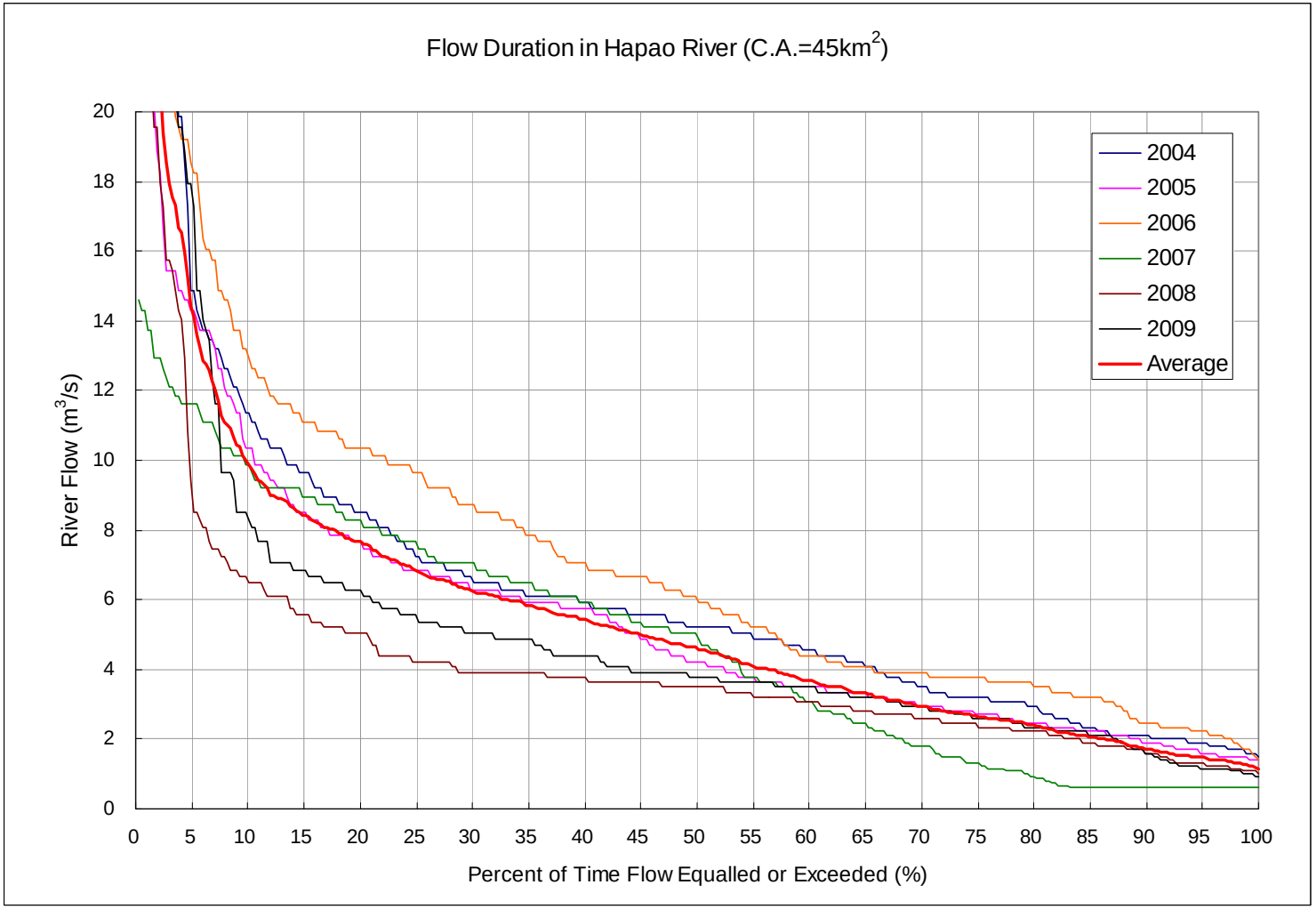


Fig.1-6 Monthly Mean River Flow at Hapao Gauging Station

Table 1-1 Monthly Mean River Flow at Hapao Gauging Station

Unit: m^3/s

Year	2004	2005	2006	2007	2008	2009	Average
Jan.	5.92	3.64	9.00	6.89	3.40	4.01	5.48
Feb	6.18	1.96	4.70	2.42	3.45	2.13	3.47
Mar	3.11	2.99	4.31	0.63	3.67	1.20	2.65
Apr	1.88	2.23	2.23	0.61	1.50	3.57	2.00
May	2.62	2.16	4.66	2.66	8.56	10.38	5.17
Jun	7.64	5.66	5.69	4.28	3.02	4.25	5.09
Jul	14.31	4.75	10.32	1.89	3.19	4.04	6.42
Aug	13.03	8.66	8.86	8.98	4.85	3.11	7.92
Sep	6.76	12.62	11.24	8.37	4.53	12.03	9.26
Oct	4.46	7.41	10.32	8.04	7.11	12.04	8.23
Nov	6.05	6.32	9.43	9.37	4.35	5.22	6.79
Dec	10.13	10.01	8.35	5.14	3.24	3.64	5.68
Average	6.84	5.70	7.43	4.94	4.24	5.47	5.68



Percentage (%)	River Flow (m^3/s)
1	33.08
5	14.45
10	9.99
20	7.69
30	6.25
40	5.46
50	4.58
60	3.68
70	2.95
80	2.40
85	2.07
90	1.71
95	1.47
100	1.15

Fig.1-7 Flow Duration Curve at Hapao Gauging Station

1-2-1-4 River Flow Measurement at the Project Site

(1) River Water Level Observation

In February, 2011, the Study Team installed a staff gauge on Lamut River, the target river of the Project, and the river water level is being measured on a daily basis.

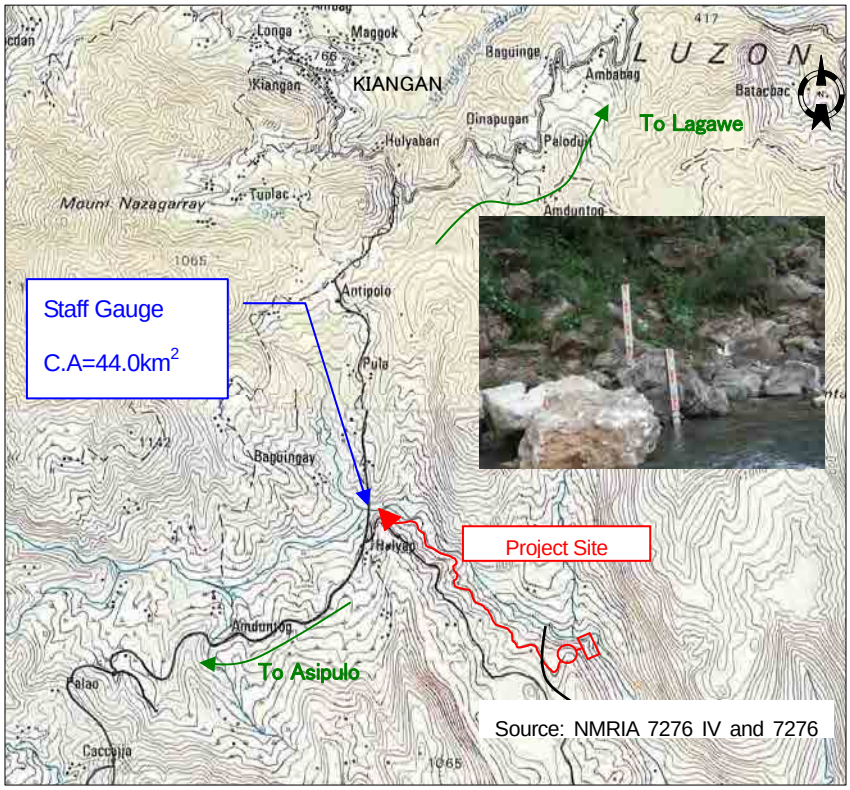


Fig.1-8 Location of Likud Gauging Station

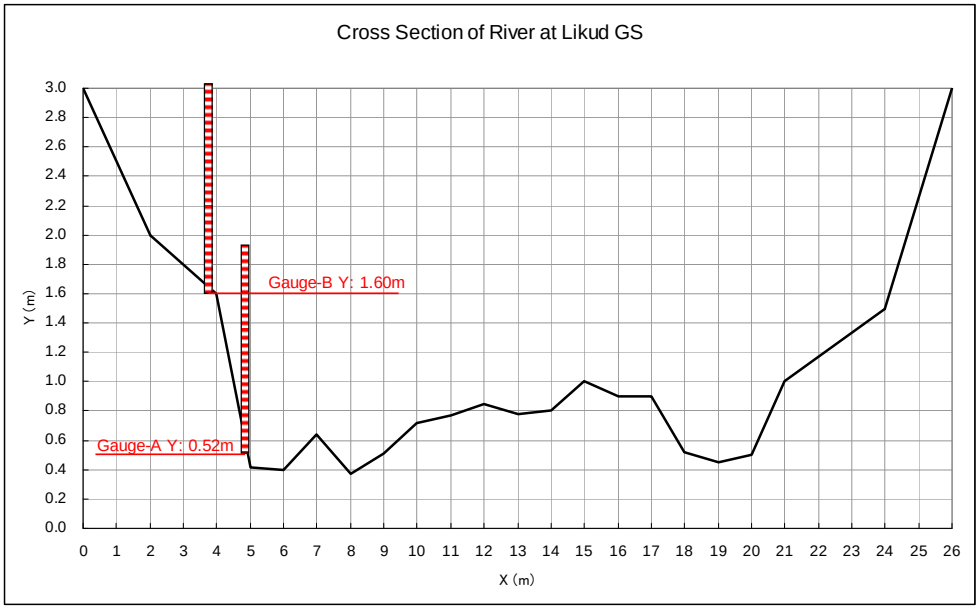
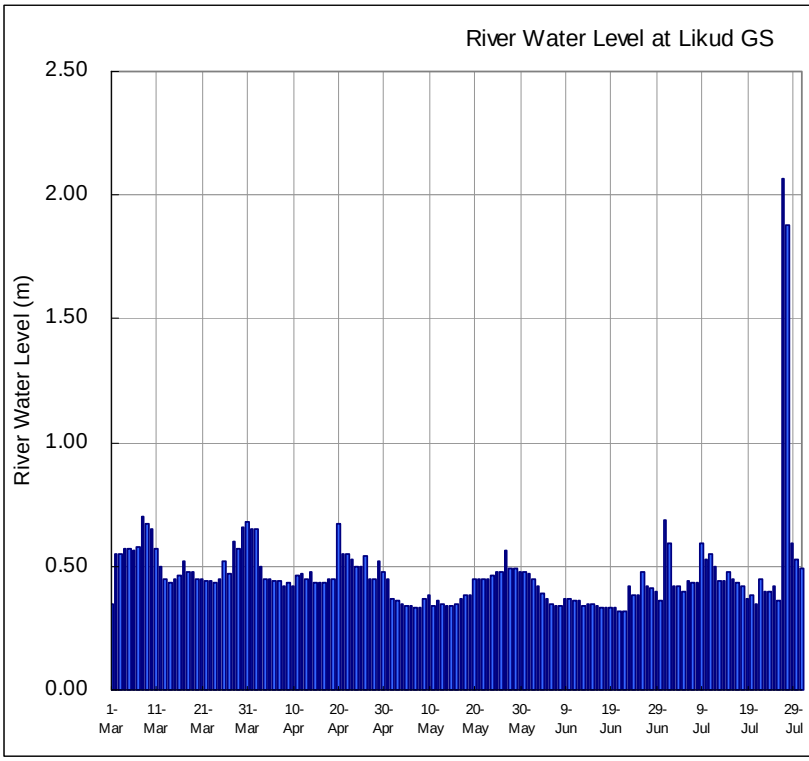


Fig.1-9 Cross Section of River at Likud GS

The river water level observation results up to the end of June at this site are shown in Fig. 1-10.



Date	Water Level (m)				
	March	April	May	June	July
1	0.35	0.65	0.45	0.47	0.69
2	0.55	0.65	0.37	0.45	0.59
3	0.55	0.50	0.36	0.42	0.42
4	0.57	0.45	0.35	0.39	0.42
5	0.57	0.45	0.34	0.37	0.40
6	0.56	0.44	0.34	0.35	0.44
7	0.58	0.44	0.33	0.34	0.43
8	0.70	0.42	0.33	0.34	0.43
9	0.67	0.43	0.37	0.37	0.59
10	0.65	0.42	0.38	0.37	0.53
11	0.57	0.46	0.34	0.36	0.55
12	0.50	0.47	0.36	0.36	0.50
13	0.45	0.45	0.35	0.34	0.44
14	0.43	0.48	0.34	0.35	0.44
15	0.45	0.43	0.34	0.35	0.48
16	0.46	0.43	0.35	0.34	0.45
17	0.52	0.43	0.37	0.33	0.43
18	0.48	0.45	0.38	0.33	0.42
19	0.48	0.45	0.38	0.33	0.37
20	0.45	0.67	0.45	0.33	0.38
21	0.45	0.55	0.45	0.32	0.35
22	0.44	0.55	0.45	0.32	0.45
23	0.44	0.53	0.45	0.42	0.40
24	0.43	0.50	0.46	0.38	0.40
25	0.45	0.50	0.48	0.38	0.42
26	0.52	0.54	0.48	0.48	0.36
27	0.47	0.45	0.56	0.42	2.07
28	0.60	0.45	0.49	0.41	1.88
29	0.57	0.52	0.49	0.40	0.59
30	0.66	0.48	0.48	0.36	0.53
31	0.68		0.48		0.49
Average					

Fig.1-10 River Water Level at Likud Gauging Station

(2) Flow Measurement and Rating Curve

The Study Team conducted flow measurement at Lamut River with a view to producing a H-Q rating curve.

Table 1-2 Results of Flow Measurement at Lamut River

Date	Reading of Staff Gauge (m)	Result of Flow Measurement (m^3/s)	Measuring Point (km^2)	River Flow at Intake site (m^3/s)
Apr.30,2011	0.38	1.738	Near GS (C.A=44km^2)	1.738
Jun.30,2011	0.42	2.152	Near GS (C.A=44km^2)	2.152
Jul.1,2011	0.50	4.298	Mappit Bridge (C.A=49km^2)	3.859

The H-Q rating curve produced based on the flow measurement results in shown in Fig. 1-11.

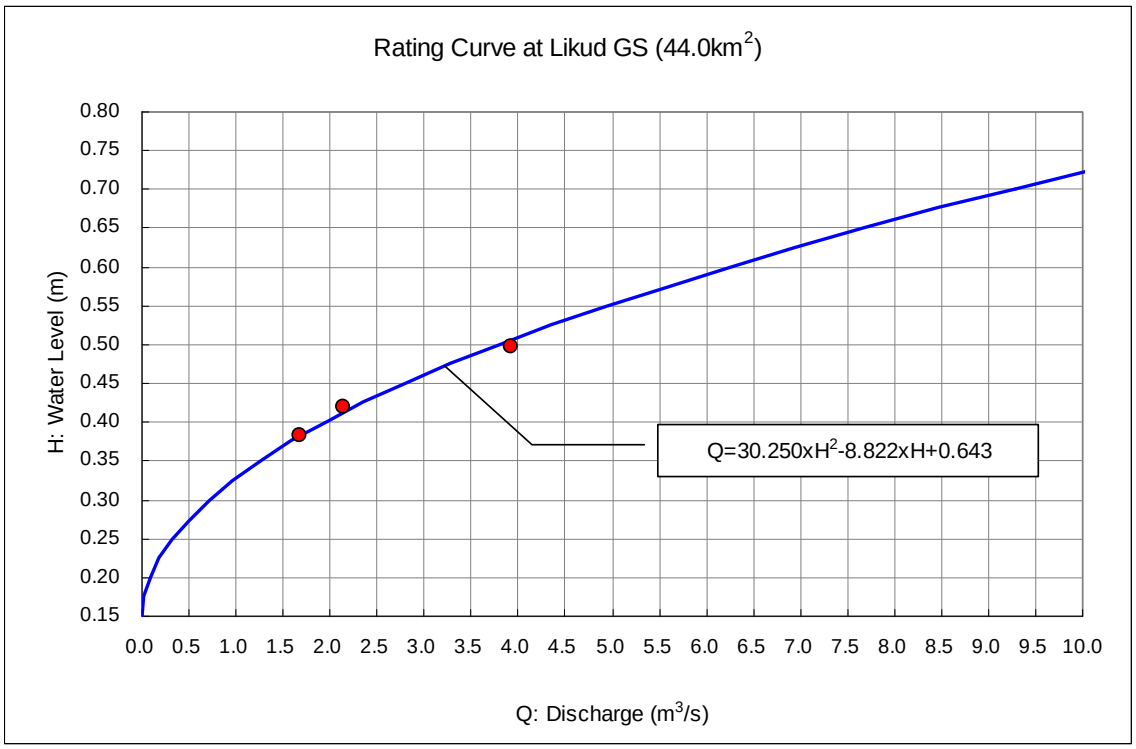


Fig.1-11 H-Q Rating Curve at Likud GS

(3) River Flow Rate at the Intake Site (March ~ June, 2011)

Using the H-Q rating curve (see Fig. 1-11), the river flow rate at the intake site during the observation period was calculated as shown in Table 1-3.

Table 1-3 River Flow Rate at Intake Site of Likud MHP

Date	Water Level (m)					River Flow Rate (m^3/s)				
	March,2011	April	May	June	July	March	April	May	June	July
1	0.35	0.65	0.45	0.47	0.69	1.261	7.689	2.799	3.179	8.958
2	0.55	0.65	0.37	0.45	0.59	4.942	7.689	1.520	2.799	5.968
3	0.55	0.50	0.36	0.42	0.42	4.942	3.795	1.387	2.274	2.274
4	0.57	0.45	0.35	0.39	0.42	5.443	2.799	1.261	1.803	2.274
5	0.57	0.45	0.34	0.37	0.40	5.443	2.799	1.140	1.520	1.954
6	0.56	0.44	0.34	0.35	0.44	5.189	2.618	1.140	1.261	2.618
7	0.58	0.44	0.33	0.34	0.43	5.702	2.618	1.026	1.140	2.443
8	0.70	0.42	0.33	0.34	0.43	9.290	2.274	1.026	1.140	2.443
9	0.67	0.43	0.37	0.37	0.59	8.311	2.443	1.520	1.520	5.968
10	0.65	0.42	0.38	0.37	0.53	7.689	2.274	1.659	1.520	4.465
11	0.57	0.46	0.34	0.36	0.55	5.443	2.986	1.140	1.387	4.942
12	0.50	0.47	0.36	0.36	0.50	3.795	3.179	1.387	1.387	3.795
13	0.45	0.45	0.35	0.34	0.44	2.799	2.799	1.261	1.140	2.618
14	0.43	0.48	0.34	0.35	0.44	2.443	3.378	1.140	1.261	2.618
15	0.45	0.43	0.34	0.35	0.48	2.799	2.443	1.140	1.261	3.378
16	0.46	0.43	0.35	0.34	0.45	2.986	2.443	1.261	1.140	2.799
17	0.52	0.43	0.37	0.33	0.43	4.235	2.443	1.520	1.026	2.443
18	0.48	0.45	0.38	0.33	0.42	3.378	2.799	1.659	1.026	2.274
19	0.48	0.45	0.38	0.33	0.37	3.378	2.799	1.659	1.026	1.520
20	0.45	0.67	0.45	0.33	0.38	2.799	8.311	2.799	1.026	1.659
21	0.45	0.55	0.45	0.32	0.35	2.799	4.942	2.799	0.918	1.261
22	0.44	0.55	0.45	0.32	0.45	2.618	4.942	2.799	0.918	2.799
23	0.44	0.53	0.45	0.42	0.40	2.618	4.465	2.799	2.274	1.954
24	0.43	0.50	0.46	0.38	0.40	2.443	3.795	2.986	1.659	1.954
25	0.45	0.50	0.48	0.38	0.42	2.799	3.795	3.378	1.659	2.274
26	0.52	0.54	0.48	0.48	0.36	4.235	4.700	3.378	3.378	1.387
27	0.47	0.45	0.56	0.42	2.07	3.179	2.799	5.189	2.274	112.000
28	0.60	0.45	0.49	0.41	1.88	6.240	2.799	3.583	2.111	90.973
29	0.57	0.52	0.49	0.40	0.59	5.443	4.235	3.583	1.954	5.968
30	0.66	0.48	0.48	0.36	0.53	7.997	3.378	3.378	1.387	4.465
31	0.68		0.48		0.49	8.632		3.378		3.583
Average						4.557	3.681	2.151	1.612	9.549

1-2-1-5 Usable River Flow Rate for Power Generation

(1) Existing Gauging Station with Valid Data for the Project

In general, a hydropower generation project involving a run-of-river type power plant must be implemented based on long-term river flow rate measurement data.[3] The reality is that it is often difficult to obtain such data at the feasibility study stage, making it necessary to estimate the river flow rate for a project based on corresponding data provided by an existing gauging station if such a station with long-term observation data exists near the project site.

In this case, however, the following condition must be met regarding the catchment area of the existing gauging station (Aexi) and catchment area of the project site (Apro).

$$Aexi = 0.5 \sim 2.0 \times Apro$$

For the Likud MHP project, the Hapao GS with a catchment area of 45 km^2 is the only gauging station which meets the above condition. Because of this, it is decided to estimate the river flow rate at the project site using data recorded at the Hapao GS.

(2) Estimation of River Flow Rate at the Project Site Using Data Recorded by the Hapao GS

The river flow rate can be affected by a number of factors, including the climatic type, catchment area, vegetation, topology, geology and rainfall, and it is not easy to quantify the impacts of vegetation, topology and geology. Therefore, the common practice for the planning of a run-of-river type hydropower plant is to estimate the river flow rate by comparing areas of an identical climatic type[4] while taking their differences in terms of the catchment area and rainfall into consideration.

1) Conversion Rate for Catchment Area

Given the respective sizes of the catchment area of the Hapao GS and the project site, the conversion rate for area (CR-A) is calculated to be 0.978 as shown below.

- ✧ Catchment area of the Hapao GS : 45.0 km^2
- ✧ Catchment area of the intake site of the Project : 44.0 km^2
- ✧ CR-A : 44.0/45.0 = 0.978

[3] Ideally, a minimum period covering the return period for a large-scale drought (approximately 10 years; see Fig. 5-3) is required.

[4] Both the Hapao GS and the project site have a Type II climate.

2) Conversion Rate for Rainfall

There is no recent rainfall observation data for the project site or a nearby area. The only available data is an isohyetal map covering a much wider area based on observation data in the 1980's (see Fig. 1-12).

Fig. 1-13 is an isohyetal map of the area around the project site based on the above map, producing the following annual rainfall for the Hapao GS and the project site.

- ✧ Annual precipitation at the Hapao GS : 3,671 mm
- ✧ Annual precipitation at the project site : 2,575 mm

The relationship between the level of rainfall (R) and the level of run-off (q) is also expressed by the following equation.

$$q = R - loss$$

Here, loss means the amount of precipitation lost due to evaporation and infiltration into the ground and the actual amount varies depending on the temperature, vegetation and geology of the catchment area. In general, it is understood to be some 500 ~ 1,000 mm a year.

For the present Study, the annual precipitation loss is calculated as shown in Table 5-4 based on the relationship between the annual total rainfall and the annual total runoff for the Hapao GS.

While the calculated annual precipitation loss of 452 mm is smaller than the generally accepted theoretical figure, this calculated figure is adopted for the project site due to the following reasons.

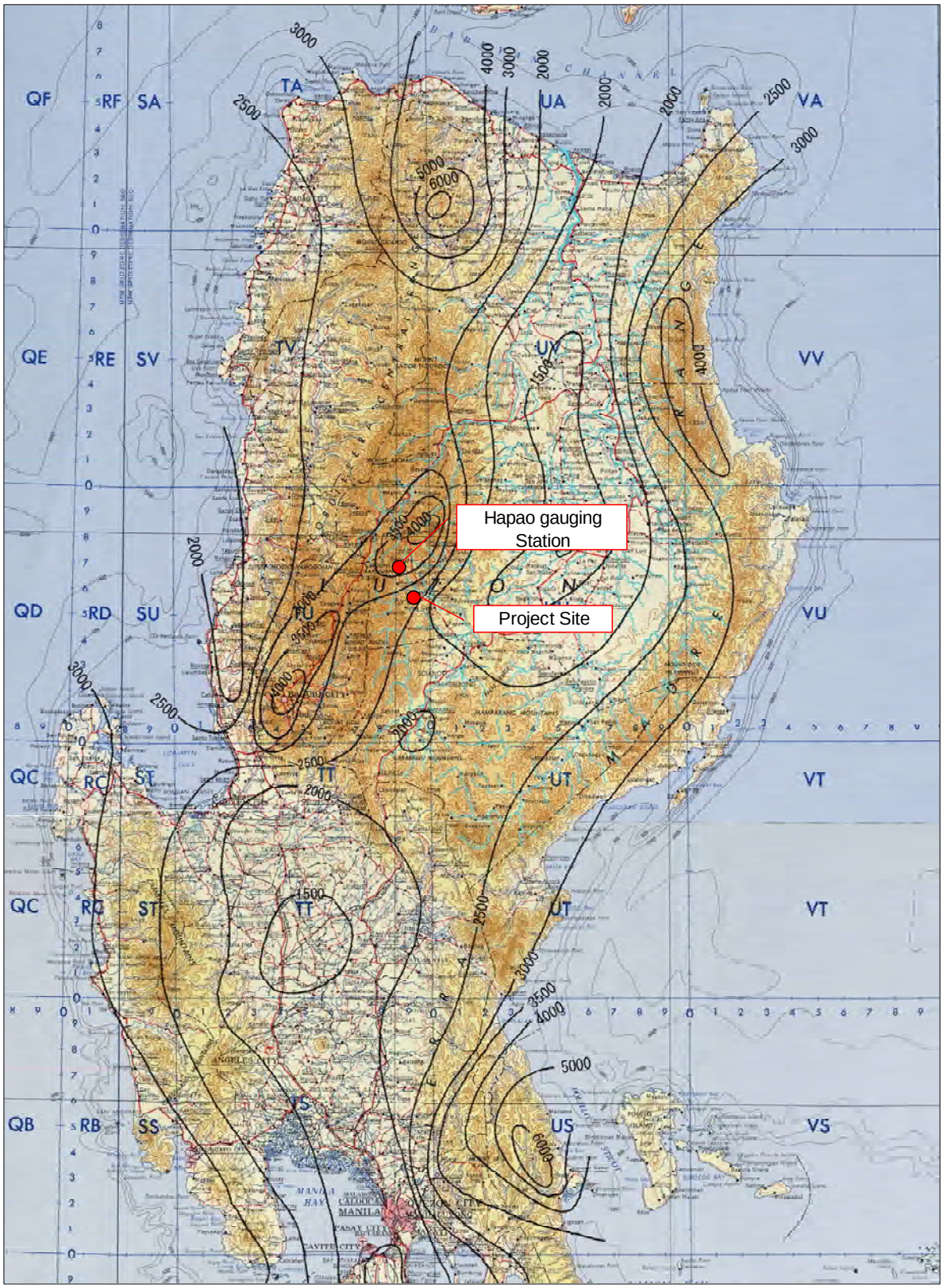
- ✧ The observation period for rainfall is not identical to the observation period for runoff.
- ✧ As the rainfall data covers a huge area, it is not very accurate for its use as rainfall data for a small area.

Based on the above, the annual effective rainfall (annual total rainfall – annual precipitation loss) is 3,219 mm for the Hapao GS and 2,123 mm for the project site as shown in Table 1-5 and the ratio between these two figures (2,123 ÷ 2,219 = 0.660) is used as the conversion rate for rainfall (CR-R).

3) Comprehensive Conversion Rate (CCR) from the Hapao GS to the Project Site

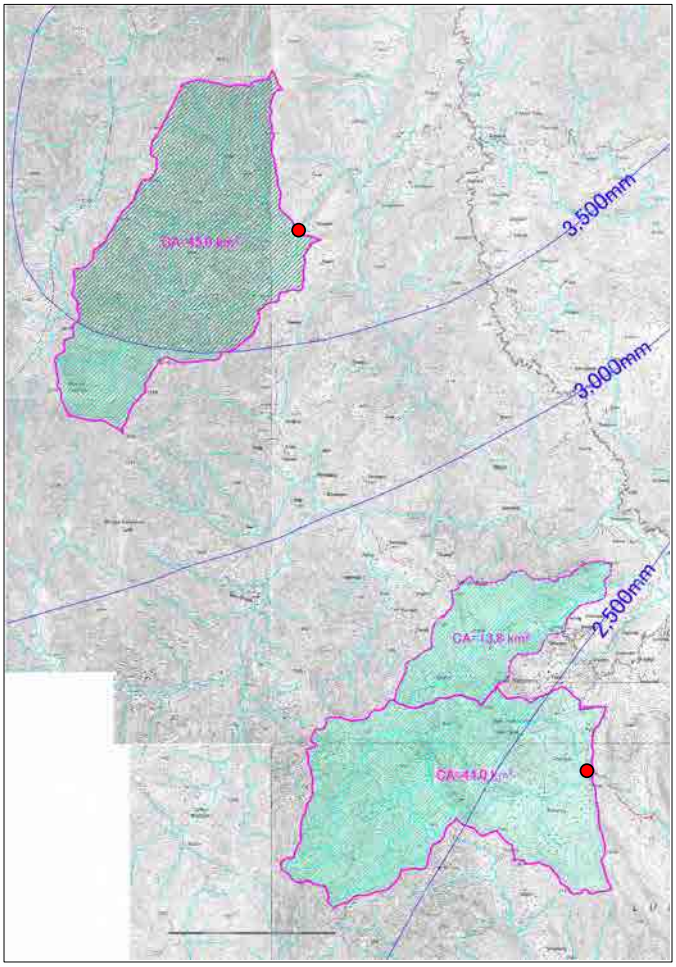
The comprehensive conversion rate (CCR) for data recorded at the Hapao GS to be applied to the project site is 0.645 based on the above exercises.

