CHAPTER 19 CONSTRUCTION PLAN AND PRELIMINARY COST ESTIMATE

19.1 PROJECT IMPLEMENTATION PROGRAM

The Masang-2 Hydropower Project (hereinafter referred to as "the project,") was formulated as a run-of-river type development and proposed to conduct a pre F/S in the framework of the study. The project consists of major structures, namely: 1) intake weir, 2) intake and sand trap, 3) connection culvert, 4) connection tunnel, 5) intermediate pond, 6) headrace tunnel, 7) surge tank, 8) penstock, 9) powerhouse, 10) tailrace, 11) switchyard, and 12) transmission line. The construction items incorporated in the project are summarized in Table 19.1.1 and the layout of project facilities is shown in Drawing No. M-100. The construction of site access roads, preparatory works, river diversion, etc., is also stated in this chapter.

Table 19.1.1 Construction Items for the Masang-2 HEPP

Category	Structure/Equipment
Civil Works	Intake Weir, Intake, Sand Trap, Connection Culvert, Connection Tunnel, Intermediate Pond, Headrace Tunnel, Surge Tank, Penstock Line, Powerhouse, Tailrace, Switchyard, Transmission Line
Hydro-Mechanical Works	Gates, Valves, Trash rack, Stoplogs, River Outlet Steel Pipes and Valves, Penstock Pipe, Draft Tube Gate
Electro-Mechanical Works	Turbines, Generators, Main Transformers, Control Equipment, Switchgear, Transmission Line

Source: JICA Study Team

The overall implementation schedule the project proposes as shown in Figure 19.1.1 started with the year 2011. The project would require about six (6) years including transaction activities of about three (3) years and construction period of three (3) years started with the year 2014 after the completion of this pre-feasibility study in the year 2011 to enable commissioning by November 2017. Implementation items to be incorporated are listed as follows:

- Financial arrangement for further study
- Feasibility study and supplemental survey
- EIA study
- Land acquisition, compensation and resettlement
- Procurement of consultant
- Detailed design and preparation of tender documents

- PQ, tender, tender evaluation and award of contract
- Construction

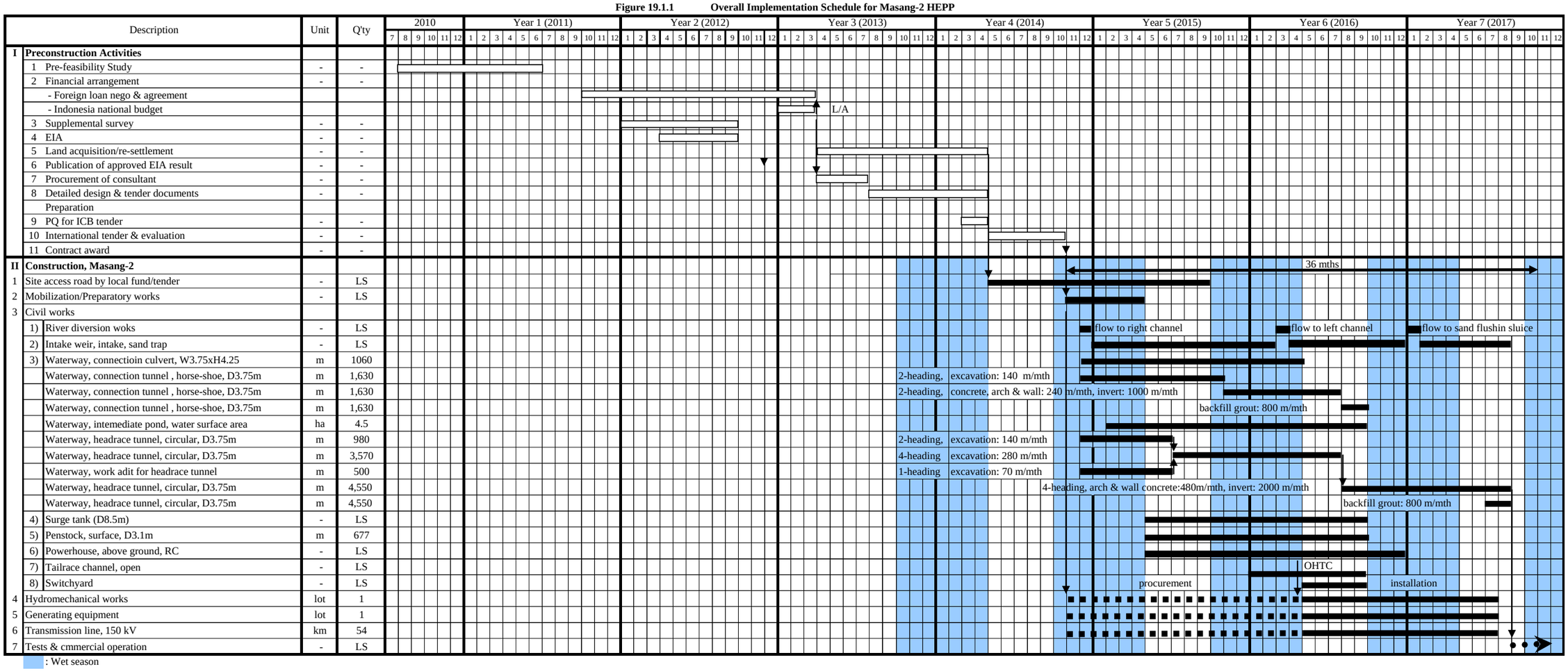
It is expected that financial source the project will be Japan's ODA loan for the further study and construction execution.

It is planned that the project will be implemented under the responsibility of the PLN. The construction works will be executed by the selected contractor through international competitive bid (ICB). The engineering consultant will be employed for feasibility study, detailed design and construction supervision.

It is planned that the construction of site access roads will have to be conducted by the local contractor separating and advancing the main works under local competitive bid (LCB) under financing the local budget for the purpose to shorten the construction period of the main works and to meet to commence the target time the commercial operation in November 2017.

Figure 19.1.1 Overall Implementation Schedule for Masang-2 HEPP

	Description	Unit	Q'ty
I	**Preconstruction Activities**		
1	Pre-feasibility Study	-	-
2	Financial arrangement	-	-
	- Foreign loan nego & agreement		
	- Indonesia national budget		
3	Supplemental survey	-	-
4	EIA	-	-
5	Land acquisition/re-settlement	-	-
6	Publication of approved EIA result	-	-
7	Procurement of consultant	-	-
8	Detailed design & tender documents Preparation	-	-
9	PQ for ICB tender	-	-
10	International tender & evaluation	-	-
11	Contract award	-	-
II	**Construction, Masang-2**		
1	Site access road by local fund/tender	-	LS
2	Mobilization/Preparatory works	-	LS
3	Civil works		
1)	River diversion woks	-	LS
2)	Intake weir, intake, sand trap	-	LS
3)	Waterway, connectioin culvert, W3.75xH4.25	m	1060
	Waterway, connection tunnel , horse-shoe, D3.75m	m	1,630
	Waterway, connection tunnel , horse-shoe, D3.75m	m	1,630
	Waterway, connection tunnel , horse-shoe, D3.75m	m	1,630
	Waterway, intemediate pond, water surface area	ha	4.5
	Waterway, headrace tunnel, circular, D3.75m	m	980
	Waterway, headrace tunnel, circular, D3.75m	m	3,570
	Waterway, work adit for headrace tunnel	m	500
	Waterway, headrace tunnel, circular, D3.75m	m	4,550
	Waterway, headrace tunnel, circular, D3.75m	m	4,550
4)	Surge tank (D8.5m)	-	LS
5)	Penstock, surface, D3.1m	m	677
6)	Powerhouse, above ground, RC	-	LS
7)	Tailrace channel, open	-	LS
8)	Switchyard	-	LS
4	Hydromechanical works	lot	1
5	Generating equipment	lot	1
6	Transmission line, 150 kV	km	54
7	Tests & cmmercial operation	-	LS



: Wet season

19.2 CONSTRUCTION PLAN AND SCHEDULE

19.2.1 CONSTRUCTION PLAN

(1) Scope of Works

The major work items and its quantities are calculated from the pre-feasibility design and summarized in Table 19.2.1 below.

Table 19.2.1 Items and Quantities for Major Works of Masang-2 HEPP

	Work item	Quantity
(1)	Access road	
	- Access road, new 4m carriage way	: 14.2 km
	- Existing road improvement	: 1.5 km
	- Bridge	: 2 sets
(2)	Preparatory works	: LS
(3)	Environmental mitigation works during construction	: LS
(4)	Diversion weir, intake and sand trap	
	- Excavation	: 66.000 m^3
	- Concrete, mass	: 7,000 m^3
	- Concrete, structural	: 12,900 m^3
	- Foundation grouting, 10mx50 nos.	: 500 m
(5)	Connection culvert, L 1,060 m	
	- Excavation	: 243,,000 m^3
	- Earth backfill	: 30,000 m^3
	- Concrete	: 10,200 m^3
(6)	Connection tunnel, L 1,630 m	
	- Excavation, open	: 3,600 m^3
	- Excavation, underground	: 32,200 m^3
	- Tunnel support	: LS
	- Concrete lining	: 13,200 m^3
(7)	Intermediate pond, water surface area 4.5ha	
	- Excavation for storage space	: 840,000 m^3
	- Excavation for structural foundation	: 150,000 m^3
	- Dike embankment, rock fill	: 325,000 m^3
	- Slope stabilize cover concrete, below El 343	: 2,200 m^3
	- Slope stabilize drain holes, below El. 343	: 5,000 m
	- Cut slope sodding, above water	: 9,000 m^2
	- Cut slope shotcrete, above water	: 3,000 m^2
	- Foundation grouting, 10mx100 nos.	: 1,000 m
	- Concrete, open structures	: 5,400 m^3
(8)	Headrace tunnel L4,730 m and surge tank	
	- Excavation, open	: 11,300 m^3
	- Excavation, tunnel	: 94,000 m^3

	- Excavation, shaft	: 4,700 m^3
	- Tunnel support	: LS
	- Concrete lining	: 28,900 m^3
	- Consolidation grouting	: 23,000 m
	- Work adit, L 500 m	: LS
(9)	Penstock line, powerhouse, tailrace and switchyard	
	- Excavation, open, penstock	: 64,000 m^3
	- Excavation, open, powerhouse	: 83,000 m^3
	- Earth backfill	: 10,000 m^3
	- Concrete, penstock line	: 4,100 m^3
	- Concrete, powerhouse	: 9,000 m^3
	- Architectural finish & utility	: LS
(10)	Steel and mechanical works	
	- Sand flushing gate, 5mx4m, 1 no.	: 30 tons
	- Sand flushing stoplog, 5mx4mx, 1 no.	: 20 tons
	- River outlet valves, D0.3m slide valve, 2 nos.	: LS
	- Intake trash rack	: 14 tons
	- Intake gate, 2 nos.	: 50 tons
	- Intake stoplog, 1 no.	: 25 tons
	- Sand drain gate, 2 nos.	: 6 tons
	- Settling basin, end stoplog	: 22 tons
	- Culvert inlet stoplog gate	: 32 tons
	- Connection tunnel outlet stoplog	: 27 tons
	- Pond river outlet steel pipe, D0.5mx110m	: 13 tons
	- Pond river outlet emergency valve, D0.4m	: LS
	- Pond river outlet service valve, D0.4m	: LS
	- Draft tube stoplog, 2 nos.	: 21 tons
	- Penstock pipe, D3.4m	: 1,010 tons
(11)	Generating equipment and switchyard equipment	
	- Turbines	: 1 lot
	- Generator	: 1 lot
	- Control equipment	: 1 lot
	- Others	: 1 lot
(12)	Transmission line	
	- Transmission line, 150 kV	: 54 km

Source: JICA Study Team

(2) Site Conditions

Existing access to the site

The project is located on the most upstream of the Masang River, about 15 km north of Lake Maninjau and 90 km north of Padang city, West Sumatra. Access to the site is by existing provincial road via Padang, Bukittinggi and Palembaian.

Topography

Topography the proposed site is mountainous highlands that elevation ranges from El. 140 m to El.

344 m. The Masang river originates from Minangkabau highlands near Bukittinggi. The river flows to north, then turns to west and finally into the Indian Ocean.

Meteorology and hydrology

Average monthly rainfall is 299 mm and annual rainfall of 3661 mm. The average daily rainfall under 5 mm is 250 days per year according to the data at Bukit Tinggi, maninjau, Jambak and Kota Bahru. Wet season defines October to April referring rainfall data. Average air temperature is max. 31^{o}C and min.22 ^{o}C.

Geology

According to the existing geological map, the project site is underlain by Quaternary volcanical rocks, mainly including tuff with some andesitic or basaltic lava. In the vicinity of the project site the Masang river flows to the northwest, nearly parallel to the Great Sumatra Fault (GSF) zone on the right (northeast) side of the Masang river.

Around the weir site, alluvial deposits are widely distributed on both bank sides, about 200 to 300 m wide in the right bank and about 50 m wide in the left bank.

Andesitic rocks or tuffs are expected to be encountered along the waterway route. In addition, based on the existing geological map, some local faults run obliquely through the proposed waterway line, and therefore would have some impact on the excavation of the waterway.

The proposed powerhouse was proposed on the left bank side. The left bank slope is very steep with outcrops of andesitic rocks.

The riverbed sediments, including coarse sands, gravels and boulders of andesite and sandstone origins, can be used as fine and coarse aggregates of concrete. Limestone quarries, quarry 1, 2 and 3 as shown in Drawing No. M-100 in general layout, will also be used as concrete aggregates.

Construction resources

Major construction resources for the Project will be procured from following sources based on site reconnaissance and hearing survey:

Labor force	1) Skilled	: Bukittinggi, Padang and Jawa
	2) Semi-skilled	: Bukittinggi, Padang
	3) Common	: Project site
Materials	1) Cement	: Padang
	2) Reinforced steel bar	: Jawa, Sumatra
	3) Shaped steel, H, I	: Jawa
	4) Concrete aggregates	: Project site
	5) Fuel and lubricants	: Bukittinggi
Plant/Equipment	1) Earthmoving equipment	: Bukittinggi, Padang, Jawa
	2) Tunneling equipment	: Import
	3) Concreting	: Bukittinggi, Padang, Jawa
	4) Crane	: Bukittinggi, Padang, Jawa

Cargo transportation

Handling of project's sea cargo is Teluk Bayur Sea Port, Padang Port. The port is facilitates having 25 tons mobile crane, 45 tons head truck, 40 tons trailer, 2-5 tons fork lift and other handling equipment that satisfies to handling the project cargoes. The provincial road via Padang, Bukittinggi and Palembain is the major route for inland transportation of project's cargoes.

(3) Yearly Working Days

Working days for typical construction work are assumed as follows considering suspended days of 48 days for Sunday, 14 days for National holiday, 7 days for Hari Raya, and rainfall data that the work suspended over the daily rainfall of 5 mm that assumes 115 days (365 days – 250 days).

Earth works, open	: 365 – (48+14+7) = 296 days
	365 – 115 = 250 days
Concrete works	: 250 days
Tunnel works	: 296 days

Working hours are from 8:00 to 17:00, including one hour for lunch. Amount is to 48 working hours per week, from Monday to Saturday.

(4) Preparatory Works

Site access road

The following site access roads having about 4m of carriage way are planned as shown in Drawing No. M-100 and planned to be constructed or improved by the local contractor.

Road AR1 New, between right bank and left bank, intake site
AR2 New, along left bank and upstream
AR3 New, along Kototinggi village, left bank
AR4 New, left bank from intermediate pond to spoil bank 3
AR5 New, left bank between Kototinggi village and powerhouse
AR6 New, left bank between work adit and AR5
AR7 New, left bank between powerhouse and Masang river
AR8 New, right bank existing road to powerhouse
AR9 New, right bank existing road to powerhouse

Bridge BR1 New, at just downstream of intake site
BR2 New, at near powerhouse site

Spoil banks

Excavation volume assumes at about 1.5 million m3 in total for all the structures of civil works. The excessive excavated materials are spoiled to the designated spoil banks that propose at 9 places, SB1

to SB9, as shown in Drawing No.M-100. However, excavated materials should be planned to use effectively such as concrete aggregates, road maintenance, low land reclamation and others.

Base camp and plant yard

The contractor's base camp and plant yard will be located at the left bank the river near the Kototinggi village. The total land area of the camp and plant yard is assumed to be about 2 ha.

(5) Temporary Facilities

Temporary construction facilities such as buildings, plant and plant yard, laboratory, workshop, warehouse and magazine will also be provided.

Concrete mixing plant

The total concrete volume is estimated at about 100,000 m^3, including allowances. No ready mixed concrete factory is found around the project site that needs to provide concrete production facility by the contractor. The required mixing capacity of the plant is to be estimated based on the peak monthly placing volume.

Aggregate plant

To supply concrete aggregates, it is necessary to define the supply source from rock quarry or commercial supplier. Potential quarry site, quarry 1, 2 and 3, proposes as shown in Drawing No.M-100. The required aggregate plant capacity is to be calculated based on the peak concrete requirement, in case to own production.