$CCR = (CR - a) \times (CR - R) = 0.978 \times 0.660 = 0.645$



Source: Hydro-Potential Study in Northern Luzon, JICA; Aug.1987

Fig.1-12 Isotheral Map in Northern Luzon



Source: Hydro-Potential Study in Northern Luzon, JICA; Aug.1987

Fig.1-13 Isotheral Map at the Project Site

Table 1-4 Calculation of Annual Precipitation Loss at the Project Site

Items		Unit	Value	Remarks
Annual Total Rainfall	R	mm/year	3,671	
Annual Mean River Flow	Qave	m^3/s	5.744	
Base Flow	Qbase	m^3/s	1.150	100% Discharge
Annual Total Runoff	q	mm/year	3,219	
Annual Precipitation Loss		mm/year	452	R-q

Note : q =3.6 x (Qave-Qbase) x 24 x 365/Cathment Area = 700.8 x (Qave-Qbase)

Table 1-5 Conversion Rate on Rainfall

Items	Unit	Hapao GS	Project Site	Remarks
Annual Total Rainfall	mm/year	3,671	2,575	
Annual Precipitation Loss	mm/year	452	452	
Annual Effective Rainfall	mm/year	3,129	2,123	
Conversion Rate on Rainfall (CR-R)	–	0.660		Hapao to Project Site

(3) Verification of the Suitability of the CCR

The flow duration at the Hapao GS is compared with that at the Likud GS for the period from March to June, 2011 as shown in Fig. 1-14 as the corresponding data is available for both GSs. As shown in this figure, in the low river flow range (approximately 5.0 m^3/sec or lower), the discharge at the Likud GS is similar to that at the Hapao GS. In contrast, in the high river flow range, the river flow at the Likud GS is approximately half of that at the Hapao GS. This discrepancy presumably occurs due to the wider distribution of limestone around the Likud GS.[5]

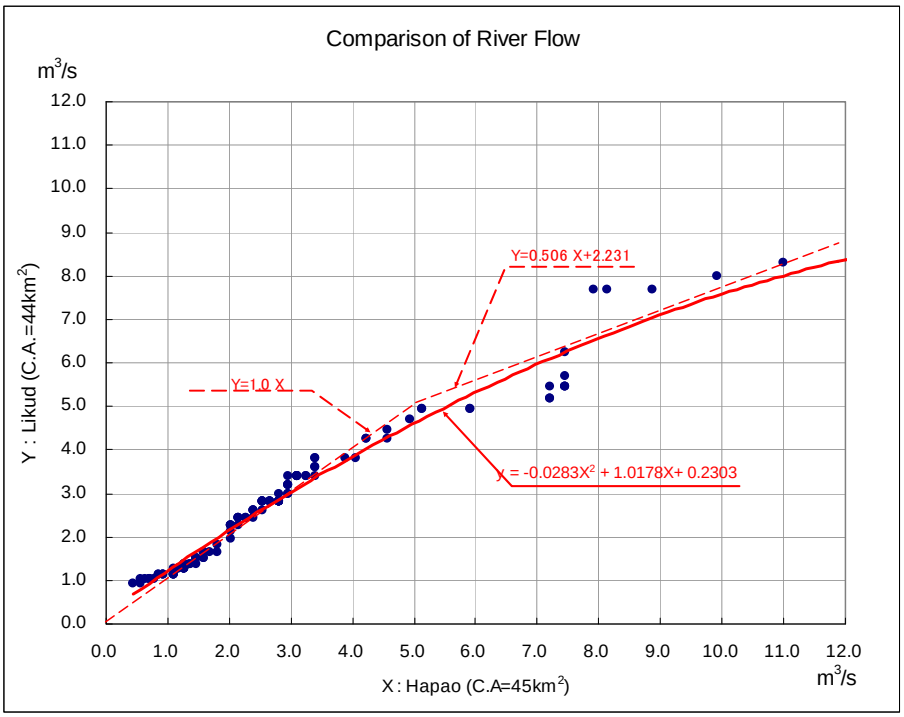


Fig.1-14 Comparison of Flow Duration between Likud GS and Hapao GS

If the data in Fig. 1-14 is correct, the converted river flow using the CCR (in the present case: 0.645) is under-estimated within the low river flow range as in the case of a run-of-river power generation system.

Nevertheless, the risk of over-estimating the power generation potential cannot be denied when the conversion of the river flow is based on the relationship shown in Fig. 1-14. This argument is supported by two facts: ① the observation period of six years at the Hapao GS does not totally cover the return period for a severe drought (8 ~ 11 years) shown in Fig. 1-4 and ② the overlapping period of observation at the two GS sites is as short as approximately four months.

[5] In general, an area of limestone has a high level of groundwater flow. When a fountain point(s) is located in the upstream of an observation point, the level of river flow in the dry season tends to be higher than other areas without much limestone. Conversely, the level of river flow in the wet season tends to be lower than areas without much limestone.

Accordingly, it is decided to use a CCR of 0.645 which offers a conservative power generation potential for the river flow conversion from the Hapao GS data.

(4) Estimation of Flow Duration at the Project Site

Fig. 1-15 shows the estimation results for the flow duration at the project site based on the river flow observation results at the Hapao GS from 2004 to 2009. For this estimation, the CCR referred to in (4) above is used. Fig. 1-15 carries both the series method-based flow duration curve where the six year period from 2004 to 2009 is considered to constitute a single period and the parallel method-based flow duration curve where each year is considered to constitute an independent period. The former is employed for the Project as it gives a more conservative power generation potential.

(5) Available Flow for Power Generation

For any hydropower generation project, it is impossible to use the entire river flow for power generation. In the Philippines, the priority for river water usage is given to irrigation and domestic use (here, the river flow required for such usage is generally called the "river maintenance flow") over power generation. Because of this, it is essential to deduct this river maintenance flow from the actual river flow in a hydropower generation project.

According to the rule set by the NWRB (NWRB Board Res. No. 01-0901), 10% of the flow with an 85% probability of exceedance must be discharged as the river maintenance flow.

For the Project, it has been decided to deduct a river flow of 0.136 m^3/sec (10% of 1.36 m^3/sec) in compliance with this rule.

In addition, some of the existing irrigation water intake weirs will be strengthened and used in the Project, however, parts of the irrigation channel system have lost their functions after being washed away in floods. Since the local citizens voiced a strong desire for the rehabilitation of the irrigation equipment in the field survey, the said work would have negligible impact on the Project, and the said rehabilitation work is relatively simple, it has been decided to add this to the Project activity.

In addition to the irrigation facilities targeted for rehabilitation (supply area: 2.43 ha, A and B in Fig. 1-16), there are three irrigation facilities in the vicinity of the Project, and these are used to supply water on both the left and right sides of the river (supply area: 4.96 ha, C~E in Fig. 1-16). The water supply to the three irrigation districts in the downstream is 2.0 liter/s/hectare (National Irrigation Authority regulations) or approximately 10 liters/s. This will be included in the above river maintenance flow (0.136m^3/s) and will be

discharged via the discharge valve installed in the grit chamber. The water supply flow of the irrigation facilities targeted for rehabilitation is estimated as 10 liters/second, however, since a reduced flow section arises, this will need to be separately deducted without inclusion in the river maintenance flow.

Accordingly, the water flow that can be used for power generation has been set upon deducting 0.146m^3/s from the flow regime indicated in Fig. 1-15.

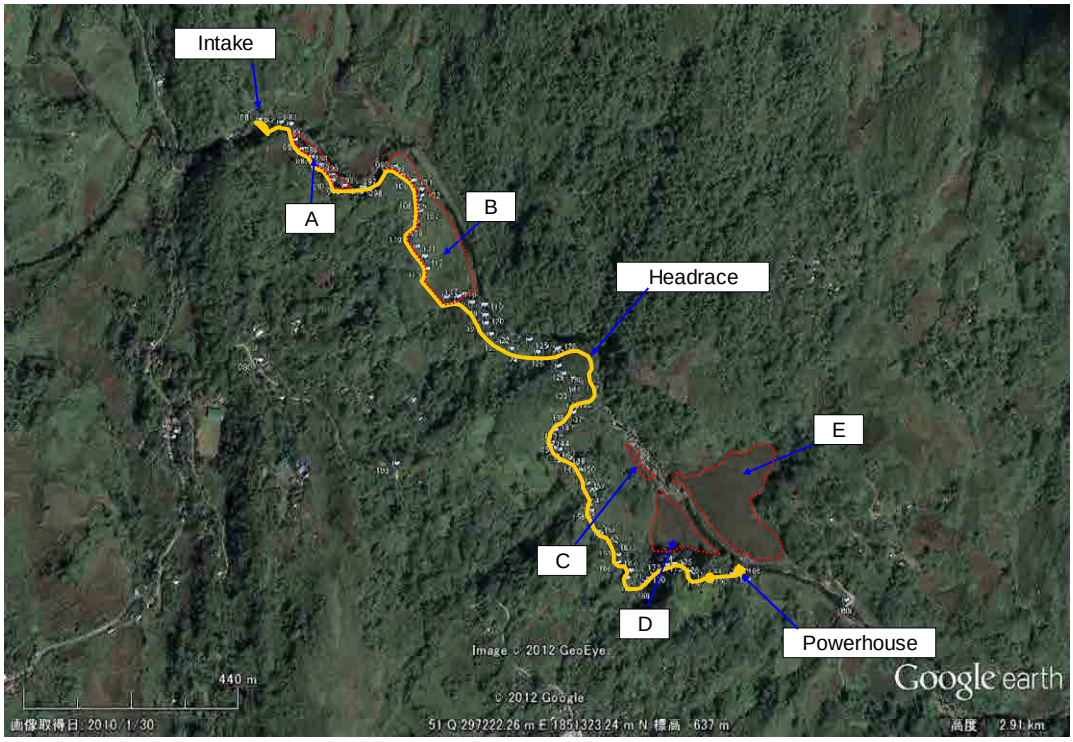
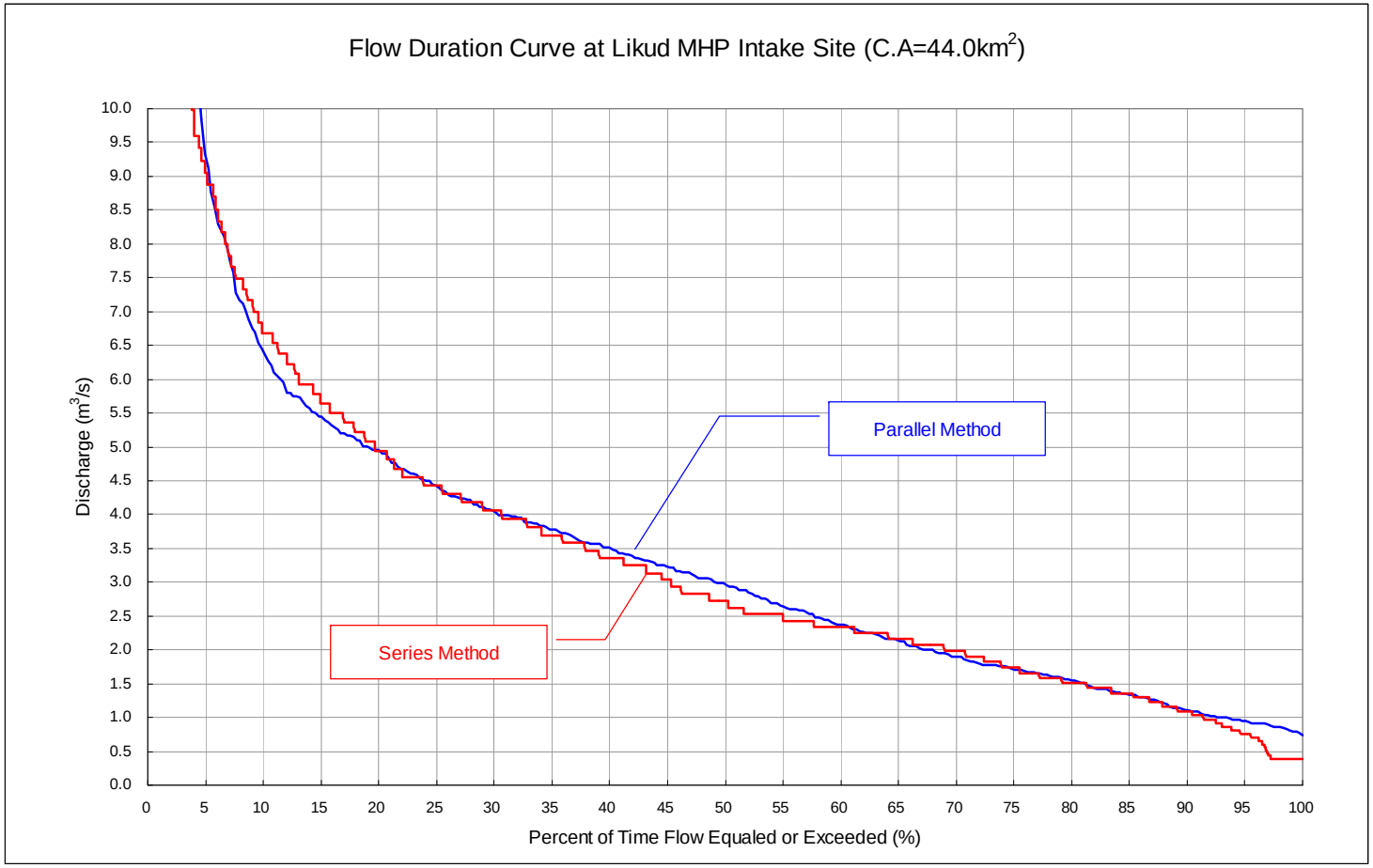


Fig.1-16 Irrigated Area around the Project Site



Percentage (%)	River Flow (m^3/s)
1	20.67
5	9.05
10	6.69
20	4.94
30	4.05
40	3.36
50	2.72
60	2.34
70	1.99
80	1.51
85	1.36
90	1.10
95	0.75
100	0.39

Fig.1-15 Flow duration Curve of The Project Site

1-2-2 General view of Topography and Geology

The Philippines belongs to the geological mountain-forming zone called the circum -Pacific organic zone same as Japan and has the complicated topographically, geologically because it is sandwiched in between Pacific plate and Eurasian plate and continue getting compression by them. Fig.1-17 shows earth's crust of Luzon schematically which the project belongs. The Likud site is at the green colored point in the Figure which is in central Coldirella mountain range.

Geologic quadrangles (scale 1:50,000) such as Cabatuan, Cordon and Aritao are generally issued surrounding the project site, and the site is pointed in a green circle on Fig.1-18.

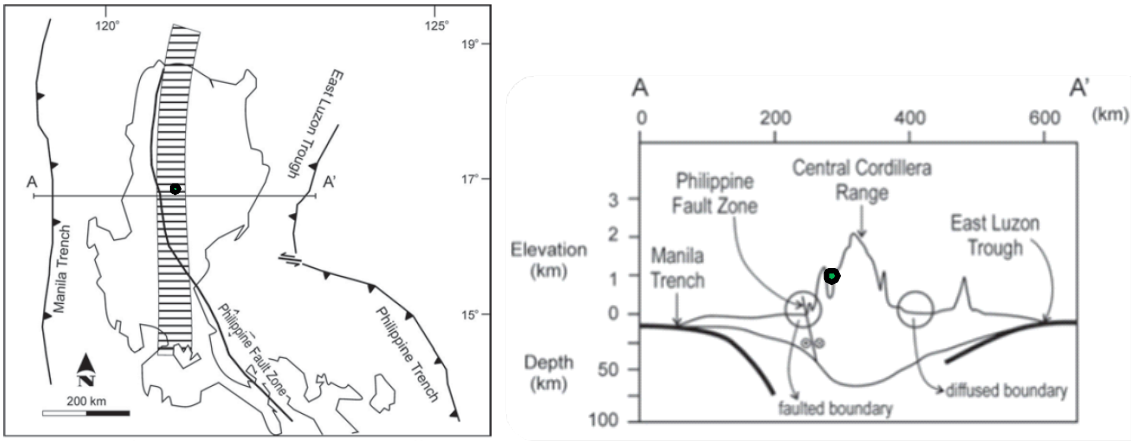


Fig.1-17 Tectonics of the Luzon and schematic profile of W-E direction

（ C.B.Dimalanta and G.P.Yumul,Jr., 2004 ）

(1) Natural environment surrounding the major structures of Likud scheme

The waterway route between intake and powerhouse is designed at a 1/500 gradient along the right bank gentle mountain side of the Lamut River.

Lands along the waterway route is used for cropland except forests which is unsuitable for cultivation such as barren land that steep and covered by boulders. Farmers in this region grow staple food crops, such as sweet potatoes, corn and rice.

Wide-spread colluvial footslope behind Barangay Haliap is noticeable (Photo1-1). It covers the slope between the table land and the north-western mountain ridge, and is expected those stones had been came off from the ridge and accumulated on the slope. Since they are easily removable the villagers have been collecting the rocks for selling. These stone pebbles are widely used for roadbed material because of its physical characteristics for hardness (Photo 1-2).

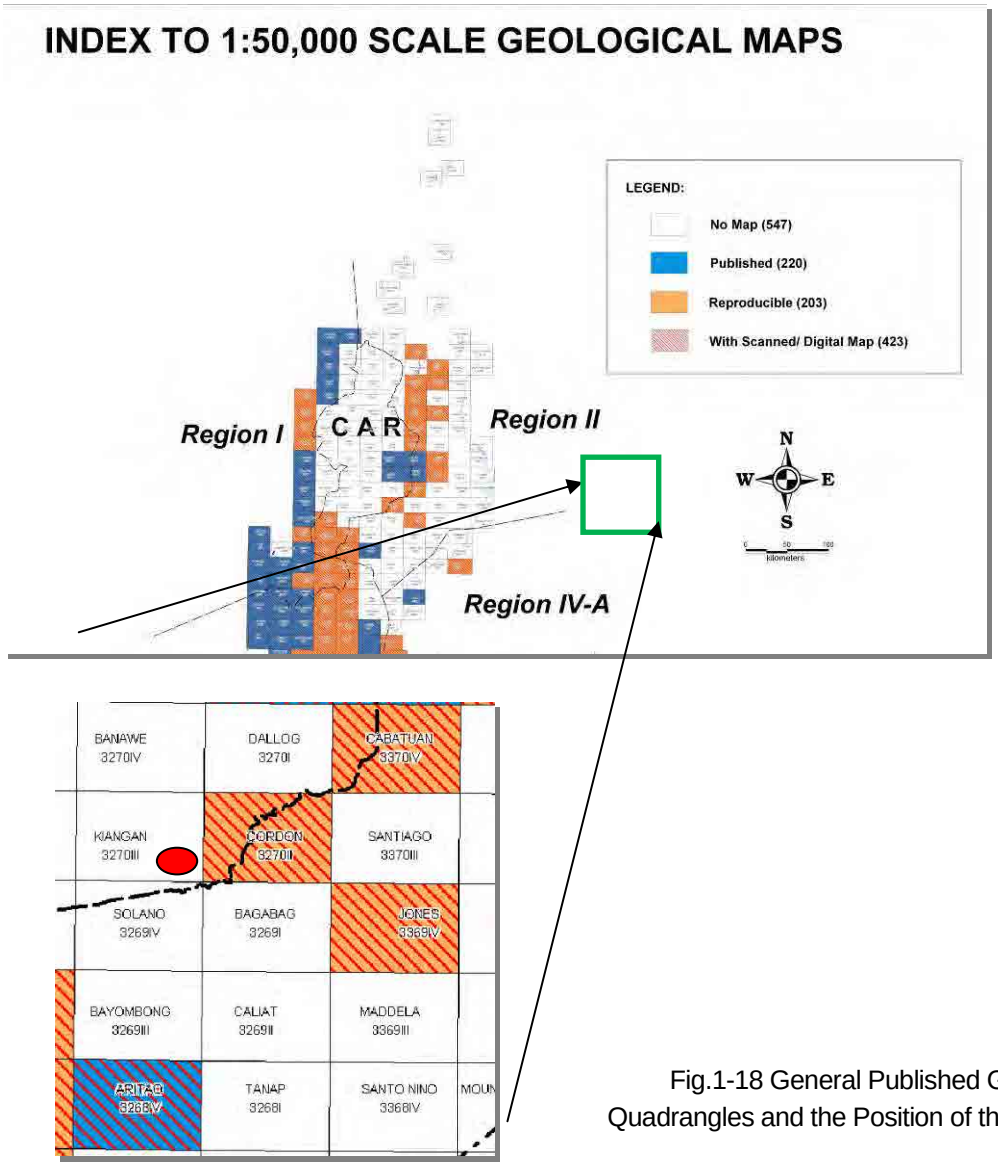


Fig.1-18 General Published Geologic Quadrangles and the Position of the Project Site

Photo 1-1
Colluvial footslope behind Barangay Haliap

Photo 1-2
widely used Limestone pebbles for roadbed material because of its physical characteristics

As mentioned above colluvium and collapsed slopes are common, and Lamut River erodes at many places in this project area natural environmental should be surveyed with referring these natural phenomenons. Accordingly, topographical and geological wide range reconnaissance is necessary, and the results should be applied to the project site. Furthermore, hydro-geological characteristics were examined observing river and spring water to grasp the water quality. The characteristics of the measured water are shown in Table1-6.

The pH value varies from 6.7 to 7.1, and are near-neutral. On the other hand, EC (Electrical Conductivity) values of most mountain streams are extremely higher than Lamut River's it. These values of mountain streams mean there may contain some electrolytic substances. Even EC shows high value the water has sufficient quality for concrete mixing and stabile for the constructed structures because the pH is almost neutral.

Table 1-6 The Characteristics of the Water Surrounding Likud Scheme

place	No.	pH	EC (mS/m)	Temp (℃)	date
left bank mountain stream	Likud-1	6.9	39.6	23.1	20 Aug. '12
mountain stream North of Village	Likud-2	6.8	36.1	27.3	
mountain stream near peg 1+372	Likud-3	6.7	58.0	23.7	21 Aug. '12
mountain stream near peg 1+150	Likud-4	6.9	58.6	23.2	
Likud river near the eroded cliff	Likud-5	7.1	25.2	24.3	22 Aug. '12
srring water	Likud-6	6.4	70.1	23.8	
tap water of Banaue Hotel		7.0	9.0	20.8	

(2) Geological view of surrounding the Likud scheme

In many cases, top of the mountain ridge of the project area are consist of limestone and the others are alternation of sandstone and mudstone. The occurrences of their boundary are not detected in the schemed area, but the boundary of limestone and older sedimentary rocks is confirmed at the right bank of Lamut river at the halfway point between Lagawe and the Likud site. Limestone is in the upper strata with conformity condition (refer Photo 1-3 and Photo 1-4) . The result was reflected to make the geologic map of the project area.

Photo 1-3
A gorge which is north of the site –viewed from E to W. Geology of the cliff is limestone, which massive upper half and banded lower half.

Photo 1-4
An outcrop which contributed to determine the boundary condition of limestone and older sedimentary rocks. They come in contact with conformity condition.

The geology through the waterway of the Likud site is alternation of sandstone and mudstone except the half way point of the route which consist of limestone (refer Fig.1-19). The limestone is mere a local rock mass but is presumed oldest strata of this area since it is recognized beneath the sedimentary rocks. On the other hand, the limestone on the mountain ridge is the youngest.

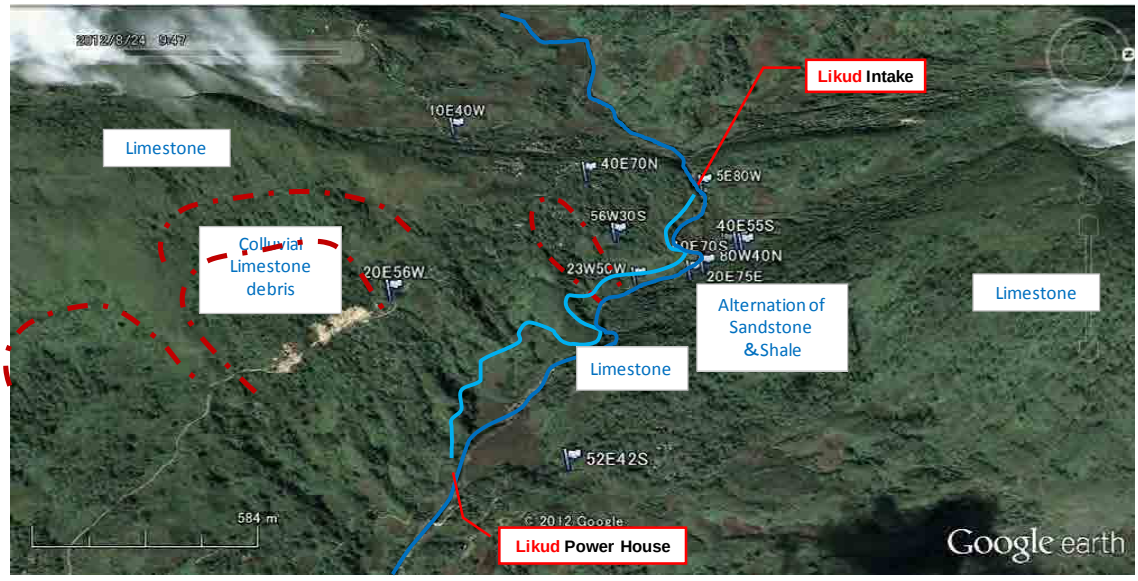


Fig 1-19 Bird's Eye View of whole Likud Scheme Area and Illustration of Geology

Strike-line map of the sedimentary rocks such as mudstone and alternation of mudstone and sandstone is illustrated on the Google Earth map in Fig.1-20. The arrows on the map shows dip directions which were observed at the outcrop along the Lamut River side and hillside. The colors of the strike line of thick lines on the figure are light blue; mudstone, and green; alternation of mudstone and sandstone. Dotted lines were inferred strike-line based on the actual surveyed strikes. On the figure, solid lines are actually measured

strike direction of the bedding plane, and dashed faint lines are adjusted imaginary lines based on the afore-said strikes. The figure indicates bedding planes along the waterway route incline to SW which strata comes in on the right bank hillside, and an anticlinal axis plunging to S is surrounding the powerhouse. By contrast, the strata in the upstream from the intake site incline to SE, and it turns to syncline plunging to S.

General geologic profile across the Likud river is shown on Fig.1-21.

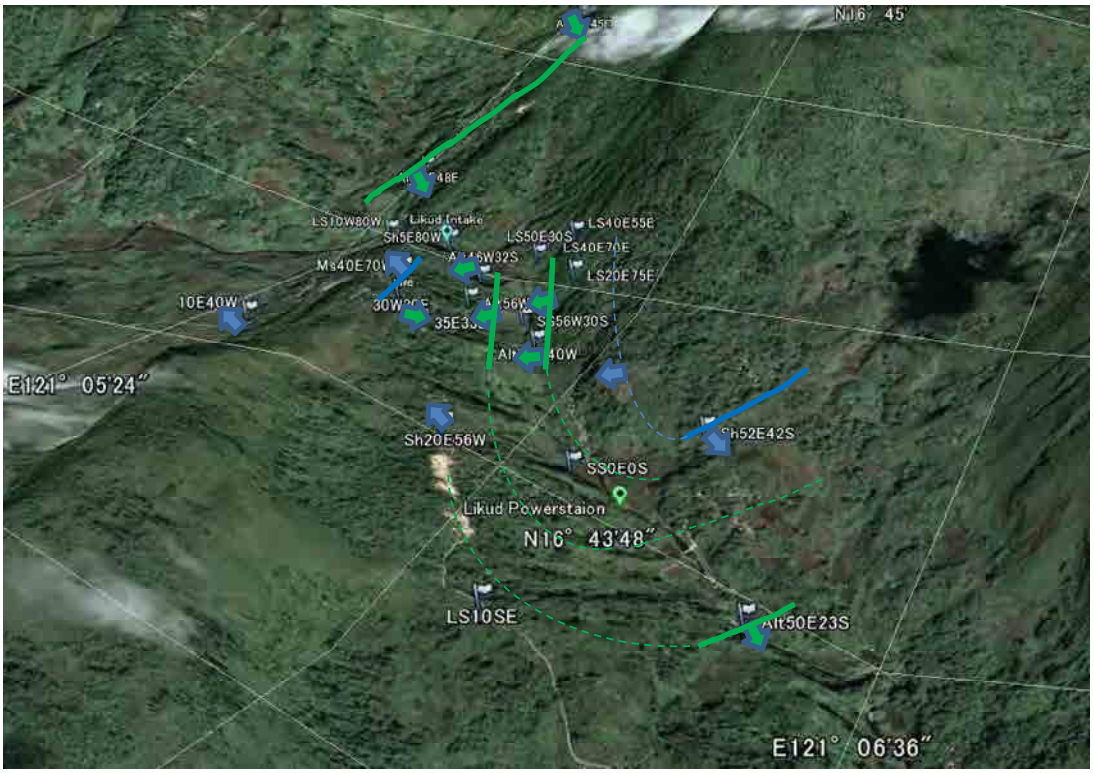


Fig.1-20 Strike-line map of whole Likud Scheme Area looked down from SSE Direction

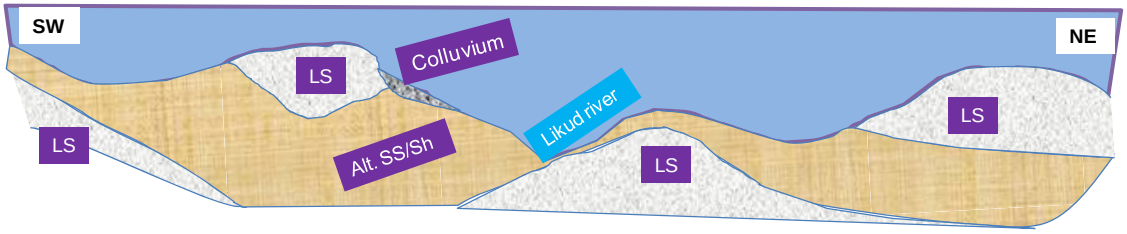


Fig.1-21 Schematic Geological Profile of Likud Scheme Area(SW-NE direction)

(3) Geotechnical assessment for the Likud Scheme

To apply to the design of the Likud scheme, we inspected the Ambangal mini-hydro power plant which was completed and has been operating two years.

Waterway of the Ambangal site passes through hillside which is steeper than it of Likud site, and all topographic and geologic contents such as debris, weathered and fissured rock masses are stable as shown

in Photo 1-5 and Photo 1-6. Wooden covers in some parts of the headrace are so effective to protect the structure from damage of falling rocks.

Photo 1-5
Vertically excavated cutting slope on debris to construct the headrace

Photo 1-6
Wooden cover which was set up by collapse from jointed bedrock to keep the headrace structure

Attentive themes regarding the topography and geology for Likud scheme referring the above mentioned reconnaissance results for Ambangal mini-hydro power plant are;

a. How to repair the existing irrigation weir for the intake
b. how to withstand the force of surface land sliding at around T.D.100m
c. how to protect the head race structure from water attack of flood at undercut slope of concave bank
d. possibility of the debris-slide recurrence occurred about 15 years ago
e. slope stability of the backyard slope of powerhouse

Countermeasures for each theme are as follows.

a. The existing weir was made filling up the empty space of huge boulders with concrete cementation. However, bottom of the apron of the weir had scored and the huge boulders slid down. It is necessary to consolidate the basis of apron and repair the damaged portions.
b. A minor land sliding with 1 m thickness at T.D.100m is in process which came from abandoned paddy. It was caused by penetration of groundwater to the soft cultivation soil. An aqueduct bridge is recommendable at the part to protect from the attack of landslide mass.
c. Lamut River turns sharp left at around T.D.500m, therefore, right bank has been eroded and sound rock mass has been exposed by repeated flooding. The outcrop was smooth when the team visited first in august of 2012(Photo 1-7), however, the team recognized there collapsed cliff in October (Photo 1-8). The headrace structure should be designed more than 6m high at this place, because the maximum water depth in flooding is about 6m according to the local peoples interview
d. According to the local people, a debris–slide was occurred at around T.D.800m several decades ago.

Trees are grown in the debris body and they grow smooth with no curvatures in the trunk, furthermore, one of the villager's houses is standing through more than 50 years which is in the upper part of the debris, therefore, it is assumed the sliding is over. The debris body contains huge limestone boulders and most of the huge boulders with several meters diameter accumulate at its utmost part of the body, accordingly, the upmost part play a role of natural dike against erosion of flooding (Photo 1-9 and Photo 1-10).

According to the present design, the cutting slope behind the powerhouse might be more than 10m high. When the slope is steep, spring water of the slope is required to release carefully since the slope may lose its stability.

Photo 1-7 (natural condition ; August)undercut slope, where the Lamut river turns left around at TD.500m
Central portion of the outcrop is jointed and loosen.

Photo 1-8 (after collapsed ; October)same part as left
Collapse of the central portion was occurred caused by water penetration after heavy rain

Photo 1-9
Front row of the debris-slide runs out to the right bank of Likud River.

Photo 1-10
Accumulated huge boulders arranging in front row of the debris-slide prevent from erosion of Lamut river.

1-3 Environmental and Social Considerations

In the Preparatory Survey, investigation concerning environmental and social consideration was basically implemented according to the JICA Guidelines for Environmental and Social Considerations (Oct. 2010). Concerning the Project, however, Initial Environmental Examination (IEE) including Heritage Impact Assessment (HIA) was implemented on the case study of the JICA Study for promoting implementation of environmental development project (Mini-hydropower scheme) (the FS Study), and there is confirmed to be no significant impact. Since there is no major difference between the FS Study findings and the Project contents, and the Project is classified as Category D (project with little environmental impact load) under the Philippine Environmental Law (Procedural Manual for DENR Administrative Order No.30-2003, DAO 03-30) described later, no additional IEE was implemented in this Preparatory Survey.

Moreover, the opinions of residents concerning land acquisition have been surveyed and confirmed within the preparatory survey for this Project.

The following paragraphs outline the results of the IEE survey and important findings of this study.

1-3-1 Scoping

Table 1-7 summarizes the environmental and social items that need to be considered when implementing the Project in light of the results of IEE and EIA in a similar project nearby (the e8 project at Ambangal 200 kW mini hydropower plant).

Table 1-7 Scoping

Environmental Item		Evaluation		Reason for Evaluation
		Before works/ During construction	Operation	
Environmental pollution	Air pollution	B-	D	・Operation of construction machinery during the construction period will lead to deterioration of air quality due to exhaust gases and particulates. The scope of impact will be limited to the works area. ・When operation starts, since traffic will be less than during construction and only one or two vehicles or motorbikes will be used by plant staff each day, the impact will be limited. ・Operation of the mini hydropower plant will not emit particulates.

	Water pollution	B-	D	・Discharge of miscellaneous wastewater from the works office during construction will cause some change in river BOD. Moreover, discharge of works wastewater together with rain water during the works period will cause temporary turbidity of the river. ・There will be no discharge of wastewater in line with operation of the power plant.
	Solid wastes	B-	D	・During construction, it is forecast that construction waste materials, residual soil and general wastes will be generated. ・After the plant goes into operation, there will be no generation of wastes that have a serious impact on the surrounding environment.
	Noise and vibration	B-	D	・During construction, it is forecast that construction waste materials and noise and vibration from vehicles will be generated. The impact will be limited to the works area. ・After the plant goes into operation, there will be no impact from noise and vibration.
	Traffic accidents, etc.	B-	B-	・At the peak time during construction, since up to 200 workers will enter and leave the works site, it is forecast that accidents will occur. ・Since jeepneys and tricycles use the road to the construction site in places, there will be a risk of traffic accidents. ・After the plant goes into operation, since the traffic volume will decrease, it is forecast that the risk of traffic accidents will also fall.
	Soil pollution	D	D	There will be no handling of the kind of substances that can cause soil pollution.
	Ground subsidence	D	D	There will be no use of groundwater.
	Odor	D	D	There will be no kind of work that causes bad odor.
	Bottom sediment	D	D	There will be no discharge of wastewater to or landfilling of natural lakes and marshes.
	Topography and geology	D	D	There are no important topographical or geological features around the project site.
Natural environment	Protected districts	D	D	There are no designated environmental protection sites around the project site.
	River flow	D	D	There will be no work that causes alteration of the water flow or riverbed.
	Ecosystems	D	D	・ There will be no impact by the works activities on valuable habitats and endangered species or ecosystems during the construction. ・ Discharge of the river maintenance flow will not exert a negative impact on aquatic life forms in the river. ・ Vegetation will recover quickly in the project area. In the case of Ambangal power plant, which has almost the same works alteration area as this project, vegetation in the altered area recovered in around three to six months.
Social environment	Landscape	D	D	Since the installed facilities will not be visible from major viewpoints, there will be no impact on the landscape.
	Relocation of residents	B-	D	・The Project will not cause any relocation of residents. ・Acquisition of land for installation of the power plant equipment will have an impact.

	Economic activities	B+	B+	・During construction, local residents will receive priority in gaining employment and thus obtaining cash income in the works. ・During construction, since up to 200 workers will gather, business opportunities for local shops and stalls will be boosted. ・After the plant goes into operation, local residents will have the opportunity to be recruited as operating staff.
	Land use	B-	D	・A total of 1.2 hectares will be purchased from landowners as site for the hydropower plant, however, the scope of impact on landowners will be relatively small, similar to that in the case of the existing irrigation channel. ・The impact on landowners will not be so great that they can no longer make a living.
	Water use	B	D	The river is used for other purposes (fishing, irrigation water, etc.), however, since these can be sustained through discharging the maintenance flow, the project will essentially exert no impact.
	Poverty people, indigenous peoples	B-	D	The Ifugao race do not fall under the WB defined conditions for indigenous peoples (except for there being an indigenous language, no other conditions apply). Since the project aims to conserve the rice terraces, which are representative of the culture of the Ifugao race, it will conversely have a positive impact rather than negative for the local people. However, in the Philippines, since the Ifugao people are defined as an indigenous race, it will be necessary to build consensus according to domestic law (see 1-3-7 for details). Moreover, concerning poverty people, since the project aims to conserve rice cultivation (rice terraces), which is the main industry for Ifugao Province where there are a lot of poverty people (out of 82 provinces in the Philippines, Ifugao ranks 16th in terms of poverty as of 2005), it will have a positive impact on poverty people when operation starts. Almost all the residents inside the project area (22 out of 23 people affected) are above the designated poverty line in the Philippines (per capita income of 16,975 pesos per year) (2009) (see Table 2-28). One resident, who is physically disabled, has annual income of only 5,000 pesos, however, since he is supported by nearby family and friends and only 2.4% of his land is affected by the project, the project will have no impact on impoverished people. The scope of land acquisition for the mini hydropower equipment is small and can be compensated (concerning compensation, see the concrete measures for compensation and assistance in section 1-3-6-4 to 1-3-6-8).
	Monuments and cultural assets	D	D	There are no cultural monuments around the project area.
	Disaster (risk)	B-	B-	Possible risks include natural disaster, landslide, rock fall and accidents, etc.

Judgment categories

A+/-: Serious impacts are forecast

B+/-: Some impacts are forecast

C+/-: Unknown (examination is required, and conditions will be revealed as survey progresses)

D: Hardly any negative impacts can be considered.

1-3-2 Impacts on Natural Environment

The Project site and surrounding area are not designated as a national park or protected area. Five sites of Ifugao Rice Terraces were designated as UNESCO's World Heritage sites, but the Project site is out of those heritage sites. Moreover, since a forestation, farmland and vegetation is not advanced, the need to conserve land animals is extremely limited. Concerning forests, it will be necessary to grasp the types and quantities of vegetation and provide compensation to owners in affected areas before land acquisition starts. Cutting of trees will be kept to a minimum.

Although primary negative impacts such as soil erosion, water pollution and noise and so on will arise before and during construction, these impacts can be kept to a minimum through mitigation measures implementing environmental protection and safety measures. Also, judging from the size of the hydropower plant, it will be possible for vegetation losses to be recovered in a short time.

1-3-3 Impacts on Social Environment

Project implementation will not entail any resettlement of residents. There is no gap between JICA Guideline and the Philippines' Local Government Code on way of thinking for compensation. Concerning the land acquisition for installation of hydropower facilities, it will be necessary for Ifugao Provincial Government to provide compensation in accordance with the Local Government Code to landowners that are directly affected. Also, since irrigation water is directly taken from Lamut River, it will be necessary to give priority to water diversion for agricultural use ahead of water for hydropower generation.

Implementation of the Project can be expected to have the following kinds of positive effects: ① infrastructure will be constructed in the local area, ② employment opportunities for local people will increase during and after construction, and ③ activities for preservation of the rice terraces will be expanded as a result of expansion of the Rice Terraces Conservation Fund due to revenue from sale of power.

1-3-4 Environmental Management Plan

Judging from the scale of development (820 kW) and area of land (approximately 1.2 hectares) subject to alteration in the project, the scope of impact is extremely limited and the degree of impact is minor. However, in order to mitigate negative impacts, the Department of Energy and Provincial Government of Ifugao (the implementing agencies) will conduct monitoring.

Table 1-8 shows the environmental management plan

Table 1-8 Environmental Management Plan

Environmental Item	Impact	Conservation Measures	Implementation Period	Budget	Implementation Agency
Water quality conservation	Water pollution	Discharge turbid water via the grit chamber to ensure that it doesn't directly flow into the river.	During construction and at the time of operation	This is included in the project cost.	DOE and contractors
Ecosystem	Environmental change in the aquatic biota in the reduced water section (1.8 km)	Generate a maintenance flow of 0.136m^3/s.	At the time of operation	Not needed	PGI

1-3-4-1 Monitoring Plan

According to the Environmental Impact Assessment Guidelines of the Philippines (DAO03-30), auxiliary conditions such as the implementation of monitoring, etc. are rarely required when issuing a certificate of non-coverage, however, the existing IEE report proposes that self-monitoring should be implemented, and the DOE and PGI have consented to implementing monitoring based on this suggestion (see Annex 6 Other relevant data (2) for the letter of consent).

During construction:

A water quality monitoring report will be submitted from the Department of Energy (the responsible agency for implementation) to the Department of Environmental and Natural Resources (DENR-EMB) regional office once every quarter.

After start of operation:

The Provincial Government of Ifugao (the operating agency) will autonomously implement monitoring. In the first year, it is required to give a monitoring report on water quality and aquatic biota once every quarter, while reporting from the second year onwards will be in accordance with instructions from the DENR-EMB.

Table 1-9 shows the Monitoring Plan and the monitoring forms of water quality and the aquatic biota are in from Table 1-10 to Table 1-12.

Table 1-9 Monitoring Plan

Key Environmental Aspects per Project Phase	Potential Impacts Per Envt'l Sector	Parameter to be Monitored	Sampling & Measurement Plan			Lead Person	Estimated Cost (PhP)	EQPL Management Scheme			
			Method	Frequency	Location			EQPL Range		Management Measure	
								Action	Limit	Action	Limit
Construction Phase											
Water	Water Pollution	TSS, pH	AS/NZS 5667.1	Quarterly	Four water stations in Lamut River	Environmental Officer of DOE & Contractor	50,000/ sampling		DAO 1990-34		
Operation Phase											
Water	Water Pollution	TSS, BOD,	AS/NZS 5667.1	Quarterly for the first year; will be adjusted as necessary	Four water stations in Lamut River	Environmental Officer of PGI	50,000/ sampling		DAO 1990-34		
Aquatic Biota	Loss of habitat and aquatic biota.	Freshwater fishes	Scientifically accepted methodologies; photo transect and visual census	Quarterly for the first year; will be adjusted as necessary especially if there's no perceived impacts after a year		Environmental Officer of PGI	100,000/ sampling				

1-3-4-2 Monitoring Form

1) Water Quality (During construction)

Table 1-10 Water quality (During construction)

Item (Unit)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks Measurement Point, Frequency
pH			Class C 6.5-8.5	
TSS(mg/l)			Not more than 30mg/l increase	

2) Water Quality (During operation)

Table 1-11 Water quality (During operation)

Item (Unit)	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Remarks Measurement Point, Frequency
TSS(mg/l)			Not more than 30mg/l increase	
BOD(mg/l)			7	

3) Monitoring of Aquatic biota (Freshwater fish) (During operation)

Table 1-12 Monitoring of Aquatic biota (Freshwater fish) (During operation)

Item	Status		
	Method	Date of survey	Result of survey
Aquatic Biota (Freshwater fishes			

1-3-5 Stakeholder Meeting

At the time of the Project survey, the Provincial Government of Ifugao (the future development implementing agency) took the initiative in disclosing information on the objectives and contents of the Project and the survey implementation methods, and it is implementing ongoing consultation with Project officials and residents in the Project target area. The table 1-13 shows the member of stakeholder and the community consultation. Table 1-14 and 1-15 show the stakeholder meetings and the community consultations held in 2011 and 2013.

The discussions focused on the Project objectives, Project benefits, Project plan, schedule and progress of the Survey, and Table 1-16 shows the major questions asked by the stakeholders and local citizens. The minutes of meetings refer to appendix 6 (3) and (4).

The Provincial Government of Ifugao already owns and operates Ambangal mini hydropower plant (200 kW) in Kiangan District situated next to the Project area. In the Survey, officials and residents who will be impacted by Likud mini hydropower plant conducted observation of the existing Ambangal mini hydropower plant. In doing so, the local residents were able to understand the mini hydropower development relatively easily.

Thanks to these activities, the local residents have no opposition to the Project development but rather welcome the idea.

Table 1-13 The Member of Stakeholder and the Community

Member	The concerned agency
Responsible Organization	Department of Energy (DOE)
The concerned agency at Provincial level	Governor Provincial Council Member Provincial Planning and Development Office (PPDO) Provincial Assessor Office (PAssO) Ifugao Cultural Heritage Office (ICHO) Provincial Legal Office (PLO) Provincial Agriculture and Environmental Office (PAENRO) Provincial Engineering Office (PEO) Provincial Accounting Office (PACCO) Provincial Treasury Office (PTO)
The concerned agency at Municipal level	Mayor Municipal Council Member Municipal Planning Development Office (MPDO) Municipal Assessors Office (MAssO)
The concerned people at Barangay level	Barangay Captain Baranagy Council Member Irrigation Association Affected landowners by the Project
Others	Ifugao Electric Cooperative（IFELCO） NGO（Save the Ifugao Terraces Movement :SITMO）

Table 1-14 The Stakeholder Meetings and the Community Consultations in 2011

Public/ Stakeholder Consultation	Date	Place	Participants	Topic of discussion
1st SP meeting	Feb. 21, 2011	SP conference room	• Vice Gov. • SP members • JICA • TEPSCO	• Purpose of the project • Survey area • Schedule of survey and methodology
1st SB meeting	Feb. 21, 2011	SB conference room	• Vice Mayor • SB members • JICA • TEPSCO	• Purpose of the project • Survey area • Schedule of survey and methodology
1st community consultation	Feb. 22, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Brgy. Council of Haliap • Brgy. Council of Panubtuban • PPDO • TEPSCO • AECOM	• Purpose of the project • Survey area • Schedule of survey and methodology
Plant visit to the Ambangal mini-hydropower plant	Feb. 28, 2011	Ambangal power plant, Kiangan	• Brgy. Council of Haliap • Brgy. Council of Panubtuban • Ambangal operators • PPDO • TEPSCO	• Tour of inspection the Ambangal mini-hydropower plant • Operation and Maintenance work
2nd Stakeholder meeting	Apr. 27, 2011	PPDO office	• PPDO • IFELCO • DOE • TEPSCO	• General layout of the Likud power plant
2nd community consultation	Apr.28, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Brgy. Council of Haliap • Brgy. Council of Panubtuban • PPDO • TEPSCO • Haliap Farmers	• The location of the Likud power plant • Major components of the Likud power plant • Comparative study or the waterway routes
Key Informant Interview	Jun. 23, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Kgd Rosemarie Doque	• Opinions and requests for the Likud project by the affected people
Key Informant Interview	Jun. 23, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Kgd Basilio Fedelito • Basilio Bayawna • Christina Ngabit • Nancy Addab	• Opinions and requests for the Likud project by the affected people • The benefit of the project
Key Informant Interview	Jun. 23, 2011	Barangay Hall, Barangay Panubtuban, Asipulo	• Brgy Captain • Kgd Josie • Brgy Treasurer • Brgy Secretary • Brgy staff	• Opinions and requests for the Likud project by the affected people • The benefit of the project • Water User of Lamut River
Key Informant Interview	Jun. 23, 2011	Barangay Haliap, Asipulo	• Landowners	• Opinions and requests for the Likud project by the affected people • The benefit of the project
3rd SP meeting	Jun.30, 2011	Prvl. Livelihood Center, Lamut	• SP members • PPDO • DBP	• Progress of the survey • Basic design of the Likud power plant • Guidance on EDP scheme under DBP

			• DOE • TEPSCO	
3rd stakeholder meeting	Jun. 30, 2011	GAZEBO, Lagawe	• PPDO • PACCO • PTO • PGO • PPDO • DOE • TEPSCO	• Progress of the study • Basic design of the Likud power plant
3rd community consultation	July 1, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Brgy. Captain of Haliap • Brgy. Council of Haliap • PPDO • TEPSCO	• Progress of the study • Basic design of the Likud power plant • Size and location of major component of the power plant • Confirm with affected landowners of the affected area
4th SP meeting	Aug. 8, 2011	SP conference room	• SP members • PPDO • JICA • TEPSCO	• Report of the final design of the Likud power plant
4th SB meeting	Aug. 8, 2011	SB conference room	• SB members • PPDO • JCIA • TEPSCO	• Report of the final design of the Likud power plant
4th community consultation	Aug. 9, 2011	Barangay Hall, Barangay Haliap, Asipulo	• Brgy. Captain of Haliap • Brgy. Council of Haliap • PPDO • TEPSCO	• Report of the final design of the Likud power plant

Table 1-15 The Stakeholder Meetings and the Community Consultations in 2012

Public/ Stakeholder Consultation	Date	Place	Participants	Topic of discussion
1st Stakeholder meeting	Aug. 7, 2012	GAZEBO	• Gov. • PPDO • ICHO • PACCO • PEO • Mayor • MPDO • Brgy. CAP • IFELCO • DOE • NIA-CO • JICA • TEPSCO	• Explanation of re-survey for the Likud project, and JICA Grant Aid scheme • Schedule • Explanation of the cost burden on the Philippines side for the project
1st community consultation	Aug. 8.2012	Barangay Hall, Barangay Haliap, Asipulo	• Brgy. Council of Haliap • MPDO • PPDO • Affected landowners • JICA • TEPSCO	• Explanation of re-survey for the Likud project, and JICA Grant Aid scheme • Schedule • Explanation of the cost burden on the Philippines side for the project • Request of cooperation by study team for the survey
1st SP	Aug.	SP conference	• Vice GOV.	• 協力 Explanation of re-survey for the Likud

meeting	28, 2012	room	• SP members • PPDO • DOE • JICA • TEPSCO	project, and JICA Grant Aid scheme • Schedule • Explanation of the cost burden on the Philippines side for the project • Request of cooperation by study team for the survey のよる実施について
2nd stakeholder meeting	Oct. 8th, 2012	GAZEBO	• PPDO • PEO • PGO • IFELCO • Mayor • MPDO • MAssO • Brgy. Haliap representative	• The result of the 1st mission survey • Confirm the status of tasks on the Philippine side • Schedule and the contents of the 2ne mission survey • Review of Energy Sale Agreement
3rd stakeholder meeting	Dec. 11th, 2012	GAZEBO	• PPDO • PEO • PGO • IFELCO • Mayor • MPDO • Brgy. Haliap representative	• Report of the final design of the Likud power plant • Confirm the status of tasks on the Philippines side since the last confirmation • Overall schedule of the Project • Procedure and schedule of the land acquisition for the Project
3rd community consultation	Dec. 13th, 2012	Barangay Hall, Barangay Haliap, Asipulo	• Affected landowners • Brgy. Council of Haliap • Vice Mayor • MAssO • MPDO • MAO • PPDO • PAENRO • PAssO • PLO • IFELCO • DOE • Study team	• Report of the final design of the Likud power plant • Confirm the status of tasks on the Philippines side since the last confirmation • Overall schedule of the Project • Procedure and schedule of the land acquisition for the Project

Table 1-16 Questions and Answers of Stakeholders Meetings

	Points of Interest	Response of the Counterparts and Survey Team
Provincial governor, provincial council member, Mayor, Municipal Council members	1. For the provincial government, owning a second mini hydropower plant will lead to expansion of the RTCF and comply with the provincial development goals. 2. The operation and maintenance setup will basically be the same as the one at Ambangal, however, since it will be necessary to permanently assign staff with electrical machinery qualifications,	2. Operators and water guards will be sought from within the province (giving priority to the host village) and will be given training and practical training during the construction period, and

	the outsourcing of management will be considered.	plant personnel will be selected upon conducting final tests. When conducting the practical training, the participation of employees from the Department of Energy and local Electric Cooperative will also be welcomed.
	3. The power sale unit price for Ambangal mini hydropower plant is lower than expected, so contributions to the RTCF are not going as scheduled. It will be necessary to carefully set the sale price of power from Likud mini hydropower plant.	3. It will be necessary for the Department of Energy to take part in discussions between the Provincial Government of Ifugao and Energy Regulatory Committee to ensure that the power sale unit price for Ambangal mini hydropower plant doesn't impact the price for Likud.
Ifugao Electric Cooperative	4. Will the off-taker of power from Likud sign a bilateral agreement or a FIT agreement?	4. The FIT unit price was approved in July 2012, however, the FIT still hasn't started and the situation remains opaque. Moreover, since adopting the FIT rate will led to higher power tariffs for end consumers, a bilateral agreement will be considered.
	5. Considering the current purchase price of power (4.2 peso/kWh + transmission cost 1.0 peso/kWh), the power sale price in the case where a bilateral agreement is signed will be 4.35 peso/kWh.	5. The PGI and DOE both agree to the above proposal.
	6. Can the operation and maintenance of Likud mini hydropower plant be consigned to the power distribution company?	6. The Japanese side will conduct training on power plant maintenance during the construction period, and staff from the power distribution company will be welcome to participate in this. The actual maintenance will be based on negotiations between the provincial government and electric cooperative.
Irrigation association	7. Will the Project impact the rice paddies located in the downstream of Lamut River?	7. The Philippine River Law requires that priority be given to water supply for drinking and irrigation purposes rather than for hydropower generation, so adjustment will be conducted at the intake point to ensure that the necessary flow for irrigation of downstream areas is secured. Operation of the power plant will be suspended during the dry season.

Residents impacted by the Project	8. Will compensation be provided for land impacted by the Project? 9. Can residents take part in construction? 10. If residents cooperate with the Project, can family members be employed as government official? 11. Will electricity tariffs go down? 12. Can residents directly obtain electricity for household use from the Project?	8. Compensation will be provided according to the local government law and discussions with the affected residents (see Section 1-3-6-4 Compensation Assistance for the specific contents of compensation). 9. Priority will be given to residents of the host village when recruiting workers. 10. Apart from the Project, the local government has office vacancies in accordance with its employment criteria, and residents will be able to apply for such positions. 11. Since the tariff dropped by 40 centavos following construction of Ambangal mini hydropower plant, the tariff is likely to similarly fall if Likud is constructed. 12. Because Likud mini hydropower plant will be directly connected to the local electric cooperative, electricity will be indirectly supplied to local households.

1-3-6 Acquisition of Land

As a result of Project implementation, it will be necessary to acquire land for the hydropower facilities (power plant, headrace, head tank and penstock), and roughly 1.23 hectares of land will be transformed. Since this land is owned by both the national government (0.05ha) and individual persons (1.18ha), Ifugao Provincial Government (the developing entity) will need to acquire land and provide compensation based on Local Government Code concerning the land owned by individuals. There is no gap between JICA Guideline and the Philippines' Local Government Code on way of thinking for compensation.

1-3-6-1 Legal Framework for Land Acquisition

As the ultimate operator of the Project, Ifugao Provincial Government is responsible for acquiring land, and it will provide compensation according to the Local Government Code (RA7160). Table 1-17 shows the outline of compensation.

Table 1-17 LGU Code for Land Acquisition

LGU Code	Contents
Section 19 Eminent Domain	A local government unit may, through its chief executive and acting pursuant to an ordinance, exercise the power of eminent domain for public use, or purpose or welfare for the benefit to of the poor and landless upon payment of just compensation. The local government unit may immediately take possession of the property upon making a deposit with the proper court of at least fifteen percent (15%) of the fair market value of the amount to be paid for the expropriated property shall be determined by the proper court, based on the fair market value at the time of the taking of the property.
Section 219 General Revision of Assessment and Property Classification	The provincial, city or municipal assessor shall undertake a general revision of real property assessment within two years after the effectivity of this Code and every three years thereafter
Section 212 Preparation of Schedule of Fair Market Values	The LGC provides that before any general revision of property assessment is made, there shall be prepared a schedule of fair market values for enactment through ordinance by the Sanggunian concerned.
Section 218 Assessment Levels	The LGC provides that the assessment levels to be apply to the fair market value of real property to determine its assessed value shall be through ordinance by the Sangguniang Panlalawigan.

The gap between JICA guidelines and laws of the Philippines on compensation is shown in Table 1-18. However, since there is no involuntarly ressettlment by the Project, the items related to invluntary resettlement are no responded.

Table1-18 Gap between JICA Guidelines and Laws of the Philippines on Compensation

No.	JICA Guidelines	Laws of the Philippines	Gap between JICA Guidelines and Laws of the Philippines	Project Policy
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	EO 1035 (1985) Procedures and guidelines for the expeditious acquisition by the government of private real properties or rights for infrastructure and other government development projects RA8371･IPRA (1997) Recognize, protect and promote the rights of indigenous cultural communities RA7160(1991) Local government Code	No gap	Land acquisition for the project has to be minimized. The damage and inconvenience has to be minimized.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	Ditto	No gap	Impact by the project shall be minimized and compensate on the loss of land based on the result of

No.	JICA Guidelines	Laws of the Philippines	Gap between JICA Guidelines and Laws of the Philippines	Project Policy
				consultation with the affected land owners and the MOA between the PGI and the affected owners.
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Ditto	No gap	In accordance with the LGU Code, the compensation shall be taken.
4.	Compensation must be based on the full replacement cost as much as possible.	RA7160(1191) Local government Code, and Provincial Ordinance No. 2009-015Sec. 219 and 212	Not always full replacement cost	Basically compensate by replacement cost. Pls. refer the compensation price of each item, table 1-3-6-4
5.	Compensation and other kinds of assistance must be provided prior to displacement.	N/A	Not stated on the timing of compensation	Compensation on the affected land must be paid before construction starts. Conduct inventory study on the possible affect trees and agricultural products, and will compensate on the actual damage after construction finish.
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	EO 1035 (1985) Procedures and guidelines for the expeditious acquisition by the government of private real properties or rights for infrastructure and other government development projects RA8974(2000) Facilitate the acquisition of right of way, site or location for national government infrastructure projects and for other purposes	No gap	No involuntary resettlement on the project
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	DAO03-30 Procedural Manual of EIA, Social Acceptability RA8371/IPRA (1997) Recognize, protect and promote the rights of indigenous cultural communities	No gap	There is no involuntary resettlement by the Project. However, the community consultations were implemented for information disclosure, and

No.	JICA Guidelines	Laws of the Philippines	Gap between JICA Guidelines and Laws of the Philippines	Project Policy
				gain the consent of the community for the project. NCIP as the third party will implement FPIC upon the applying of the PGI, and confirm the social acceptability.
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	Ditto	No gap	Information disclosure was translated in the local language for the community's understandable.
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	EO 1035 (1985) Procedures and guidelines for the expeditious acquisition by the government of private real properties or rights for infrastructure and other government development projects RA8368･IPRA (1997) Recognize, protect and promote the rights of indigenous cultural communities RA7160(1991) Local Government Code DAO 03-30 EIA Procedural Manual, Social Acceptability	No gap	There is no involuntary resettlement and big loss of means of livelihood. However, the plan and the schedule of the land acquisition for the hydropower facilities shall be explained to the affected land owners
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	N/A	Not stated on grievance mechanism	PPDO and PassO of the PGI will be in charge of claims and/or grievance.
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	EO 1035 (1985) Procedures and guidelines for the expeditious acquisition by the government of private real properties or rights for infrastructure and other government development projects DPWH DP 142 (1995) Inclusion of preparation of parcellary plans and cost estimates for ROW acquisition in detailed engineering of infrastructure projects RA8368 (1997) Penalizing squatting and other similar acts RA7160(1991) Local Government Code	No gap	There is no involuntary resettlement by the Project, but the baseline study on necessary land area, and the land acquisition for the hydropower facilities shall be compensated by the PGI.
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or	Ditto	No gap	Correspond in accordance with the Philippines' law

No.	JICA Guidelines	Laws of the Philippines	Gap between JICA Guidelines and Laws of the Philippines	Project Policy
	assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)			
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Ditto	No gap	Ditto
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	RA7279 A comprehensive and continuing urban development and housing program, establish the mechanism for its implementation and for other purposes RA8371･IPRA (1997) Recognize, protect and promote the rights of indigenous cultural communities	No gap	Not applicable withRA7279 due to not urban development project. However land compensation and the other requirement by the community shall be consulting with the affected community under the FPIC process.
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	EO 1035 (1985) Procedures and guidelines for the expeditious acquisition by the government of private real properties or rights for infrastructure and other government development projects	No gap	Correspond in accordance with the Philippines' law
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	N/A	There is no law on involuntary resettlement of fewer than 200 people.	There is no involuntary resettlement by the project. Not Applicable.

1-3-6-2 Extent of Impact by the Project

There is no involuntary resettlement by the Project. The impacted area where the hydropower plant of facilities will be installed is limited to Barangay Haliap. The numbers of affected land owners are 23 people, and the total affected land area is 1.23 hectare which is covered 0.25 percent of the total land area (490 hectare) of Barangay Haliap.

1-3-6-3 Results of Hearing Opinions about Land Acquisition

Since the IEE survey of 2011 did not cover the impact of land acquisition or include investigation of household budgets and livelihoods, these items were surveyed in the study here. The survey was conducted from August 15 to August 26, 2012, and 22 land claimants were visited and surveyed based on a questionnaire prepared in advance.

All the land claimants responded that they would not oppose offering land for the Project providing that the resulting would be advantageous for them, and they also indicated that the impact of the Project on their land would not be great. The minimum impact for the affected land owner is around 0.0096 hectare (the affected area by the project is around 0.6 percent of the owner's total land area), the maximum affected area is around 0.17 hectare (18 percent of owner's total land area), and the average affected area by each landowner is around 0.05 hectare. Therefore it can be said the impact of land and livelihood by the project is very minimum.

Table 1-19 summarized the results of interviews on land acquisition.