Water supply system

Water supply is required for places such as the contractor's office and camp, construction plant, repair shop, tunnel headings, and tunnel portals. The Masang River will be the water source for construction and spring water or tributaries for drinking upon treatment.

Power supply system

No public power is available in the construction site of intake, intermediate pond, work adit and powerhouse. Thus, the contractor is responsible for the provision of diesel generators or extension of public power lines from nearest public distribution line for construction use.

Air supply system

Since the main drilling operation for tunnel blasting work will be planned to involve hydraulic drifters equipped in the tunnel jumbo, air requirement is not very large. However, some auxiliary equipment need compressed air supply that will be supplied by engine-driven portable air compressor provided at the tunnel portal.

Ventilation system

There are three independent sources of air contamination in the tunneling work, namely: 1) exhaustion of workers, 2) blasting, and 3) diesel engines. Since muck truck system will be adopted, diesel

powered engines will produce the most contamination among the three elements. Thus, ventilation facilities will be planned so as to overcome gas emissions from engine-driven equipment used in the tunnel. The required ventilation volume should be calculated in a further study.

Drainage system in tunnel

Seepage water into the tunnel will be drained in the following manner:

Site	Drainage method
Connection tunnel	Gravity from pond side portal and pump up from intake side
Headrace tunnel	Gravity from the work adit and surge tank side tunnel portal, and pump up from the work adit and pond side tunnel portal
Powerhouse	By pumping-up
Intake	By pumping-up

Telecommunication system

Telecommunication system requires in the project site such as internal telephone, external telephone, radio hand phone, and mobile phone.

(6) Main Civil Works

Diversion weir, intake and sand trap

The technical features and work quantities for major items on these works are as follows:

- Type of weir — Un-gated concrete weir
- Type of intake — Screened horizontal inlet
- Type of sand trap — Double settling basins
- Height, overflow section — 4 m
- Foundation excavation — 66,000 m^3
- Mass concrete — 7,000 m^3
- Concrete, structural — 12,900 m^3
- Foundation grouting, 10mx 50 nos. — 500 m
- Hydro-mechanical works — 1 lot

The intake weir will be constructed in three stages using the multiple river diversion method, which shall provide a cofferdam along the river.

1st stage: A temporary cofferdam will be constructed using rock, gravel, and soil to divert river flow to the right side channel and allow construction of the structures situated in the left bank side. Mass concrete works for the left section of the weir body will resume in the third stage

2nd stage: The construction works are shifted to the right bank section and river flow is diverted to the left side channel and to construct remaining section of the weir.

3rd stage: This stage will cover placement of mass concrete for the remaining block of the left weir section. The river will flow through sand flush gate and sand flushing sluice.

The excavation for the diversion weir, intake and sand trap will be carried out using a 21 ton bulldozer equipped with ripper, 1.2 m^3 backhoe, and 15 ton dump truck. A 800 kg giant breaker will be used for rock excavation. Mass and structure concrete will be poured through a chute way or a 3.0 m^3 concrete bucket with 30 ton crawler crane, 3 m^3 class agitator truck, and a concrete mixing plant.

Construction period will be scheduled at about 33 months for 1st, 2nd and 3rd stages including three dry seasons.

Connection channel

The technical features and work quantities for major items on connection channel are as follows:

- Type of channel	Free flow box culvert
- Size of channel	W3.75m x H4.25m
- Length of channel	1,060 m
- Excavation	243,000 m^3
- Concrete, structural	10,200 m^3

Standard type of construction equipment will be applied for the excavation and concrete works such as 12 tons class bulldozer, 0.6 m^3 class backhoe, 10 tons class dump truck, 3 m^3 class agitator truck and others, provided 2 to 3 construction parties to conduct the works in parallel. Two dry seasons will be required for this channel construction.

Connection tunnel

The technical features and work quantities for major items on the connection tunnel are as follows:

- Type	Free flow tunnel, horse-shoe
- Tunnel diameter	D3.75 m
- Length of tunnel	1,630 m
- Excavation, tunnel	32,200 m^3
- Tunnel lining concrete	13,200 m^3

It is assumed that full-face excavation will be generally performed throughout the tunnel by applying the conventional method of drilling and blasting. However, top and bottom bench cut method might be required in some parts, depending on the current geological condition. Pilot boring from the cut face are recommended to forecast the geological condition and ground water. No work adit is planned in the connection tunnel.

The excavation will be carried out providing two headings of ascending from downstream side and descending from upstream side applying drill jumbo. A standard progress of excavation assumes at 70 m/month per heading. Tunnel support will be required by applying steel rib, shotcrete, wiremesh, rock bolt and forepoling. To drain unexpected water during the excavation, drainage system is to be provided.

The concrete lining follows after the driven of whole length the tunnel. A standard progress assumes at 120 m/month and 500 m/month for arch and wall and invert respectively applying steel sliding form.

The backfill grout follows the concrete lining.

Intermediate pond

The technical features and work quantities for major items on intermediate pond are as follows:

- Type of pond	Excavated natural creek
- Water surface area	4.5 ha
- Gross storage volume	0.4 MCM
- Excavation, storage space	840,000 m^3
- Excavation, structural foundation	150,000 m^3
- Dike embankment, rockfill	325,000 m^3
- Cut slope protection	LS
- Foundation grouting, 10mx100 nos.	1,000 m
- Concrete, open structures	5,400 m^3

Standard type of construction equipment will be applied for the excavation and concrete works such as 12 tons class bulldozer, 0.6 m3 class backhoe, 10 tons class dump truck, 3 m3 class agitator truck and others, provided 2 to 3 construction parties to conduct the works in parallel advancing the excavation works. A standard progress of huge amount of excavation work plans at about 230 m3/hour in 20 months construction period. Two dry seasons will be required for this pond construction.

Headrace tunnel, surge tank and drain tunnel

The technical features and work quantities for major items on headrace tunnel, surge tank and drain tunnel are as follows:

- Type of headrace tunnel	Pressure flow tunnel, circular
- Tunnel diameter and length	D3.75 m, L4,550 m
- Type of surge tank	Vertical shaft
- Surge tank diameter and height	D8.5 m
- Type of drain tunnel	Horse shoe
- Drain tunnel diameter and length	D3.6 m, L100 m
- Excavation, open	11,300 m^3
- Excavation, tunnel	94,000 m^3
- Excavation, shaft	4,700 m^3
- Tunnel lining concrete	28,900 m^3
- Consolidation grouting	23,000 m

(Headrace tunnel)

It is assumed that full-face excavation will be generally performed throughout the headrace tunnel by applying the conventional method of drilling and blasting. However, top and bottom bench cut method might be required in some parts, depending on the current geological condition.

The tunnel excavation will be carried out applying the following method and schedule provided with a

work adit at intermediate section the tunnel:

1st step; To excavate the work adit at intermediate point and about 500 m long and the main tunnel provided with 2 headings descending from upstream the pond side portal (heading-a) and ascending from surge tank side (heading-b) in parallel, and

2nd step: To excavate the main tunnel provided with 4 headings adding from work adit of descending and ascending directions (heading-c and heading-d).

A standard progress of excavation assumes at 70 m/month per heading. The work adit will be driven at 7 months for 500 m long, and the main tunnel will be progressed the 980 m long by 2 headings. The remaining 3,570 m long main tunnel will be driven in about 13 months work period attacked by 4 headings. Drill jumbo of 4 sets is required to mobilize in the 2nd step. Tunnel support will be required by applying steel rib, shotcrete, wiremesh, rock bolt and forepoling. Pilot boring from the cut face are recommended to forecast the geological condition and ground water. To drain unexpected water during the excavation, drainage system is to be provided. The work sequence of the phased excavation work including the supporting work will be planned as follows:

Drilling Blast Hole:

Two boom hydraulic wheel jumbos will be employed during drilling. Drilling speed will be 1.3 to 1.5 m/min.

Loading Explosive:

Loading and wiring for blasting will be done by three powder men. The charge rate of explosives is estimated to be about 2 kg/m³.

Blasting and Ventilation:

After withdrawal of tunnel jumbo from the heading, the explosives will be triggered with electric detonators. Ventilation of blast fumes will require 20 minutes.

Mucking:

Wheel type side dump loader equipped with a 0.4 m³ rock bucket will be used for loading of muck into 6 ton dump trucks. The bottom tunnel width is 3.5 m. To enable easy maneuvering of dump trucks and easy passage of two trucks inside the tunnel, a turning space is necessary to be provided with over-cut of the tunnel wall.

Shotcrete:

After mucking operation is completed, steel fiber reinforced concrete will be poured through shotcrete on the tunnel arch and side walls with 10 cm thickness. Ready mixed concrete will be carried by 3.0 m³ truck mixer from the batching plant to the tunnel heading.

Rock Bolt:

Rock bolts with length of 2.5 m and diameter of 25 mm will be placed, keeping the designated spacing in between. Full-bond rock bolt type with cement mortar will be used. The hole will be drilled using tunnel wheel jumbo.

Steel Support:

The H-150 steel support will be erected using a 3 ton hydraulic crane and will be mounted on a 6 ton cargo truck.

The daily progress rate is assumed to be 3.5 m, and there will be three blast works per day by drilling 1.0-1.5 m long per time. Pilot boring from the cut face are recommended to forecast the geological condition and ground water. Dewatering in the tunnel will be by gravity method through the drainage ditches at the head tank side, and by pumping at the intake side.

The concrete lining follows after the driven of whole length the tunnel. A standard progress assumes at 120 m/month and 500 m/month for arch and wall and invert respectively applying steel sliding form.

The side wall and invert of the tunnel will be lined with 25 cm thick reinforced concrete after excavation of the whole length. The arch and side wall will first be applied with concrete and then the invert will follow. Concrete works will be carried out in opposite directions from the center of the tunnel.

Concrete will be transported to the site by 4.5 m^3 truck mixers and placed using a concrete pump with a capacity of 60 m^3/hr. Following the concrete works, backfill mortar will be used to fill up gaps between the concrete lining and the surrounding rock.

(Surge tank and drain tunnel)

Drain tunnel will be constructed first applying the same method of connection tunnel advancing the construction of surge tank.

The excavation of vertical shaft will be commenced after the driven of drain tunnel for the surge tank. A pilot hole is driven first upward from the bottom portion of the surge tank. Enlargement excavation continues by using light class excavator and excavated muck hauls to the pilot hole to haul outside spoil bank via drainage tunnel. Concrete works follow the shaft excavation.

Penstock line and powerhouse

(Penstock line)

The technical features and work quantities for major items on headrace tunnel, surge tank and drain tunnel are as follows:

- Type of penstock	Surface penstock
- Steel pipe diameter and length	D3.1 m, L677 m
- Pipes after Y-branch	D1.8 m x 17 m x 2 nos.
- Excavation, open, penstock	64,000 m^3
- Concrete、penstock	4,100 m^3
- Excavation, powerhouse	63,000 m^3
- Concrete, powerhouse	9,000 m^3
- Architectural finish and utility	LS

The excavation of penstock line carries out at mountainous slope that will have to be conducted by combination of equipment and human power. Light class equipment, bulldozer and backhoe, will be applied. Winch will be helped for safety construction operation.

(Powerhouse)

Major construction items required for the above-ground type powerhouse comprises; 1) powerhouse, 2) tailrace channel, and 3) switchyard. The two sets of horizontal shaft type Francis turbines are planned to be installed in the powerhouse.

Standard type of earthmoving and concrete equipment will be used for the construction of powerhouse that is 16 t bulldozer, 0.6 m3 excavator, 10 t dump truck, 3 m3 agitator truck, 60 m3/hr concrete pump car and others.

An overhead traveling crane with a lifting capacity of 50 tons is installed in the powerhouse until the end of April 2016 in order to assure the commencement of installation works of generating equipment. The installation of two sets of turbines and other hydro-mechanical and electro-mechanical equipment will be carried out using the overhead traveling crane.

Commissioning of the power station is scheduled in the beginning of November 2017, after two month period for dry and wet test.

(7) Hydro-Mechanical Works

Hydro-mechanical work items and quantities which are required for the Project are summarized as follows:

1) Sand flushing gate (SFG), 5mx4m	1 set	30 tons
2) Sand flushing stoplog, 5mx4m	1 set	20 tons
3) River outlet valves, D0.3m slide valve	2 sets	LS
4) Intake trashrack	1 set	14 tons
5) Intake gate	2 sets	50 tons
6) Sediment stoplog	1 set	25 tons
7) Sand drain gate	2 sets	6 tons
8) Settling basin, end stoplog	1 set	22 tons
9) Culvert inlet stoplog gate	1 set	32 tons
10) Connection tunnel outlet stoplog	1 set	27tons
11) Pond river outlet steel pipe, D0.5mx110 m	1 lot	13 tons
12) Pond river outlet emergency valve, D0.4m	1 lot	LS
13) Pond river outlet service valve, Do.4m	1 lot	LS
14) Draft tube stoplog	2 sets	21 tons
15) Steel penstock, D3.1 m	1 lane	1,010 tons

Figure 19.1.1 shows the construction time schedule for hydro-mechanical works including the design, manufacturing, transportation, and installation works after the award of contract, which is assumed to be in October 2014. The design, manufacturing and transportation of steel penstocks are scheduled for 18 months in order to ensure the commencement of the installation works, which is scheduled to be completed within 15 months.

Installation works will be carried out combining mechanical equipment and manual power. The major equipment for the installation works will be truck crane, crawler crane, dump truck, winch for penstock installation, etc.

(8) Electro-Mechanical Works

The electro-mechanical work items and quantities required for the Masang-2 HEPP are summarized as follows:

- Turbine, Horizontal Francis type 2 sets
- Generator, 3-phase, synchronous 2 sets
- Transformer 1 lot
- Auxiliary equipment 1 lot
- Panels 1 lot

Figure 19-1 also shows the construction time schedule for the electro-mechanical works, including design, manufacturing, transportation, and installation works.

The design, manufacturing and transportation of electro-mechanical equipment are scheduled for 18 months in order to ensure the commencement of the installation works, which are plans at 15 months and also an essential part of the project. Heaviest equipment is transformer of approx. 120 tons that needs careful planning the inland transportation and installation works. Other electro-mechanical works will have to be conducted in order to meet the proposed construction time schedule.

The Francis type turbine and its ancillaries are installed through the use of manual power and an overhead traveling crane with 45 ton lifting capacity. The installation period including dry and wet test are scheduled to be 17 months. Its commissioning date is scheduled to be November, 2017.

(9) Transmission Line

A 54 km long transmission line (T/L) with a capacity of 150 kV is connected to the existing 150 kV line between Simpang Empat and Maninjau by incomer. The T/L tower having 100 m2 foundation base plans to constructed at 350 m long interval.

19.2.2 CONSTRUCTION SCHEDULE

(1) Construction Sequence

It was proposed that site access roads of about 15.0 km long including 2 bridges are to be constructed advancing the main works the project under local finance and local contractor to shorten the main civil works. The construction of the site access roads is scheduled to start in May 2014 and be completed in 17 months construction period. The site access road of AR3, AR5 and AR6 are constructed giving the priority, to commence the headrace tunnel excavation on time.

The civil works will have to schedule to conduct almost in parallel at the major structure site of 1) intake, 2) connection culvert, 3) connection tunnel, 4) intermediate pond, 5) headrace tunnel, 6) surge tank, 7) penstock line, and 8) powerhouse.

(2) Construction Time Schedule

An overall implementation period of the project plans at about 6 years as presented in Figure 19-1. Those 3 years for pre-construction activities of feasibility study, EIA, detailed design and other

activities and 3 years for the construction works.

The construction time schedule is also shown in Figure 19-1, assuming 36 months in total construction period started with November 2014 in order to achieve commissioning by November 2017.

It is anticipated that the critical path of the construction works will be the 4,550 m long headrace tunnel works, which include construction of portal, excavation, concreting, and backfill grout of main tunnel and work adit of about 500 m long.

The construction of the 4,550 m long headrace tunnel schedules at 33 months in total work period under the following breakdown:

Work item	Work period	Monthly progress
Work adit of 500 m, excavation, 1 heading	7.0 months	70 m/month
Main tunnel, 980 m, excavation, 2 headings	7.0 months	140 m/month
Main tunnel, 3,570 m, excavation, 4 headings	13.0 months	280 m/month
Main tunnel, 4,550 m, arch & wall concrete, 4 parties	10.0 month	480 m/month
Main tunnel, 4,550 m, invert concrete, 4 parties	1.0 month	4,000 m/month
Main tunnel, 4,550 m, backfill grout, 4 parties	2.0 months	3,200 m/month

In planning the construction schedule, the dry and wet season should be taken into account, particularly in planning for the river diversion.