Table 1-19 Results of Interviews on Land Acquisition

1	Number of claimants affected by the Project	23
2	Number of persons interviewed	22
3	Awareness of the Project	All 22 persons understand the project
4	Acceptance of the Project	20 persons agree with the Project. 2 persons give conditional agreement (on condition that family members or relatives are employed as provincial government workers and so on)
5	Concerning provision of land	All 22 persons agree to provide land. 18 of the 22 are willing to provide land based on consultation of the price and purchase, and 4 are willing to offer land free of charge on condition that they can participate in restoration and construction of the existing irrigation channel.
6	Land use by landowners	Mixture of rice cultivation and upland farming: 6 persons Upland fields: 9 persons Rice cultivation: 2 persons Forest, rice cultivation and upland fields: 1 person Upland fields and fruit orchard: 2 persons Rice cultivation and forest: 1 person Rice cultivation and fruit orchard: 1 person
7	Number of participants in the land acquisition explanation meeting	Participation in the May 21 explanation meeting: 7 persons Participation in the walk-through on October 10: 6 persons Affected persons who didn't participate in explanations, but know the affected area: 6 persons
8	Number of people in families	Minimum 1 person, maximum 8 persons, average 4.7 persons
9	Number of years lived in Barangay Haliap	19 persons have lived in the same place since birth.
10	Home ownership	19 persons own their own homes
11	Annual family salary	Minimum: 5,000 pesos, median value: 30,900 pesos Average: 74,641 pesos, maximum: 309,075 pesos
12	Occupations	Agriculture and forestry, teachers, midwives, drivers, day labors, barangay council members

13	Electrification rate	16 households are electrified, and 6 are not (using kerosene lamps).
14	With or without saving	4 respondents have saving with cooperative.
15	With or without borrowing	4 respondents have borrowing with cooperative and their relatives.
16	Have you ever received any compensation by any project in the past?	1 respondents received by the load project (No land compensation, but the cutting trees were compensated.)
17	Will lifestyle change as a result of receiving compensation?	No change: 22 persons
18	Do you have any concern for the Project? Or any expectation on the Project?	・ Expect the implementation of project is push through, if no project realize, we doubt the Japanese has a hidden ・ Expect the completion of the project ・ Will be able to utilize electricity ・ Expect the rehabilitation of the existing irrigation canal ・ The project constructs a high dam? ←the study team explained the height of intake was 3.5 meter from the surface of water.
19	Do you think the project will benefit to you?	・ Will be able to receive electricity ・ Access road of surrounding project area will be improved ・ Will be able to use again the existing irrigation canal by its rehabilitation.

1-3-6-4 Compensation Measures

Compensation of land, cutting trees and damaged agricultural products shall be implemented in accordance with Local Government Code and the Provincial Ordinance (No. 2009-015). Each compensation price is indicated to landowners by the Provincial Assessors Office during the community consultations, and all affected landowners accepted the said price. The compensation prices show in from Table 1-20 to Table 1-22.

Table 1-20 Compensation Rates according to Land Use

Unit price: peso/m^2

Land Classification		Price 2012 (RA7160)			**Price after community consultation Dec. , 2012**
		1st class	2nd class	3rd class	
Rice Field	Irrigated	10.8	9.2	8.0	**85**
	Un-irrigated	18.2	16.0	11.6	**70**
Vegetable Land		8.3	6.7	5.0	**50**
Banana Land		8.5	7.6	6.8	**50**
Citrus Land		13.7	11.4	9.1	**50**
Mango Land		12.6	5.9	2.5	**50**
Pineapple Land		21.0	14.0	10.0	**50**

Rambutan Land	19.6	15.6	11.7	**50**
Root Land	8.3	6.7	5.0	**50**
Corn Land	8.3	6.7	5.0	**50**
Cogonal Land	2.0	-	-	**50**
Coffee Land	6.8	5.3	3.1	**50**
Coconut Land	6.5	5.1	3.7	**50**
Lansones Land	19.6	14.7	9.8	**50**
Tree Plantation	2.7	2.1	1.6	**50**
Fish Pond	25.0	20.0	15.0	**50**

Table 1-21 Compensation Rate of Existing Forest Trees

Unit price : peso/board foot

Name of tree	Unit Price
Acacia, Alimit, Analtop, Daladalit, Dogwe, Gmelina, Halaha, Hamindang, Ipil-ipil, Lablabong, Marakape, Marapias, Momma, Putukan, Talanak, Tuai, Tucu	5.0
Dalakan, Red Lawan	6.0
Coffee, Narra, Rattan	10.0
Avocado, Banana, Jackfruit, Mango, Orange	25.0

Table 1-22 Compensation Rate of Existing Fruit Bearing Trees

peso

Name of Fruit bearing trees	Yield / Tree	Unit Cost
Alavica Coffee		100 / tree
Robusta Coffee		100 / tree
Santol	150 pcs. Or 25 kgs/ tree per year	10 / tree
Betel Nut	Half can / tree per year	600 / can
Avocado	150 pcs. Or 38 kgs/ tree per year	10 / kg
Lychee	7 kgs / tree per year	35 / kg
Banana	7 bunches / tree per season	24 / bunch
Cacao	20 pcs. / tree per year	50 / pc
Pomelo	80 pcs. / tree per season	4 / pc
Coconut	-	300 / tree
Rantan	20 kgs. / vine	20 / kg
Papaya	20 fruits or 32 kgs. / tree	10 / kg
Rambutan	7 kgs. / tree	35 / kg
Chesa	50 pcs. Or 10 kgs. / tree	10 / kg
Gayunan	80 pcs. Or 16 kgs. / tree	12 / kg

1-3-6-5 Grievance Mechanism

Ifugao Provincial Government currently has no office for handling grievances, however, as the implementing agency, the Provincial Planning and Development Office (PPDO) acts as the window agency for dealing with complaints or troubles arising from the Project. Moreover, the PPDO acts in collaboration with the following offices and village leaders:

1) Provincial Legal Office (PLO)
2) Provincial Assessor Office (PAssO)
3) Provincial Agricultural and Environment Office (PAENRO)
4) National Commission on Indigenous Peoples Office –Provincial Office (NICP Provincial)
5) Municipal Assessor Office (MAssO)
6) Municipal Agricultural Office (MAO)
7) Barangay council member in Haliap

1-3-6-6 Implementation Setup for Land Acquisition

The Provincial Planning and Development Office (PPDO), Provincial Assessor Office (PAssO) and Provincial Agriculture Environment Natural Resources Office (PAENRO) conducted the first land compensation confirmation (walk-through) with landowners on May 21, 2012. In an orientation meeting on land acquisition, these agencies gave explanations on how they will purchase the necessary land for the Project, presented land prices according to land uses (forest, rice cultivation, upland field, fruit orchard, etc.) and explained the method for transferring land rights. In addition, with a view to providing compensation for the cutting of coffee and fruit trees and timber producing trees that generate cash incomes, an inventory survey of trees was conducted between May 31 and October 10 with participation from the landowners concerned.

Payment of land compensation is conditional on the landowners paying fixed assets tax. In hearing surveys, since it was found that six out of 22 landowners haven't paid taxes nor conducted official land rights transfer procedures, it was explained to each landowner that these steps will need to be taken first.

Since not all of the landowners have participated in these activities and explanations conducted by the provincial government, the provincial government intends to continue implementing explanations and walk-throughs and to deal with the situation before the Project is implemented.

Since the Assessor office (MAssO) in Asipulo municipality is in charge of the land division chart and is the window agency for paying fixed assets tax, the provincial government will conduct the above measures in cooperation with the municipal government.

1-3-6-7 Funding for Land Acquisition

The Provincial GOvernment of Ifugao has appropriated 1,000,000 pesos (approximately 2,000,000 yen) to cover land compensation costs in the 20% development fund of its general budget for fiscal 2013. Table shows the basis of land compensation.

Table 1-23 The Basis of Land Compensation

Total affected area (m^2)	11,854	
Compensation price (Peso)	85	The highest unit price is used for calculation, but not all the affected area are cultivated rice field
Total Compensation (Peso)	1,000,000	11,854 × 85＝1,000,7590≒1,000,000

1-3-6-8 Implementation Schedule

The Provincial Government of Ifugao has staged consultation concerning Project implementation in Barangay Haliap in Asipulo Municipality on a number of occasions. Concerning land acquisition, it held consultations two times – the first time on May 21, 2012 and the second time on October 10. It intends to further consult with all landowners with a view to concluding a Memorandum of Agreement (MOA) based on fundamental consensus by the end of December 2012. It plans to finish making actual payments following the Cabinet decision on Project implementation and before the start of construction (October 2013).

The compensation will be monitored by the responsible agency of Department of Energy (DOE) and the Legal Office (PLO) of the Provincial Government of Ifugao (PGI).

Table 1-24 Compensation Schedule

	2012			2013				2014			
	2nd Qt	3rd Qt	4th Qt	1st Qt	2nd Qt	3rd Qt	4th Qt	1st Qt	2nd Qt	3rd Qt	4th Qt
Explanation of land compensation	■	■	■								
Negotiation of compensation price				■	■						
Payment					■	■					
Monitoring					■	■	■	■	■		

Table 1-25 Monitoring Format of Land Compensation

	CLAIMANT	Land Description	Affectedl Land Area (m^2)	Value (Peso)	Status of Payment	Remarks
1	JOSE BIMMUCAL, et. al.					
2	NIDO LUMAHO					
3	LEON DONATO					
4	BENITA DAMMIT					
5	MOD-E PAD-E					
6	BEN POH NAC					
7	ERNESTO PALIJA					
8	RAMON APOY					
9	LAGGUY NAD-UG					
10	CHRISTOPHER CATAMA					
11	ROGELIO CATAMA					
12	CALIXTO CATAMA					
13	CARLOS CATAMA JR.					
14	CONSTANCIO CATAMA					
15	ALVIN CATAMA					
16	JOSE BIMMUCAL, et. al.					
17	JOSEPH OTAHA					
18	ANTONIO TIMOTEO					
19	BENITO BAGTO					
20	JOSE BIMMUCAL, et. al.					
21	ALEX PELLOG					
22	JOSEPHINE OCAMPO					
23	UNKNOWN (Penstock)					
	Total					

1-3-7 Social Acceptability

(1) The impact for the Ifugao's landscape, life and culture by the Project

In the environmental impact assessment report for Ambangal mini hydropower plant[6], Mr. August Villalon, who is a member of the International Council of Monuments and Sites (ICOMOS), which is an international non-government organization concerned with the protection of UNESCO cultural assets, reports on the Project's impact on the life and culture of the Ifugao people[7].

"Ambangal hydropower plant is a small project in terms of the size of equipment, and although the power plant structure has an impact on the rice terrace landscape, it doesn't ruin the scenery and steps can be taken to alleviate any negative impacts. The size of each plant equipment (headrace and head tank, etc.) is harmonized with the surrounding landscape. This kind of development project for supporting basic human lifestyles is necessary for the Ifugao people too and in no way threatens the traditions and culture of the Ifugao."

[6] This project was implemented with support from e8 (a framework established by major power companies of the G8 countries, with participation from Japanese power companies too).

[7] Refer to Appendix 6 (5) Write-up of Mr. August Villalon, the impact for the Ifugao's landscape, life and culture by the Project

Mr. Manuel Durawan, who lives locally and is a researcher of Ifugao culture, says, “Mini hydropower generation entails sustainable development of a local resource, and development that contributes to the local economy of areas such as Ifugao is welcome. The concept of the proposed project is a prime example of developing local resources (mini hydropower development) and restoring the profits back to the community (rice terrace conservation). Such development is well suited to the current lifestyle of Ifugao people while sustaining the traditional culture and this may be described as a project that actively conserves the traditional cultural heritage of the Ifugao.”

Also, Mr. Raymond Vinbino, who has been involved with the rights of indigenous peoples for many years since the time of the Office of Muslim and Cultural Communities[8], which was the predecessor of the National Commission on Indigenous People (NCIP), had the following to say in an interview: “This project has involved and accepted numerous persons of Ifugao Province during the survey stage. I firmly believe that the project will not impart major negative impacts on the lives and culture of the Ifugao people. Even if there are some negative impacts in the development stage, these are far outweighed by the positive effects of the project.”

(2) Indigenous Peoples Rights Act (IPRA: RA 8371)

The Indigenous Peoples Rights Act (IPRA, RA8371) was enacted in 1997 against a backdrop of increasingly conspicuous land and resources development problems, in particular mineral resource rights. This law stipulates, “indigenous peoples, and their culture and society shall have priority when it comes to the collection, extraction, development and utilization of natural resources on the traditional lands of ancestors.”

Based on this law, the National Commission on Indigenous Peoples (NICP) was established under the Office of the President. This agency compiles and implements policies, plans and programs for granting, protecting and promoting the rights of indigenous peoples, and their culture and society, and it has 12 regional offices and 46 provincial offices throughout the country.

(3) Implmentation of Free Prior Informed Consent (FPIC)

Out of the 152 ethnic groups mentioned above, since Ifugao Province is regarded as home to the Ifugao Indigenious Community, the developer of Project must obtain Free Prior Informed Consent (FPIC) from the local residents living within the impacted area of the Project based on the IPRA Law.

The National Commission on Indigenous Peoples (NICP) will implement the FPIC based on application

[8] Established in 1984

from the developer (Provincial Government of Ifugao in the case of the Project). Assuming there are no problems in particular, the period from application to issuance of the Certificate of Pre-condition will be no longer than 55 days according to law. It is necesary for the developer to acquire the certificate prior to the start of the Project (start of construction). Therefore, it is important for the developer to implement ample advance explanations to residents in order to secure their basic consent in the early stage of the Survey.

Ifugao Provincial Government has already instigated application to the NCIP provincial office for the FPIC concerning the Project hydropwoer development. Next, a Field Based Investigation (FBI) team comprising staff of the NCIP regional office or provincial office will visit the Project site to conduct hearings with the local residents and Provincial Government of Ifugao and then implement public consultation three times. In the fist public consultation, which will have participation from the NCIP study team and local residents, the NCIP will give explanations about FPIC and the rights of indigenous peoples, etc. In the second public consultation, which will have participation from the NCIP study team, local residents and developer, explanations and a question and answer session will be conducted. The third public consultation will be an opportunity for local residents to make a decision, and if consent for the Project is secured here, the Memorandum of Agreement will be signed between the local residents and developer in the presence of the NCIP. The NCIP will issue the Certificate of Pre-condition following signing of the Memorandum of Agreement.

1-3-8 Environmental Checklist

Table 1-26 shows the environmental checklist under JICA guideline.

Table 1-26 Environmental Checklists

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N/A (b) N/A (c) N/A (d) N	(a) Based on procedural manual for DAO2003-30 (EIS guideline), run-of-river type hydropower project is classified as Category-D which means non-coverage under Philippines Environmental Impact System (EIS). The Likud project is not required EIA/IEE. (b) On-going process pending issuance the certificate of Non-Coverage (CNC). (c) N/A (d) No.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) The series of public consultations at Provincial & Municipal level: 3 times, Brangay/village level:3. During the FS stage, the stakeholders meetings were conducted three times at each level. The stakeholders fully understood the contents of the project, and they strongly support the project. (b) Community's concern is priority given to water supply to rice field and farm crops rather than power generating.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) we examined alternative plans by assessing several schemes and conducted socio-environmental studies to mitigate the impact to the communities and environment.
2 Pollution Control	(1) Water Quality	(a) Does the water quality of dam pond/reservoir comply with the country's ambient water quality standards? Is there a possibility that proliferation of phytoplankton and zooplankton will occur? (b) Does the quality of water discharged from the dam pond/reservoir comply with the country's ambient water quality standards? (c) Are adequate measures, such as clearance of woody vegetation from the inundation zone prior to flooding planned to prevent water quality degradation in the dam pond/reservoir?	(a) N/A (b) N/A (c) N/A (d) N (e) N/A	(a) The scheme of hydropower development is run-of-river type so there will be no stored or stagnant water to cause any biological impairment (b) not applicable (c) not applicable (d) The project will abide by the rule of National Water Resources Board (NWRB) that 10% of 85% probable discharge in the flow duration will be retained as river maintenance flow and also the water used by the power plant will flow back to the river at the tailrace point without consuming/reducing the amount (of water) diverted at the intake.

		(d) Is there a possibility that reduced the river flow downstream will cause water quality degradation resulting in areas that do not comply with the country's ambient water quality standards? (e) Is the discharge of water from the lower portion of the dam pond/reservoir (the water temperature of the lower portion is generally lower than the water temperature of the upper portion) planned by considering the impacts to downstream ar		(e) not applicable
	(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a) The excavated materials will be treated properly since these will be used as construction materials, excess aggregates will be deposited in properly identified areas with considerations to its effects on the environment.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no protected area within the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) Is there a possibility that the project will adversely affect downstream aquatic organisms, animals, plants, and ecosystems? Are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that installation of structures, such as dams will block the movement of the migratory fish species (such as salmon, trout and eel those move between rivers and sea for spawning)? Are adequate measures taken to reduce the impacts on these species?	(a) N (b) N (c) N (d) N	(a) Private forest and farm land within the project site. (b) There is no valuable habitats and endangered species. (c) The project will abide by the rule of NWRB that 10% of 85% probable discharge in the flow duration will be retained as river maintenance flow and also the water used by the power plant will flow back to the river at the tailrace point without consuming/reducing the amount (of water) diverted at the intake. (d) There are no migratory fish species that could be affected.

	(3) Hydrology	(a) Is there a possibility that hydrologic change due to the installation of structures, such as weirs will adversely affect the surface and groundwater flows (especially in "run of the river generation" projects)?	(a) N	(a) There will be reduction in the flow between the weir intake and the powerhouse but since there will be a 10% river retention flow, no adverse effect is expected. The groundwater will not be adversely affected since no subsurface flow will be extracted from the ground. The existing intake weir for irrigation canal will be reinforced, and will be utilized also for power generation. There will be no hydrologic change.
	(4) Topography and Geology	(a) Is there a possibility that reductions in sediment loads downstream due to settling of suspended particles in the reservoir will cause impacts, such as scouring of the downstream riverbeds and soil erosion? Is there a possibility that sedimentation of the reservoir will cause loss of the storage capacity, water logging upstream, and formation of sediment deposits at the reservoir entrance? Are the possibilities of the impacts studied, and adequate prevention measures taken? (b) Is there a possibility that the project will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas (especially in run of the river generation projects and geothermal power generation projects)?	(a) N/A (b) N	(a) The scheme of hydropower development is run-of-river type so there will be no reduction along the river. (b) Minor alteration along the headrace (width:2m, height:1.4m, length:1.8km), settling basin (width:6.5m, length: 23m), head-tank (width:6.2m, length:14m), and penstock (diameter: 85cm, length:150m) will be built on a rice field and private forest land.

4. Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a)N /A (b) N/A (c)N /A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No resettlement because there no residential within a project site. (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A

4. Social Environment	(2) Living and Livelihood	(a) Is there any possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there any possibility that the project causes the change of land uses in the neighboring areas to affect adversely livelihood of local people? (c) Is there any possibility that the project facilities adversely affect the traffic systems? (d) Is there any possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (e) Is the minimum flow required for maintaining downstream water uses secured? (f) Is there any possibility that reductions in water flow downstream orseawater intrusion will have impacts on downstream water and land uses? (g) Is there any possibility that water-borne or water-related diseases (e.g., schistosomiasis, malaria, filariasis) will be introduced? (h) Is there any possibility that fishery rights, water usage rights, and common usage rights, etc. would be restricted?	(a) N (b) N (c) N (d) Y (e) Y (f) N (g) N (h) N	(a) No. (b) The total affected area is around 1.5ha, and there are no residents inside the project area. (c) There is no adversely impact by the project since the project site is located in rural area wherein there are only few vehicles passing by. Even during the construction, most of the works will be manually implemented, only a few trucks and heavy equipment will be used. (d) In accordance with Renewable Energy Safety, Health and Environment Rules and Regulations of 2012 (RESHERR), Health program, such as health examination, management and treatment of occupational injuries and disease, immunization, health education and counseling etc. will be implemented. (e) The project will abide by the rule of NWRB that 10% of 85% probable discharge in the flow duration will be retained as river maintenance flow. (f) The project will abide by the rule above mentioned and also the water used by the power plant will flow back to the river at the tailrace point without consuming/reducing the amount (of water) diverted at the intake. During hottest season, if a river flow is very small, supply water for irrigation canal is prior to the generation of power plant, thus the power plant has to stop the operation. (g) Since there will be no reservoir or resorted water for generating power, such disease will be very low possibility. (h) Necessary water for the irrigation canal is around /s 0.02m3/s for 7.45 Ha of rice fields. 0.136m3/s is the required river maintenance flow. As the river maintenance flow is larger than water for irrigation, no conflict by water usage right. There is no other right.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There are no sites with archeological or religious significance in the project area based on the surveys conducted. Although the project will be located close to the rice terraces, the facilities were planned to have no negative impact on the people, their culture as well as the environment/surroundings.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no tourism spot within/near the project site. You won't see any power generation facility from major access road.

4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a) Y (b) Y	(a) The provisions of the MOA between the Indigenous Peoples (IPs) and the proponent (the PGI) will make sure that impacts to IPs will be mitigated pursuant to the Indigenous Peoples Rights Act or IPRA Law implemented/regulated by the National Commission on Indigenous Peoples (NCIP), (b) The NCIP conducted Field-Based Investigation and now getting the Free and Prior Informed Consent (FPIC) from the host community, these processes will make sure that IPs concerns were respected.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) The contractor will follow the existing national and local labor law and codes (PD 442 or Labor Code of the Philippines). (b) As safety measure, the contractor will be required to follow safety protocols during the construction period (based on Occupational Safety and Health Standards). (c) The contractor will be required to implement the safety training, and establishment of safety and health program pursuant to the DOE Circular 2012-11-009 or the Renewable Energy Safety, Health and Environment Regulations (RESHER). (d) The regulation is included in the provisions of the RESHER.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	(a) Y (b) N (c) N	(a) Contractor will be required to implement the mitigation measures as stated in their occupational health and safety program such as use of ear mufflers, safety nets, proper waste disposal and other best practices in good housekeeping. Construction activates will also be done during daytime in order not to disturb the resting time of the residents. (b) The scheme of hydropower development is run-of-river type so there will be no impounding, and therefore no adverse effect to environment. (c) There is no adverse impact to social environment. The project is expected to bring positive economic benefits to the community. Jobs will be created as result of the construction and operation of the project.

	(2) Accident Prevention Measures	(a) Is a warning system established to alert the inhabitants to water discharge from the dam?	(a) N/A	(a) not applicable
5 Others	(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) – (c) Y (d) Y	(a) Since the small hydro power project (820kW capacity) will be implemented in rural mountainous area. The project site is far from residents; hardly hear the noise of construction. Most of construction works will be manually taken, only some heavy equipment will be used, therefore minor air pollution will be observed. Only muddy water during intake weir construction shall be taken into consideration, establishment of settling basin to release clearer water to the original river as mitigation measure will be necessary. DOE and PGI with the local environmental office, will implement monitoring program in accordance with DAO2003-30, Chapter 7.3 Monitoring Protocol, letter B, Self-monitoring (b) Water (Seminar-annual), Air (Semi-Annual), Noise (Semi-Annual), and Health and Safety (Daily). (c) During the construction stage, DOE, HOEMD will be responsible, while the operation time, PPDO of PGI will be responsible for monitoring. (d) DENR-EMB Procedural Manual for DAO2003-30. Chapter 7.3 Monitoring Protocol, letter B, self-monitoring.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects in the mountains including large areas of deforestation). (b) In the case of dams and reservoirs, such as irrigation, water supply, and industrial water purposes, where necessary, pertinent items described in the Agriculture and Water Supply checklists should also be checked. (c) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N/A (b) N/A (c) Y	(a) not applicable (b) not applicable

	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No impacts to global issues as a small project with no impacts to environment
1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from				
international standards, appropriate environmental considerations are requested to be made.				
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries				
(including Japan's experience).				
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and				
the particular circumstances of the country and locality in which it is located.				

1-3-9 Other Information (Global Issues)

As is indicated in Chapter 2 Section 2-1, construction of mini hydropower plants in Ifugao Provicne is expected to contribute to the stabilization of the provincial power supply and reduction of greenhouse gas emissions. Moreover, revenue from the sale of power will be used for the rice teraces conservation fund and contribute to improving the livelihood of local residents engaged in cultivating the rice terraces. In this way, the Project will contribute to the mitigation of global issues.

The Project will be implemented as part of the Green Growth Promotion (New Energy Introduction Promotion) Program in accordance with the fiscal 2012 priority policy for international cooperation (Ministry of Foreign Affairs, International Cooperation Division). Therefore, consideration is given to utilizing products made by Japanese small and medium enterprises as the key components in the mini hydropower development equipment (turbine). In line with this, in the procurement plan for the hydropower generating equipment in the Project, the procurement specifications are compiled in consideration of the technologies and production capacity of Japanese small and medium enterprises (see Chapter 2 for details).

Meanwhile, the Project target area has unique culture and indigenous technology, for example, watershed protection forest systems and small-scale irrigation channel construction technology, etc. that is geared to constructing and maintaining the rice terraces. Because showing consideration for local culture and utilizing indigenous technologies will be effective for minimizing impact on the local environment and maintaining the power plant, the Project facilities design and execution plan has been compiled assuming basically no utilization of large machinery that would require construction of temporary roads and giving consideration to adopting the traditional subcontracting method (“*Pakiyaw*”) for constructing irrigation channels.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

In October 2008, the Government of the Philippines enforced the Renewable Energy Act of 2008, R.A. 9513 (hereinafter referred to as the "RE Act") - the first comprehensive legislation on renewable energy in Southeast Asia. This Act has the objectives of improving the self-sufficiency of energy supply, strengthening the capacity of central and local governments via development of renewable energy, and balancing economic growth with environmental protection. Furthermore, the Government of the Philippines in June 2011 announced the National Renewable Energy Program with the goal of increasing the amount of power generated from renewable energy by three times (to approximately 16,200 MW) over the 2010 level by 2030.

Because the Philippines relies on imported fossil fuels to cover around 40% of its power generation requirement, implementation of the Project can be expected to promote the utilization of renewable energy based on domestic water resources, and thereby contribute to energy security and reduction of greenhouse gas emissions.

In these circumstances, the Government of Ifugao Province enacted the Mini Hydro Electric Power Plant Development Program Ordinance (Ordinance No. 2007-045) geared to expanding the provincial development budget, reducing power tariffs in the province and securing funds for preservation of the rice terraces in 2007 prior to enactment of the RE Act. Based on this, it has been promoting development of hydropower within the province.

Against the aforementioned background, assuming the overall goal to be to make a contribution towards realizing the goals of the RE Act, the National Renewable Energy Program and the Ifugao Province Mini Hydro Electric Power Plant Development Program Ordinance, the Project will be implemented with the purpose of expanding the RTCF, stable energy supply with lower electric tariff rate for preservation of the rice terraces of Ifugao.

2-1-2 Outline of the Project

Through constructing Likud mini hydropower plant (maximum output 820 kW) in Barangay Haliap in Asipulo Municipality, Ifugao Province, the Project intends to promote utilization of domestic renewable energy, and thereby contribute to the diversification of energy sources and reduction of greenhouse gas emissions. Moreover, through disseminating electricity and directing revenue from power sales to the RTCF, it will contribute to the conservation of tourism resources.

(1) Hydropower Equipment

The hydropower generating equipment is composed of the equipment and instruments indicated in Fig.2-1.

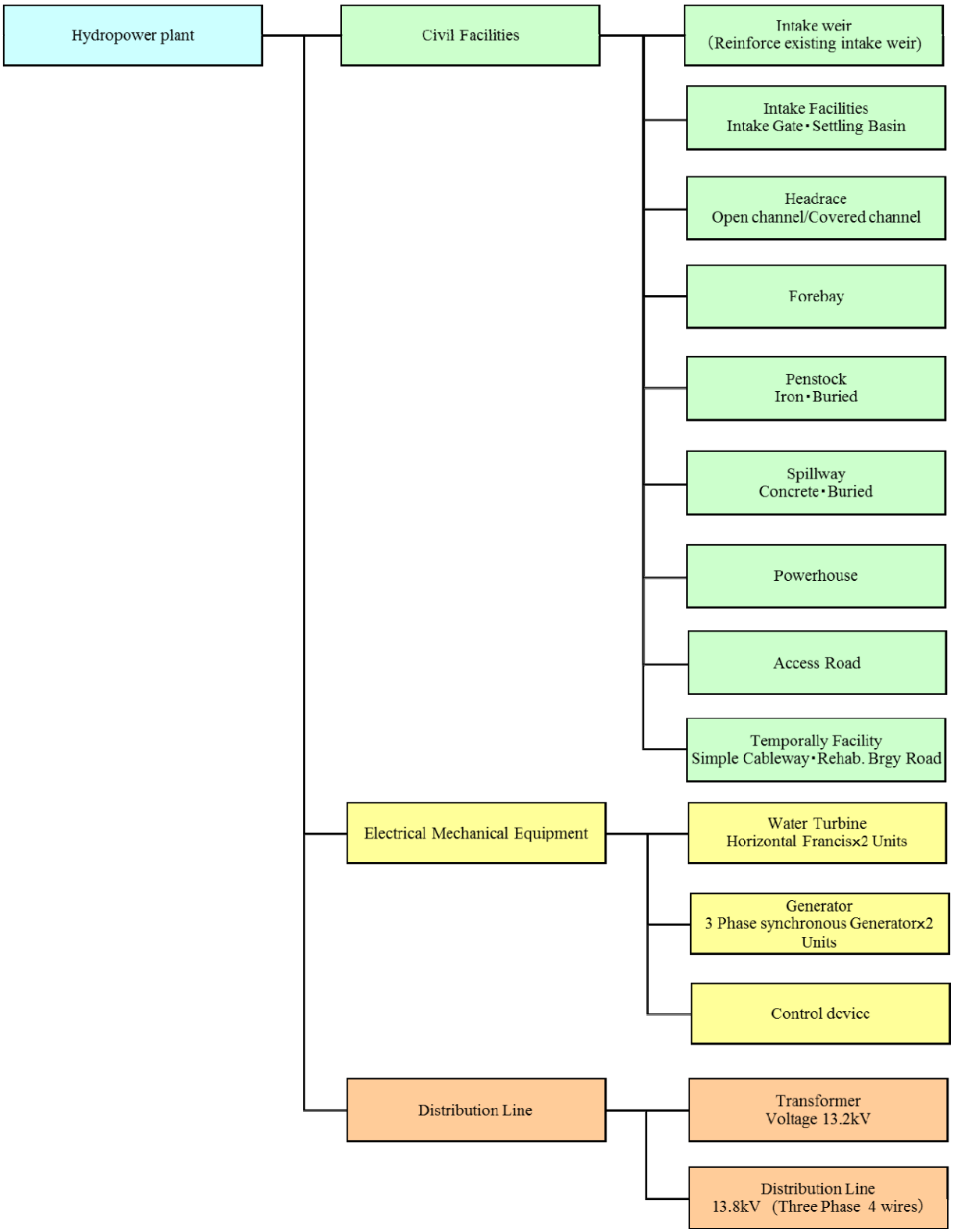


Fig. 2-1 Composition of the Hydropower Generation Equipment

(2) Repair of Existing Irrigation Facilities

The intake weir to be used in the Project was originally constructed with the aim of supplying water to paddy fields on the right bank downstream of the intake point, however, it has lost its inherent function because part of the water channel has been washed away by flooding. During the preliminary survey conducted by JICA in March 2012, it was confirmed that the local residents strongly desire the repair of the irrigation channel. As a result of confirming the required water flow and repair method in the first field survey, since it was found that this will have no impact on the hydropower project and the repair work is relatively easy, it was decided to add this to the Project components.

Fig. 2-2 shows the contents of the repair work.

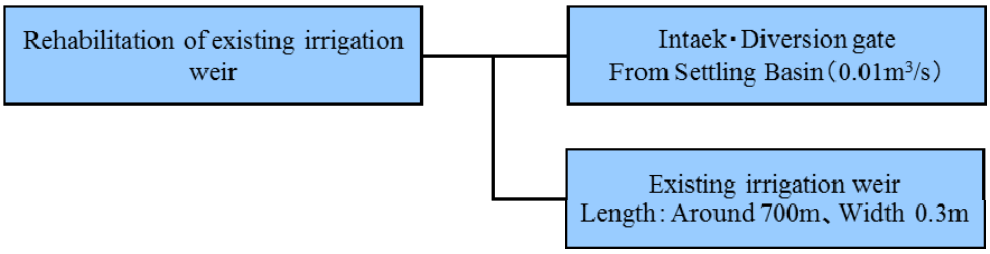


Fig.2-2 Contents of Rehabilitation of Existing Irrigation Facilities

(3) Soft Component

The Project aims to contribute towards the stable supply of power in Ifugao Province through constructing a mini hydropower plant, and to sustain the preservation of rice terraces through utilizing some of the earnings from the sale of generated power to strengthen the Rice Terraces Conservation Fund.

The soft component indicated in Fig.2-3 will be implemented in order to ensure that the Project effects are definitely realized.

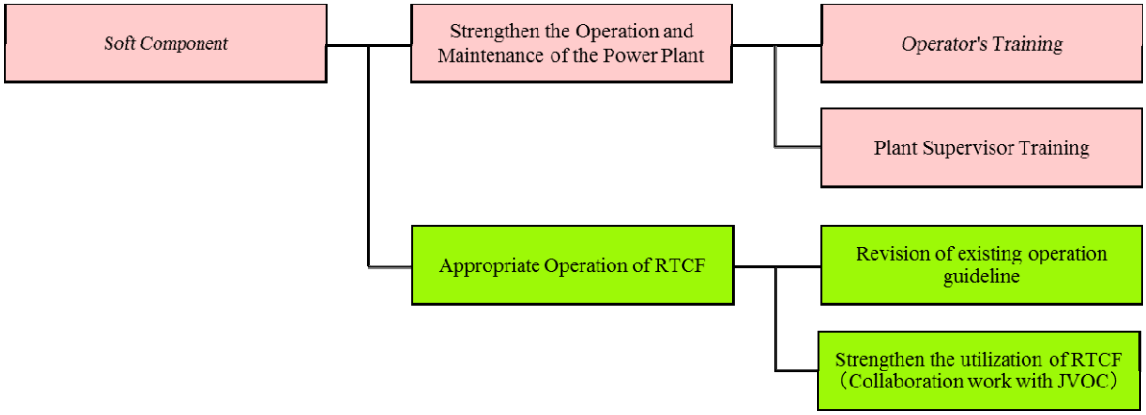


Fig.2-3 Composition of the Soft Component

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

The Project contents were designed based on the following policies upon considering the request from the Philippine side, the field survey findings and the results of the discussions with the provincial government, which will be the implementing and operating agency for the Project.

(1) Technical Implementation Policy

The plan for Likud mini hydropower plant was compiled based on the following basic policy.

- ✧ Improve the power supply and demand situation in Ifugao Province, which depends on external power supply to provide 91% of its annual power requirement of 13,576 MWh (2011).
- ✧ Secure as much of the necessary funding for the RTCF (30~50 million pesos per year) as possible.
- ✧ Be able to respond to fluctuations in daytime and nighttime demand, and avoid exerting impact on the higher level National Grid Corporation Philippine (NGCP) as much as possible.

(2) Technical Standard and Cost Estimate Standard in the Project

The technical standards and cost estimate standards that are required in implementing the Project will basically be adopted from the standards used by the host local government, but Japanese and international standards will be referred to in situations where the local standards are insufficient or unclear. Concerning design of civil engineering and electrical and mechanical equipment, the Hydropower Development Guide Manual (March 2011) prepared by JICA will be referred to. As for power transformation and transmission equipment, it has been decided to conduct the design based on standards prescribed by the National Electrification Administration of the Philippines.

Table 2-1 shows the main technical and cost estimate standards that need to be prepared in the Survey for the Project.

Table 2-1 Technical Standard and Cost Estimate Standard Used in the Project

Name		issue	Remark
Philippines	Guide on Mini-Hydropower Development in the Philippines	DOE	Regulation on development scale, procedure, etc based on “Mini-Hydroelectric Power Incentives Act” (Act. No. 7156)
	Manual for Design, Implementation and Management for Micro-Hydropower Development ;June 2009	DOE -EUMB	Technical manual prepared on JICA technical cooperation project “Rural Electrification Project” covering lower than 1MW scale
	Philippine Grid Code Jan,2001	ERC	Criteria for transmission
	Distribution Code Jan,2001	ERC	Criteria for distribution
	Philippine Electric Code (PEC)	ERC	Electrical standard in the Philippines
	NEA Regulation	NEA	Regulation by NIA
Japan	Technical Standard for Hydropower Facilities	METI	
	Technical Standard for Electrical Facilities	METI	
	Technical Criteria for River Works	MILT	
	Standard Specification of Concrete Structures	JSCE	
	Technical Standard for Gate & Penstock	JHGPA	

	Criteria for Transmission/Substation	JESC	
	Technical Requirement Guideline for Interconnection	METI	
	Technical Guideline for Interconnection by Distributed Generation	JEA	
	Technical Guideline for Design of Steel Structures, Mini-hydropower Edition	MAFF	
	The Institute of Electrical Engineers of Japan	JEC	
	Standard Criteria of JEMA	JEMA	
	Electric Technology Research Association	ETRA	
	Standard for Cost Estimation on Civil Works	MILT	
	Estimation Table for Machinery Ownership Rate	MILT	
	Standard Yardstick for Construction	CRI	
Reference	Guideline and Manual for Hydropower Development Vol.2 Small Scale Hydropower	JICA	Technical manual for rural electrification on mini-hydropower under 500kW

(3) Design Concept

In this project according to the policy by Government of Japan, Turbine, Generator and Control System are designed on the assumption to utilize the elaborated products fabricated by Japanese small, medium scale enterprise. On that basis, Outline design was conducted with following basic policy.

<Utilization of Local Traditional Civil Engineering Technology>

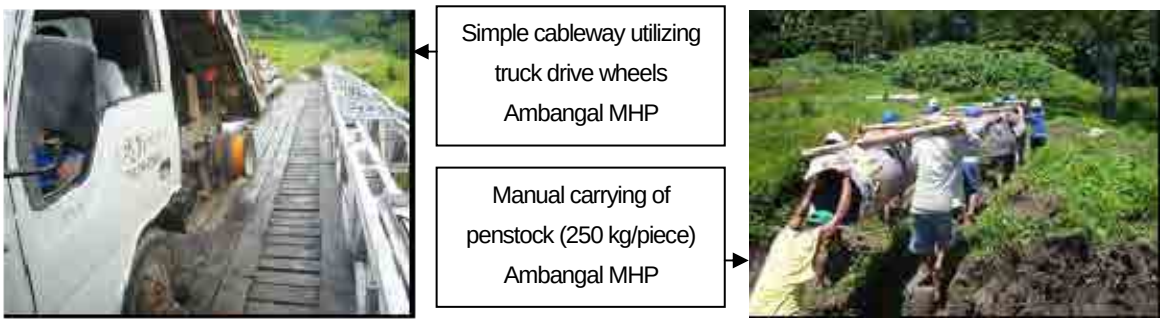
Ifugao is home to unique stone masonry technology typified by the rice terraces, and it boasts the highest levels of accuracy and reliability in the northern part of Luzon Island. This stone masonry technology was also used in constructing the intake weir, headrace and power plant foundations in the Ambangal MHP project. Another advantage of utilizing such traditional local technology is that damage and so on occurring after completion can be immediately responded to.

The construction site for Likud mini hydropower station is entirely private land[1], while the surrounding area contains rice terraces[2], and watershed protection forest locally referred to as *Muyon*. When executing the main structural works, it will be necessary to minimize or avert any impacts on these features. In planning the layout of facilities and execution of works in the Project, it will be necessary to avoid the construction of roads for carrying in machinery and materials. Even if such roads are temporarily constructed, steps will need to be taken to ensure that they can be jointly utilized as the headrace route or converted to use as Municipal Road/Barangay Road in the future. Local construction operators who have worked under similar conditions have learned how to carry equipment and materials by simple cableways, and cableway was also used in the Ambangal MHP project. In view of this, the simple cableway will be utilized in the Project in an effort to minimize impacts on the local environment. Furthermore, due to the work conditions already described, since use of construction machinery such as excavator, etc. will be restricted in the Project; manual labor will be relied on to implement almost all the works. Laborers will basically be recruited locally, however, since many

[1] Not including existing roads inside river areas.
[2] Since the higher goal of the Project is the conservation of rice terraces, it will basically be necessary to decide the water channel route and location of major facilities so that there is no impact on the rice terraces.

laborers are also farmers, it may be difficult to secure sufficient labor during the farming season. Moreover, some landowners are averse to having laborers from outside areas enter their land[3].

In the Ambangal MHP project, the traditional sub-contracting system locally known as *Pakyaw*[4] was utilized and allowed the said project to finish on schedule. Since it will be essential to smoothly execute the main structural works in the Project too, an implementation plan that complies with local culture and customs including use of *Pakyaw* will be compiled.



(4) Concept for Rehabilitation of Existing Communal Irrigation System

Rehabilitation of the existing irrigation system in the Project will target the rice paddies indicated in Fig. 2-4 and aim to supply a maximum of 10 liters/second to an area of 2.43 hectares (2.43 ha x 2 l/s + allowance). The irrigation channel will be constructed adjoining the power system headrace.

Fig.2-4
Target Area of the Rehabilitation

[3] Ifugao Province was a place where the former Japanese Imperial Army was defeated in WWII and many locals believe that treasures left behind by the army are still buried in the area. This explains why they are averse to entry by outsiders. In the former JBIC survey and e8 project, this factor was frequently an impediment to survey and construction work.

[4] In this method, the main contractor binds a sub-contract with the landowner concerned, and the landowner takes responsibility for securing labor and finishing the works within the contract period. This approach has been widely adopted in irrigation channel works and so on around Ifugao.

(5) Concept for Soft Component in the Project

In order to achieve the Project objectives, it is essential to secure the stable operation of the mini hydropower plant and appropriate utilization of the RCTF. The soft component has been compiled in order to help the host local government build its systems, etc. more certainly and effectively.

(6) Policy for Setting Quantitative Effect Indicators

The following three items are set as indicators for assessing the quantitative effect of the Project:

① Annual effective electric power
② Reduction in greenhouse gas emissions

The above indicators are basically predicated on the assumption that evaluation is conducted three years following the start of operation (excluding power generating output). The setting conditions and setting methods are indicated below.

1) Annual effective electric power

Since the annual effective electric power fluctuates greatly[5] according to the river flow/weather conditions, the target annual effective electric power is set by the following method:

a. Use the converted flow regime (conversion coefficient 0.66) from the existing Hapao water observation post.
b. Out of the period for which observation records exist (six years between 2004~2009), the years targeted for calculating the annual effective electric power are 2007, 2008 and 2009, when the river flow was low, and the mean flow regime (series method) is calculated based on these materials (see Fig. 2-5).
c. If the water intake flow (the flow following deduction of the river maintenance flow, etc. from the river flow) is greater than 1.0m^3/s (rated flow for one water turbine), the possible electric power is calculated as follows upon considering the output limit based on the nighttime low-power demand.

   GEi＝Pmax.i x 16hr + 410kW x 8hr

   GEi : Possible electric power (kWh) on the day concerned (kWh)

   Pmax.i : Possible maximum generating output on the day concerned (kW)
d. Deduct the river maintenance flow from the river flow. (Maintenance flow 0.136m^3/s, Cot-Cot irrigation 0.010m^3/s)
e. Concerning the stoppage factor for calculating the effective electric power, a stoppage factor of 5% for distribution network stoppages is added to the conventional stoppage factor of 5%, and the effective electric power is set at 90% of the annual possible generating output.

[5] According to existing meteorological observation results in the Project area, weather conditions in the target area fluctuate in three~five year cycles, and extreme dry years occur once every 8~11 years.

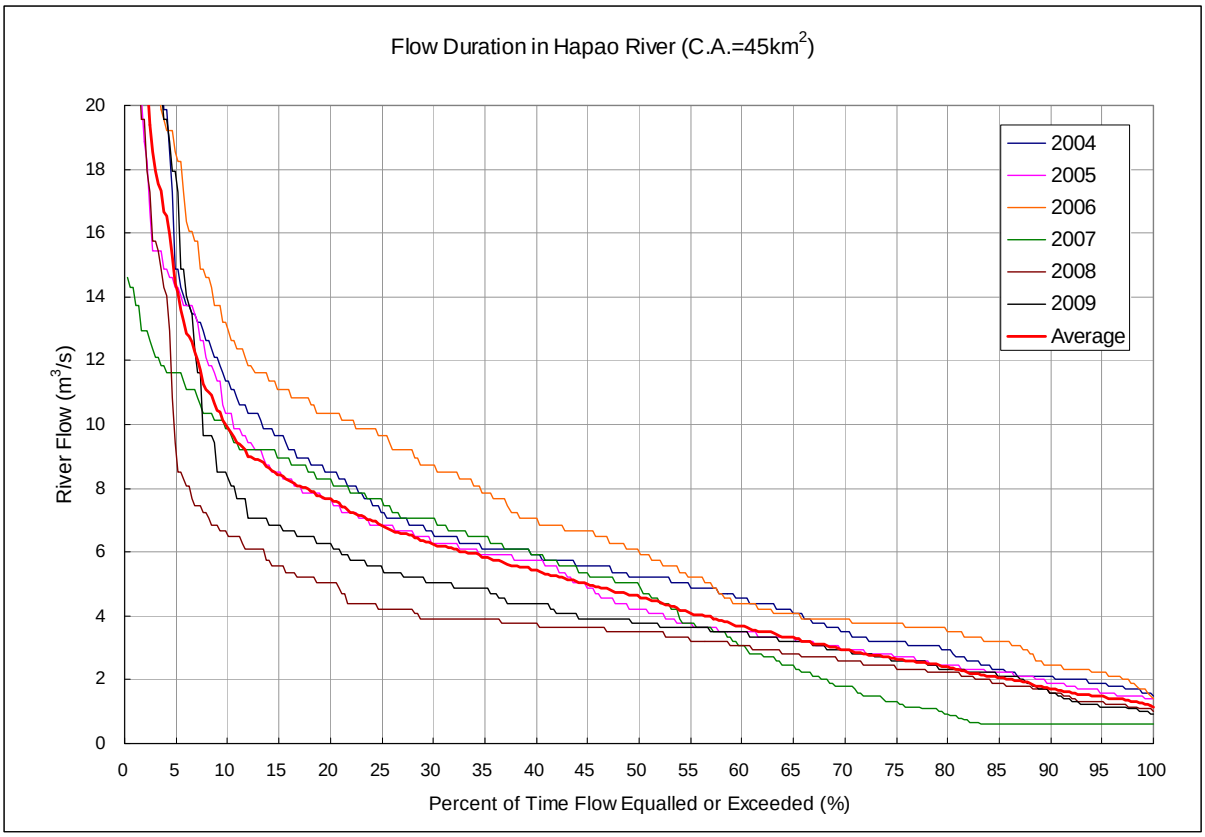


Fig. 2-5 Flow Duration Curve at Hapao Gauging Station

2) Reduction in greenhouse gas emissions

The emissions reduction is calculated according to the following Guidelines for Measurement, Reporting and Verification of GHG Emission Reductions in JBIC GREEN Operation ("J-MRV Guidelines").

① Basic thinking on the amount of emissions reduction

In the case of power generation activities, the amount of emissions reduction is calculated as the disparity between 1) emissions (baseline emissions) in the case where electric power from renewable energy is generated assuming the mean value of power at all plants in the country concerned (mean value for all power sources) and 2) emissions (project activity emissions) arising from energy consumption in the Project activity.

② Emissions reduction calculation formula

This is expressed as the difference between baseline emissions and Project activity emissions.

$ER_y = BE_y - PE_y$ ·

ER_y: Annual emissions reduction (tCO2/year)

BE_y: Baseline annual emissions (tCO2/year)

$BE_y = EG_y \times EF_{elec}$ (case of power generating project)

EG_y: Annual generated electricity (MWh/year)

EF_{elec}: Emission coefficient at all power sources (tCO2/MWh)

In the case of the Philippines, this is 0.487 tCO2/MWh at the generating end and 0.520 tCO2/MWh at the sending end.

PE_y: Annual emissions in the project activity (tCO2/year)

This isn't considered in the case of renewable energy (small-scale flow-in hydropower project).

2-2-2 Project Site

There was no hydropower development in Ifugao Province for a long time following construction of the dam type hydropower plant (Magat hydropower plant: output 360 MW) close to the border with Isabella Province in 1983, however, Ambangal mini hydropower plant was constructed in January 2010 and has been in operation ever since.

Since Ifugao Province has precipitous terrain, abundant rainfall and healthy forests, it has abundant potential hydropower resources. A survey of hydropower resources throughout the province was conducted under the "JBIC Pilot Study on Rural Revitalization Project for the Conservation of the Ifugao Rice Terraces (World heritage Site), Philippines" (the old JBIC Study) in December 2004.

According to this study, Ifugao Province has 51 potential hydropower sites possessing total output of 123,250 kW and total annual generating capacity of 907,734 MWh (see Fig. 2-6 and Table 2-2). As is indicated in Table 3-2, some of these sites have poor access or entail potential risk to nearby paddies; however, depending on the future development of infrastructure and environmental mitigation measures, there are numerous sites with high development potential. Likud site (code number AS-1 in the old JBIC Study), which is the target of the Project, is situated in one of the most economically advantageous locations among potential sites with capacity of less than 1,000 kW, and there is also hardly any risk of impact on rice paddies. Therefore, this site was put forward as the candidate for implementation of a grant aid project in the said study.

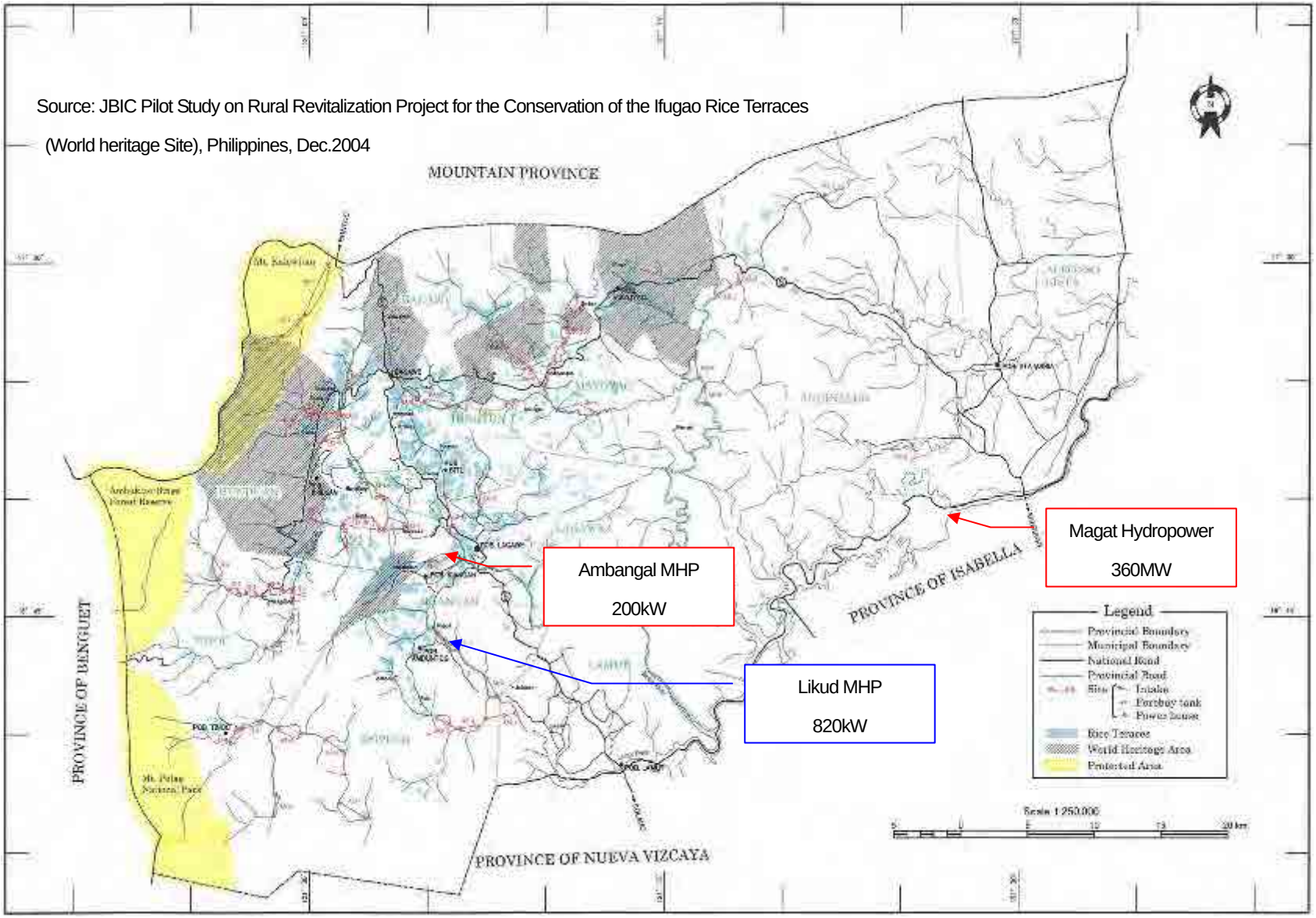


Fig. 2-6 Hydropower Potential Sites in Ifugao Province

Table 2-2 Hydropower Potential Sites in Ifugao Province

Rank	Name	P_{max} (kW)	Q_{max} (m^3/s)	He (m)	Energy (MWh)	Cost (10^3Peso)	Cost/kWh (Peso)	Screening point
1	HU-5	5,200	4.4	140.1	42,504	820,729	19.3	World Heritage
2	KI-1	6,700	10.2	78.2	54,899	1,138,420	20.7	
3	HU-10	11,100	14.3	91.6	90,701	1,920,691	21.2	Can not access
4	KI-2	13,300	24.1	65.1	108,817	2,513,056	23.1	
5	HU-4	1,200	1.4	68.0	9,781	232,752	23.8	Rice field
6	TI-6	2,000	3.2	77.1	16,394	431,990	26.4	Can not access
7	TI-4	3,400	4.3	97.0	27,778	754,312	27.2	
8	AS-4	4,600	4.4	126.3	37,659	1,064,453	28.3	Can not access
9	TI-2	2,600	3.5	88.4	21,243	603,967	28.4	Can not access
10	AS-1	880	1.1	96.6	7,285	241,371	33.1	
11	HU-2	7,200	3.7	246.3	35,960	1,309,475	36.4	Protected Area
12	HU-6	7,900	4.2	234.6	39,687	1,529,526	38.5	Rice field
13	BA-4	1,500	2.3	78.4	12,225	472,012	38.6	Can not access
14	TI-3	1,900	3.9	58.2	15,483	618,811	40.0	
15	LM-1	1,500	1.1	153.6	12,242	562,206	45.9	
16	AS-7	2,900	6.1	56.2	23,705	1,102,587	46.5	Can not access
17	TI-1	1,900	2.0	116.6	15,553	725,271	46.6	Can not access
18	MA-4	2,900	5.1	66.7	23,705	1,141,931	48.2	Can not access
19	BA-1	1,400	1.2	137.7	11,427	551,292	48.2	Rice field
20	KI-4	1,400	1.6	107.4	11,471	556,809	48.5	Can not access
21	HU-1	1,900	1.7	136.0	15,553	773,985	49.8	Protected Area
22	TI-7	1,500	2.0	87.4	12,220	611,466	50.0	Can not access
23	HU-3	4,500	2.9	196.7	22,588	1,130,325	50.0	Protected Area
24	HU-9	980	0.9	132.2	6,139	314,902	51.3	Can not access
25	BA-5	1,900	5.0	47.4	15,531	824,463	53.1	Can not access
26	BA-2	1,400	1.4	116.6	11,441	618,392	54.2	World Heritage
27	MA-1	1,300	1.2	137.1	10,661	583,864	54.8	World Heritage
28	BA-3	1,100	1.6	85.7	8,983	515,161	57.4	
29	AG-6	1,200	1.5	96.6	9,802	562,443	57.4	Can not access
30	HU-8	840	1.0	68.1	6,877	398,116	57.9	Can not access
31	AS-6	870	1.6	67.1	7,033	409,290	58.2	Can not access
32	TI-8	1,300	1.3	116.5	10,604	630,105	59.4	Can not access
33	AG-4	1,400	3.3	53.2	11,476	700,065	61.0	Can not access
34	TI-9	1,200	1.4	97.1	9,776	604,642	61.9	Can not access
35	MA-2	920	1.4	78.1	7,611	514,011	67.5	Can not access
36	AG-1	570	0.8	86.8	4,747	330,999	69.7	Can not access
37	AS-5	1,400	5.2	32.7	11,432	800,042	70.0	Can not access
38	TI-5	910	4.0	28.3	7,370	521,036	70.7	
39	HU-7	900	1.0	117.7	6,461	459,586	71.1	Can not access
40	AG-3	800	1.7	58.2	6,545	473,081	72.3	Can not access
41	AG-2	560	1.2	58.1	4,581	350,966	76.6	Can not access
42	MA-3	760	1.6	57.6	6,292	521,042	82.8	
43	AS-3	670	1.0	77.9	5,505	466,213	84.7	Can not access
44	LG-1	1,800	0.8	274.9	9,089	778,905	85.7	Rice field
45	AG-5	7,800	32.8	28.2	41,610	3,867,607	93.0	Can not access
46	BA-6	1,200	1.3	117.3	5,874	594,369	101.2	Rice field
47	KI-3	380	0.3	155.7	1,964	216,930	110.5	
48	HI-1	850	0.8	135.5	6,879	778,151	113.1	Can not access
49	AS-2	260	0.6	58.1	2,132	316,821	148.6	
50	BA-7	440	0.6	96.8	3,595	582,272	162.0	Can not access
51	LG-2	160	0.3	67.8	1,046	340,814	325.8	Rice field

Source: JBIC Pilot Study on Rural Revitalization Project for the Conservation of the Ifugao Rice Terraces (World heritage Site), Philippines, Dec.2004

2-2-3 Basic Plan

2-2-3-1 Overall Plan

Concerning the overall plan for the Project, examination on the FS level was conducted in "the JICA Study for promoting implementation of environmental development project (Mini-hydropower scheme)" (the FS Study) in September 2011. In the Survey here, however, revisions have been made to the detailed power generation route and development scale following additional survey based on the FS Study findings.

(1) Route of the Power Plant

1) Location of the Intake

As a result of the field survey, considering the following points, as in the FS, it has been decided to rehabilitate and utilize the existing intake facility of irrigation.

- There is no other appropriate location for installation of intake facilities in the surrounding area.
- In the event where the intake facility is moved upstream from the existing irrigation water intake, it would be difficult to construct the headrace due to steep cliffs in the immediate area.
- In the event where the intake facility is moved downstream from the existing irrigation water intake, the head would be greatly reduced.
- In the event where a new intake facility is constructed without utilizing the existing equipment, costs would increase.

2) Headrace Route

The headrace route was selected upon conducting comparative examination on the four routes indicated in Fig. 2-7 including the zero option. As a result, as is indicated in Table 2-3, Route B was selected as the most superior from the viewpoints of technology, natural and social environmental impact and economy.

Fig. 2-8 shows the details of the optimum route.

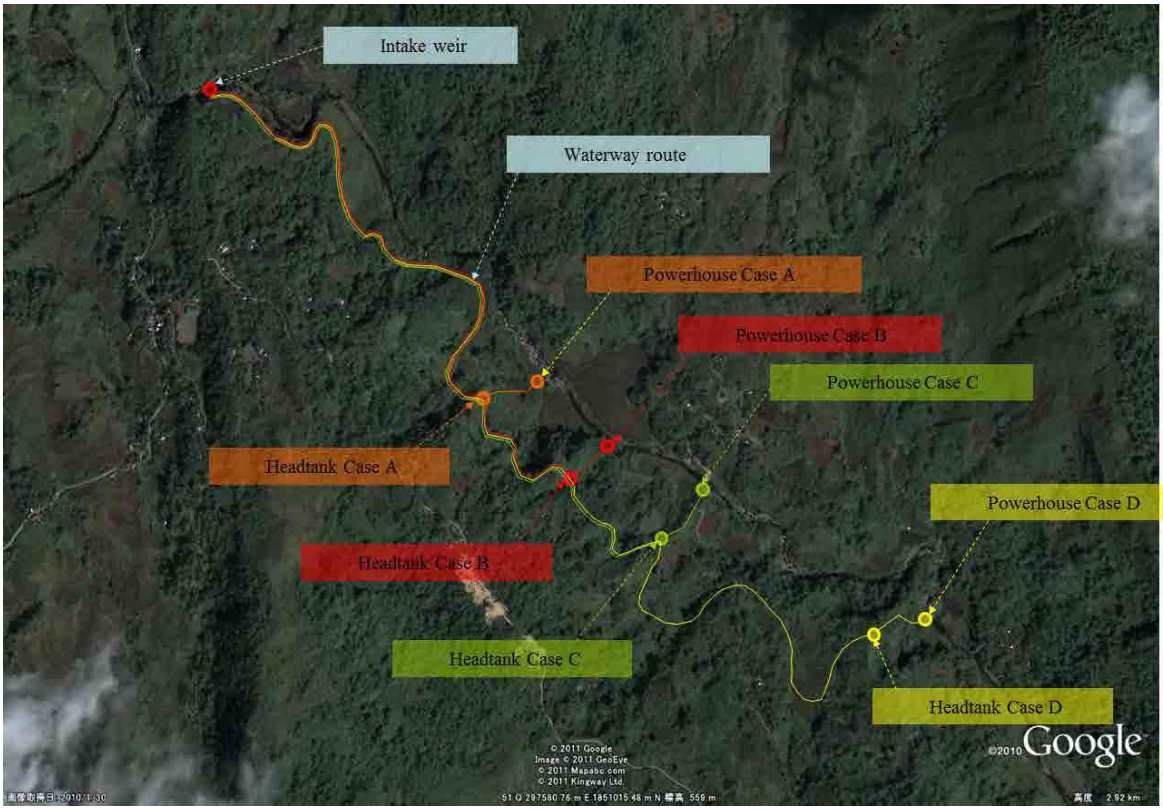


Fig. 2-7 Alternatives Plans of Headrace Route

(2) Development Scale

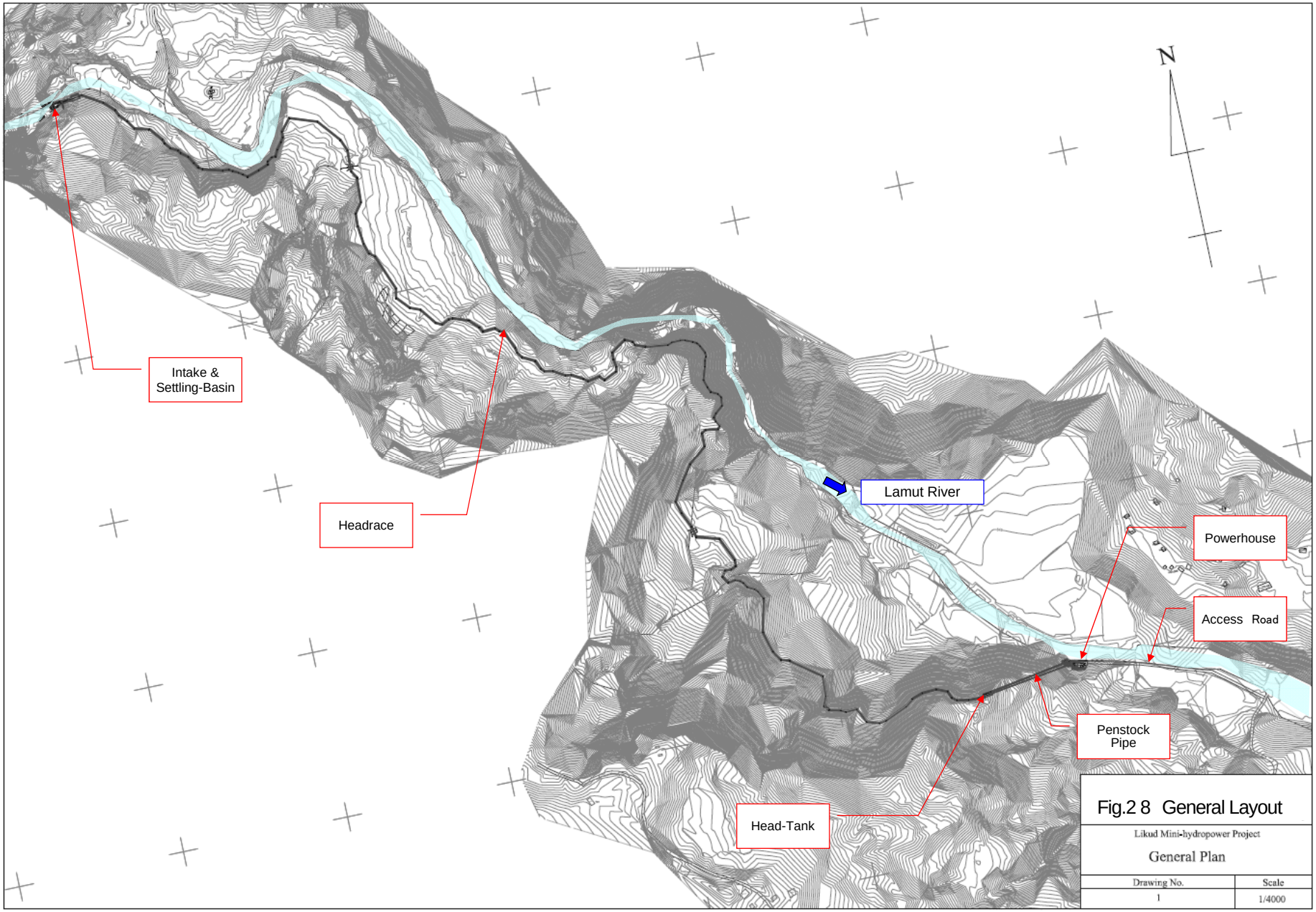
In the FS on the project that was implemented last year, the most feasible case was found to be maximum water usage of 2.0 m^3/s and maximum output of 810 kW taking into account the river flow duration indicated in Fig. 2-9, however, as a result of revising the turbine efficiency in this Preparatory Survey, the maximum output has been revised to 820 kW (the maximum water usage is the same). Assuming the maximum water usage to be 2.0 m^3/s, the system can operate at maximum output for approximately 240 days in the year.