19.3 PRELIMINARY COST ESTIMATE

19.3.1 CONDITIONS AND ASSUMPTIONS FOR COST ESTIMATE

The conditions and assumptions for the cost estimate in this pre-feasibility study stage of Masang-2 HEPP are as follows:

- Base year for the cost estimate is 2010.
- Fiscal year is January – December
- Exchange rate: US$ 1.0 = Rp. 9,000.0 = JPY 82.0
- The cost is estimated divided into the foreign currency portion (FC) and local currency portion (LC) on the following items:
  - Construction cost with VAT
  - Land acquisition, compensation and resettlement cost
  - Administration cost of executing agency
  - Engineering services cost
  - Price and physical contingencies

- The construction cost includes the environmental mitigation cost during construction such as environmental monitoring, treatment cost for muddy water, protection cost for dust and noise, forest royalty cost、compensation cost for plantation products and other negative affection on environment.
- The cost for EIA (Environmental Impact Assessment) is incorporated into the engineering services cost by man-month basis including indirect cost in the feasibility study stage to assess flora, fauna, aquatic fauna and other impact.
- The cost for land acquisition and resettlement cost includes the preparation of the cost for resettlement action plan and its monitoring cost.
- The estimated cost is expressed in USD and Rp. for FC and LC portions respectively.
- Unit rates of construction cost applied for civil works is estimated referring to the other hydropower projects under implemented or implementing recently in Indonesia.
- Costs for hydro-mechanical and electro-mechanical equipment works are estimated on the basis of the consultant's database related to recent international bid prices for similar works.
- The contractor's overhead cost and profit are included into the unit rates of construction cost.
- Value Added Tax (PPn) is 10% of the direct construction cost and incorporated to the LC portion.
- Land acquisition and resettlement cost is estimated referring the micro hydro project of IPP of Indonesia in 2009 and others.
- Administration cost of executing agency is estimated at 5% in proportion to the direct construction cost excluding the VAT portion.
- Engineering costs is estimated on a man-month basis for consulting engineers in principle.
- Price contingency is accounted at 1.3% and 5.0% per annum for foreign portion and local portion respectively.
- Physical contingency covers unforeseeable matter during construction that is assumed at 10% for all the cost items.
- The share between the foreign portion and local portion is estimated at 38%:62%.
- The annual disbursement schedule is provided based on the estimated costs and overall implementation schedule.

19.3.2 UNIT RATES

The applied unit rates are indicated in the Table 19.3.1 for the priced bills of quantities of the construction cost of the Masang-2 HEPP.

19.3.3 PROJECT COST

The project cost for the Masang-2 HEPP presents in Table 19.3.2. Annual disbursement schedule is seen in Table 19.3.3.

Table 19.3.1 Priced Bill of Quantities for Masang-2

US$ 1.0 = 9,000 Rp. 4 hr peak kW 52,000

No.	Construction Work Items	Unit	Qquantity	Unit Rates, Pre-FS2011			Amount, Pre-FS2011		Total, FC+LC
				FC (US$)	LC (Rp.)	Total (US$)	FC (US$)	LC (Rp.)	(US$ mil.)
I	**CIVIL WORKS**								
I.1	Diversion Weir, Intake and Sand Trap								
	1) Excavation, all classes	m^3	66,000	3.6	27,060	6.6	237,600	1,785,960,000	0.44
	2) Earth backfill	m	9,000	4.0	16,280	5.8	36,000	146,520,000	0.05
	3) Concrete, mass	m^3	7,000	30.0	630,000	100.0	210,000	4,410,000,000	0.70
	4) Concrete, structure w/form	m^3	12,900	30.0	1,080,000	150.0	387,000	13,932,000,000	1.94
	5) Re-bar	t	920	6	15,828,792	1,764.8	5,520	14,562,488,640	1.62
	6) Foundation grouting (10mx50nos.)	m	500	30.0	630,000	100.0	15,000	315,000,000	0.05
	7) Miscellaneous, 10% of 1) to 6)	-	LS				0	4,317,204,864	0.48
	8) River diversion works, 20% of 1) to 7)	-	LS				316,595	6,648,495,491	1.06
	Subtotal I.1						**1,207,715**	**46,117,668,995**	**6.33**
I.2	Connection Culvert (Free flow, L1,060 m)								
	1) Open excavation, all classes	m^3	243,000	3.6	27,060	6.6	874,800	6,575,580,000	1.61
	2) Earth backfill	m^3	30,000	4.0	16,280	5.8	120,000	488,400,000	0.17
	3) Concrete, structure w/form	m^3	10,200	30.0	1,080,000	150.0	306,000	11,016,000,000	1.53
	4) Re-bar	t	1,220	6	15,828,792	1,764.8	7,320	19,311,126,240	2.15
	5) Miscellaneous, 10% of 1) to 4)	-	LS				0	4,916,418,624	0.55
	Subtotal I.2						**1,308,120**	**42,307,524,864**	**6.01**
I.3	Connection Tunnel , free flow (L1,630m)								
	1) Open excavation, all classes	m^3	3,600	3.6	27,060	6.6	12,960	97,416,000	0.02
	2) Excavation, underground	m^3	32,200	22.6	813,600	113.0	727,720	26,197,920,000	3.64
	3) Tunnel support, 20% of 2)	-	LS				509,404	1,964,844,000	0.73
	4) Concrete open structures	m^3	400	30.0	1,080,000	150.0	12,000	432,000,000	0.06
	5) Concrete lining	m^3	13,200	51.0	1,071,000	170.0	673,200	14,137,200,000	2.24
	6) Re-bar	t	280	6	15,828,792	1,764.8	1,680	4,432,061,760	0.49
	7) Miscellaneous, 15% of 1) to 6)	-	LS				0	9,704,117,664	1.08
	Subtotal I.3						**1,936,964**	**56,965,559,424**	**8.27**
I.4	Intemediate pond (Water surface area 4.5 ha)								
	1) Excavation for storage space	m^3	840,000	3.6	27,060	6.6	3,024,000	22,730,400,000	5.55
	2) Excavation, structural foundation	m^3	150,000	3.6	27,060	6.6	540,000	4,059,000,000	0.99
	3) Dike embankment, rockfill	m^3	325,000	1.1	91,065	11.2	357,500	29,596,125,000	3.65
	4) Slope stabilize cover conc, below El.343	m^3	2,200	44.0	1,584,000	220.0	96,800	3,484,800,000	0.48
	5) Slope stabilize drain holes, below El.343	m	5,000	10.0	180,000	30.0	50,000	900,000,000	0.15
	6) Cut slope sodding, above water	m^2	9,000	0.3	24,300	3.0	2,700	218,700,000	0.03
	7) Cut slope shotcrete, above water	m^2	3,000	8.0	288,000	40.0	24,000	864,000,000	0.12
	8) Foundation grouting (10mx100nos.)	m	1,000	30.0	630,000	100.0	30,000	630,000,000	0.10
	9) Concrete, open structure	m^3	5,400	30.0	1,080,000	150.0	162,000	5,832,000,000	0.81
	10) Re-bar	t	270	6	15,828,792	1,764.8	1,620	4,273,773,840	0.48
	10) Miscellaneous, 10% of 1) to 9)	-	LS				0	11,118,637,884	1.24
	Subtotal I.4						**4,288,620**	**83,707,436,724**	**13.59**
I.5	Headrace Tunnel, Work Adit & Surge Tank								
	1) Excavation, open	m^3	11,300	3.6	27,060	6.6	40,680	305,778,000	0.07
	2) Excavation, underground	m^3	94,000	22.6	813,600	113.0	2,124,400	76,478,400,000	10.62
	3) Excavation, shaft	m^3	4,700	51.0	1,071,000	170.0	239,700	5,033,700,000	0.80
	4) Tunnel support, 20% of 2)	-	LS				1,487,080	5,735,880,000	2.12
	5) Concrete, open structures	m^3	2,400	30.0	1,080,000	150.0	72,000	2,592,000,000	0.36
	6) Concrete lining	m^3	28,900	51.0	1,071,000	170.0	1,473,900	30,951,900,000	4.91
	7) Re-bar	t	970	6	15,828,792	1,764.8	5,820	15,353,928,240	1.71
	8) Consolidation grouting	m	23,000	13.5	283,500	45.0	310,500	6,520,500,000	1.04
	9) Miscellaneous, 15% of 1) to 8)	-	LS				0	29,213,820,936	3.25
	Subtotal I.5						**5,754,080**	**172,185,907,176**	**24.89**
I.6	Penstock Line, Powerhouse, Tailrace, S'Yard								
	1) Excavation, open penstock	m^3	64,000	3.6	27,060	6.6	230,400	1,731,840,000	0.42
	2) Excavation, open powerhouse	m^3	83,000	3.6	27,060	6.6	298,800	2,245,980,000	0.55
	3) Earth backfill	m^3	10,000	4.0	16,280	5.8	40,000	162,800,000	0.06
	4) Concrete, penstockline	m^3	4,100	30.0	1,080,000	150.0	123,000	4,428,000,000	0.62
	5) Concrete, powerhouse	m^3	9,000	30.0	1,080,000	150.0	270,000	9,720,000,000	1.35
	6) Re-bar	t	790	6	15,828,792	1,764.8	4,740	12,504,745,680	1.39
	7) Architectural finish & utility, 15% of PH	-	LS				0	5,924,373,852	0.66
	8) Miscellaneous, 10% of 1) to 7)						0	4,542,019,953	0.50
	Subtotal I.6						**966,940**	**41,259,759,485**	**5.55**
	Subtotal I.1 to I.6						**15,462,439**	**442,543,856,668**	**64.63**
I.7	Environmental mitigation cost during	-	LS				154,624	4,425,438,567	0.65
	Construction, 1% of Subtotal I.1 to I.6								
	Subtotal I.7						**154,624**	**4,425,438,567**	**0.65**
	Subtotal I (I.1 to I.7)						**15,617,063**	**446,969,295,234**	**65.28**
II	**STEEL & HYDRO-MECHANICAL WORKS**								
	1) Sand flushing gate, 5mx4m, 1no.	t	30	4,900.0	18,900,000	7,000.0	147,000	567,000,000	0.21
	2) Sand flushing stoplog, 5mx4m, 1 no.	t	20	4,200.0	16,200,000	6,000.0	84,000	324,000,000	0.12
	3) River outlet slide valves, D0.3m, 2 nos.	-	LS				42,000	162,000,000	0.06
	4) Intake trashrack	t	14	3,500.0	13,500,000	5,000.0	49,000	189,000,000	0.07
	5) Intake gate, 2 nos.	t	50	4,900.0	18,900,000	7,000.0	245,000	945,000,000	0.35
	6) Intake stoplog, 1 no.	t	25	4,200.0	16,200,000	6,000.0	105,000	405,000,000	0.15
	7) Sand drain gate, 2 nos.	t	6	4,200.0	16,200,000	6,000.0	25,200	97,200,000	0.04
	8) Settling basin, end stoplog	t	22	4,200.0	16,200,000	6,000.0	92,400	356,400,000	0.13
	9) Culvert inlet stoplog gate	t	32	4,900.0	18,900,000	7,000.0	156,800	604,800,000	0.22
	10) Connection tunnel outlet stoplog	t	27	4,200.0	16,200,000	6,000.0	113,400	437,400,000	0.16
	11) Pond river outlet steel pipe, D0.5mx110m	t	13	4,200.0	16,200,000	6,000.0	54,600	210,600,000	0.08
	12) Pond river outlet emergency valve, D0.4m	-	LS				35,000	135,000,000	0.05
	13) Pond river outlet service valve, D0.4m	-	LS				35,000	135,000,000	0.05
	14) Draft tube stoplog, 2 nos.	t	21	4,200.0	16,200,000	6,000.0	88,200	340,200,000	0.13
	15) Penstock pipe, D3.1m	t	1,010	3,850.0	14,850,000	5,500.0	3,888,500	14,998,500,000	5.56
	Subtotal II						**5,161,100**	**19,907,100,000**	**7.37**

III	**GENERATING EQUIPMENT**									
	1	Turbine	lot	1				9,360,000	9,360,000,000	10.40
	2	Generator	lot	1				7,290,000	7,290,000,000	8.10
	3	Control equipment	lot	1				7,290,000	7,290,000,000	8.10
	4	Others	lot	1				5,310,000	5,310,000,000	5.90
	Subtotal III							**29,250,000**	**29,250,000,000**	**32.50**
IV	**TRANSMISSION LINE**									
	1	Transmission line, 150 kV	km	54	41,250	123,750,000	55,000.0	2,227,500	6,682,500,000	2.97
	Subtotal IV							**2,227,500**	**6,682,500,000**	**2.97**
	Subtotal, I to IV							**52,255,663**	**502,808,895,234**	**108.12**
V	**PREPARATORY WORKS**		-	LS				**5,225,566**	**50,280,889,523**	**10.81**
	(10% of Subtotal I to IV)									
	Subtotal V							**5,225,566**	**50,280,889,523**	**10.81**
VI	**SITE ACCESS**									
	1	Access roads		15.7				0	48,159,000,000	5.35
	(1)	AR1, new gravel, right bank, cultivated land	km	1.0	0.0	1,800,000,000	200,000.0	0	1,800,000,000	0.20
	(2)	AR2, new gravel, left bank, bush/shrubs	km	0.7	0.0	3,420,000,000	380,000.0	0	2,394,000,000	0.27
	(3)	AR3, new gravel, left bank, bush/shrubs	km	3.5	0.0	3,420,000,000	380,000.0	0	11,970,000,000	1.33
	(4)	AR4, new gravel, left bank, bush/shrubs	km	0.5	0.0	3,420,000,000	380,000.0	0	1,710,000,000	0.19
	(5)	AR5, new gravel, left bank, bush/shrubs	km	3.5	0.0	3,420,000,000	380,000.0	0	11,970,000,000	1.33
	(6)	AR6, new gravel, left bank, bush/shrubs	km	2.0	0.0	3,420,000,000	380,000.0	0	6,840,000,000	0.76
	(7)	AR7, new gravel, left bank, bush/shrubs	km	1.0	0.0	3,420,000,000	380,000.0	0	3,420,000,000	0.38
	(8)	AR8, new gravel, right bank, bush/shrubs	km	2.0	0.0	3,420,000,000	380,000.0	0	6,840,000,000	0.76
	(9)	AR9, improve asphalt, along Kototinggi vil	km	1.5	0.0	810,000,000	90,000.0	0	1,215,000,000	0.14
	2	Bridge						0	8,100,000,000	0.90
	(1)	BR1, new and permanent near intake site	m^2	300	0.0	13,500,000	1,500.0	0	4,050,000,000	0.45
	(2)	BR2, new and permanent near PS site	m^2	300	0.0	13,500,000	1,500.0	0	4,050,000,000	0.45
	Subtotal VI							**0**	**56,259,000,000**	**6.25**
	TOTAL, I to VI							**57,481,230**	**609,348,784,758**	**125.19**
	%							46	54	

Table 19.3.2 Summary of Project Costs for Masang -2 HEPP

Item No.	Project Cost Items	Cost total		Total, FC+LC
		FC (US$)	LC (Rp.)	Million US$
I	Construction cost			
1	Preparatory works	5,225,566	50,280,889,523	10.8
2	Civil works	15,617,063	446,969,295,234	65.3
3	Hydro-mechanical works	5,161,100	19,907,100,000	7.4
4	Generating equipment	29,250,000	29,250,000,000	32.5
5	Transmission line	2,227,500	6,682,500,000	3.0
6	Site access roads	0	56,259,000,000	6.3
	Subtotal-1	57,481,230	609,348,784,758	125.2
	Value Added Tax (PPn)	0	112,667,985,255	12.5
	Subtotal-2	57,481,230	722,016,770,013	137.7
II	Land acquisition & resettlement cost	44,000	18,807,300,000	2.1
III	Administration of executing agency	0	56,333,992,628	6.3
IV	Engineering services cost	2,885,000	5,690,000,000	3.5
	Subtotal-3	60,410,230	802,848,062,641	149.6
V	Price contingency	4,466,052	219,624,057,059	28.9
	Subtotal-4	64,876,282	1,022,472,119,700	178.5
VI	Physical contingency	6,041,023	80,284,806,264	15.0
	Grand total	70,917,305	1,102,756,925,964	193.4

Table 19.3.3 Annual Disbursement Schedule for Masang-2

Item No.	Disbursement items			Cost Total (mil.)		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
				FC (US$)	LC (Rp)	2012	2013	2014	2015	2016	2017
	FC portion										
I	Construction Cost			57,481,230		0	0	2,366,951	9,707,342	25,191,946	20,214,992
	VAT										
II	Land Acquisition & Resettlement Cost			44,000		0	35,200	8,800	0	0	0
III	Administration of Executing Agency			0		0	0	0	0	0	0
IV	Engineering Services Cost			2,885,000		419,000	199,500	668,100	599,400	599,400	399,600
	Sub Total - 1			60,410,230		419,000	234,700	3,043,851	10,306,742	25,791,346	20,614,592
V	Price Contingency <1	% p/a	1.3	4,466,052		5,992	6,756	132,286	601,142	1,892,655	1,827,222
	(Base year 2013 of L/A)	=	1								
	Sub Total - 2			64,876,282		424,992	241,456	3,176,137	10,907,883	27,684,000	22,441,814
VI	Physical Contingency <2			6,041,023		41,900	23,470	304,385	1,030,674	2,579,135	2,061,459
	Total			70,917,305		466,892	264,926	3,480,522	11,938,557	30,263,135	24,503,273
	LC portion										
I	Construction Cost				609,348,784,758	0	0	68,887,387,682	231,183,287,434	224,365,425,361	84,912,684,281
	VAT				112,667,985,255	0	0	9,018,994,220	31,854,936,135	45,109,293,584	26,684,761,316
II	Land Acquisition & Resettlement Cost				18,807,300,000	0	15,045,840,000	3,761,460,000	0	0	0
III	Administration of Executing Agency				56,333,992,628	0	0	4,509,497,110	15,927,468,068	22,554,646,792	13,342,380,658
IV	Engineering Services Cost<3				5,690,000,000	600,000,000	205,000,000	1,141,000,000	1,404,000,000	1,404,000,000	936,000,000
	Sub Total - 1				802,848,062,641	600,000,000	15,250,840,000	87,318,339,011	280,369,691,637	293,433,365,738	125,875,826,255
V	Price Contingency <1	% p/a	5.0		219,624,057,059	33,000,000	1,719,532,210	15,139,908,505	66,463,562,944	89,177,251,653	47,090,801,746
	(Base year 2013 of L/A)	=	1								
	Sub Total - 2				1,022,472,119,700	633,000,000	16,970,372,210	102,458,247,517	346,833,254,581	382,610,617,391	172,966,628,001
VI	Physical Contingency <2				80,284,806,264	60,000,000	1,525,084,000	8,731,833,901	28,036,969,164	29,343,336,574	12,587,582,625
	Total				1,102,756,925,964	693,000,000	18,495,456,210	111,190,081,418	374,870,223,744	411,953,953,965	185,554,210,626
	Total FC+LC equivalent US$ mil.			193.4		0.5	2.3	15.8	53.6	76.0	45.1

Notes <1 1.3% for FC and 5.0% for LC per annum
<2 10% of subtotal - 2
<3 Feasibility Study not included.