Fig. 2-10 shows the daily load curve (excluding the daily mean generating output of Ambangal hydropower plant) in Ifugao Province from March 26 to July 25, 2012. In the Project, it is necessary to respond to the power demand indicated in Fig. 2-10. The nighttime power demand is around 400 kW, and since it would be necessary to conduct operation with low turbine efficiency (thereby risking negative impact on the turbine) in the case where one primary unit is adopted, it has been decided to adopt two main units.

Table 2-3 Results of Headrace Route Comparative Examination

Item		Unit	Route A	Route B	Route C	Route D	Zero Option
Features	Total head	M	55.0	59.0	60.0	90.0	
	Effective head	M	48.1	51.8	50.8	75.7	
	Maximum discharge	m^3/s	2.0	2.0	2.0	1.7	
	Maximum output	kW	740	820	770	990	
	Channel length	m	1,764	2,050	2,612	4,038	
	Channel length per unit head (L/H)	-	36.7	39.8	51.4	53.3	
	Annual effective generation	MWh	5,317	5,826	5,616	7,345	
	Rough construction cost	X1000 pesos	This column cannot be disclosed until the construction and procurement contracts are certified				
	Rough construction cost per kWh	Pesos/kWh					
Potential for expression	Technical issues	-	There is a barangay road that leads to the scheduled construction site, however, its alignment and gradient are unsuitable for use as a power plant access road (a permanent road designed for transporting heavy objects), and it is necessary to construct approximately 1.2km of new road.	The power plant access road can be easily installed along the river from the existing bridge approximately 300 m downstream from the site.	Because the topography and geology of the power plant site are unstable, the cost of laying the plant foundations is higher than in other plans.	A new road needs to be constructed as the power plant access road: approximately 2.2 km.	
	Natural and social environment	-	- There is no relocation of residents. - The channel route can be shortened by approximately 300 m	- There is no relocation of residents. - The channel is longer than in Route A (the route passes through	- There is no relocation of residents. - The channel is longer than in Routes A and B, and the impact on forest	- There is no relocation of residents. - The channel and power plant access road are longer than in Routes A,	- Funds for the RTCF cannot be secured and devastation of the rice terraces continues unabated.

			compared to Route B, however, it is necessary to newly construct the power plant access road (approximately 1.2 km). Moreover, since much of the access route goes through forest and it would be necessary to change the terrain and cut trees, environmental load is greater than in Route B.	grassland and shrub land and doesn't require cutting of many trees), however, the power plant access road can be easily constructed and there is little impact on forest and paddies.	and paddies is also larger than in A and B.	B and C, and the impact on forest and paddies is also the largest among the plans.	
	Economy	-	There are no merits of scale and economy is inferior to that in Route B.	This route offers the best economy.	Compared to Route B, because the effective head declines (due to the relationship between river gradient and channel gradient), economy is the lowest of all the routes.	The head is 1.5 times larger and the headrace is 2 times longer than in Route B, but economy is lower than in Routes A and B.	- The RTCF is not established. - The World Heritage rice terraces will become increasingly devastated. - Reduction of paddy rice productivity
Order		-	2	1	4	3	5


N
Intake &
Settling-Basin
Headrace
Lamut River
Powerhouse
Access Road
Penstock
Pipe
Head-Tank
Fig.2 8 General Layout
Likud Mini-hydropower Project
General Plan
Drawing No.
1
Scale
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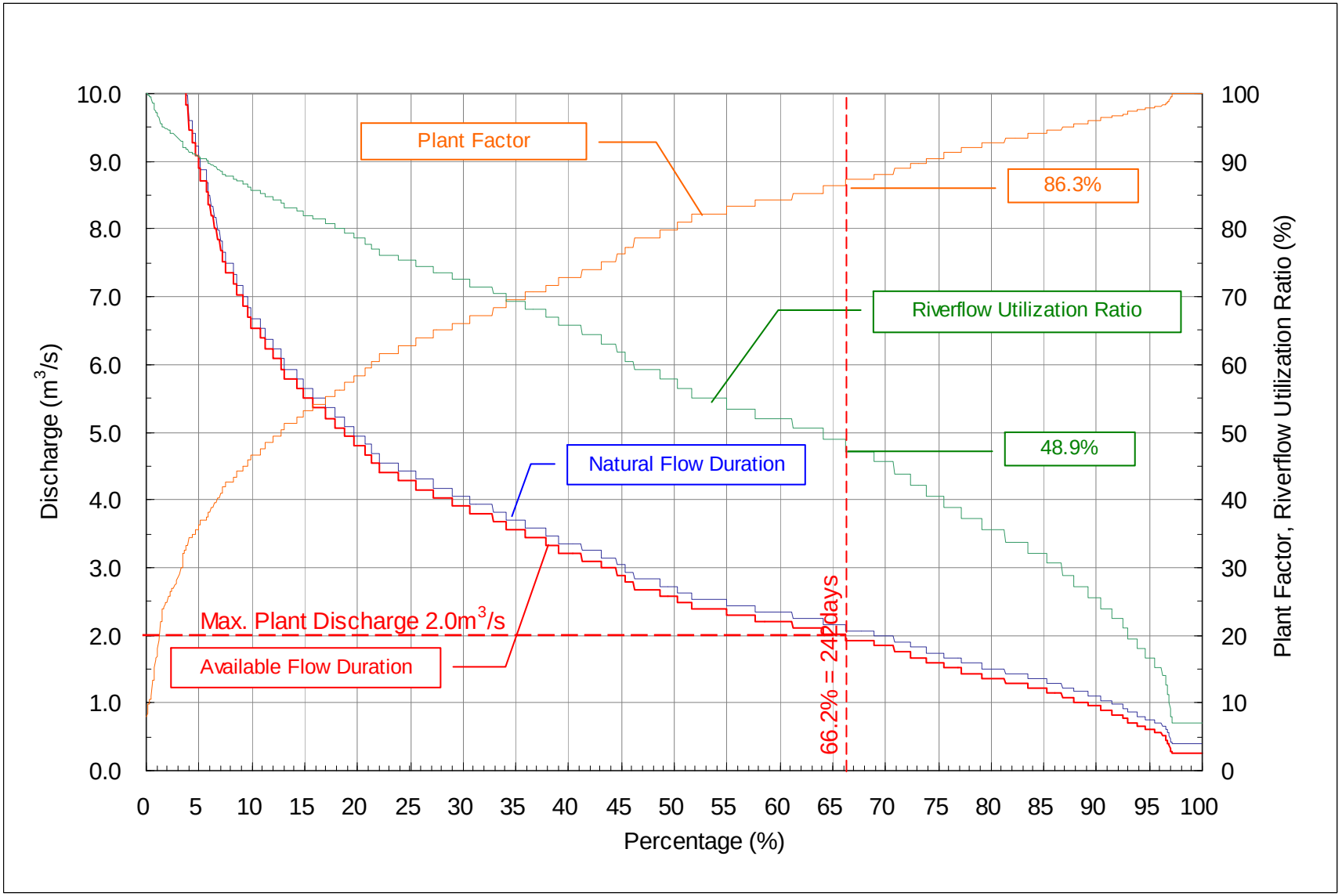
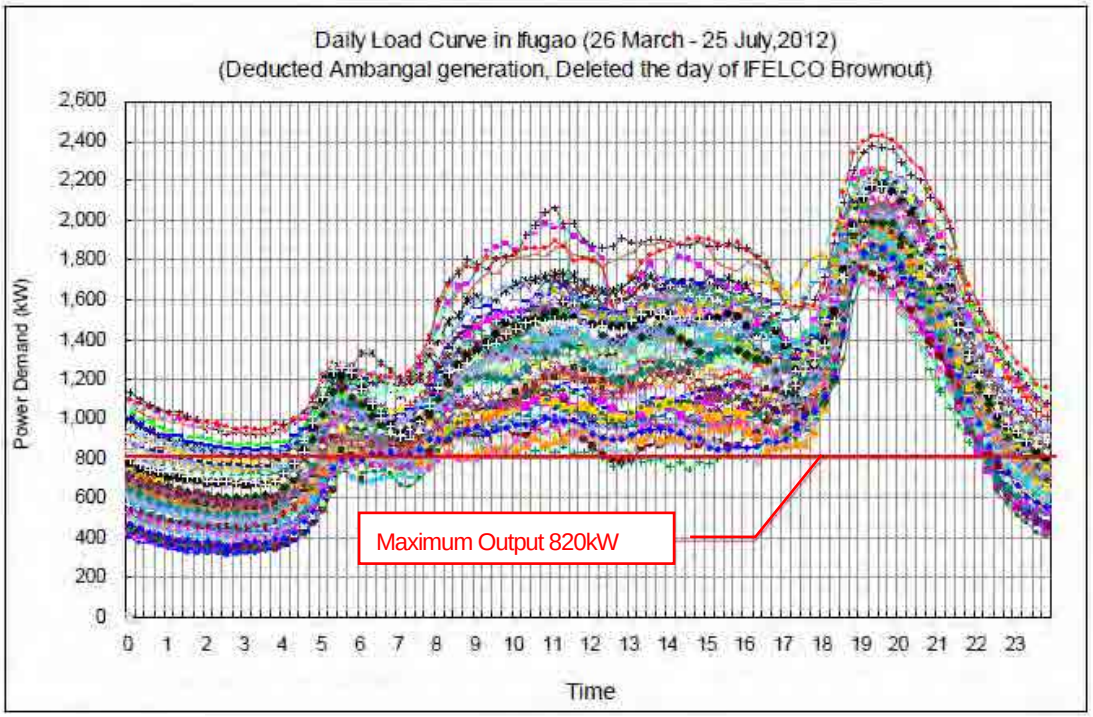


Fig. 2-9 Flow Duration Curve at the Project Site （Catchment Area; 44.02km^2）



Source; NGCP

Note: Generating output at Ambangal mini hydropower plant is already deducted.

Fig 2-10 Target Daily Load Curve

2-2-3-2 Facility and Equipment Plan

2-2-3-2-1 Hydropower Plant

(1) Civil Structures

Table 2-4 Feature of Civil Structures

	Items	Contents	Remarks
Power Generation Plan	Type of Power Plant	Run-of −River, Conduit Type	
	Max. Plant Discharge	2.0m^3/s	
	Effective Head	51.8m	
	Maximum Output	820 kW	
Structures	Intake Weir	H=4.5m、L=22.0m	Utilizing existing irrigation intake weir
	Intake Equipment	H=1.5m、W=1.6m	
	Settling Basin	H=3.5m、W=6.5m、L＝13.7m	
	Headrace Channel	H=1.7m、W=2.0m、L=1,844.4m	Open Channel, Box Colbert and Flume
	Head-Tank	H=4.0m、W=6.2m、L=14.1m	
	Spillway	H=1.6m、W=1.6m、L=152.6m	Buried type
	Penstock	D=0.85m、L=148.7m	Buried type, Philippine Made
	Powerhouse	H=5.0m、W=9.4m、L=14.0m	
	Access road	W=4.0m、L=200.0m	

1) Intake Weir

The existing irrigation weir will be strengthened and rehabilitated for use as the intake weir. Since there are numerous holes in the limestone that forms the weir body, these will be plugged with boulders and concrete to ensure the stability. Also, there is concern over scouring of foundations caused by the river flow downstream of the weir. The foundations will be protected with concrete and an apron will be constructed in order to prevent scouring. As for the basic structure, in line with the findings of the FS, concrete reinforcement will be conducted downstream of the weir in order to secure structural stability. Design has been implemented while paying attention to the following points.

- Since there are holes ranging from 10~20 cm in size in the weir body, these will be completely filled with boulders and concrete.
- A concrete apron will be constructed downstream of the weir in order to prevent scouring.
- Since there is minor leakage from the upstream to the downstream on the left side of the weir, this will be blocked with concrete.
- There is a small limestone hillock along the route of the channel connecting the intake to the settling basin, and this will be shaped when constructing the channel.

2) Intake equipment

Concerning the intake structure, the opening for obtaining water will be located on the right bank of the intake weir described above. Downstream from the intake, a spillway will be constructed to return excess water that enters at times of flooding back to the river. Also, a settling basin will be installed in order to remove sand and sediment that flows into the headrace. Moreover, the rehabilitated irrigation channel described later and river maintenance discharge will be diverted from the settling basin.

3) Headrace

The headrace will comprise a concrete open channel and covered conduit leading from the mountain slope on the right bank of Lamut River to the head tank. Since there are numerous locations where landslides occur along the headrace route, an aqueduct bridge structure will be selected in such parts and covered conduits will be adopted in order to prevent inflow of rocks and sediment. Moreover, at the point 300 meters downstream from the intake weir where Lamut River bends greatly to the left and there is a steep cliff terrain, a concrete retaining wall will be constructed from the river bed in order to prevent slope failure, and the headrace will be constructed on top of the wall. In addition, aqueduct bridge structures or inverted siphons will be installed in a number of locations where the headrace crosses over mountain streams.

4) Penstock

Since the slope on the north side of the penstock route selected in the FS is steep and there is concern over safety, the penstock route has been slightly moved to the east side. The penstock structure will be the same as that selected in the FS, i.e. a buried steel pipe, in consideration of landscape.

5) Head tank and spillway

The head tank will have enough capacity to safely flow water to the generator equipment to a standstill in the event of emergencies. Also, a sand trap will be installed to remove any sediment that may enter the water turbine generator, and the spillway will serve to safely discharge any excess water (more than required to generate power). The spillway will be a concrete structure combined with the penstock, and dissipation works will be executed to dissipate the energy of the water before it is discharged into the river.

6) Power plant

In line with the change to the penstock route, the power plant will be shifted roughly 40 meters downstream on Lamut River. As a result, an excavated face of around 10 meters will arise behind the power plant, however, a stone masonry retaining wall and drainage structure will be constructed in order to ensure stability of the slope and remove spring water emerging from the ground.

7) Access road to the power plant

The access road to the power plant will be constructed along the route from the sunken bridge (currently under repair) on the barangay road and along the right bank of Lamut River to the power plant. In order to ensure access to the power plant even during times of flood, the road will be paved with concrete and slope sections will be protected with stone masonry.

8) Temporary Facility

As was mentioned earlier, a cableway for carrying equipment and materials will be installed from the barangay road along the left bank of Lamut River. This will be used when executing works between the intake weir and the upstream side of the headrace. In addition, on the downstream side of the headrace, the existing road channel that runs to along the proposed headrace route will be rehabilitated and utilized. The access road mentioned above will be utilized for constructing the penstock and power plant.

(2) Electrical and Mechanical Equipment

Table 2-5 Specification of Electrical and Mechanical Equipments

Item	Specification	Remarks
Turbine	Horizontal shaft Francis Turbine x2 420 kW、1200 rpm	Procure from Japanese small-medium industry
Generator	3 Phase synchronous Generator x2 460 kVA	Ditto
Control Device	Water Level Controller Governor Excitation system Auto Synchronizer Protection Relay Individual Operation Detector	Ditto
Main Transformer	1 phase kVAx3 Voltage 440/13.2kV	NEA Standard
Switchgear	3phase Load Breaker Switch Voltage 24 kV	Ditto

1) Water Turbine

a. Turbine type

In selecting the type of water turbine, since it is necessary to adopt a "general-purpose turbine not subject to any patent, etc. in order to ensure fairness in procurement," the inline-type Francis turbine that was selected in previous FS is not applicable.

Among general-purpose machines, in consideration of head and flow rate, the horizontal axis Francis turbine and cross-flow turbine are both applicable, however, the cross-flow turbine is close to the head limit and it is desirable to select the horizontal-axis Francis turbine from the viewpoint of durability.

b. Generating output

The power plant output is as follows:

Effective head:	51.8m
Maximum water discharge:	1.0 x 2＝2 m^3/s
Turbine output:	430 kW x 2 units
Generator output:	410 kW x 2 units
Power plant output:	810 kW

c. Number of main units

According to the daily load curve indicated in Fig.2-10, nighttime demand is roughly 600 kW on average, and it is forecast this will become 350 kW at the lowest time. Therefore, it is forecast that nighttime power generation will often be less than 50% of the peak output. In the case of a horizontal axis Francis turbine, when the water discharge ratio falls to 50% or less, there is concern that this will cause rapid decline in the generating efficiency and shorten the service life of runners in the long term. Therefore, it has been decided to install two main units.

2) Generator

Generator types are broadly divided into induction generators and synchronous generators. In the Project, since the grid capacity is lower than the generating output, applying an induction generator would cause both the continuous voltage fluctuation and instantaneous voltage fluctuations to not satisfy permissible values. Therefore, synchronous generators will be adopted in the Project.

3) Control device

In the FS conducted in 2011, comparison was implemented between manual output control and automatic control and, because reverse flows to the NGCP grid cannot be fully prevented in the case of manual output control, automatic control was adopted.

However, even if reverse flows do arise, since generation output in the Project is sufficiently smaller than the NGCP grid capacity, it is envisaged that there would be no actual impact on the higher grid. Moreover, in the case of automatic control, it would be necessary to install a communications line from Lagawe substation. Also, due to the 7% annual rate of increase in the demand for power in the province in recent years, it is predicted that output control can be conducted manually without having to resort to automatic output adjustment. In consideration of these factors, it has been decided to adopt the manual approach in this study.

(3) Transformation and Distribution Equipments

Transformation and distribution equipment will basically be in accordance with standards of the National Electrification Administration (NEA) of the Philippines. Outline of specifications are as indicated in Table 2-6, and the details are given below.

Table 2-6 Specification of Transformation and Distribution Equipments

Item	Specification	Remarks
Distribution Line	3 Phase 4Wire 13.2kV New construction 2.9 km Repair 9.3 km	NEA Standard
Distribution Pole	Steel	Ditto
Watt hour Meter etc	Voltage transformer Current transformer Watt hour meter	Ditto

1) Outline

The transformation equipment for the power plant will be installed outdoors on the plant premises. The transformation equipment will comprise a 24 kV load switcher (with Power Fuse), 13.2 kV/400V main transformer, business energy meter and arrester, etc. and will be installed inside an area enclosed by fence, etc.

2) Main instruments

From the viewpoints of economy and ease of maintenance, the main instruments used in the power generating equipment will be procured from local standard items. The specifications of major instruments will be as follows.

a. Transformation equipment

i) Transformer

In order to connect to the existing distribution system (13.2 kV), a step-up transformer having the following specifications will be installed close to the power plant.

Type: Single phase x 3 units

Voltage: 440 V / 13.2 kV

Capacity: 333 kVA x 3 units

ii) Switchgear

Switchgear will be assembled on the transformation equipment pole located at the power plant exit, which can act as a demarcation point between the power plant and distribution line and can be cut off in the event of accidents.

Type: 3 phase load switchgear with fuse (Load Break Switch)

Voltage: 24 kV

iii) Lightning conductor

A lightning conductor will be assembled on the transformation equipment pole to prevent lightning surges damaging the generating equipment.

Type: Insulator lightning rod

Voltage: 20 kV

iv) Instrumentation

In order to gauge the quantity of power supplied to the distribution line, an instrument transformer will be installed on the transformation equipment pole, and an energy meter will also be installed.

- Instrument transformer (PT) 3 phase
  Voltage ratio: 14kV / 200V
- Instrument current transformer (CT) 3 phase
  Current ratio: 50 A/5 A
- Energy mater 3 phase
  Type: GEKV2C x 2

b. Distribution line equipment

The route from Likud power plant to the existing distribution line will be directed away from residential areas where there is no need for tree felling in consideration of the environmental and social impact. Moreover, in consideration of maintenance following construction of the distribution line, consideration has been given to economy in deciding the route. Table 2-7 shows the length of the works sections.

Table 2-7 Length of the Distribution Line Works Sections

Section	Length (m)	Remarks
Likud power plant ~ No. 89 pole (near Haliap bridge)	2,930	Newly installed length
No.89 pole ~ Existing 3 phase distrbution line end (Baguinge)	9,310	
Total	12,240	

i) Power line

The local distribution company IFELCO frequently uses ACSR which has good tensile strength, and it uses a unified cable type in consideration of maintenance.

Also, a power line size that entails no problem in terms of transmission capacity will be selected

- Power line specifications: 1/0 ACSR (approximately 53.5mm^2)

ii) Distribution poles

Hollow steel poles, which are easy to obtain in the Philippines, will be adopted. The length of poles will be decided in consideration of the local environment, but basically a length of 35 feet will be adopted to facilitate carrying.

Since badly deteriorated wooden poles are used on existing distribution lines, steel poles will be used to replace them. Existing steel poles will continue to be used.

2-2-3-2-2 Rehabilitation of Damaged Communal Irrigation System

(1) Existing irrigation facilities around the Project site

Irrigation facilities around the Project site comprise those for supplying water from the intake weir to the right bank (currently not functioning due to collapse of the channel) and two downstream facilities that supply water to both the right and left sides. In the case where the irrigation facilities for supplying water from the weir are rehabilitated in the Project, it will be necessary to ensure that enough water flow is discharged to ensure that the three downstream irrigation facilities can supply water. Water for the three downstream irrigation facilities will be discharged via the discharge valve installed in the grit chamber.

<Calculation of irrigation discharge flow>

- ✧ Stipulated discharge flow: 2.0 liter/second/hectare (National Irrigation Authority regulations)
- ✧ Target irrigation area: 4.96 ha (total of C~E below)
- ✧ As is shown in Fig. 2-4, the area of each paddy field is as follows: A: 0.28 ha, B: 2.15ha, C: 0.15 ha, D: 1.00 ha, E: 3.81 ha. Out of these, C, D and E are targeted for rehabilitation in the Project.
- ✧ Necessary discharge flow: 2.0 l/s/ha x 4.96 ha = 9.92 l/s = 0.01 m^3/s
  Out of these, the target scope of irrigation discharge from the grit chamber discharge valve is C, D and E (A and B will be targeted for rehabilitation in the Project described below).

Meanwhile, the Philippine Department of Water Resources stipulate that 10% of the 85% probable discharge of the river should be discharged downstream as the river maintenance flow, so according to this 0.136m^3/s of water should be discharged from the intake weir. (For FS reference) The necessary irrigation flow can be secured by discharging only the river maintenance flow of 0.136m^3/s.

(2) Outline and rehabilitation method of the targeted irrigation facilities

The irrigation facilities targeted for rehabilitation have a supply area of 2.43 hectares upstream from the intake weir (areas A and B in Fig. 2-4). The supply flow is deemed to be 0.010m^3/s (2.01 s/ha) including some allowance, and the irrigation channel will be installed in tandem with the headrace as illustrated in Fig. 2-11.

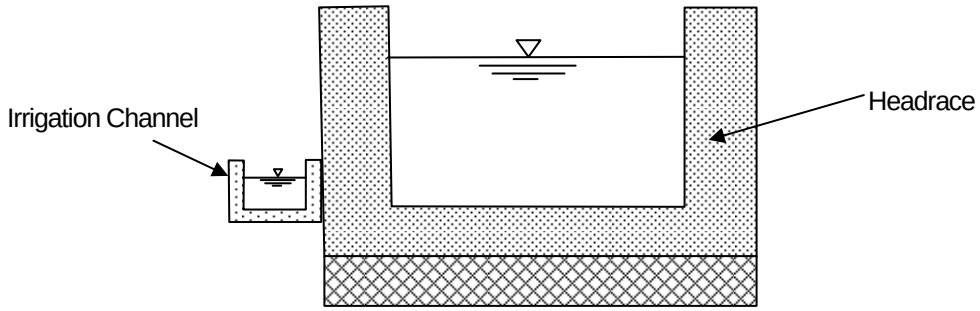


Fig. 2-11 Proposed Rehabilitation of Irrigation Channel

2-2-4 Design Drawing

Based on the design concept above mentioned, the basic design of each facility is attached in "Drawings"

No-1: General Plan
No-2: Longitudinal Profile
No-3: Intake Weir
No.-4: Plan and Longitudinal Profile of Settling Basin
No-5: Cross Section of Settling Basin
No-6: General Cross Section of Headrace
No-7: General Cross Section of Headrace
No-8: Overflow Spillway at Headrace
No-9: Flume at Headrace IP-2~4)
No-10: Flume at Headrace IP-5.16)
No-11: Flume at Headrace IP-56, 57)
No-12: Flume at Headrace IP59, 90)
No-13: Flume at Headrace IP-90, 91)
No-14: flume at Headrace IP-94, 95)
No-15: Flume at Headrace IP-105,106)
No-16: Discharge Control Spillway at head-tank)
No-17: Head-Tank
No-18: Cross Section of Head-tank

No-19: Penstock Profile
No-20: Spillway Profile
No-21: Anchor Block of Penstock 1/2
No-22: Anchor Block of Penstock 2/2
No-23: General Cross Section of Penstock and Spillway
No-24: Energy Dissipater of Spillway
No-25: Powerhouse
No-26: Cross Section of Powerhouse
No-27: Cross Section of Access Road
No-28: Single Diagram
No-29: Sub-Station Layout and Plan
No-30: Distribution Line Route 1/4
No-31: Distribution Line Route 2/4
No-32: Distribution Line Route 3/4
No-33: Distribution Line Route 4/4

2-2-5 Implementation Plan

2-2-5-1 Implementation Policy

(1) Minimization of the Scope of Alteration in line with works

Although the Project site is located outside of the area designated as World Heritage, because it aims to make a contribution to the rice terrace conservation activities and headwater forests that provide the water supplied to the rice terraces that are located around the Project site, it will be necessary to avoid constructing temporary roads and so on for carrying in equipment and materials. For this reason, simple cableways are frequently used when conducting civil engineering works in this area.

In the Project too, it will be important to utilize cableways to the full and thereby strive to minimize the area of alteration arising from the works apart from the main structures.

(2) Utilization of Local Traditional Works Practices

In the Project, due to the circumstances described in (1) above, almost all the works will need to be executed manually, however, since only around 16 months, which is short for this type of work, is permitted for the Project, it will be important to secure laborers. The total length of small-scale irrigation systems in Ifugao Province is 700 kilometers, and these have been constructed by local residents based on the traditional sub-contracting system locally known as ***Pakyaw***. In the Project too, an implementation plan that complies

with local culture and customs including use of *Pakyaw* will be compiled.

(3) Utilization of local construction Company.

Out of the civil engineering contractors that are based in Ifugao Province, a few have obtained operating permits from the DTI (Department of Trade & Industry) and have been granted category B[6] or higher licenses from the PCAB (Philippine Contractors Accreditation Board), however, most of these companies primarily conduct road and building works, while only one company has experience of constructing hydropower plants.

This company has experience of completing the civil engineering works (including penstock installation and generating equipment installation) for the e8 Ambangal mini hydropower plant upon concluding a direct contract with Tokyo Electric Power Co., Ltd. Considering that this company completed the said works on schedule in spite of incurring damage caused by a large typhoon during the works and the civil engineering facilities following completion have experienced no major problems, this company has ample capacity to take part in the Project.

Out of the site works, concerning the distribution line and transformer substation works, it will be possible to utilize the local power distribution company (IFELCO) (as was also the case in the e8 project).

However, because the Project works have to be finished in a short period and greater accuracy than in the e8 project is demanded, it will be essential for Japanese engineers in the civil engineering, electrical and mechanical fields to conduct guidance and supervision.

In the Project, the implementation plan will be compiled upon giving consideration to the capacity of local operators and the experience gained in the e8 project.

2-2-5-2 Implementation Conditions

(1) Access to the Project Site

The Project site is located in Barangay Haliap in Asipulo Municipality, Ifugao Province, Cordillera Administrative Region in the north of Luzon Island. A national highway connects Manila to Lagawe, the Provincial capital of Ifugao, and since this is paved along its entire route, there is no problem regarding transportation of large-size goods. The distance from Manila to Lagawe is approximately 350 kilometers and the journey takes around eight hours by ordinary vehicle. Concerning the landing of equipment and materials arriving by boat, general freight can be imported via Manila Port. Located in Manila Bay to the west of Metro Manila, Manila Port is one of the leading international ports in Southeast Asia and poses no problems

[6] Category B means that the company has qualifications to tender for works of up to 100 million pesos.

regarding the landing of equipment and materials.

Between the Provincial capital of Lagawe and the Project site, a provincial road, municipal road (partially unpaved) and barangay roads have been constructed and are passable for vehicles. The travel time from Lagawe is approximately 30 minutes.

Moreover, a barangay road leads from the center of Barangay Haliap to midway along the headrace route, and it will be possible to utilize this as a works road simply by making a few repairs.

Considering the above factors, access conditions to the Project site are relatively good, however, since shoulder collapse and slope failure caused by typhoons can sometimes lead to road blocks, it will be necessary to take this point into consideration when deciding the timing of equipment and materials transport.

(2) Construction Machinery Procurement Conditions

Although the majority of Project works will be conducted by manual labor, general construction machinery such as back hoes and dump trucks, etc. will be required for the power plant and access road works. Since these machines can be procured locally in Ifugao Province, there will be no problem in terms of the implementation planning.

(3) Weather Conditions

In Ifugao Province, the dry season usually lasts from March to May. Temperatures at this time are high and it is the best time for conducting work. On the other hand, the rainy season lasts from August to October, and this period is also characterized by frequent typhoons. In consideration of these conditions, it will be necessary to compile the implementation plan so that works around rivers and other civil engineering works avoid the rainy season as much as possible.

(4) Power Supply and Water Supply for Works

Since it is basically difficult to secure the works power supply from the existing grid, a portable generator will be prepared for the penstock welding works. Since the Project site is situated close to a river with a lot of incoming streams, there will basically be no problem when it comes to securing water supply for the works.

(5) Transport of Equipment and Materials

In the Project, because the generating equipment works are small-scale and will mostly be conducted manually, and since rice is cultivated on rice terraces around the site (although it isn't located inside the area of the Cordillera rice terraces that are designated as World Heritage), installations that entail large-scale alteration of land must be avoided. Accordingly, cableway (with maximum carrying load of approximately 40 kg) for carrying equipment and materials will be installed from the barangay road running parallel to Lamut River to

the other side of the river, and the barangay road (currently impassable due to partial collapse) will be rehabilitated (partial correction of the alignment and paving with concrete) in order to transport the equipment and materials for the bottom part of the headrace. The abovementioned power plant access road will be used to carry equipment and materials to the penstock and power plant sites. From the power plant, a cableway or incline will be installed downstream of the head tank and headrace in order to allow equipment and materials for the penstock, headrace and head tank to be carried in.

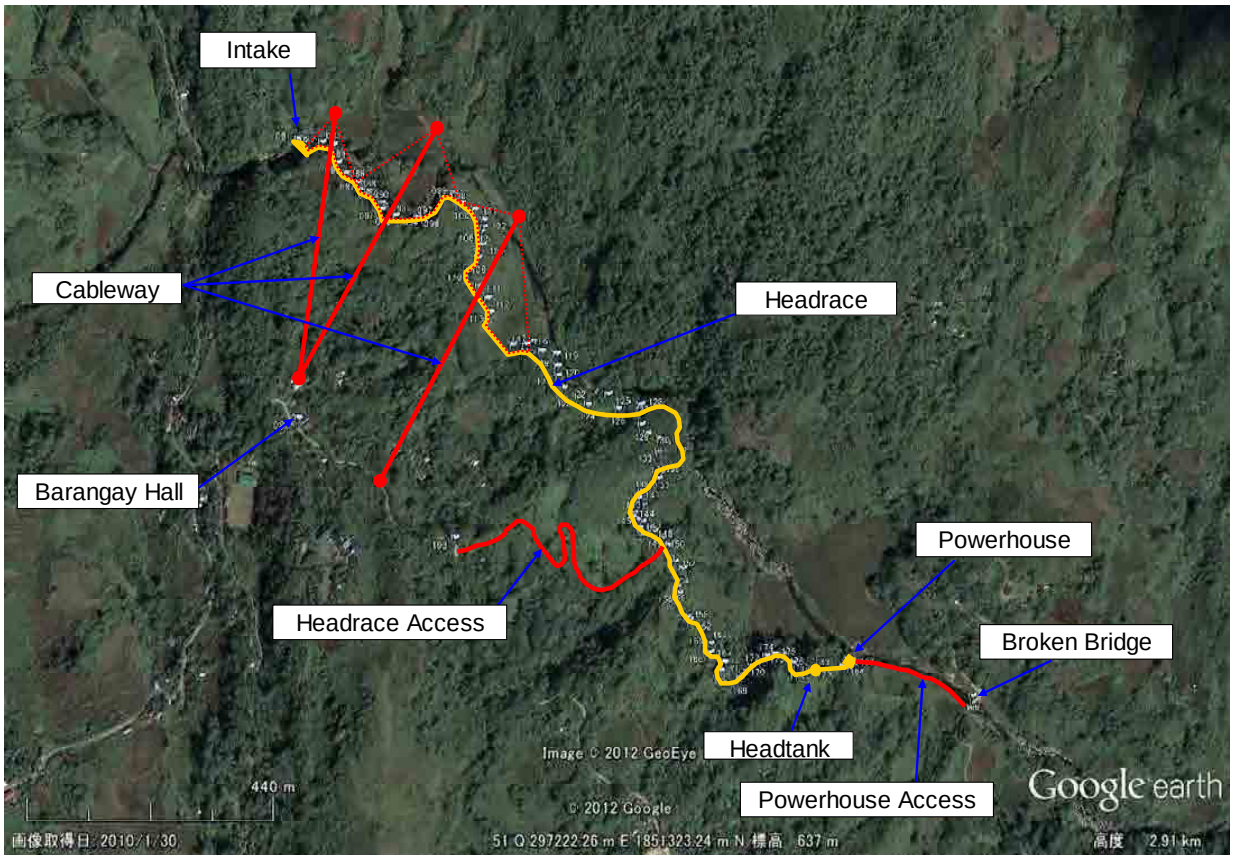


Fig. 2-12 Conceptual View of the Temporary Installation Plan

2-2-5-3 Scope of Works

The works targeted by Japan's grant aid are as indicated below in Fig. 1-1 and Fig. 1-2. There are no works that need to be borne by the Philippine side.

(1) Hydropower Equipment

Civil engineering facilities: Intake weir, intake equipment, headrace, head tank, penstock, spillway, power plant, power plant access road and temporary installations (cableway and barangay road strengthening for carrying in materials)

Power generating equipment: Water turbine, generator, control device

Transmission equipment: Substation, grid-connection line (13.2 kV)

(2) Repair of Existing Irrigation System

The channel of the Cot-Cot irrigation system that takes water from the existing weir (which will be used for power generation) has partially collapsed and is currently not functioning. The repair of this will be included in the Japanese scope of works.

2-2-5-4 Construction Plan

The general construction methods for each civil engineering facility are described below.

(1) Intake weir and intake facilities

a. Construction period: It will basically be constructed in the dry season (March to May).
b. Flow diversion works: The river will be diverted to the stream (currently a dry stream bed) located immediately upstream of the planned point on the left bank upon removing boulders from the stream course. Following diversion, work will be conducted on the right bank of the intake weir and the intake equipment, and following completion, the river will be discharged from the scouring sluice and works will be conducted on the left bank of the weir. River bed materials will be banked in order to provisionally stem the flow.
c. Construction method: All the work will basically be executed by manual labor, however, a small concrete mixer (0.15 m^3) will be used to perform the concrete mixing. The cableway shown in Fig. 2-12 will be used to carry equipment and materials.

(2) Headrace

a. Construction period: Since the headrace works are critical works in the Project, they will be started immediately following completion of the preparatory works.
b. Construction method: All the work will basically be executed by manual labor; however, a small concrete mixer (0.15 m^3) will be used to perform the concrete mixing. The cableway shown in Fig. 1 will be used to carry equipment and materials to the upper section, however, for the lower section, the access road to the midway point of the headrace and the power plant access road will be used to transport equipment and materials to the temporary storage yard, and from there they will be carried to the building site manually.
c. Division of works sections: In the Project, assuming adoption of the aforementioned Pakyaw method of contracting, the headrace works will be divided into 25 sections (according to landowner).

(3) Penstock and head tank spillway

a. Construction period: Work will be started following construction of the power plant access road and incline (rail works), and the concrete work and penstock installation will be completed during the dry season.

b. Construction method: All the work will basically be executed by manual labor, however, a small concrete mixer (0.15 m^3) will be used to perform the concrete mixing (but the concrete will be placed manually). Materials and equipment including the penstock will be transported using the power plant access road and incline. The penstock will be installed from the bottom up.

(4) Head tank

a. Construction period: Excavation of the head tank will be started following completion of the headrace rough excavation and excavation of the penstock and head tank spillway. Work will be started following installation of the concrete power plant access road and incline (rail), and concrete works will be started after installation of the penstock.
b. Construction method: All the work will basically be executed by manual labor, however, a small concrete mixer (0.15 m^3) will be used to perform the concrete mixing (but the concrete will be placed manually). Materials and equipment will be transported using the power plant access road and incline.

(5) Power plant and outfall

a. Construction period: Power plant works will be started following installation of the penstock and finished before installation of the turbine generator.
b. Construction method: Excavation to the power plant base will be conducted by back hoe (0.6m^3), and the after bay will be excavated by manual labor. A small concrete mixer (0.15 m^3) will be used to perform the concrete mixing (but the concrete will be placed manually). Materials and equipment will be transported using the power plant access road. The generator equipment will be installed using the 15 ton truck lane.

(6) Access road

a. Construction period: Since the access road works are critical works in the Project, they will be started immediately following completion of the preparatory works.
b. Construction method: Civil works will be executed by manual labor and machinery. A small concrete mixer (0.15 m^3) will be used to perform the concrete mixing (but the concrete will be placed manually). Materials and equipment will be transported using the power plant access road.

2-2-5-5 Construction Supervision

Following conclusion of the consultant agreement, the Japanese team comprising the works chief, civil design engineer (hydropower civil works), electric/mechanical engineer, distribution engineer and tender manager will implement the detailed design, preparation of tender documents, tender, and checking and approval of plant drawings for the penstock, gate, screen, generator equipment and power distribution equipment. Site work for the detailed design will comprise the pre-design field confirmation survey, approval of tender documents and

tender evaluation to be implemented by the works chief, civil design engineer and tender manager. The other work will basically be implemented in Japan.

Execution supervision during the construction period, comprising checking and approval of execution drawings, environmental conservation and yield checking, will be implemented by the works chief, permanent supervisor (general civil engineering), civil engineer (hydropower civil works: channel and power plant), electrical engineer, mechanical engineer and power distribution engineer. All members apart from the permanent works supervisor will only be dispatched for limited periods according to the local works schedule.

Table 2-8 shows the work to be managed by the Consultant's supervisory staff (Japanese personnel).

Table 2-8 Consultant Supervision Staff

Category	Number	Local Dispatch Period	Reason for Appointment/Contents of Work
Work chief	1	1.0	Starting arrangements and completion inspection
Permanent supervising engineer (general civil engineering)	1	16.0	Approval of works drawings, yield check, checking of quality test results, etc.
Civil engineer (hydropower civil works: channel)	1	4.23	Since the headrace at this site is long at 1,800 meters and there are numerous works sections (approximately 20 sections in the case where Pakyaw is adopted), a civil engineer will be dispatched to assist the permanent supervising engineer at the start of excavation, at the start of concrete placement and during the rainy season.
Civil engineer (hydropower civil works: weir and power plant) Hydropower generation (generation civil works in general)	1	2.0	The dry season around the Project site is around three months so efficient execution will be required in the works areas close to the river, i.e. the weir and power plant, etc. Moreover, because connections with electricity and machines will be required in the power plant works, a civil engineer will be dispatched to assist the permanent supervising engineer during the weir and power plant construction works.
Hydropower generation (generation civil works in general)	1	1.0	In the case of a hydropower plant, not only do the weir, headrace, head tank, penstock, spillway, access road and power house, etc. need to function individually, they also must function as an integrated system. Moreover, since connections with electrical, mechanical and power distribution equipment are also important, an engineer who possesses general experience in hydropower plant construction will be dispatched when profile sketches of almost all the civil engineering structures are clarified and prior to the electrical and mechanical works (at the time of small water flow testing for flushing of the channel).
Mechanical engineer	1	2.0	Checking and approval of turbine-related shop drawings, supervision of site tests both with and without water passage, and witnessing of receiving inspections

Electrical engineer	1	2.0	Checking and approval of generator and control device-related shop drawings, supervision of site tests both with and without water passage, and witnessing of receiving inspections
Power distribution engineer	1	1.0	Checking and approval of distribution line (grid connection line) shop drawings, works supervision, and witnessing of receiving inspections

2-2-2-6 Quality Control Plan

(1) Civil engineering structures

Quality control will target concrete. Except for the penstock, all the civil engineering structures will be made from concrete. The main structures in the Project will not require the type of high-strength concrete that is sought in general bridges (the stress occurring in headrace concrete, etc. will be around 20~30kg/cm^2). Moreover, since many of the works sites will be inaccessible to vehicles, the frequent implementation of strength tests and so on would cause delays in the implementation schedule.

In consideration of the above points, the following concrete tests (compression strength tests) will basically be conducted in the Project.

Table 2-9 Frequency of Concrete Tests

Structure	Concrete compression test frequency	Remarks
Intake weir	2 sites (body and apron)	Quantity of concrete: 71m^3
Intake and settling basin	2 sites (1 place/50m$^{3)}$	Ditto: 101m3/s
Headrace	Open channel (1 place/70m) Covered channel (1 place/50m) Aqueduct (body 1 place, abutment 1 place)	Open channel: 1.44m3/m Covered channel: 1.86m3/m Aqueduct: 8 places
Head tank	2 sites (1 place/50m^3)	Quantity of concrete: 86m^3
Spillway	3 sites	Quantity of concrete: 315m^3
Power plant	Foundations: 1 place Side wall: 1 place Beam: 1 place	Quantity of concrete: 340m^3

(2) Penstock

The penstock will be procured in Manila, however, prior to manufacture, submission of a sample of steel mill sheet will be requested in order to confirm the quality of the steel.

2-2-5-7 Procurement Plan

(1) Construction Materials

Construction materials, except for the penstock, will basically be procured in Lagawe, the capital of Ifugao Province. Concrete aggregate will be procured at the Iburao River stone quarry on the outskirts of Lagawe.

Table 2-10 Procurement of Construction Materials

Equipment and Materials	Procurement Source			Remarks
	Local	Japan	Third Country	
[Construction materials]				
Sand, gravel, cement, reinforcing bars, crushed stone, chipboard, sawn timber, gasoline, light oil	○			
[Vehicles for transporting construction machinery]				
General construction machinery	○			

(2) Equipment

1) Equipment Suppliers

Table 2-11 Procurement Plan for Main Equipments

Item	Rough Specifications	Philippines	Japan	Reason
Turbine	Horizontal shaft Francis turbine x 2 430 kW, 1200 rpm		○	Assuming procurement from a Japanese small , medium enterprise
Generator	3 phase synchronous generator x 2 450 kVA		○	Ditto
Control device	Water level adjustment operating device Speed regulator Exciter Automatic synchronizer Protective relay Independent operation detector		○	Ditto
Main transformer	Single phase 333 kVAx3 Voltage 440/13.2kV	○		Standard of the Philippine National Electrification Agency
Switchgear	3 phase load isolating switch with fuse Voltage 24 kV	○		Ditto
Distribution line (grid connection line)	3 phase 4 line, 13.2kVA New 2.9 km Repaired 9.3 km	○		Ditto
Distribution pole	Steel pole	○		Ditto
Electricity meter, etc.	Instrumentation transformer Instrumentation current transformer Integrating electricity meter	○		Ditto
Penstock	Spiral steel pipe D=0.85m	○		
Gate		○		Local manufacture is possible

2) Scope of Spare Parts

To ensure that the Project effects are sustained, the necessary spare parts and maintenance and repair tools will be provided. Spare parts are divided into expendable parts and replacement parts. In the Project, expendable parts such as lamps and fuses, etc. necessary for operation (one set) and replacement items such as packing needed for conducting disassembly inspections (enough for two units) will be supplied.

Table2-12 Spare Parts List

Item	Remark
Bearing	For 1 unit
Shear pin	For 1 unit
Each type of seal	For 2 unit
SSG sensor	For 1 unit
Rectifier	For 1 unit
Protection relay	For 1 unit
Aux/ relay	For 1 unit
Converter Sequencer	For 1 unit
Water level sensor	For 1 unit

3) Thinking on warranty

All the equipment and materials procured in the Project will require defect warranty. Moreover, the period of defect warranty will be one year.

2-2-5-8 Initial Control Guidance and Operation Guidance Plan

The initial control guidance will be carried out by expert engineers dispatched from makers during the equipment installation and testing. Meanwhile, operation guidance (training for operators in periodic inspections and operation recording, etc.) will be implemented during the Soft Component described below.

The method for implementing initial control guidance is as indicated below.

1) Guidance Method

An operation and maintenance manual will be prepared and guidance will be conducted for operators at the times of installation adjustment, testing and trial operation.

2) Contents

Guidance will be conducted on equipment adjustment methods when installing the equipment and when conducting overhauls.

Guidance will be conducted on start-up method, operating method, output setting method, stopping method and method for restoring operation after simple troubles and so on.

Guidance will be offered on items to be notified to makers when major breakdowns occur.

3) Implementation Plan

Around two weeks each will be spent on initial operational guidance at the times of installation adjustment, testing and trial operation.

Table 2-13 Implementation Plan of Initial Control Guidance and Operation Guidance

	Dec 2014	Jan. 2015	Feb. 2015	Remark
Installation of Equipment	▬▬			
Pre-Commissioning Test		▬▬		
Commissioning Test			▬▬	

2-2-5-9 Soft Component Plan

The Provincial Government of Ifugao will implement operation and maintenance of Likud mini hydropower plant (820 W) constructed in the Project, and administration of the RTCF, which will be replenished by earnings from the new power plant. The Philippine Department of Energy and provincial government are working on developing the power plant operation and maintenance setup and securing the appropriate administration of the RTCF. The Project goal of contributing to the rice terraces conservation program can only be achieved through realizing the stable operation of Likud mini hydropower plant and appropriate utilization of the RTCF, and since this is an important factor in determining the success or failure of the Project, the soft component activities described below will be implemented in order to help the host local government build its systems, etc. more certainly and effectively.

The soft component will target both the facilities and equipment that are constructed and installed in the Project. For details, refer to the Soft Component Plan in Annex 5.

(1) Soft component objectives

The soft component will be conducted with the objectives of developing the organization and human resources for conducting the stable operation and maintenance of Likud mini hydropower plant, which will be constructed in the Project, and ensuring the appropriate administration of the RTCF in order to promote conservation of the rice terraces.

(2) Soft component items

① Establishment of the power plant operation and maintenance setup

② Appropriate administration of the RTCF

(2) Outline of Soft Component Activities

① Establishment of the power plant operation and maintenance setup

The soft component will be implemented in tandem with the initial operation guidance (instruction on how to handle the turbine, generator and control equipment) conducted by some of the makers. Eventually, guidance will be conducted as follows so that the operators can perform general operation and maintenance of civil engineering facilities and transmission equipment.

The training will basically be implemented over the following four stages between the start of site works to before the completion inspection. Moreover, tests for gauging the contents of training will be implemented at the end of each stage, and the results will be reflected in the final selection of operators, etc. The operator training will basically be opened to graduates of industrial high schools (electrical, mechanical and civil engineering), while plant supervisor training will be open to holders of electrical and mechanical engineer qualifications (or their equivalent).

a. First stage: Immediately after the start of works (basic knowledge lectures on hydropower generation)

The targets of training will be selected immediately after the start of works.

The first stage will be implemented with the objective of imparting basic knowledge about hydropower generation to the trainees. The specific contents of lectures will be as follows.

- Current conditions and issues of hydropower development in the Philippines
- Mechanism of hydropower generation
- Functions and roles of hydropower generation facilities
- Operation and maintenance of hydropower plants

b. Second stage: Headrace concrete works period (OJT in the construction works)

Through having trainees participate in the actual construction of Likud mini hydropower plant as laborers, they will learn and understand about the structures and functions of the power house, major structures and auxiliary equipment such as gate and so on, and they will be better equipped to handle repairs following the start of operation.

c. Third stage: After the second stage (practical training in the existing Ambangal mini hydropower plant)

Operators from Ambangal mini hydropower plant will act as trainers while the trainees will work under them as operation and maintenance assistants.

d. Fourth stage: Likud mini hydropower plant water flow test period (practical training in basic operations)

Practical training on plant operations will be conducted during the water flow testing.

In this stage, the training will be conducted as initial operation guidance by the engineers of the turbine, generator and control equipment makers, while the consultant engineers will conduct guidance on deciding

generation capacity in consideration of river flow and power demand and general operating methods for civil engineering equipment, electrical and mechanical equipment and transmission and distribution equipment.

Before the start of the fourth stage, engineers in Japan will prepare the operation and maintenance manual that will be used to conduct the training.

③ Appropriate administration of the RTCF

a. Establishment of a working group for revising the existing guidelines

GSEP established guidelines for how to operate the RTCF. When revising these, a working group composed of members from the province, municipality and barangay will be organized.

b. Grasping issues in the current guidelines

The working group will clarify problems in the current guidelines and examine countermeasures.

c. Guideline revision work

The working group will revise the current guidelines while taking the above problems and countermeasures into consideration.

d. Approval of the revised guidelines

The revised guidelines will receive the official approval of the steering committee, and then a roadmap geared to revision of the current provincial ordinance will be compiled.

Public education activities will be conducted jointly with the provincial agencies in accordance with the revised guidelines.

(3) Soft Component Implementation Schedule

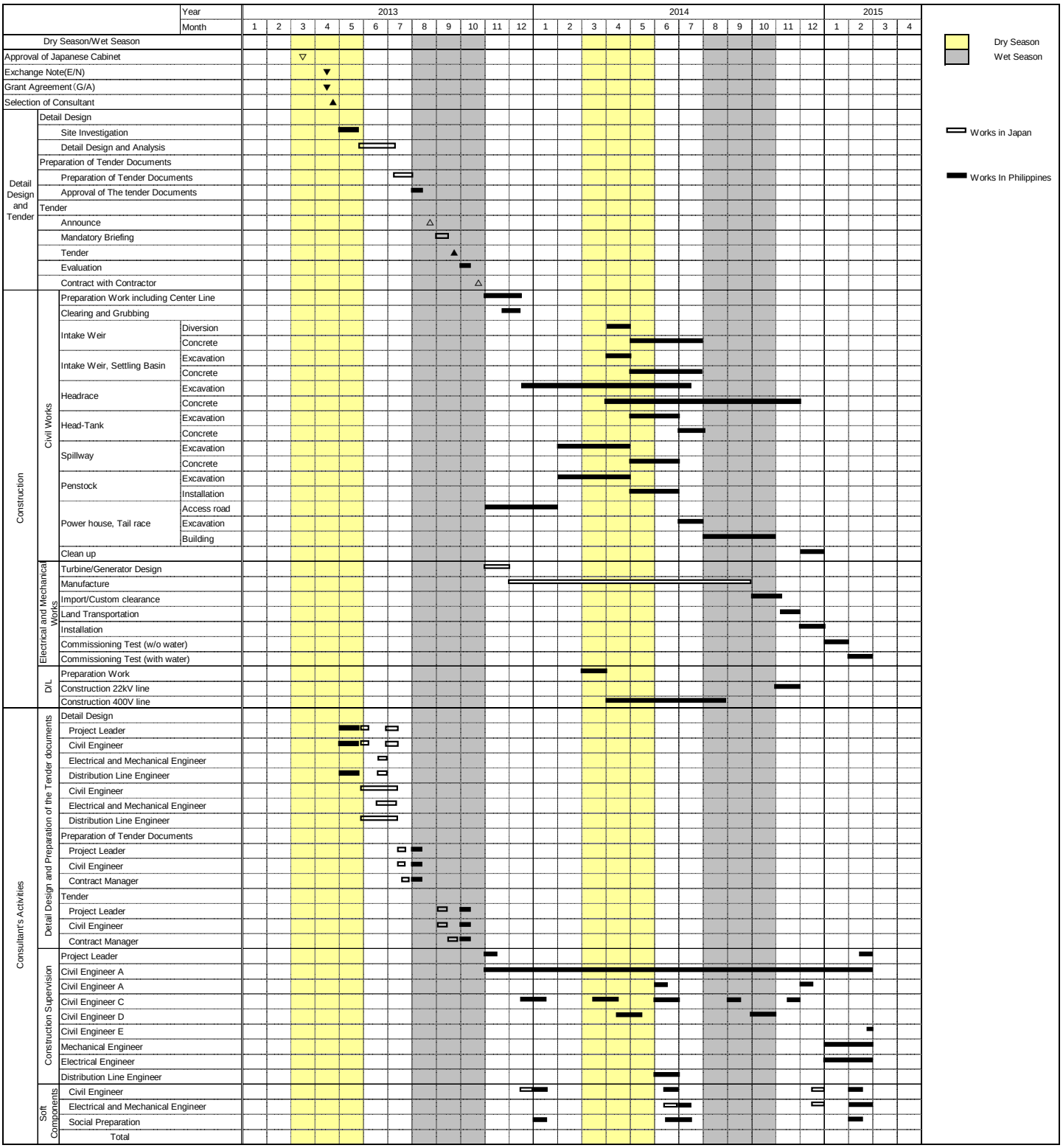
Table 2-14 Soft Component Implementation Schedule

Year		2013	2014	2015
Works, etc. schedule	Implementation design			
	Facilities works			
	Equipment installation			
Soft component	Establishment of O&M setup			
	Appropriate administration of the RTCF			

2-2-5-10 Implementation Schedule

Implementation Schedule of the Project is shown in Table 2-15.

Table 2-15 Implementation Schedule of the Project



2-3 Obligation of Recipient Country

In the Project, the following tasks will be the scope of works on the Philippine side.

(1) Signing of MOA

The JICA grant aid implementing agency is the Department of Energy (DOE), which will be responsible for implementation from survey through to construction. However, because Ifugao Provincial Government will conduct operation and maintenance of the hydropower plant after handover, it will be necessary for the DOE and provincial government to exchange a memorandum to clarify the divisions of responsibility. The DOE signed the MOA with PGI on February 11, 2013. The MOA describes outline of the Project and agreed duties and responsibilities of DOE and PGI as summarized below. (the MOA is attached in Appendix-4(3))

(2) Authorization Procedure Concerning the Hydropower Development

In accordance with the Renewable Energy Act of the Philippines, various authorization procedures necessary for the hydropower development will be conducted as shown in Table 2-16.

Table 2-16 Authorization Procedures Needed for the Hydropower Development

Application/Authorization (Agencies for Clearance)	Contents of Authorization	Responsible Implementing Agency	Necessary Period	Items to Consider in the Study
1. LGU Endorsement (PLGU,MLGU,Brangay)	Approval by municipality, barangay and provincial assemblies	PGI	1 week at shortest	Give timely reports on the survey progress and reach a basic consensus.
2. Right of Way (Land Owners)	Land acquisition/compensation	PGI	Around 3 months	Stage public explanation meetings according to the survey progress and reach a basic consensus.
3. NCIP Certification FPIC (NCIP)	Approval of indigenous people's organizations	PGI	55 days	Ditto, and reporting on the survey progress to the National Commission on Indigenous People
4. Environment Compliance Certificate (DENR)	Demonstration of environmental compliance	PGI	Around 20 days	In the case of flow-in type, a Certificate of Non-Coverage (CNC) is issued in a short time.
5. Water Rights Permit (NWRB)	Water rights	PGI	Around 1 month	Permission is conditional on the CNC already being acquired.
6. Energy Sales Agreement (ERC)	Power sale contract	PGI & IFELCO	Around 2 months	Coordinate and attain a basic consensus with the distribution cooperative and transmission company during the study period. Finally, the contract is confirmed on provision of the ERC authorization stated below.
7. Renewable Energy Service / Operating Contract (DOE)	Power plant operating permission	PGI	43 days	FS report and items 1, 3, 4, 5 and 6 above are required as the attached documents.
8. Certificate of Compliance (ERC)	Power sale price approval	PGI	60 days	FS report and items 1, 3, 4, 5, 6 and 7 above are required as the attached documents.

(3) Construction of the operation and maintenance setup (PGI)

The operation and maintenance setup for the mini hydropower plant will be constructed and staffed with personnel who possess the necessary skills. During the construction period, as the Japanese side will conduct technical training on operation and maintenance methods, the provincial government of Ifugao will need to secure the required number of supervisors and operators through advertising both inside and outside of the province.

(4) Operation of the Rice Terraces Conservation Fund (PGI)

In order to secure funds for conserving the rice terraces, the mini hydropower plant will be continuously operated and funds will be used for conservation activities.

(5) Tariff exemption procedure (PGI)

When the Project is implemented, VAT budget measures will be taken. Also, during construction, procedure will be taken to exempt tariffs imposed on products imported to the Philippines.

Concerning VAT on grant aid projects conducted after July 2000 in the Philippines, the governments of both countries have agreed that, "VAT will not be exempted but will be borne by the implementing agency in the Philippines (in this case the DOE)."

In the Project, the DOE and Survey Team held a number of discussions and the DOE promised to secure the necessary budget.

(6) Procedure for issue of a banking agreement and authority to pay (DOE)

When the Project is implemented, a banking agreement and authorization to pay will be issued.

(7) Other points

- Exemption of taxes on overseas nationals including Japanese nationals involved with the Project (DOE)
- Bearing of all items not covered by Japan's grant aid during implementation of the Project. (DOE)
- Coordination among relevant organizations and application/approval of necessary documents for permits and licenses.

2-4 Project Operation Plan

2-4-1 Project Operation and Maintenance Setup

In Ifugao Province, Ambangal MHPP has been in operation since 2010 and is operated by the province. The provincial government also manages the Rice Terraces Conservation Fund (RTCF), which is funded with earnings from the sale of power generated at the plant.

As seen from power generated and power sale shown in Table 2-17 and approved RTCF project shown in Table 2-18, total project cost is approximately 1.74 million peso and is funded by the income of power sale of Ambangal MHPP (6.70 million peso). Remaining fund will be utilized for future conservation activities.