CHAPTER 20 JUSTIFICATION OF THE PROJECT

20.1 INTRODUCTION TO JUSTIFICATION

Justification of the project in this chapter appraises the profit of an investment through two analyses; the economic analysis and financial analysis. The economic analysis measures the effect of the questioned project on the national economy, whereas the financial analysis estimates the profit accruing to the project-operating entity. For the project to be feasible, it must be economically efficient, as well as financially sustainable.

Both of the economic and financial analyses are conducted in monetary terms, by using the Discounted Cash Flow (DCF) models. The major difference lies in the definition of the respective costs and benefits. In the economic analysis, overall impact of the project is considered for the economic welfare of the citizens of the country. In the financial analysis, by contrast, all expenditures to be incurred under the project and revenues resulting from it are taken into account.

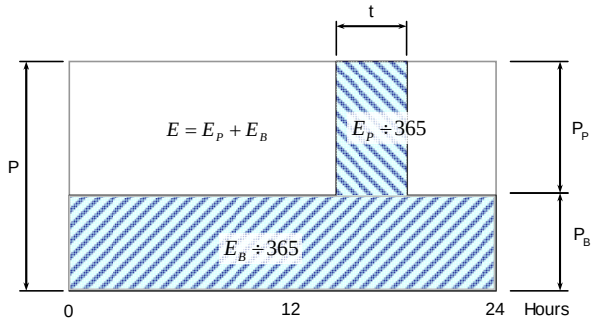
20.2 ECONOMIC EVALUATION

20.2.1 METHODOLOGY

The economic evaluation is to compare two different electricity; one generated from the questioned hydropower project and the other supplied by possible power plants (the alternative plant). The idea is that the hydropower should be chosen for electricity supply to the system, only when its generation cost is evaluated more economical than any other possible alternative plants. The practical types of the alternative plants are three thermal plants in the country. They are i) coal fired steam plants, which can generate base load electricity only, ii) gas turbines using natural gas, which can generate any pattern of electricity in a single day, and iii) gas turbines using high speed diesel (HSD), which also can generate any pattern of electricity.

The questioned hydropower scheme has been optimized to be a 52 MW of run-of-river equipped with a daily peak generation capability. It will generate every day 22.5 MW of the base load in average and additional 29.5 MW of the 4-hour peak load. Its typical daily generation pattern looks like Figure 20.2.1.

This generation pattern can be equalized with a combination of two alternative plants; one 28.1 MW[1] base load plant plus one 33.2 MW peak load plant. As compared in Table 20.2.1, the coal fired plant is the cheapest in generation cost and is chosen as the alternative plant for base load. Very similarly, as compared in Table 20.2.2, the gas turbine using natural gas is selected as the alternative plant for peak load. Note that these alternative plants are virtual machines and do not necessarily have to have exact installed capacities of 28.1 MW and 33.2 MW.



P = 52 MW, t = 4 hours

$E = E_P + E_B$ = 240 GWh/year

$P_P = \frac{24P - E \div 365}{24 - t}$ = 29.5 MW

$E_P = 365 P_P t$ = 43 GWh/year

$P_B = P - P_P = \frac{E \div 365 - tP}{24 - t}$ = 22.5 MW

$E_B = 24 \times 365 P_B$ = 197 GWh/year

Figure 20.2.1 Typical Daily Generation Pattern Planned for Masang-2 Hydropower Project

Table 20.2.1 Generation Costs of Base Load Plants

	Descriptions	Unit	Natural Gas	Coal Fired
1.	Unit Construction Cost	US$/kW	600	1,300
2.	Construction Period	Yrs	2	2
3.	Disbursement		40%, 60%	40%, 60%
4.	Project Life	Yrs	20	20
5.	Annual Fixed O&M Cost Ratio		2.5%	2.0%
6.	Capacity Cost	US$/Year	79.01	165.38
7.	Fuel Price	US$/MMBtu	6.000	3.459
8.	Thermal Efficiency		0.260	0.300
9.	Fuel Consumption	MMBTU/kWh	0.013	0.011
10.	Unit Cost of Fuel	US$/kWh	0.079	0.039
11.	Losses		0.020	0.090
	Station Use Loss		0.010	0.070
	Transmission Line Loss		0.010	0.020
	Forced Outage		0.070	0.080
	Scheduled Outage		0.100	0.120
12.	Plant Factor*		98.00%	91.00%
13.	Unit Generation Cost	US¢/kWh	8.795	6.009

* The theoretical maximum value is assumed.
10% discount rate.
Source: Study Team based on RUPTL 2010-19, PLN

[1] The installed capacity of an alternative plant is not equal to that of the hydropower, because of differences of efficiencies. See "Economic Benefit" discussed later in this chapter.

Table 20.2.2 Generation Costs of Peak Load Plants

	Descriptions	Unit	Natural Gas	HSD
1.	Unit Construction Cost	US$/kW	600	550
2.	Construction Period	Yrs	2	2
3.	Disbursement		40%, 60%	40%, 60%
4.	Project Life	Yrs	20	20
5.	Annual Fixed O&M Cost Ratio		2.5%	2.5%
6.	Capacity Cost	US$/Year	79.01	72.43
7.	Fuel Price	US$/MMBtu	14.448	14.448
8.	Thermal Efficiency		0.260	0.310
9.	Fuel Consumption	MMBTU/kWh	0.013	0.011
10.	Unit Cost of Fuel	US$/kWh	0.079	0.159
11.	Losses		0.020	0.020
	Station Use Loss		0.010	0.010
	Transmission Line Loss		0.010	0.010
	Forced Outage		0.070	0.070
	Scheduled Outage		0.100	0.100
12.	Plant Factor*		25.00%	25.00%
13.	Unit Generation Cost	US¢/kWh	11.482	19.210

* 6 hour daily peak load generation is assumed.
10% discount rate.
Source: Study Team based on RUPTL 2010-19, PLN

20.2.2 BASIC ASSUMPTIONS IN ECONOMIC ANALYSIS

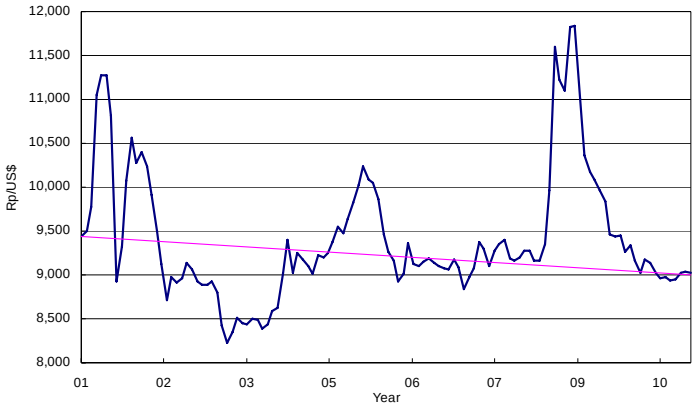
In the economic analysis, the following assumptions were made:

(1) The evaluation period is 54 years, being composed of 4 years of construction and 50 years of operation.

(2) The useful life of the civil components is 50 years, same as the period of operation. The life of the non-civil components, such as hydro-electrical works and transmission line, etc., is 30 years. After 30 years, all of the non-civil components are renewed. No residual values are considered.

(3) All costs and benefits are expressed in constant US Dollars at 2011 price level. Any future change in the general price level is ignored. The exchange rate used is Rp. 9,000/US$, which is an estimation for year 2011 based on the past trend as illustrated in Figure 20.2.2.

(4) 10% p.a. of a discount rate is assumed in the economic analysis. This assumption focuses on the economic rate of return on alternative marginal projects or the economic opportunity cost of capital, so that investments can be selected that show a minimum rate of return that is not exceeded by other possible investments.



Source: PACIFIC Exchange Rate Service

Figure 20.2.2 Historical Exchange Rate

20.2.3 ECONOMIC COST

20.2.3.1 Capital Expenditure

The economic cost comes from the financial cost, but is not equal. The economic analysis attempts to value the costs from national economic perspective. To achieve this, some adjustments and deletions should be made to the financial prices to account for the effects of the government intervention and market structure. Using world price numeraire, standard conversion factor = 0.90, the following financial-to-economic conversions are ruled in this economic analysis.

Table 20.2.3 Financial to Economic Conversions

Financial	FC	LC	Total	**Economic**	FC	LC	Total
Feasibility study	0.44	0.07	0.51	Feasibility study	0.00	0.00	0.00
Civil Works	20.84	61.50	82.34	Civil Works	20.84	55.35	76.19
Generating Equipment	29.25	3.25	32.50	Generating Equipment	29.25	2.93	32.18
Other Construction	7.39	2.95	10.34	Other Construction	7.39	2.66	10.05
VAT	0.00	12.52	12.52	VAT	0.00	0.00	0.00
Land acquisition	0.04	2.09	2.13	Land acquisition	0.04	1.88	1.92
Administration	0.00	6.26	6.26	Administration	0.00	0.00	0.00
Engineering	2.47	0.57	3.03	Engineering	2.47	0.51	2.98
Contingency	6.00	8.91	14.91	Contingency	6.00	6.33	12.33
Price Escalation	4.46	24.40	28.86	Price Escalation	0.00	0.00	0.00
Total	70.89	122.52	193.41	Total	65.99	69.66	135.65

Conversion Factors	FC	LC	Average	
Feasibility study	0.00	0.00	0.00	Excluded from financial CAPEX
Civil Works	1.00	0.90	0.93	
Generating Equipment	1.00	0.90	0.99	
Other Construction	1.00	0.90	0.97	
VAT	0.00	0.00	0.00	
Land acquisition	1.00	0.90	0.90	
Administration	0.00	0.00	0.00	
Engineering	1.00	0.90	0.98	Unit US$ million
Contingency	1.00	0.71	0.83	VAT & Administration excluded from Contingency

Price Escalation	0.00	0.00	0.00
Total	0.93	0.57	0.70

FC: foreign currency, LC: local currency
Source: Study Team

Here, any sunk costs, which might have been incurred before implementation, are excluded from the capital expenditure (CAPEX). The administration cost is converted nil, because it will be incurred regardless of the project development. The price contingency is also nil, because escalation effects are beyond the scope of the economic analysis.

The economic CAPEX is assumed to be disbursed during four years of construction with the yearly disbursement ratios; 20%, 35%, 35%, and 10%.

20.2.3.2 Operating Expenditure

In the economic analysis, the operating expenditure (OPEX) is also expressed in the economic terms. There are three kinds; i) fixed operating cost, which will be incurred no matter how much electricity is generated, ii) variable operating cost, which will be burdened proportionally to electricity actually generated, and iii) major maintenance cost, which will cost periodically for replacing or overhauling aged machines.

(1) Fixed Operating Cost

The fixed operating cost is composed of costs required for daily operation, maintenance, and management. From the past experience, its yearly cost is assumed to be 0.5% of the civil portion plus 1.5% of the non-civil portion of CAPEX.

(2) Variable Operating Cost

The variable operating cost includes water charges, which is Rp. 5.0 per kWh of electricity levied by the regional government.

(3) Major Maintenance Cost

The major maintenance cost substantially consists of replacement cost of non-civil components, mainly hydro-mechanical and electrical equipment. It is expected to be scheduled every 30 years after the equipment has been installed or replaced. One year period is estimated for such replacement.

20.2.4 ECONOMIC BENEFIT

20.2.4.1 Concept of Economic Benefit

If the questioned hydropower project is not developed, alternative electricity (generated by the alternative plants) needs to be supplied to meet the increasing demand. The economic benefit can lie on an evasion of the opportunity cost of such alternative electricity, which can be defined as the capacity benefit and the energy benefit.

20.2.4.2 Capacity Benefit

The capacity benefit is the opportunity cost required for the alternative plants being ready to generate electricity as demanded.

Hydropower units are different from the alternative plants in terms of performances. Hydropower units consume less energy than thermal plants do and therefore their station loss of electricity is less than that of thermal plants. However, hydropower units are in general located remote and farther from the demand center and therefore their transmission loss is greater. As a result, usable electricity generated by a hydropower plant and that by a thermal power plant are different, even if they have an identical installed capacity. To adjust the difference, one needs to introduce the power (or kW) adjustment factor. That is:

$$\text{kW adjustment factor} = \frac{s_H \times a_H \times m_H \times t_H}{s_A \times a_A \times m_A \times t_A}$$

$$= \frac{0.997 \times 0.995 \times 0.980 \times 0.950}{0.930 \times 0.920 \times 0.880 \times 0.980} = 1.252 \text{ for coal fired plants}$$

$$= \frac{0.997 \times 0.995 \times 0.980 \times 0.950}{0.990 \times 0.930 \times 0.900 \times 0.990} = 1.126 \text{ for gas turbines using natural gas}$$

where
- s_x: station factor = 1– station loss
- a_x: availability factor = 1– forced outage loss
- m_x: maintenance factor = 1– schedule outage loss
- t_x: transmission factor = 1– transmission line loss
- $_x$: $_H$ for hydropower, $_A$ for alternative thermal plant

The 22.5 MW of the base power generation capacity of the questioned hydropower is equalized to be 28.1 MW (22.5 MW x 1.252) of a coal fired power plant, while the 29.5 MW of the peak power generation capacity of the same is equalized to be 33.2 MW (29.5 MW x 1.126) of a gas turbine using natural gas.

20.2.4.3 Energy Benefit

The energy benefit is the opportunity cost required for generating electricity by using the alternative plants.

As discussed earlier, because of different characteristics, usable amount out of 1 kWh electricity

generated by a hydropower plant and by a thermal plant is not equal. To adjust the difference, the energy (or kWh) adjustment factor need be introduced. That is:

$$\text{kWh adjustment factor} = \frac{s_H \times t_H}{s_A \times t_A}$$

$$= \frac{0.997 \times 0.950}{0.930 \times 0.980} = 1.039 \text{ for coal fired plants}$$

$$= \frac{0.997 \times 0.950}{0.990 \times 0.990} = 0.966 \text{ for gas turbines using natural gas}$$

The 197 GWh of the base power energy by the questioned hydropower is then equalized to be 205 GWh (197 GWh x 1.039) by a coal fired power plant, while the 43 GWh of the peak energy by the same is to be 42 GWh (43 GW x 0.966) of a gas turbine using natural gas.

20.2.4.4 Depletion Premium

Alternative thermal plants involve exploitation of fossil fuels. They are the depletable resources, which initially exist in the form of deposits and their use leads to a decline in them. The economic analysis needs to explicitly include the depletion premium as one of the economic benefits. The depletion premium can be defined as:

$$D_t = \frac{(P_T - C_t)(1+r)^t}{(1+r)^T}$$

where D_t = depletion premium at time t,
P_T = price of substitute at the time of complete exhaustion T,
C_t = extraction cost of present resource, assumed to be constant for all years,
r = discount rate, and
T = time of exhaustion of deposit.

The prices of natural gas and HSD given in Table 20.2.1 and Table 20.2.2 can be recognized as to a level of the respective international prices, because Indonesia has been a net importer for both of the fossil fuels. No depletion premiums need be discussed for natural gas and HSD. By contrast, the coal price in Table 20.2.1 has not reached a level of the international price. Therefore, one should value the depletion premium of coal.