Table 2-17 Power Generated and Power Sale of Ambangal MHPP (Period: January, 2010 – July, 2012)

Billing Period Covered		Present Reading	Previous Reading	kWh Comsumption	Rate/kWh	Total Power Sales	2%PPD	Penalty by IFELCO	Total Power Sales Paid by IFELCO
	Jan.	24.10	0.00	0	0	0.00	0.00	0	0.00
	Feb	0.00	0.00	0	0	0.00	0.00	0	0.00
	Mar	38.60	24.10	4,060	2.58	10,474.80	209.50	0	10,265.30
	Apr	45.40	38.60	1,904	2.58	4,912.32	98.25	0	4,814.07
	May	0.00	0.00	0	2.58	0.00	0.00	0	0.00
2010	Jun	93.90	45.40	13,580	2.58	35,036.40	700.73	0	34,335.67
	Jul	388.10	93.90	82,376	2.58	212,530.08	4,250.60	0	208,279.48
	Aug	785.60	388.10	111,300	2.58	287,154.00	5,743.08	0	281,410.92
	Sep	1,192.20	785.60	113,848	2.58	293,727.84	5,874.56	0	287,853.28
	Oct	1,556.10	1,192.20	101,892	2.58	262,881.36	5,257.63	0	257,623.73
	Nov	2,044.40	1,556.20	136,696	2.58	352,675.68	7,053.51	0	345,622.17
	Dec	2,525.90	2,044.40	134,820	2.58	347,835.60	6,956.71	0	340,878.89
			2010 Sub-TOTAL	700,476		1,807,228.08	36,144.56	0	1,771,083.52
	Jan.	3,046.00	2,525.90	145,628	2.58	375,720.24	7,514.40	0	368,205.84
	Feb	3,452.30	3,046.00	113,764	2.58	293,511.12	5,870.22	0	287,640.90
	Mar	3,750.10	3,452.30	83,384	2.58	215,130.72	4,302.61	0	210,828.11
	Apr	4,060.40	3,750.10	86,884	2.58	224,160.72	4,483.21	0	219,677.51
	May	4,186.40	4,060.40	35,280	2.58	91,022.40	1,820.45	0	89,201.95
2011	Jun	4,498.50	4,186.40	87,388	2.58	225,461.04	4,509.22	0	220,951.82
	Jul	4,745.00	4,498.50	69,020	2.58	178,071.60	3,561.43	0	174,510.17
	Aug	5,171.00	4,745.00	119,280	2.58	307,742.40	6,154.85	0	301,587.55
	Sep	5,659.00	5,171.00	136,640	2.58	352,531.20	7,050.62	0	345,480.58
	Oct	6,002.80	5,659.00	96,264	2.58	248,361.12	4,967.22	0	243,393.90
	Nov	6,484.90	6,002.80	134,988	2.58	348,269.04	6,965.38	0	341,303.66
	Dec	6,969.50	6,484.90	135,688	2.58	350,075.04	7,001.50	0	343,073.54
			2011 Sub-TOTAL	1,244,208		3,210,056.64	64,201.13		3,145,855.51
	Jan.	7,455.30	6,969.50	136,024	2.58	350,941.92	7,018.84	0.00	343,923.08
	Feb	7,895.20	7,455.30	123,172	2.58	317,783.76	6,355.68	0	311,428.08
	Mar	8,148.40	7,895.20	70,896	2.58	182,911.68	3,658.23	0	179,253.45
	Apr	8,608.00	8,148.40	128,688	2.58	332,015.04	6,640.30	13,958.05	311,416.69
	May	8,783.30	8,608.00	49,084	2.58	126,636.72	2,532.73		124,103.99
2012	Jun	9,120.20	8,783.30	94,332	2.58	243,376.56	4,867.53	48,790.04	189,718.99
	Jul	9,527.40	9,120.20	114,016	2.58	294,161.28	5,883.23	0	288,278.05
			2012 Sub-TOTAL	716212		1,847,827	36,956.54	62,748.09	1,748,122.33
			TOTAL	2,660,896		6,865,111.68	137,302.23	62,748.09	6,665,061.36

Table 2-18 List of Approved RTCF Project

		Project Title	Project Location	Approved Cost			Imple. Office
				Clients	PLGU	Total	
1	2011	Rehab of Kapugan Baay CIS	Ambabag, Kiangan	25,000	100,000	125,000	BLGU
2	2011	Rehab of Mongkilong Pindongan CIS	Pindongan, Kiangan	25,000	100,000	125,000	BLGU
3	2011	Rehab of Umiyon CIS	Mungayang, Kiangan	25,000	100,000	125,000	Kiangan MLGU
4	2011	Rehab of Holang & Carne CIS	Nagacadan, Kiangan		125,000	125,000	Kiangan LGU
5	2011	Rehab of Nungkilat CIS	Julongan, Kiangan		125,000	125,000	Ifugao PLGU
6	2011	Rehab of Lilin Pindongan CIS	Pindongan, Kiangan		53,000	53,000	Ifugao PLGU
7	2011	Rehab of Fangki CIS	Mayoyao Proper, Mayoyao		50,000	50,000	Ifugao PLGU
8	2011	Rehab of Agaddang Bayon CIS	Batad, Banaue		100,000	100,000	Ifugao PLGU
9	2011	Rehab of Bolbol Bangaan CIS	Bangaan, Banaue		170,765	170,765	Ifugao PLGU
10	2011	Rehab of Olohan Bukig CIS	Bongan, Mayoyao		50,000	50,000	Ifugao PLGU
11	2011	Bakle Ad Kiangan	Kiangan		32,000	32,000	Kiangan MLGU
12	2011	Reserch & Development for potential MH	Province wide		52,935	52,935	Ifugao
			2011 RTCF Approved	75,000	**1,058,700**	1,133,700	
13	2012	Aid to Umiyon CIS	Mungayang, Kiangan		33,913	33,913	BLGU
14	2012	Staging the bakle ad Ambabag	Ambabag, Kiangan		33,913	33,913	BLGU
15	2012	Improvement of the Lohob CIS	Pindongan, Kiangan		33,913	33,913	BLGU
16	2012	Tattawang CIS	Pindongan, Kiangan		103,306	103,306	Kiangan MLGU
17	2012	Nakahakan CIS	Nagacadan, Kiangan		168,000	168,000	Kiangan MLGU
18	2012	Lamag Picdot CIS Canal Riprap	Hapao, Hungduan		100,000	100,000	Ifugao PLGU
19	2012	Rehab. Of Pulla Lubina CIS	Hapao, Hungduan		171,306	171,306	Ifugao PLGU
20	2012	Reserch & Development for potential MH	Province wide		33,913	33,913	Ifugao PLGU
			2012 RTCF Approved		**678,264**		
			TOTAL		1,736,964		

A new organization that includes newly recruited operators will be responsible for the operation and maintenance of the Likud MHPP in the Project. The new organization will form part of the overall management structure illustrated in Fig 2-13. As shown in Fig. 2-13, while PPDO will be the administration/responsible body of the Project, actual supervising/management will be done by the Steering Committee which consists of relevant organizations of the Province.

Meanwhile, the management of funds raised from the sale of power generated at Likud MHPP will be conducted within the current organization. (However, revision of the fund operation guidelines and provincial ordinance will be required; see Chapter 2 section 2-2-5-9 Soft Component Plan).

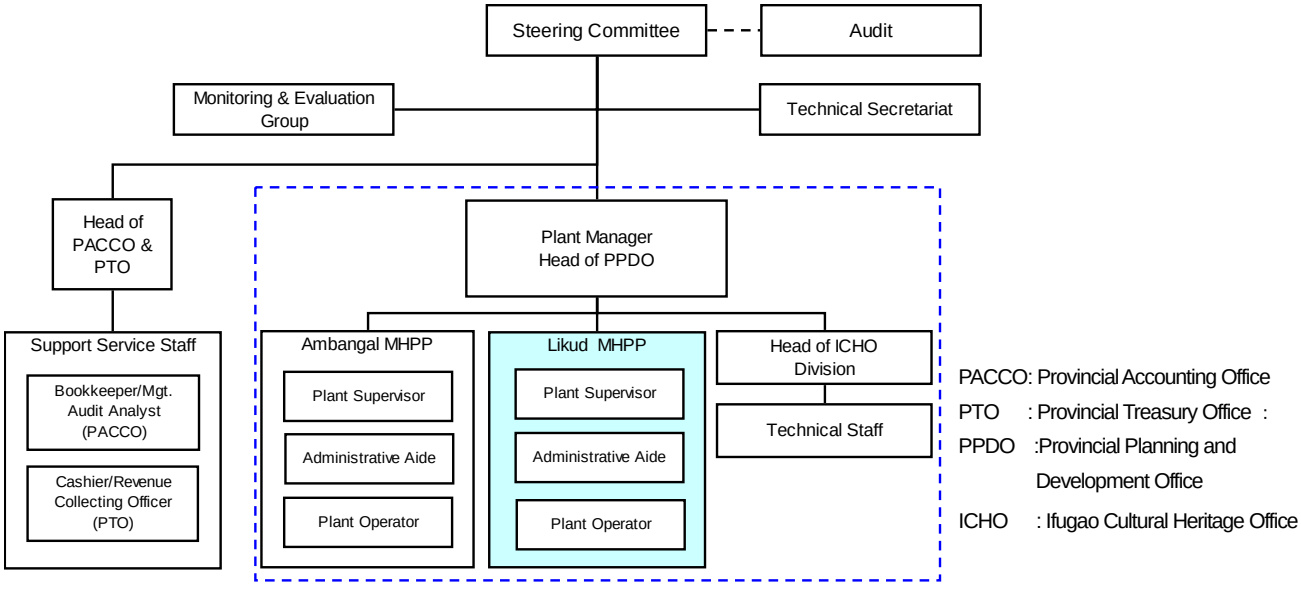


Fig. 2-13 Project Management Setup

Table 2-19 Roles in Operation of the Power Plant and Rice Terraces Conservation Fund

Organization/Office Name	Role	Members
Steering Committee	• General supervision of power plant operation and maintenance and rice terraces conservation and maintenance • Formulation of operation and maintenance regulations • Formulation of annual budget	• Provincial Governor • 11 municipal mayors • Ifugao Provincial Assembly Representative • Kiangan Municipal Assembly • Mayors of 3 beneficiary barangay • 1 NGO
Technical Secretariat	• Support for formulation of operation and maintenance regulations • Support of Steering Committee activities	• Provincial Planning and Development Office • Provincial Governor's Office • Provincial Legal Office • Provincial Assembly Secretary's Office
Monitoring & Evaluation Group	• Monitoring and evaluation of rice terrace conservation activities	• Provincial Engineering Office • Provincial Agriculture Environment Natural Resources Office • Provincial Governor's Office • 1 NGO
Audit	• Implementation of annual accounting audit • Reporting of audit results	• Provincial Audit Office
Accounts and disbursements (PACCO & PTO)	• Support of financial management of Ambangal MHPP • Preparation of accounting reports • Confirmation of balance status with PPDO and ICHO	• Provincial Accounting Office • Provincial Treasury Office
Provincial Planning and Development Office (PPDO)		
Plant Manager	• Person responsible for power plant operation and maintenance and rice terraces conservation and maintenance	• Provincial Planning and Development Office Director
Plant Supervisor	• Person responsible for operation and maintenance of Ambangal MHPP • Confirmation of generated electric energy • Preparation of monthly report • Confirmation of operation stop times	• Provincial Planning and Development Office member
Ambangal operators	• Power plant operation and maintenance • Routine plant inspections • Recording of generated electric energy • Preparation of inspection reports • Preparation of weekly reports	• Provincial Planning and Development Office member
Administration aid	• Balance control records concerning hydropower plant operation and maintenance and the rice terraces conservation fund	• Provincial Planning and Development Office member
Ifugao Cultural Heritage Office (ICHO)	• Support of conservation activities under the rice terraces conservation fund • Support of local residents in preparing application forms to utilize funds • Support of barangay development plan preparation • Monitoring and evaluation of rice terrace conservation activities by local residents	• Jurisdiction will switch from the Provincial Governor's Office to the PPDO in 2011. However, there are no full-time staff; rather, all the ICHO staff members are contracted.

2-4--2 Power Plant Operation and Maintenance Setup

In discussions with the DOE and provincial government during the preparatory survey, the operation and maintenance setup of the power plant was confirmed as shown in Fig2-14. Table 2-18 indicates the roles of each staff member.

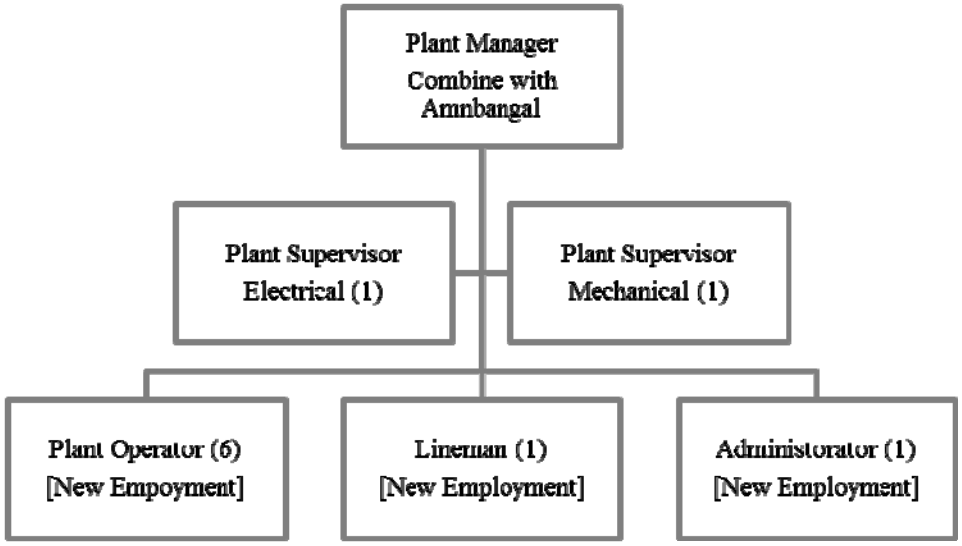


Fig.2-14 Likud Mini Hydropower Plant Operation and Maintenance Setup

Table 2-20 Hydropower Plant Operation and Maintenance Personnel

Position	Department	Role
Plant Manager (1)	Director of the Provincial Planning and Development Office (PPDO)	Person responsible for general operation and management of the power plant and the Rice Terraces Conservation Fund (combined with duties at Ambangal MHHP)
Plant Supervisors (2: electrical and mechanical)	Provincial Planning and Development Office employees (PPDO)	Person responsible for operation and maintenance of the hydropower plant Electrical engineer and mechanical engineer
Plant operators (6)	Provincial Planning and Development Office employees (PPDO)	Operation and maintenance of the hydropower plant 8-hour shifts by teams of 2 Patrolling of the headrace, head tank and intake equipment, and periodic inspection of the water turbine and generator Recording of generated electrical energy
Line operator (1)	Provincial Planning and Development Office employee (PPDO)	Patrolling inspection and maintenance of grid-connection line
Office staff (1)	Provincial Planning and Development Office employee (PPDO)	Balance control for the hydropower plant Requesting power sales to IFECLO Allocation management of the Rice Terraces Conservation Fund

2-5 Project Cost Estimation

The total cost of Project implementation was estimated based on the conditions indicated in (3) below. However, this amount does not represent the grant limit stated in the E/N.

2-5-1 Initial Cost Estimation

(1) Cost burden on the Japanese side

. This cannot be disclosed until the construction and procurement contracts are certified

(2) Cost burden on the Philippine side

Table 2-21 shows the cost items, contents and amounts on the Philippine side. The amount to be borne by the Department of Energy, which is the responsible agency for the Project, is equivalent to approximately 1.2% of its budget for fiscal 2011 (1,366 million pesos). Also, because the burden for Ifugao Provincial Government, which is the Project implementing and operating agency, corresponds to approximately 5.6% of its development budget of 116 million pesos (2011), the Project is deemed to be affordable for both agencies.

Table 2-21 Cost Burden of the Philippines

Cost Item/Contents	Amount (1000 pesos)	Remarks
Commission based on the bank agreement (A/P commission fee, B/A commission fee)	469	Department of Energy
VAT on locally procured materials FPIC, environmental compliance certificate, water rights, approval by the Energy Regulatory Commission, operating contract, etc.	15,953	Ditto
Subtotal	16,422	
Land acquisition cost	1,000	Ifugao Province
Authorization fees	1,700	Ditto
Initial year operating expenses (personnel expenses repair cost, etc.)	3,793	Ditto
Subtotal	6,493	
Total	22,915	

(3) Estimation conditions

① Estimation point: October 2012

② Exchange rate: 1.0 Php = 2.03 JPY (mean rate for the past 6 months at the estimation point)

③ Price fluctuation factor

The price fluctuation factor from the estimation point to the tender month was calculated as follows based on the IMF inflation average consumer prices for 2011 and 2012. As a result, the price fluctuation factor came to 1.033.

④ Construction and procurement period

Table 2-15 shows the detailed design and the construction schedule.

⑤ Others

Estimation was implemented based on the Government of Japan's Grant Aid scheme.

Table 2-22 Setting of Exchange Rate (JPY/Php) and Price Fluctuation Factor

Month	2012 April	May	June	July	August	September	Mean
JPY/Php	2.07	2.02	2.01	2.04	2.03	2.03	2.03

According to Mitsubishi UFJ Research and Consulting Co., Ltd. "Customer Foreign Exchange Rates Published by Mitsubishi Tokyo UFJ Bank" and "Local Reference Foreign Exchange Rates"

2-5-2 Operation and Maintenance Cost

Ifugao Provincial Government, which is the implementing and operating agency for the Project, has conducted the operation and maintenance of Ambangal mini hydropower plant without any problems since it began operation in 2010. As with this Project, the purpose of developing Ambangal was to secure funds for the RTCF, and since the turbine and generating equipment here are Japanese products and the civil engineering facilities specifications are similar to those in the Project, the local side possesses the basic capability for maintaining the Project. If technical guidance on mini hydropower plant operation and maintenance can be implemented through the soft component of the Project and the RTCF administration system can be strengthened and boosted with additional funds from the Project, it should be possible to implement the Project operation and maintenance and administer the RTCF without much trouble.

It is estimated that the annual total revenue from power sales by Likud mini hydropower plant will be approximately 19.4 million pesos/year, while the cost of maintenance will be approximately 3.8 million pesos/year. Since the maintenance cost will only correspond to around 20% of the total power sales revenue, it will be affordable.

Table 2-23 Power Plant Operation and Maintenance Cost

Type	Personnel	Numbers	Monthly Unit Cost (Php)	Annual Cost (Php)
Power plant operation Maintenance personnel expenses	Plant Supervisor	2	18,000	432,000
	Operator	6	15,000	1,080,000
	Line operator	1	12,000	144,000
	Office staff	1	10,000	120,000
	Subtotal	10	-	1,776,000
Repair cost				2,020,000
Total				3,796,000

Note) Since the plant manager will combine duties with his existing position at Ambangal MHHP and is already a provincial government employee, he is not included above.

Since operation of the RTCF is handled by an existing provincial government employee, it is not included above

Chapter 3 Project Evaluation

3-1 Preconditions

The necessary permits and approval must be obtained from the following relevant agencies before the mini hydropower plant can go into operation.

In the Project, the Provincial Government of Ifugao (PGI) will need to advance the procedures for permits and approvals without delay in accordance with the Project progress. The time required for permit and approval procedures and the items that need to be considered in the Project are as indicated in Chapter 2 Table 2-15.

(1) Local Government Units Endorsement: from LGUs
(2) Land Acquisition / Right of Way : from Land Owners
(3) Certificate of NCIP/FPIC: from National Commission on Indigenous People (NCIP)
(4) Environmental Compliance Certificate :from Environmental Management Bureau(EMB-DENR)
(5) Water Right Permit: from National Water Resources Board (NWRB)
(6) Energy Sales Agreement: from Ifugao Electric Cooperative (IFELCO)
(7) Renewable Energy Service / Operation Contract: from Department of Energy (DOE)
(8) Certificate of Compliance: from Energy Regulatory Commission (ERC)

The following paragraphs give an outline of permit and approval applications and the current situation regarding procedures for Likud mini hydropower project.

(1) LGUs: LGU Endorsement

All administrative bodies at the provincial, municipal and barangay levels must be approached by the project implementing body to provide support, approval and relevant resolutions in writing. It will be necessary for the project implementing body to explain the planned contents of the project to the assembly of each LGU and/or communities (through community consultation meetings). The said body must submit documents, including a survey report, location map of the project site and planned contents of the project, with a view to obtaining approval. The said body must also obtain various permits, including a business permit, power plant operation permit and building permit, during the implementation of the project.

Concerning Likud mini hydropower development project, the Survey Team and PGI jointly held barangay consultation seven (7) times in total (FS study period: 4 times, preparatory survey period: 3 times), and they have already obtained the approval of the barangay (No.89-2012). Also, basic understanding has been obtained through conducting meetings to explain the project outline to the municipal and provincial assemblies (once each during the FS and preparatory survey).

(2) Land Acquisition/ Right of Way

All of the land intended for Likud mini hydropower development project is privately owned, however, almost all the landowners have consented to offering their land for the Project (see Chapter 1 Sectioon 1-3 for details).

(3) NCIP: NCIP Certification

The Indigenous People's Rights Act (IPRA Law; Act No. 8371) demands that any development in areas inhabited by indigenous people must obtain FPIC (free and prior informed consent) certification by means of disclosing the project contents and any other relevant information to stake holding communities of indigenous people. When the general consent of such communities is obtained based on the FPIC certification mechanism, the NCIP issues a Certification Precondition (CP) to the project implementing body.

Concerning Likud mini hydropower development project, application for the FPIC has already been made and the first NCIP meeting with local residents has already finished (three meetings are required). The FPIC activities are scheduled to finish and a certificate will be issued by NCIP soon.

(4) EMB-DENR: Environment Compliance Certificate

The EMB is responsible for the issue of an environment compliance certificate in response to an application lodged by a project implementing body. There is an agreement between the DOE and DENR that the Certificate of Non-Coverage (CNC) arrangement is applicable to power generation projects of which the scale of development is 1.0 MW or lower. An application for a CNC must be accompanied by a project description report. According to the Procedural Manual for Environmental Impact Statement System (DAO 03-30), the CNC process is applicable to all run-of-river type hydropower generation projects regardless of the development scale for which the submission of a project description report is required.

Concerning Likud mini hydropower development project, PGI is currently applying for issue of a CNC, and the EMB is expected to issue this soon.

(5) NWRB: Water Rights Permit

The NWRB issues a water rights permit to authorize a hydropower generating project which is classified under a special category of river water use to take a certain amount of water from the river concerned for the purpose of power generation. The CNC mentioned in c) above is required to obtain this water rights permit. After obtaining a permit, the project implementation body must pay an annual fee for its water use.

Concerning the Project, PGI will need to implement the permit application procedure following the official decision to implement the Project (E/N and G/A) and issue of CNC.

(6) DOE: Renewable Energy Service/ Operating contract

The Renewable Energy Act (Act No. 9513) makes the DOE responsible for the supervision of all renewable energy development projects in the Philippines. The DOE issues permits concerning pre-development contracts for an investigation and service/operating contracts for a project implementation. Based on the same Act No. 9513, the DOE also provides some incentives, including special tax exemption, for developers to facilitate the development of renewable energy.

In the case of the Project, the DOE is the Project responsible agency and there is no need for a pre-development contract, however, it is necessary for PGI to obtain permission for the operating contract by the end of construction.

(7) PGI&IFELCO: Energy Sales Agreement (ESA)

In the Project, work has progressed up to the energy sales agreement between PGI and IFELCO (it is necessary to bind the ESA. Both agencies have started working together on preparing the draft contract and reaching basic agreement on the power purchase price (4.35 peso/kWh)).

(8) ERC: Certificate of Compliance (Approval of Unit Energy Sales Cost)

In accordance with the Electric Power Industry Reform Act (Act No. 9136), the ERC examines whether or not the wholesale unit price of electricity is appropriate and issues a certificate of compliance. A project implementation body must obtain this COC prior to the start of operation.

In the Project, ERC approval must be obtained by the end of construction. PGI (the Project operator) is the applying party, and the DOE plans on supporting the application procedure and providing additional explanations to the ERC.

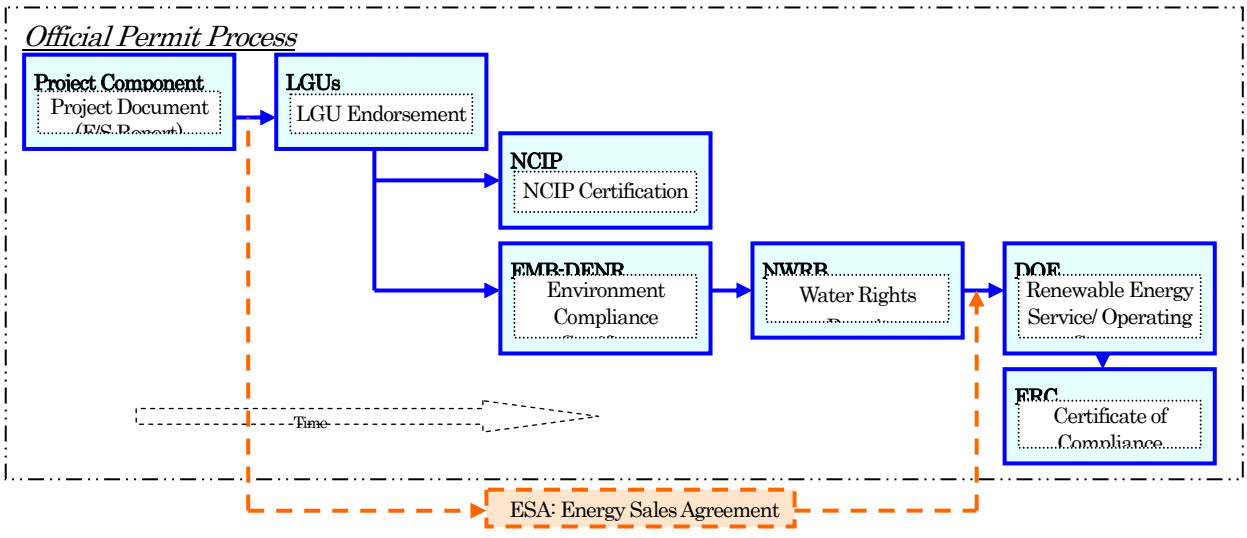


Fig. 3-1 Mini-hydro Permit Process Flow

3-2 Necessary Input by Recipient Country

The items that need to be implemented by the Philippine side in order to achieve the overall Project plan are separately described below according to the DOE (the implementer) and PGI (the cooperation agency).

The items to be inputted by the DOE and PGI during Project construction are listed below. The DOE will basically assume responsibility until the completion of construction, while PGI will be responsible for operating the facilities after the operation and maintenance setup in Ifugao Province has been confirmed following completion.

3-2-1 Inputs of DOE

① Cooperation with JICA concerning the Project implementation
② Support for legal procedures by PGI
③ Verification of the relevance of Project contents
④ Support for consensus building activities by PGI
⑤ Support for training of operators, etc.
⑥ Ownership of the power generating facilities (completion of construction ~ handover to PGI)
⑦ Support for power plant operation and maintenance conducted by PGI
⑧ Bearing of VAT and handling of import tariff exemptions, etc. (see Chapter 2 Section 2-3)
⑨ Opening of bank account and bearing of commission fees, etc. based on the banking agreement (see Chapter 2 Section 2-3).

3-2-2 Inputs of PGI

① Land appropriation
② Legal procedures
③ Consensus building among residents
④ Support for training of operators, etc.
⑤ Revision of the RTCF administration guidelines
⑥ Bearing of costs linked to power plant maintenance and administration of the RTCF (see Chapter 2 Section 2-3).

3-3 Important Assumption

The Project aims to expand the RTCF, and the external conditions for achieving this are described below.

(1) Weather conditions

The Project entails construction of a flow-in hydropower plant, while the RTCF is dependent on the amount of electricity that can be generated in the power plant. Moreover, the generated amount of power is impacted by the size of river flow. There is a flow observation post that has observed flow conditions for a relatively long time near to the Project site, and the estimated flow is deemed to be sufficient, however, as was indicated in Chapter 2 Figure 2-8, the local weather conditions (rainfall) fluctuate in cycles of four or five years and serious dry spells occur once every 8~11 years.

Operation is schedule to commence in January 2015, however, it is difficult to predict how weather conditions will change beyond that, and the Project effect will be influenced by weather conditions.

(2) Power sale price

Because the RTCF is funded by returns from power sales, the power sale price will be a major determinant of Project effect.

In the project, the feed-in-tariff (FIT, power sale price in the case of flow-in hydropower = 5.90 peso/kWh) that was officially approved on July 26, 2012 may be applied, and IFELCO is considered as the purchaser of power for the following reasons. Concerning the power sale price, PGI and IFELCO came to agreement on a figure of 4.35 peso/kWh in the stakeholders meeting held during the preparatory survey period.

- ✧ The technical inter-connection conditions in the case where the FIT is adopted have not yet been clarified.
- ✧ The FIT system intends to promote entry of IPPS to the hydropower generation market, but there is concern that it cannot be applied to activities such as the Project where the DOE is the implementer.
- ✧ One of the Project objectives is to “make a contribution to the stabilization of power supply in Ifugao Province” including reducing power tariffs, however, if the FIT is adopted, no contribution can be made to reducing power tariffs in the province.

Power sale prices other than the FIT need to be officially approved by the Energy Regulatory Commission (ERC). In the case of Ambangal mini hydropower plant, which was developed with similar objectives to the Project, the ERC eventually decided to adopt a tariff of 2.59 peso/kWh, which was far below the 4.00 peso/kWh that was basically agreed between PGI and IFELCO, and this has remained unchanged ever since.

The ERC has decided to treat the Project as a general commercial power generating activity but it doesn't recognize a power sale price higher than the generating cost. However, because the power generating activity in the Project is a means of securing funds for the RTCF, it is inappropriate to treat it like an ordinary commercial activity, and it will be necessary for the DOE, which requested the grant aid, to quickly address this issue in coordination with the ERC[1].

[1] This matter was also pointed out by the province side in discussions with the provincial assembly implemented during the field surveys. During this meeting, the DOE committed to coordinating with the ERC. Also, the Undersecretary (Mr. Atty. Jose M. Layug, Jr. at the time) promised to coordinate with the ERC immediately.

3-4 Project Evaluation

3-4-1 Relevance

For the Philippines, which rely on imported fossil fuels to provide half of its power requirement, implementation of the Project is expected to promote the utilization of water resources-based renewable energy, contribute to improving energy security and help mitigate greenhouse gas emissions. Moreover, since this mini hydropower activity geared to promoting utilization of renewable energy is also compatible with the energy policy of the Philippines, the Project is deemed to be relevant.

Moreover, in the Project, it is planned to utilize the profits acquired from power sales for conserving the World Heritage rice terraces of Ifugao via the RTCF. Doing so will also make a contribution to preserving tourism resources and will be significant in terms of promoting environmental conservation and local economic development.

At the same time, through adding to the experience of Japanese mini hydropower equipment makers, which possess technical capability but are having difficulty making overseas advances, the Project will contribute to a new growth strategy that is based on the promotion of technical dissemination and overseas extension.

3-4-2 Effectiveness

The anticipated outputs of Project implementation are as follows.

(1) Quantitative effects

According to the policy that was described in Chapter 2 Section 2-2-1(6), the quantitative effect indicators for evaluating the Project effect have been set as shown in Table 3-1.

Table 3-1 Quantitative Effect Indicators

Indicator	Reference Value (2012)	Target Value (2018) [3 years after Project completion]
Generated electrical energy at the generating end (MWh/year)	0	4,451
Contribution to CO_2 emissions reduction (tCO_2/year) (generating end)	0	2,167

(2) Qualitative Effects

The following qualitative effects can be anticipated from implementation of the Project.

Qualitative Effects: The profit which will be secured from electricity sales of Likud Mini-Hydropower plant, will contribute to conservation of Ifugao tourism resources including rice terraces of World Heritage.