According to JCOAL, Japan, the mineable coal reserve in Indonesia is estimated to be 18.7 billion tons as of 2008, while the annual coal production is 366 million tons per year. These numbers imply that the Indonesian coal may be depleted in 51 years. Upon depletion, imported coal is the most likely substitute for the Indonesian coal, as if Japan experienced decades ago. Assuming that the present coal price (or extraction cost) of the Indonesian coal is US$70/ton and the Japanese CIF coal price is US$83.3/ton[2], the depletion premium of coal is evaluated to be US$0.103/ton at present and

[2] According to the trading database of Ministry of Finance, Japan (http://toukei-is.com/get_pdf/?p=30101&f=00), the latest CIF of the thermal coal is JPY9,520/ton, US$114/ton equivalent. Because the Japan's thermal coal has typically 7,000 kcal/kg of

US$13.300/ton, when Indonesian coal has been fully depleted. The values used for the depletion premium are given in Table 20.2.4.

Table 20.2.4 Values for Depletion Premium

Size of deposits	18,700.00	million ton
Extraction rate	365.61	million ton
Life of deposit to exhaustion	51.15	years
Present extraction costs	70.00	US$/ton
Calorific value	5,100	kcal/kg
Substitute fuel	Imported Coal	
Present price of substitute fuel	83.30	US$/ton
Price of substitute fuel at exhaustion	83.30	US$/ton
Discount rate used	0.10	p.a.

Source: Study Team

The coal price including the depletion premium was then estimated as illustrated in Figure 20.2.3. Note that the price escalation in nominal terms of future coal is estimated very gentle, as illustrated in Figure 20.2.4. This economic analysis therefore assumes that the future international coal price will be substantially equal to the present price.

Despite the analysis above, the depletion premium is not taken into account of the base case of the economic analysis. This is not only because the premium computed is marginal but because most of the past hydropower feasibility studies do not contain discussions of the depletion premium and the economic profitability of the project might mislead the readers. Instead, the depletion premium discussed here is taken into account of the sensitivity analysis later in this section.

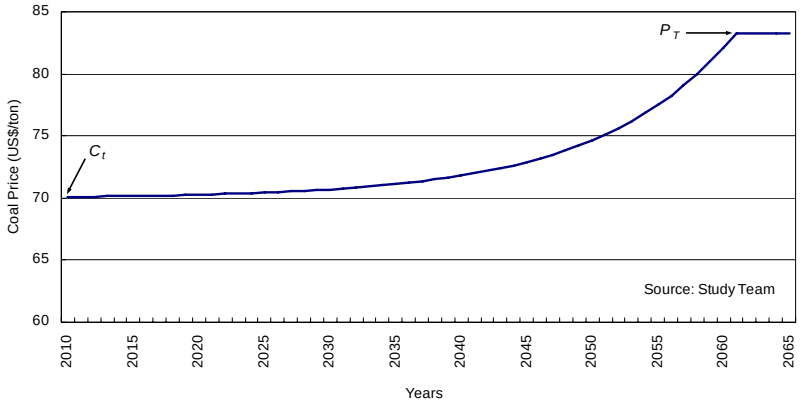


Figure 20.2.3 Coal Price with Depletion Premium

the calorific value, the CIF can be converted to be US$83.3/ton with 5,100 kcal/kg of the calorific value.

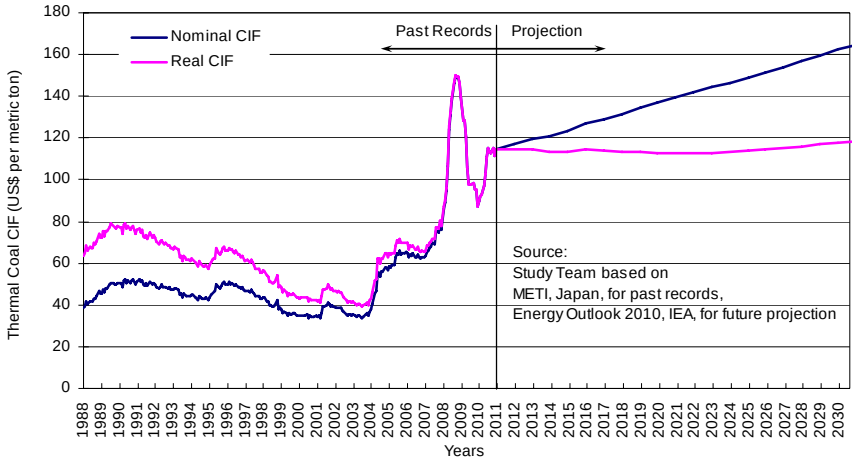


Figure 20.2.4 Coal Price Projection by IEA Energy Outlook 2010

20.2.4.5 Benefit from Certified Emission Reduction

The CDM (clean development mechanism) may be adopted to the project. Therefore, benefits from the Certified Emission Reduction (CER) are also considered.

CO2 emission factor = 0.743 tCO2/MWh[3]

Expected CER price = 12.5US$/tCO2

Possible CER Benefit = Effective Electricity Generated x CO2 emission factor x CER price
= 221.6 GWh/year x 0.743tCO2/MWh x 12.5 US$/tCO2
= 2.06 US$M/year

The CER benefit is counted in the sensitivity analysis for the base case + CDM.

20.2.5 ECONOMIC ANALYSIS

For the economic analysis, three measures of project worth are introduced as the key indicators; the net present value (ENPV), the economic internal rate of return (EIRR), and the benefit-cost ratio (B/C). These three measures are calculated with the economic costs and benefits as variables.

A DCF based economic stream is built as tabulated in Table 20.2.6. The key indicators show sufficient economic feasibility:

ENPV = US$19.2 mill. EIRR = 12.0%

B/C = 1.15

[3] Based on DNA Indonesia http://dna-cdm.menlh.go.id/Downloads/Others/KomnasMPB_Grid_Sumatera_JAMALI_2008.pdf

20.2.6 ECONOMIC SENSITIVITY

A sensitivity analysis was conducted to examine the extent to which the economic indicators change for different values of the major variables. In this economic analysis, 5 cases were tested, namely, + Depletion Premium, + CDM, – 10% Annual Energy, + 10% CAPEX & OPEX, and – 10% Fuel Prices.

The sensitivity analysis has confirmed that the hydropower project in question economically feasible, as summarized in Table 20.2.5.

Table 20.2.5 Economic Indicators

Cases	B/C	ENPV	EIRR	Notes
Base Case	1.15	19.2	12.0%	the base case
+ Depletion Premium	1.15	19.7	12.0%	depletion premium added to the base case
+ CDM	1.27	34.5	13.4%	CER benefit added to the base case
– 10% Annual Energy	1.00	0.5	10.1%	less hydropower generation by 10%
+ 10% CAPEX & OPEX	1.04	6.3	10.6%	greater cost by 10%
– 10% Fuel Prices	1.08	10.7	11.1%	Fuel cost is less expensive by 10%

Source: Study Team

Table 20.2.6 DCF Based Economic Stream of Base Case

Economic Analysis (Base Case) **Masang-2**

1. Hydro General

Discount Rate	*i*		10%
Construction Time		years	4
Life Time, Civil		years	50
Life Time, Non Civil		years	30
Evaluation Time		years	54
Installed Capacity		MW	52
Annual Energy		GWh	240
Peaking Time		hours	4
Station Use Loss	*a*		0.003
Transmission Line Loss	*b*		0.050
Forced Outage	*c*		0.005
Scheduled Outage	*d*		0.020
Implementation Cost, total		US$M	135.647
Implementation Cost, civil		US$M	83.813
Implementation Cost, non civil		US$M	35.393
Implementation Cost, others		US$M	16.442
Annual O&M Cost Ratio, civil			0.50%
Annual O&M Cost Ratio, non civil			1.50%
Annual O&M Cost		US$M/yr	0.950
CER Emmission Coeff.		tCO2/MWh	0.743
CER Unit Price		US$/CO2-ton	0.000
Annual CER		US$M/yr	0.000

2. Alternative Thermal, Gas Turbine for Peak

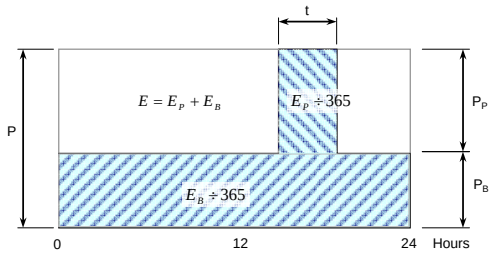
Installed Capacity	P_P	MW	29.523
Unit Construction Cost		US$/kW	600
Construction Time		years	2
Life Time		years	20
Annual Fixed O&M Cost Ratio			2.50%
Replacement Cost Ratio			90%
kW Value Adjustment Factor			1.126
Capacity Value		US$/kW	74.490
Capacity Benefit		US$M	19.943
Fixed O&M Benefit		US$/yr	0.499
Annual Energy	E_P	GWh	43.104
Station Use Loss	*a*		0.010
Transmission Line Loss	*b*		0.010
Forced Outage	*c*		0.070
Scheduled Outage	*d*		0.100
Unit Price of Natural Gas		US$/MMBTU	6
Caloric Value		kcal/MMBTU	252,000
Thermal Efficiency			26%
Heat Rate		kcal/MMBTU	3,308
Fuel Consumption		MMBTU/kWh	0.0131
Fuel Cost		US$/kWh	0.0788
Variable O&M Cost		US$/kWh	0.0040
kWh Value Adjustment Factor			0.9664
Energy Value		US$/kWh	0.0800
Energy Benefit		US$M	3.4471

3. Alternative Thermal, Coal-Fired for Off Peak

Installed Capacity	P_B	MW	22.48
Unit Construction Cost		US$/kW	1,300
Construction Time		years	2
Life Time		years	20
Annual Fixed O&M Cost Ratio			2.0%
Replacement Cost Ratio			90%
kW Value Adjustment Factor			1.252
Capacity Value		US$/kW	173.339
Capacity Benefit		US$M	36.573
Fixed O&M Benefit		US$/yr	0.731
Annual Energy	E_B	GWh	196.896
Station Use Loss	*a*		0.070
Transmission Line Loss	*b*		0.020
Forced Outage	*c*		0.080
Scheduled Outage	*d*		0.120
Unit Price of Coal		US$/ton	70
Caloric Value		kcal/kg	5,100
Thermal Efficiency			30%
Heat Rate		kcal/kWh	2,867
Fuel Consumption		kg/kWh	0.5621
Fuel Cost		US$/kWh	0.0393
Variable O&M Cost		US$/kWh	0.0008
kWh Value Adjustment Factor			1.0392
Energy Value		US$/kWh	0.0417
Energy Benefit		US$M	8.2147

4. Economic Indicators

B/C = 1.15
ENPV = US$19.2 mill.
EIRR = 12.0%



$$P_P = \frac{24P - E \div 365}{24 - t} \qquad P_B = P - P_P = \frac{E \div 365 - tP}{24 - t}$$

$$E_P = 365\,P_P t \qquad E_B = 24 \times 365\,P_B$$

Cash Flow

Year	Capacity Peak	Capacity Base	Energy Peak	Energy Base	CER	Total Benefit	Hydro Cost Capital	Hydro Cost O&M	Hydro Cost Total	Net
0	0.00	0.00	0.00	0.00	0.00	0.00	27.13	0.00	27.13	-27.13
1	0.00	0.00	0.00	0.00	0.00	0.00	47.48	0.00	47.48	-47.48
2	9.97	18.29	0.00	0.00	0.00	28.26	47.48	0.00	47.48	-19.22
3	9.97	18.29	0.00	0.00	0.00	28.26	13.56	0.00	13.56	14.69
4	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
5	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
6	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
7	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
8	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
9	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
10	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
11	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
12	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
13	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
14	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
15	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
16	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
17	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
18	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
19	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
20	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
21	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
22	9.47	17.19	3.45	8.21	0.00	38.32	0.00	0.95	0.95	37.37
23	9.47	17.19	3.45	8.21	0.00	38.32	0.00	0.95	0.95	37.37
24	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
25	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
26	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
27	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
28	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
29	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
30	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
31	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
32	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
33	0.50	0.73	3.45	8.21	0.00	12.89	35.39	0.95	36.34	-23.45
34	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
35	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
36	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
37	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
38	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
39	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
40	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
41	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
42	9.47	17.19	3.45	8.21	0.00	38.32	0.00	0.95	0.95	37.37
43	9.47	17.19	3.45	8.21	0.00	38.32	0.00	0.95	0.95	37.37
44	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
45	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
46	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
47	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
48	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
49	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
50	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
51	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
52	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
53	0.50	0.73	3.45	8.21	0.00	12.89	0.00	0.95	0.95	11.94
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	80.77	138.98	172.36	410.74	0.00	802.84	171.04	47.50	218.54	584.30
NPV	21.86	38.73	25.68	61.19	0.00	147.47	121.24	7.08	128.32	19.15
Ann	2.20	3.90	2.58	6.16	0.00	14.83	12.20	0.71	12.91	1.93

Capacity in MW, Energy in GWh, Cost & Benefit in US$ mill.

20.3 FINANCIAL EVALUATION

20.3.1 METHODOLOGY

The goal of the financial evaluation is to estimate the attractiveness of the investment opportunity. A DCF model is used, which provides future free cash flow projections and discounts them to arrive at a present value. If the value arrived at through the DCF model is higher than the current cost of the investment, the opportunity may be a good one. There are two major indicators generated from the DCF model; a financial net present value (NPV_P) and a financial internal rate of return (FIRR). On one hand, NPV_P shows the value of a financial stream of future cash flows discounted back to the present. FIRR, on the other hand, computes a break-even rate of return, which equates the cash outflows and the cash inflows.

BOX 1 Financial Rates of Return

The financial rate of return may be different depending on which cost or expense is concerned. In this financial analysis two financial rates are focused; FIRR (financial internal rate of return) and ROI (return on investment). FIRR is concerned with an entire project. By contrast, ROI measures a return to capital holders.

FIRR = an internal rate of return on the overall project expenditure in financial terms before financing charges
= discount rate that makes $NPV_P = 0$.

NPV_P = a net present value in financial terms of the overall project's return without financing charges

ROI = a return on equity in financial terms
= discount rate that makes $NPV_I = 0$.

NPV_I = a net present value in financial terms of the investment

20.3.2 BASIC ASSUMPTIONS IN FINANCIAL ANALYSIS

20.3.2.1 Evaluation Period

The evaluation period is 55 years, being composed of 1 year of leading time, 4 years of construction and 50 years of operation. Construction starts in 2014 and operation starts in end 2017.

20.3.2.2 Currency and Exchange Rate

The dollar of the United State of America (USD) is used in the analysis. The exchange rate between Indonesian Rupiah and USD is Rp. 9,000/USD.

20.3.2.3 Price Escalation

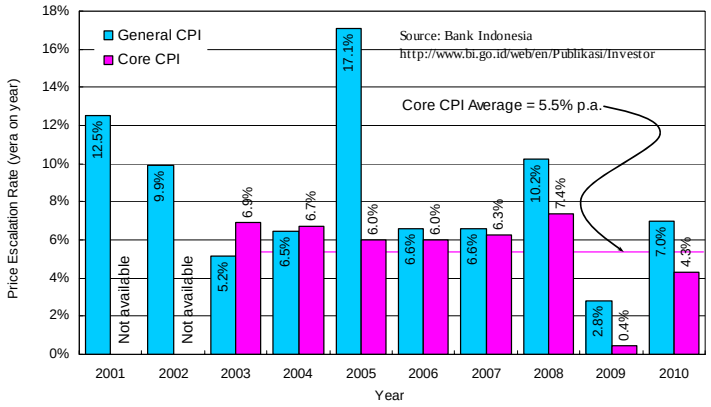
The financial analysis focuses the foreign items on the recent core price index of OECD member countries. It is a price index excluding volatile prices such as foods. As the latest core price index is 1.3% p.a., the price escalation rate for the foreign currency cost portion of the project is assumed to be the same rate.

Table 20.3.1 Price Index of OECD Member Country Average

Year	Index	Yearly Escalation
2005	100.00	1.019
2006	101.92	1.019
2007	104.04	1.021
2008	106.31	1.022
2009	108.15	1.017
2010	109.54	1.013

Source: OECD Statistics
(http://stats.oecd.org/Index.aspx) for years 1996 to 2010.
Study Team's assumption for 2011.

The core price index is also focused on the local cost portion. According to the Bank of Indonesia, the latest value is 5.5% p.a. as of end 2010, which is slightly less than the country's target, 6.0% p.a. Because the financial analysis is made in terms of US Dollars, one should incorporate the currency exchange effect into the price escalation rate for the local currency portion. As the recent 10 year trend of the exchange rate shows 0.5% appreciation of Indonesian Rupiah, the financial analysis decides the price escalation rate to be 5.0% p.a. for the local currency portion.



Source: Bank of Indonesia http://www.bi.go.id/web/en/Publikasi/Investor+Relation+Unit/

Figure 20.3.1 Price Escalation Rates of Indonesia

(1) Price Escalation for CAPEX

Because the foreign and local currency cost ratio is estimated to be 45:55 for the entire CAPEX, its price escalation rate for CAPEX becomes 3.32% p.a. (= 1.3% x 0.45 + 5.0% x 0.55), taking a weighted average of the tow currencies.

(2) Price Escalation for OPEX

Because daily operating cost is expected to be incurred mostly in the local currency, the price escalation rate for OPEX is assumed to be 5.0% p.a. that corresponds to the local currency escalation.

(3) Price Escalation for Non-civil Works

Because the foreign and local currency cost ratio is estimated to be 77.7:22.3 for the non-civil works, its price escalation rate becomes 2.12% p.a. (= 1.3% x 0.777 + 5.0% x 0.223), taking a weighted average of the tow currencies.

20.3.2.4 Discount Rate

10% p.a. of a discount rate is assumed in this financial evaluation.

20.3.2.5 Depreciation and Amortization

It is assumed that all of the hardware (tangible assets) is depreciated and counted as the accounting expenses. The applied method is the straight line. In the last year of the financial evaluation, the residual values are taken into account.

20.3.2.6 Taxes

The following tax conditions are assumed for the project implementation and operation. No tax holidays are assumed.

- VAT will be fully paid by the project owner, PLN.
- 25% of profit tax to the project owner for the operation years is applied.

Note that the water charges levied by the regional government is separately counted in the variable operating cost, and therefore it is not treated as tax.

20.3.2.7 Hurdle Rate of Return

The hurdle rate, which is the minimum desired FIRR of a project, is assumed to be the Weighted Average Cost of Capital (WACC) of the project-operating entity. WACC reflects the overall costs of combined debt and equity capital used to finance business operations, adjusted for tax savings due to interest payments. Assuming that PLN is the project-operating entity of the project in question, WACC was computed to be 2.0%, as detailed in Table 20.3.2.

Table 20.3.2 Computation of Weighted Average Cost of Capital

	Items	MDB[0)]	PLN	Total
a.	Financing Weight	75.00%	25.00%	100.00%
b.	Nominal cost of funds	3.40% [1)]	12.55% [2)]	
c.	Tax rate	25.00%	25.00%	
d.	Tax-adjusted nominal cost	2.55%	9.41%	
e.	Inflation Rate	1.30%	5.00%	
f.	Real Cost	1.23%	4.20%	

g. Weighted component of WACC	0.93%	1.05%	1.98%

0) Multilateral Development Banks, such as ADB and WBG

1) 5-year swap rate as of March 2009 = 2.7% plus ADB loan spread = 0.2% plus onlending premium = 0.5%

2) PLN XI Bonds Series B Year 2010 with terms of 10 years, interest rate of 12.55% p.a.

$d = b \times (1 - c)$ $f = (1 + d) / (1 + e) - 1$

Source: Study Team

Note that, if PLN cannot obtain MDB loan for the project, WACC may rise up to 3.8% due to a higher cost of funds, e.g., 6.75% of a rate of Bank of Indonesia.

20.3.3 FINANCIAL COST

20.3.3.1 Capital Expenditure

As discussed earlier in Table 20.2.3, the financial capital expenditure (CAPEX) is estimated to be US$188 million, excluding costs required for the feasibility study. The financial CAPEX is assumed to be disbursed during seven years of leading time with the yearly disbursement ratios; 0%, 0%, 1.2%, 8.2%, 28%, 39%, and 23%. The breakdowns are given in Table 20.3.3.

Table 20.3.3 Financial CAPEX

(a) CAPEX Breakdown Excluding Financing Charges US$M

Cost Items	FC	LC	Total	FC	LC
Civil Works	22.93	76.71	99.64	23.0%	77.0%
Generating Equipment	32.18	7.15	39.33	81.8%	18.2%
Mechanical Works & Transmission	8.13	4.39	12.52	64.9%	35.1%
Others	2.76	9.81	12.57	22.0%	78.0%
Price Escalation before COD	4.46	24.40	28.86	15.5%	84.5%
Total	70.45	122.45	192.90	36.5%	63.5%

(b) Expected Disbursement US$M

Year	2011	2012	2013	2014	2015	2016	2017	Total
FC	0.00	0.00	0.26	3.48	11.94	30.26	24.50	70.45
LC	0.00	0.00	2.06	12.35	41.65	45.77	20.62	122.45
Total	0.00	0.00	2.32	15.83	53.59	76.04	45.12	192.90
Percentage	0.0%	0.0%	1.2%	8.2%	27.8%	39.4%	23.4%	100.0%

FC = foreign currency, LC = local currency

Source: Study Team

20.3.3.2 Operating Expenditure

Despite different values, the financial operating expenditure (OPEX) can be estimated in a same manner as done in the economic analysis. There are three kinds of the financial OPEX; i) fixed operating cost, which will be incurred no matter how much electricity is generated, ii) variable operating cost, which will be burdened proportionally to electricity generated, and iii) major maintenance cost, which will cost periodically for replacing or overhauling aged machines.

- Fixed operating cost — US$1.1 mill. p.a., which is 0.6% to the construction cost
- Variable operating cost — US$0.1 mill. p.a., which is of Rp. 5.0/kWh for water charge and Rp. 1.5/kWh for lubricants
- Major maintenance cost — US$2.7 mill. p.a., which is equal to the annualized value of the generating equipment, mechanical works and transmission line cost, US$58.4 mill. with 2.12% p.a. of price escalation

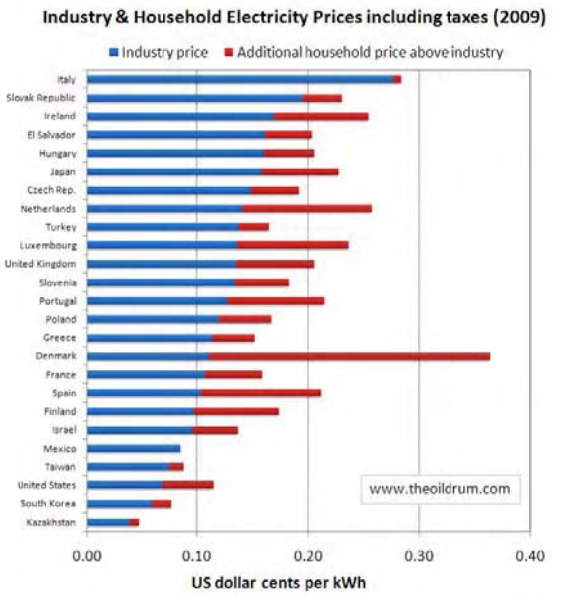
The yearly operating cost is calculated to be around US$3.9 million at the 2011 price level.

20.3.4 FINANCIAL BENEFIT

20.3.4.1 Electricity Tariff

Decision of the electricity tariff is of paramount importance. Because the present electricity charges of PLN include the government subsidy effects, its simple adoption may mislead us into underestimating a project.

This financial analysis has introduced a shadow tariff, which is a virtual electricity price. It is the latest average generation cost of PLN and estimated to be US¢9.945/kWh, which is of the total cost incurred for electricity generation by PLN plus the total government subsidy divided by the total electricity sold by PLN. The data used for this computation is tabulated in Table 20.3.4. This value is evaluated slightly greater than the present middle voltage generation cost by PLN for the Java-Bali System, and much less than the present high voltage generation cost by PLN for the North Sumatra System, as compared in Table 20.3.5. Further, it is within the modest and appropriate tariff range among major countries, as compared in Figure 20.3.2. The financial analysis decides that the electricity tariff of the questioned hydropower project is US¢9.945/kWh as of 2011.



Source: Oil Drum

Figure 20.3.2 Electricity Prices in Major Countries

Table 20.3.4 Electricity Sales and Subsidy

Year	Electricity Sales		Subsidy		Sum	Electricity	Tariff P	Tariff S
	Rp T	US$M	Rp T	US$M	US$M	(GWh)	US¢/kWh	US¢/kWh
2002	39,018	4,335	4,739	527	4,862	108,360	4.001	4.487
2003	49,810	5,534	4,097	455	5,990	113,020	4.897	5.300
2004	58,232	6,470	3,470	386	6,856	120,244	5.381	5.702
2005	63,246	7,027	12,511	1,390	8,417	127,370	5.517	6.609
2006	70,735	7,859	32,909	3,657	11,516	133,108	5.905	8.652
2007	76,286	8,476	36,605	4,067	12,543	142,441	5.951	8.806

Year	Electricity Sales		Subsidy		Sum	Electricity (GWh)	Tariff P	Tariff S
	Rp T	US$M	Rp T	US$M	US$M		US¢/kWh	US¢/kWh
2008	84,250	9,361	78,577	8,731	18,092	149,437	6.264	12.107
2009	90,172	10,019	53,720	5,969	15,988	156,797	6.390	10.197
2010*	N/A	N/A	55,100	6,122	N/A	194,459	7.479	10.627
2011*	N/A	N/A	41,000	4,556	N/A	201,977	7.689	9.945

Electricity = Electricity sold by PLN
Tariff P = average electricity charge without subsidy
Tariff S = electricity charge with subsidy
* Estimations for "Electricity Sold" and "Tariff P" based on the past trends in 2005 to 2009.
Rp.9,000/US$ is used for Rupiah to US$ conversion.
Source: Study Team based on PLN Statistics 2009 and MOF data

Table20.3.5 Electricity Generation Cost by PLN Rp./kWh

Areas	High Voltage	Middle Voltage	Low Voltage
1. North Sumatra	1,891	1,984 to 2,158	2,308 to 2,603
2. South Sumatra	565	667 to 1,164	860 to 1,433
3. Bangka Briton	-	2,476	2,919
4. West Kalimantan	2,315	2,546	3,145
5. Central and South Kalimantan	1,148	1,611	1,998
6. East Kalimantan	1,732	1,965	2,260
7. North Sulawesi	974	1,676	2,063
8. South Sulawesi	1,103	1,249	1,505
9. Maluku	-	2,320	2,919
10. Irian Jaya	-	2,526	3,192
11. NTB	-	2,289	2,743
12. NTT	-	2,433	3,072
13. Java-Bali	783	849 to 859	1,005 to 1,030

Source: Circular No.269-12/26/600.3/2008, Directorate General of Electricity Utilization, MEMR

The electricity tariff should be escalated, so that the project-operating entity can make proper profit from it and can fulfill his financial obligations. In this financial analysis, the minimal tariff escalation is assumed. That is, the extent of escalation yielded from the OPEX increase due to inflation.

The tariff escalation was then computed to be 0.963% p.a. (yearly OPEX divided by electricity sales multiplied by price escalation for OPEX = 3.9 US$M ÷ 20.8 US$M × 5.0% for 2011). The tariff US¢9.945/kWh as of 2011 will be then increased to US¢10.615/kWh as of 2018, the first operating year.

20.3.4.2 Project Revenue

The project revenue is straightforward. It is of the electricity tariff multiplied by the expected electricity sold. The first operating year revenue as of 2018 is;

US$22.2 mill./year = Rp. 0.10615/kWh x 209 GWh/year

Where 209 GWh/year is the net annual energy that is equal to 240 GWh of the gross energy subtracted by 12.93% of loss, being composed of 3.00% of the station use and 9.93% of the transmission/distribution loss.

Benefit from Certified Emission Reduction (CER) was considered in the sensitivity analysis. The CER benefit discussed in the economic analysis is, however, the maximum yield of the CER benefit. Practically, the CER benefit is shared by stakeholders, namely, a project host, CDM investor(s), and the government concerned. In this financial analysis, 50% of the CER befit computed in the economic analysis is counted as the financial CER benefit in order not to overestimate the profit from it. Thus, the financial CER benefit is assumed to be:

CO2 emission factor = 0.743 tCO2/MWh

Expected CER price = 12.5US$/tCO2

Financial CER Benefit = 0.5 x Effective Electricity Generated x CO2 emission factor x CER price
= 0.5 x 209 GWh/year x 0.743tCO2/MWh x 12.5 US$/tCO2
= 0.97 US$M/year

20.3.5 FINANCIAL ANALYSIS

20.3.5.1 Interest Free Cash Flow

An interest free cash flow here evaluates the project's profitability without financing charges but with income tax. The financial stream is tabulated in Table 20.3.6. The key indicators in present worth are:

NPV_P = –US$40.5 million FIRR = 6.6%

B/C = 0.77

The FIRR computed is greater than 2.0% of the hurdle rate, and therefore PLN as the project-operating entity will be able to make profit from the project. However, its NPV_P shows a negative value (as FIRR is less than 10% of discount rate) and therefore profit expected from the project should be evaluated marginal.

Table 20.3.6 Interest Free Financial Stream

US$ million

Year		Cost				Benefit			Net Benefit	GWh Energy Supply
		CAPEX	O&M	Tax	Sub-total	Sales	CER	Sub-total		
2011	-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2012	-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2013	-4	2.32	0.00	0.00	2.32	0.00	0.00	0.00	-2.32	0
2014	-3	15.83	0.00	0.00	15.83	0.00	0.00	0.00	-15.83	0
2015	-2	53.59	0.00	0.00	53.59	0.00	0.00	0.00	-53.59	0
2016	-1	76.04	0.00	0.00	76.04	0.00	0.00	0.00	-76.04	0
2017	0	45.12	0.00	0.00	45.12	0.00	0.00	0.00	-45.12	0
2018	1	0.00	4.49	2.70	7.19	22.18	0.00	22.18	14.99	209
2019	2	0.00	4.64	2.72	7.36	22.39	0.00	22.39	15.03	209
2020	3	0.00	4.79	2.73	7.52	22.60	0.00	22.60	15.08	209
2021	4	0.00	4.95	2.74	7.70	22.81	0.00	22.81	15.11	209
2022	5	0.00	5.12	2.76	7.88	23.03	0.00	23.03	15.15	209
2023	6	0.00	5.29	2.77	8.06	23.24	0.00	23.24	15.18	209
2024	7	0.00	5.47	2.78	8.25	23.46	0.00	23.46	15.21	209
2025	8	0.00	5.66	2.81	8.47	23.68	0.00	23.68	15.20	209
2026	9	0.00	5.86	2.85	8.70	23.90	0.00	23.90	15.20	209
2027	10	0.00	6.06	2.88	8.94	24.12	0.00	24.12	15.18	209
2028	11	0.00	6.27	2.91	9.18	24.35	0.00	24.35	15.17	209
2029	12	0.00	6.49	2.94	9.43	24.58	0.00	24.58	15.14	209
2030	13	0.00	6.72	2.97	9.69	24.81	0.00	24.81	15.12	209
2031	14	0.00	6.95	3.00	9.95	25.04	0.00	25.04	15.08	209
2032	15	0.00	7.20	3.03	10.23	25.27	0.00	25.27	15.05	209
2033	16	0.00	7.46	3.05	10.51	25.51	0.00	25.51	15.00	209
2034	17	0.00	7.73	3.07	10.80	25.75	0.00	25.75	14.95	209
2035	18	0.00	8.01	3.09	11.10	25.99	0.00	25.99	14.89	209
2036	19	0.00	8.30	3.11	11.40	26.23	0.00	26.23	14.83	209
2037	20	0.00	8.60	3.12	11.72	26.48	0.00	26.48	14.76	209
2038	21	0.00	8.92	3.13	12.05	26.73	0.00	26.73	14.68	209
2039	22	0.00	9.25	3.14	12.39	26.98	0.00	26.98	14.59	209
2040	23	0.00	9.59	3.15	12.74	27.23	0.00	27.23	14.49	209
2041	24	0.00	9.95	3.15	13.10	27.49	0.00	27.49	14.39	209
2042	25	0.00	10.33	3.15	13.47	27.74	0.00	27.74	14.27	209
2043	26	0.00	10.72	3.14	13.86	28.00	0.00	28.00	14.14	209
2044	27	0.00	11.12	3.14	14.26	28.26	0.00	28.26	14.01	209
2045	28	0.00	11.55	3.12	14.67	28.53	0.00	28.53	13.86	209
2046	29	0.00	11.99	3.11	15.10	28.80	0.00	28.80	13.70	209
2047	30	0.00	12.45	3.09	15.54	29.07	0.00	29.07	13.52	209
2048	31	0.00	12.02	0.00	12.02	0.00	0.00	0.00	-12.02	0
2049	32	0.00	13.44	2.72	16.16	29.61	0.00	29.61	13.45	209
2050	33	0.00	13.96	2.66	16.62	29.89	0.00	29.89	13.27	209
2051	34	0.00	14.51	2.59	17.10	30.17	0.00	30.17	13.07	209
2052	35	0.00	15.09	2.52	17.60	30.45	0.00	30.45	12.85	209
2053	36	0.00	15.68	2.44	18.12	30.74	0.00	30.74	12.61	209
2054	37	0.00	16.31	2.36	18.66	31.03	0.00	31.03	12.36	209
2055	38	0.00	16.96	2.26	19.23	31.32	0.00	31.32	12.09	209
2056	39	0.00	17.64	2.17	19.81	31.61	0.00	31.61	11.80	209
2057	40	0.00	18.36	2.06	20.42	31.90	0.00	31.90	11.48	209
2058	41	0.00	19.10	1.95	21.05	32.20	0.00	32.20	11.15	209
2059	42	0.00	19.88	1.83	21.71	32.51	0.00	32.51	10.79	209
2060	43	0.00	20.69	1.70	22.40	32.81	0.00	32.81	10.41	209
2061	44	0.00	21.55	1.57	23.11	33.12	0.00	33.12	10.00	209
2062	45	0.00	22.43	1.42	23.86	33.43	0.00	33.43	9.57	209
2063	46	0.00	23.36	1.27	24.63	33.74	0.00	33.74	9.11	209
2064	47	0.00	24.34	1.11	25.44	34.06	0.00	34.06	8.61	209
2065	48	0.00	25.35	0.93	26.28	34.37	0.00	34.37	8.09	209
2066	49	0.00	26.42	0.75	27.16	34.70	0.00	34.70	7.53	209
2067	50	-42.95	27.53	0.55	-14.88	35.02	0.00	35.02	49.90	209
Total		149.95	616.57	124.20	890.71	1376.91	0.00	1376.91	486.20	10,239
PV		122.89	37.26	15.74	175.89	135.41	0.00	135.41	-40.48	–
Annu		12.34	3.74	1.58	17.67	13.60	0.00	13.60	-4.07	–

NPV_P = -40.48 FIRR = 6.63% B/C = 0.77 Cost = US¢8.5/kWh

PV stands for a present value discounted by 10% p.a.

Annu stands for an annualized value of respective present value.

Source: Study Team

The total unit generation cost is US¢8.5/kWh (annualized total cost divided by annual energy supplied). The breakdown follows:

Table 20.3.7 Generation Cost Breakdown

	CAPEX	O&M	Tax	Total	Energy (GWh)
Annualized Value (US$ mill.)	12.34	3.74	1.58	17.67	208.97
Generation Cost (US ¢ /kWh)	5.91	1.79	0.76	8.45	−

Source: Study Team

20.3.5.2 Return on Investment

The interest free cash flow discussed in the previous subsection corresponds to the entire return in case when no loan is arranged. Reality often demands some loan to complete a project and another set of the cash flow analysis is needed. It is the cash flow in consideration of the financing charges and reflects the investor's return. It is often called "Return on Investment" or ROI. For ROI evaluation, DSCR (debt service coverage ratio) and LLCR (loan life coverage ratio) are introduced to measure a project's ability to generate enough revenue to cover the cost of its mortgage payments. DSCR is calculated by dividing the net operating income by the total debt service. LLCR is a measure of the long term cash flow over the scheduled life of the debt in view of how a project can repay the outstanding debt balance.

Assuming the loan conditions in Table 20.3.8, the return on investment was computed as given in Table 20.3.9 by using a DCF model. The net present value and rate of return are:

NPV_I = US$19.1 million ROI = 15.0%

Table 20.3.8 Loan Conditions Assumed for Financial Cash Flow

Lender	Interest Rate (p.a)	Front-end fee	Commitment fee (p.a)	Grace period	Repay period	Loan share
Bilateral Institution	1.90%	0.00%	0.75%	7 years	25 years	75%

Notes 1. The front-end fee will be charged only at the time of loan agreement. The commitment fee is charged against unused loan amount and will decrease gradually and end at null when the loan amount is fully disbursed.

2. Interest rate is assumed constant and being composed of 1.4% p.a. of JICA's standard rate for medium income countries plus 0.5% p.a. of onlending spread by MOF.
3. Grace period includes 4 years of construction.
4. No insurance is counted.

Source: Study Team

The project can be evaluated financially feasible from a long term view. A breakeven of the investment will be 5 years after commissioning. Because no revenue is expected in the replacement year scheduled 30 years after commissioning, however, the project will not be able to fulfill the debt service obligation in the same year. As an enough return is expected, the project can overcome the debt service issue. For example, if 7% of the annual net profit is deposited every year into a saving

account, the project will easily be able to have enough cash when no revenue is expected due to machine replacement.

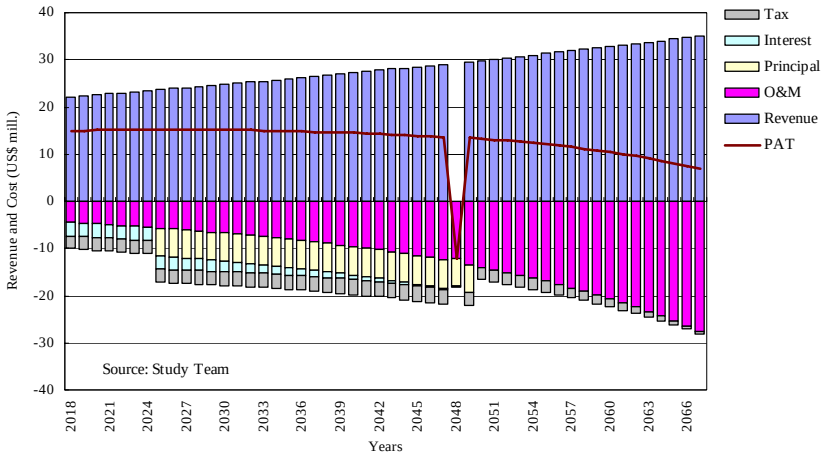


Figure 20.3.3 Cash Inflow and Outflow

Assuming the aforementioned explicit savings for the replacement cost, DSCR and LLCR can be raised as:

Minimum DSCR = 1.1 > 1.0 Minimum LLCR = 2.6 > 1.0

Now, all of the indicators show enough numbers and therefore one can evaluate the hydropower project in question is financially viable. The debt balance is illustrated in Figure 20.3.4. The profit and loss calculations are given in Table 20.3.10.

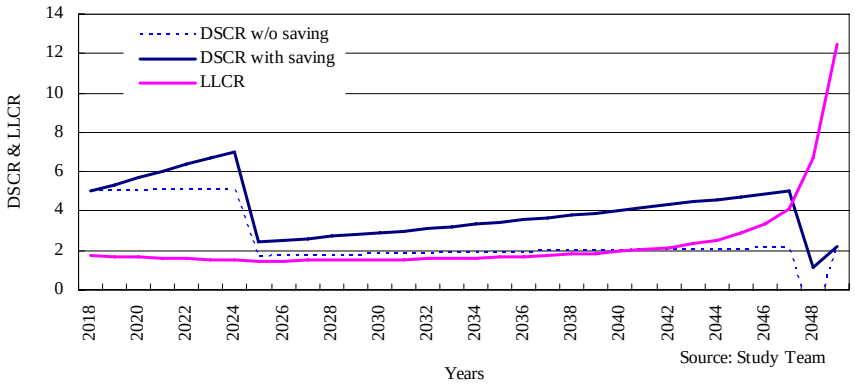


Figure 20.3.4 Debt Balance

Table 20.3.9 Financial Cash Flow for ROI

US$ million

Year		Invest	Cash Generation						Benefit	
			Sales	Residual	O&M	Interest	Repay	Tax	Net	Sum
2011	-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	-4	2.09	0.00	0.00	0.00	0.01	0.00	0.00	-2.10	-2.10
2014	-3	14.28	0.00	0.00	0.00	0.05	0.00	0.00	-14.33	-16.43
2015	-2	27.12	0.00	0.00	0.00	0.74	0.00	0.00	-27.86	-44.29
2016	-1	0.00	0.00	0.00	0.00	2.55	0.00	0.00	-2.55	-46.84
2017	0	0.00	0.00	0.00	0.00	3.20	0.00	0.00	-3.20	-50.03
2018	1	0.00	22.18	0.00	4.49	2.85	0.00	2.70	12.14	-37.90
2019	2	0.00	22.39	0.00	4.64	2.85	0.00	2.72	12.18	-25.72
2020	3	0.00	22.60	0.00	4.79	2.85	0.00	2.73	12.22	-13.49
2021	4	0.00	22.81	0.00	4.95	2.85	0.00	2.74	12.26	-1.23
2022	5	0.00	23.03	0.00	5.12	2.85	0.00	2.76	12.30	11.07
2023	6	0.00	23.24	0.00	5.29	2.85	0.00	2.77	12.33	23.40
2024	7	0.00	23.46	0.00	5.47	2.85	0.00	2.78	12.36	35.75
2025	8	0.00	23.68	0.00	5.66	2.74	6.00	2.81	6.46	42.22
2026	9	0.00	23.90	0.00	5.86	2.62	6.00	2.85	6.57	48.78
2027	10	0.00	24.12	0.00	6.06	2.51	6.00	2.88	6.67	55.45
2028	11	0.00	24.35	0.00	6.27	2.40	6.00	2.91	6.77	62.22
2029	12	0.00	24.58	0.00	6.49	2.28	6.00	2.94	6.86	69.08
2030	13	0.00	24.81	0.00	6.72	2.17	6.00	2.97	6.95	76.03
2031	14	0.00	25.04	0.00	6.95	2.05	6.00	3.00	7.03	83.05
2032	15	0.00	25.27	0.00	7.20	1.94	6.00	3.03	7.10	90.16
2033	16	0.00	25.51	0.00	7.46	1.83	6.00	3.05	7.17	97.33
2034	17	0.00	25.75	0.00	7.73	1.71	6.00	3.07	7.24	104.57
2035	18	0.00	25.99	0.00	8.01	1.60	6.00	3.09	7.29	111.86
2036	19	0.00	26.23	0.00	8.30	1.48	6.00	3.11	7.34	119.20
2037	20	0.00	26.48	0.00	8.60	1.37	6.00	3.12	7.38	126.59
2038	21	0.00	26.73	0.00	8.92	1.25	6.00	3.13	7.42	134.00
2039	22	0.00	26.98	0.00	9.25	1.14	6.00	3.14	7.44	141.45
2040	23	0.00	27.23	0.00	9.59	1.03	6.00	3.15	7.46	148.91
2041	24	0.00	27.49	0.00	9.95	0.91	6.00	3.15	7.47	156.38
2042	25	0.00	27.74	0.00	10.33	0.80	6.00	3.15	7.47	163.85
2043	26	0.00	28.00	0.00	10.72	0.68	6.00	3.14	7.45	171.30
2044	27	0.00	28.26	0.00	11.12	0.57	6.00	3.14	7.43	178.73
2045	28	0.00	28.53	0.00	11.55	0.46	6.00	3.12	7.40	186.13
2046	29	0.00	28.80	0.00	11.99	0.34	6.00	3.11	7.35	193.48
2047	30	0.00	29.07	0.00	12.45	0.23	6.00	3.09	7.29	200.77
2048	31	0.00	0.00	0.00	12.02	0.11	6.00	0.00	-18.14	182.64
2049	32	0.00	29.61	0.00	13.44	0.00	6.00	2.72	7.45	190.09
2050	33	0.00	29.89	0.00	13.96	0.00	0.00	2.66	13.27	203.36
2051	34	0.00	30.17	0.00	14.51	0.00	0.00	2.59	13.07	216.42
2052	35	0.00	30.45	0.00	15.09	0.00	0.00	2.52	12.85	229.27
2053	36	0.00	30.74	0.00	15.68	0.00	0.00	2.44	12.61	241.89
2054	37	0.00	31.03	0.00	16.31	0.00	0.00	2.36	12.36	254.25
2055	38	0.00	31.32	0.00	16.96	0.00	0.00	2.26	12.09	266.34
2056	39	0.00	31.61	0.00	17.64	0.00	0.00	2.17	11.80	278.13
2057	40	0.00	31.90	0.00	18.36	0.00	0.00	2.06	11.48	289.62
2058	41	0.00	32.20	0.00	19.10	0.00	0.00	1.95	11.15	300.77
2059	42	0.00	32.51	0.00	19.88	0.00	0.00	1.83	10.79	311.56
2060	43	0.00	32.81	0.00	20.69	0.00	0.00	1.70	10.41	321.97
2061	44	0.00	33.12	0.00	21.55	0.00	0.00	1.57	10.00	331.97
2062	45	0.00	33.43	0.00	22.43	0.00	0.00	1.42	9.57	341.54
2063	46	0.00	33.74	0.00	23.36	0.00	0.00	1.27	9.11	350.64
2064	47	0.00	34.06	0.00	24.34	0.00	0.00	1.11	8.61	359.26
2065	48	0.00	34.37	0.00	25.35	0.00	0.00	0.93	8.09	367.35
2066	49	0.00	34.70	0.00	26.42	0.00	0.00	0.75	7.53	374.88
2067	50	0.00	35.02	42.95	27.53	0.00	0.00	0.55	49.90	424.78
Total		43.50	1,376.91	42.95	616.57	60.72	150.10	124.20	424.78	–
PV		30.99	135.41	0.21	37.26	16.73	15.79	15.74	19.12	–
Annu		3.11	13.60	0.02	3.74	1.68	1.59	1.58	1.92	–

NPV_I = 19.12 ROI = 14.96% Source: Study Team

PV stands for a present value discounted by 10% p.a.

Annu stands for an annualized value of respective present value.

Table 20.3.10 Profit and Loss

US$ million

Year		Revenue	Interest	O&M Cost	Depreciation	PBT	Tax	PAT	DSCR	LLCR
2011	-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
2012	-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
2013	-4	0.00	0.01	0.00	0.00	-2.33	0.00	-2.33		
2014	-3	0.00	0.05	0.00	0.00	-15.88	0.00	-15.88		
2015	-2	0.00	0.74	0.00	0.00	-54.33	0.00	-54.33		
2016	-1	0.00	2.55	0.00	0.00	-78.59	0.00	-78.59		
2017	0	0.00	3.20	0.00	0.00	-48.32	0.00	-48.32		
2018	1	22.18	2.85	4.49	4.03	10.81	2.70	8.11	5.02	1.73
2019	2	22.39	2.85	4.64	4.03	10.87	2.72	8.15	5.36	1.70
2020	3	22.60	2.85	4.79	4.03	10.92	2.73	8.19	5.69	1.66
2021	4	22.81	2.85	4.95	4.03	10.98	2.74	8.23	6.03	1.62
2022	5	23.03	2.85	5.12	4.03	11.02	2.76	8.27	6.36	1.59
2023	6	23.24	2.85	5.29	4.03	11.07	2.77	8.30	6.69	1.55
2024	7	23.46	2.85	5.47	4.03	11.10	2.78	8.33	7.03	1.51
2025	8	23.68	2.74	5.66	4.03	11.25	2.81	8.44	2.44	1.47
2026	9	23.90	2.62	5.86	4.03	11.39	2.85	8.54	2.52	1.48
2027	10	24.12	2.51	6.06	4.03	11.53	2.88	8.64	2.61	1.49
2028	11	24.35	2.40	6.27	4.03	11.66	2.91	8.74	2.70	1.51
2029	12	24.58	2.28	6.49	4.03	11.78	2.94	8.83	2.80	1.52
2030	13	24.81	2.17	6.72	4.03	11.89	2.97	8.92	2.90	1.54
2031	14	25.04	2.05	6.95	4.03	12.00	3.00	9.00	3.00	1.55
2032	15	25.27	1.94	7.20	4.03	12.10	3.03	9.08	3.10	1.58
2033	16	25.51	1.83	7.46	4.03	12.20	3.05	9.15	3.21	1.60
2034	17	25.75	1.71	7.73	4.03	12.28	3.07	9.21	3.32	1.63
2035	18	25.99	1.60	8.01	4.03	12.36	3.09	9.27	3.43	1.66
2036	19	26.23	1.48	8.30	4.03	12.42	3.11	9.32	3.55	1.70
2037	20	26.48	1.37	8.60	4.03	12.48	3.12	9.36	3.67	1.74
2038	21	26.73	1.25	8.92	4.03	12.52	3.13	9.39	3.79	1.80
2039	22	26.98	1.14	9.25	4.03	12.56	3.14	9.42	3.92	1.86
2040	23	27.23	1.03	9.59	4.03	12.58	3.15	9.44	4.05	1.94
2041	24	27.49	0.91	9.95	4.03	12.59	3.15	9.44	4.18	2.04
2042	25	27.74	0.80	10.33	4.03	12.59	3.15	9.44	4.31	2.16
2043	26	28.00	0.68	10.72	4.03	12.57	3.14	9.43	4.45	2.33
2044	27	28.26	0.57	11.12	4.03	12.54	3.14	9.41	4.59	2.54
2045	28	28.53	0.46	11.55	4.03	12.50	3.12	9.37	4.74	2.85
2046	29	28.80	0.34	11.99	4.03	12.43	3.11	9.33	4.89	3.32
2047	30	29.07	0.23	12.45	4.03	12.36	3.09	9.27	5.04	4.11
2048	31	0.00	0.11	12.02	2.23	-14.36	0.00	-14.36	1.11	6.71
2049	32	29.61	0.00	13.44	5.30	10.88	2.72	8.16	2.17	12.49
2050	33	29.89	0.00	13.96	5.30	10.63	2.66	7.97	n.a.	n.a.
2051	34	30.17	0.00	14.51	5.30	10.36	2.59	7.77	n.a.	n.a.
2052	35	30.45	0.00	15.09	5.30	10.07	2.52	7.55	n.a.	n.a.
2053	36	30.74	0.00	15.68	5.30	9.76	2.44	7.32	n.a.	n.a.
2054	37	31.03	0.00	16.31	5.30	9.42	2.36	7.07	n.a.	n.a.
2055	38	31.32	0.00	16.96	5.30	9.06	2.26	6.79	n.a.	n.a.
2056	39	31.61	0.00	17.64	5.30	8.67	2.17	6.50	n.a.	n.a.
2057	40	31.90	0.00	18.36	5.30	8.25	2.06	6.19	n.a.	n.a.
2058	41	32.20	0.00	19.10	5.30	7.81	1.95	5.85	n.a.	n.a.
2059	42	32.51	0.00	19.88	5.30	7.33	1.83	5.50	n.a.	n.a.
2060	43	32.81	0.00	20.69	5.30	6.82	1.70	5.11	n.a.	n.a.
2061	44	33.12	0.00	21.55	5.30	6.28	1.57	4.71	n.a.	n.a.
2062	45	33.43	0.00	22.43	5.30	5.70	1.42	4.27	n.a.	n.a.
2063	46	33.74	0.00	23.36	5.30	5.08	1.27	3.81	n.a.	n.a.
2064	47	34.06	0.00	24.34	5.30	4.42	1.11	3.32	n.a.	n.a.
2065	48	34.37	0.00	25.35	5.30	3.73	0.93	2.80	n.a.	n.a.
2066	49	34.70	0.00	26.42	5.30	2.99	0.75	2.24	n.a.	n.a.
2067	50	35.02	0.00	27.53	5.30	2.20	0.55	1.65	n.a.	n.a.
Total		1,376.91	60.72	616.57	223.73	283.00	124.20	158.80	–	–
PV		135.41	16.73	37.26	22.81	-64.48	15.74	-80.23	–	–
Annu		13.60	1.68	3.74	2.29	-6.48	1.58	-8.06	–	–

PV stands for a present value discounted by 10% p.a. Source: Study Team

Annu stands for an annualized value of respective present value.

20.3.6 FINANCIAL SENSITIVITY

A sensitivity analysis was conducted to examine the extent to which the financial indicators change for different values of the major variables. In this financial analysis, 5 cases are tested, namely, + CDM, – 10% Tariff, – 10% Annual Energy, + 10% CAPEX & OPEX, and + 1 year delay of commissioning.

The sensitivity analysis has confirmed that changes of the financial indicators still remain in a viable range, as compared in Table 20.3.11.

Table20.3.11 Financial Indicators

Sensitivity Analysis	FIRR	US$M	ROI	US$M	
0. Base Case	6.6%	-40.5	15.0%	19.1	the base case
1. +CDM	7.0%	-36.4	15.9%	23.2	CDM benefit added to the base case
2. –10% Tariff	5.6%	-50.6	12.5%	9.0	electricity tariff 10% less
3. –10% Energy	5.6%	-50.6	12.5%	9.0	less annual energy by 10%
4. +10% CAPEX	5.8%	-54.5	12.8%	11.1	greater cost by 10%
5. COD Delayed by 1 yr	6.2%	-47.0	13.4%	13.9	commissioning delayed by 1 year

Columns with US$M correspond to respective net present values
Source: Study Team

20.4 BUSINESS SCHEME AND FINANCING PLAN

20.4.1 INTRODUCTION TO BUSINESS SCHEME AND FINANCING PLAN

Hydropower development requires large initial investment. Because the public sector budgets are limited, private investments are desired. However, there are many stagnated hydropower projects due to the higher natural condition risks and greater investment costs than typical thermal plants. Particularly in IPPs, these high risk and high cost issues discourage private investors and make the financing more difficult. Today, hydropower development looks possible only when the public sector implements it, with a very few exceptions.

Therefore, a Public-Private Partnership (PPP) should be sought. A PPP potentially can reduce the public sector's liability and can accelerate private investments in the country as well. Among several PPP scheme candidates as compared in the following table, so-called the Hybrid or "the vertical separation" mechanism has been chosen as the best-fitting PPP business scheme in this financial analysis.

Table 20.4.1 Evaluation of Possible PPP Schemes

Effect	Hybrid	OBA	BTO for Value	Joint Venture
i) Reduction of Implementation Cost	A certain amount of the cost reduction can be expected from the financing charges and insurance cost.			Depends on depth of public sector's involvement
ii) Relief of Private Sector's Risks	The hydro specific natural condition risk could be unbundled.	The hydro specific natural condition risk remains, because the completion risk needs to be borne 100% by the private sector.		Not sufficient for the private sector.
iii) Optimal Input of Public Money	Because of remarkable private investment, all of 4 schemes must be effective for reducing the public money input, once a project is realized. It is quite possible to optimize the public money input to the hydropower projects.			

Hybrid (a vertical separation): Design and construction role is shared by 2 sectors.
OBA (Output-Based Aid): Public sector subsidizes project outputs achieved by private sector.

BTO for Value: Public sector buys out a ready-to-use project developed by private sector.
Joint Venture: 2 sectors form a joint venture entity for a project.

Source: The Study on Optimal Electric Power Development in Sulawesi, JICA, 2008

20.4.2 DESIGN OF POSSIBLE PPP BUSINESS SCHEME

Only a proper risk allocation can bring about the feasible and sustainable business scheme, which is a basis of the financing plan of a project. In the private investment in hydropower development, four major risks are focused. They are, i) financing risk, ii) political risk, iii) hydrological risk, and iv) design and construction risk. Here, the hydrological risk raises the commercial risk, because unexpected river runoff is directly linked to the electricity generation and revenues of the project. It is of paramount importance for a PPP business scheme to reduce these risks to a level that a private investor can accept. The following table examines the power station and non-power station components to what extent each risk can be reduced from the private investor's point of view. Where, the power station component is literally the power station including the generating equipment, related mechanical works, and necessary civil works housing thereof. The non-power station components are all civil works upstream of the power station, substantially the headworks and tunnel waterway.

Table 20.4.2 Effects of Risk Mitigation for Private Sector

	Power Station Component	Non-Power Station Components
Financing Risk	The risk can be minimized, if the following 3 risks are nicely mitigated, and if the currency exchange risk can be taken away by the business contract.	
Political Risk	The risk can be eased, if a proper business contract is exercised. Government guarantees against currency inconvertibility, expropriation, etc. can greatly encourage a private investor.	
Hydrological Risk	Substantially, the commercial risk. The risk cannot be taken by a private investor, because future river runoff is beyond his power. The public sector should take over this risk.	
Design and Construction Risk	The risk can be taken by a private investor, because unforeseeable natural conditions are marginal in power station construction.	The risk can hardly be hedged by a private investor, because unforeseeable natural conditions are significant in weir and tunnel construction.

Source: Study Team

From the above table, this paper concludes that the PPP business scheme should meet the following states.

- The power station component can be developed by the private sector, if the currency exchange risk is nicely mitigated.
- The non-power station components can hardly be developed by the private sector at his risk. The public sector should develop it, instead.
- Because of the different states above, a simple private investment mechanism, such as BOT or BLT, cannot be adopted.
- If one thinks about the maximum participation of the private sector, a possible PPP scheme may be a combination of i) BOT like private finance based development only for the power station component, ii) conventional public finance based development for the non-power station components, and iii) O&M Contract based daily operation and maintenance by the private sector.

- Finally, the DBFO (design-build-finance-operate) business scheme, which can satisfy the above combination, can be the solution.

The financial analysis concludes that the DBFO is the best fitting PPP scheme for the Masang-2 Hydropower Project. Table 20.4.3 summarizes the expected roles of the private and public sectors.

Table 20.4.3 Expected Tasks of Private and Public Sectors in PPP Scheme

	Private Sector Role (Power Station)	PLN Role (Non-Power Station)
Design Stage	PLN is fully responsible for planning to basic design, as one of the conventional PLN projects.	
Construction Stage	DBFO contractor procured by PLN is responsible for detailed design, construction, and finance for the power station.	PLN develops the non-power station. At the same time, PLN supervises the DBFO performances.
Operation Stage	DBFO contractor operates and maintains all of the project components including the non-power station, based on the contract with PLN. Payments to DBFO contractor should be on cost-plus-fee basis and not be like a conventional PPA, which is directly linked with electricity actually generated.	

Source: Study Team

Table 20.4.5 attempts to divide the interest free cash flow (Table 20.3.6) into tow; one for PLN as the project owner representing the public sector, and the other is for a DBFO contractor as the private sector. Here, the following assumptions were made:

- The PPP Scheme is a DBFO based vertical separation.
- CAPEX is divided into US$126.3 million for the non-power station portion (the public sector portion) and US$66.6 million for the power station portion (the private sector portion), as detailed in Table 20.4.4.
- The payments from PLN can bring reasonable profit to the DBFO contractor. 13% of FIRR is assumed for the private sector portion.
- All of the daily operation and maintenance work for entire project facilities will be worked by the DBFO contractor.
- The DBFO contract period is 28 years being composed of 3 years of construction and 25 years of commercial operation. Upon expiration of the contract, PLN will become a sole project-operating
- Both sectors will fulfill tax obligations.

Table 20.4.4 Assumption of Public-Private Cost Demarcations

			US$M		
Private Items	FC	LC	Total	FC	LC
Penstock, Powerhouse, Tailrace, Switchyard	0.97	4.58	5.55	17.4%	82.6%
Metal & Hydro-mechanical Works	5.16	2.21	7.37	70.0%	30.0%
Generating Equipment	29.25	3.25	32.50	90.0%	10.0%
Transmission Lines	2.23	0.74	2.97	75.0%	25.0%
VAT	0.00	4.84	4.84	0.0%	100.0%
Contingency	3.76	1.56	5.32	70.6%	29.4%
Price Escalation	3.03	4.98	8.01	37.9%	62.1%
Total	44.40	22.17	66.57	66.7%	33.3%
			US$M		
Public Items	FC	LC	Total	FC	LC
Total Construction	70.45	122.45	192.90	36.5%	63.5%
Less Private Items	-44.40	-22.17	-66.57	66.7%	33.3%

Total	26.05	100.28	126.33	20.6%	79.4%

Source: Study Team

Although the DBFO scheme discussed above can nicely demarcate the public and private sectors' roles to play, it does not always guarantee its financial viability. In fact, as investigated in Table 20.4.5, the public sector's return may dramatically reduce to an unsatisfactory level, e.g., FIRR = 3.6%. This return rate is less than the alternative WACC 3.8% discussed in Subsection 20.3.2.7 for the case such that the cost of funds is increased to a level of an interest rate by the Bank of Indonesia. Note that if the private sector's minimum return is unreasonably lowered, attractiveness for private investment no longer exists and therefore the PPP concept may automatically collapse.

Table 20.4.5 PPP Financial Streams under Hybrid DBFO

Public Sector						US$ mill.	Private Sector				US$ mill.
Year	CAPEX	OPEX	PPP	Tax	Benefit	Net	CAPEX	OPEX	Tax	PPP	Net
2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013	2.32	0.00	0.00	0.00	0.00	-2.32	0.00	0.00	0.00	0.00	0.00
2014	15.83	0.00	0.00	0.00	0.00	-15.83	0.00	0.00	0.00	0.00	0.00
2015	50.39	0.00	0.00	0.00	0.00	-50.39	3.20	0.00	0.00	0.00	-3.20
2016	42.17	0.00	0.00	0.00	0.00	-42.17	33.87	0.00	0.00	0.00	-33.87
2017	15.61	0.00	0.00	0.00	0.00	-15.61	29.51	0.00	0.00	0.00	-29.51
2018	0.00	0.00	17.96	2.45	22.18	1.77	0.00	4.49	2.76	17.96	10.71
2019	0.00	0.00	17.96	2.50	22.39	1.93	0.00	4.64	2.73	17.96	10.60
2020	0.00	0.00	17.96	2.55	22.60	2.08	0.00	4.79	2.69	17.96	10.48
2021	0.00	0.00	17.96	2.61	22.81	2.24	0.00	4.95	2.65	17.96	10.36
2022	0.00	0.00	17.96	2.66	23.03	2.40	0.00	5.12	2.61	17.96	10.24
2023	0.00	0.00	17.96	2.71	23.24	2.56	0.00	5.29	2.56	17.96	10.11
2024	0.00	0.00	17.96	2.77	23.46	2.73	0.00	5.47	2.52	17.96	9.97
2025	0.00	0.00	17.96	2.82	23.68	2.89	0.00	5.66	2.47	17.96	9.83
2026	0.00	0.00	17.96	2.88	23.90	3.06	0.00	5.86	2.42	17.96	9.69
2027	0.00	0.00	17.96	2.93	24.12	3.23	0.00	6.06	2.37	17.96	9.53
2028	0.00	0.00	17.96	2.99	24.35	3.40	0.00	6.27	2.32	17.96	9.38
2029	0.00	0.00	17.96	3.05	24.58	3.57	0.00	6.49	2.26	17.96	9.21
2030	0.00	0.00	17.96	3.11	24.81	3.74	0.00	6.72	2.21	17.96	9.04
2031	0.00	0.00	17.96	3.16	25.04	3.91	0.00	6.95	2.15	17.96	8.86
2032	0.00	0.00	17.96	3.22	25.27	4.09	0.00	7.20	2.09	17.96	8.68
2033	0.00	0.00	17.96	3.28	25.51	4.27	0.00	7.46	2.02	17.96	8.48
2034	0.00	0.00	17.96	3.34	25.75	4.45	0.00	7.73	1.95	17.96	8.28
2035	0.00	0.00	17.96	3.40	25.99	4.63	0.00	8.01	1.88	17.96	8.07
2036	0.00	0.00	17.96	3.46	26.23	4.81	0.00	8.30	1.81	17.96	7.85
2037	0.00	0.00	17.96	3.52	26.48	4.99	0.00	8.60	1.73	17.96	7.63
2038	0.00	0.00	17.96	3.59	26.73	5.18	0.00	8.92	1.66	17.96	7.39
2039	0.00	0.00	17.96	3.65	26.98	5.37	0.00	9.25	1.57	17.96	7.14
2040	0.00	0.00	17.96	3.71	27.23	5.56	0.00	9.59	1.49	17.96	6.88
2041	0.00	0.00	17.96	3.78	27.49	5.75	0.00	9.95	1.40	17.96	6.61
2042	0.00	0.00	17.96	3.84	27.74	5.94	0.00	10.33	1.30	17.96	6.33
2043	0.00	10.72	0.00	3.31	28.00	13.97					
2044	0.00	11.12	0.00	3.28	28.26	13.86					
2045	0.00	11.55	0.00	3.24	28.53	13.74					
2046	0.00	11.99	0.00	3.19	28.80	13.61					
2047	0.00	12.45	0.00	3.15	29.07	13.47					
2048	0.00	12.02	0.00	0.00	0.00	-12.02					
2049	0.00	13.44	0.00	2.70	29.61	13.48					
2050	0.00	13.96	0.00	2.64	29.89	13.29					
2051	0.00	14.51	0.00	2.57	30.17	13.09					
2052	0.00	15.09	0.00	2.50	30.45	12.87					
2053	0.00	15.68	0.00	2.42	30.74	12.64					
2054	0.00	16.31	0.00	2.33	31.03	12.38					
2055	0.00	16.96	0.00	2.24	31.32	12.11					
2056	0.00	17.64	0.00	2.15	31.61	11.82					
2057	0.00	18.36	0.00	2.04	31.90	11.51					
2058	0.00	19.10	0.00	1.93	32.20	11.17					
2059	0.00	19.88	0.00	1.81	32.51	10.81					
2060	0.00	20.69	0.00	1.68	32.81	10.43					
2061	0.00	21.55	0.00	1.55	33.12	10.02					
2062	0.00	22.43	0.00	1.40	33.43	9.59					
2063	0.00	23.36	0.00	1.25	33.74	9.13					
2064	0.00	24.34	0.00	1.08	34.06	8.64					
2065	0.00	25.35	0.00	0.91	34.37	8.11					
2066	0.00	26.42	0.00	0.72	34.70	7.56					
2067	-42.95	27.53	0.00	11.27	35.02	39.18					
Total	83.38	442.46	449.08	139.35	1376.91	262.65	66.57	174.11	53.61	449.08	154.78
PV	83.02	6.94	92.04	15.86	135.41	-62.45	39.87	30.32	12.33	92.04	9.52
Annu	8.34	0.70	9.24	1.59	13.60	-6.27	4.28	3.26	1.32	9.89	1.02
Source: Study Team					FIRR = 3.62%						FIRR = 13.00%

PPP: DBFO payments from PLN to DBFO contractor.

Tax of the public sector includes 10% VAT for DBFO payment.

20.4.3 CONCLUSION OF BUSINESS SCHEME AND FINANCING PLAN

The financial analysis finally concludes that:

- The Masang-2 Hydropower Project should be developed and operated by PLN, as the executing agency of the public sector.

- The financing source for the Masang-2 Hydropower Project should be of affordable loan conditions that are possible from the bilateral funding agencies like JICA or multilateral development banks such as ADB and WBG.

CHAPTER 21 ENVIRONMENTAL STUDY

21.1 GENERAL

The environment study for Masang-2 was conducted for the selected project in the Chapter 9 as the subject for Pre-feasibility study. The environment study was conducted for advancement of the design accuracy of Pre-feasibility study. The study was carried out to identify if there is no "irreversible environmental negative impact "through field observations, literacy reviews and interviews to the related people.

The definition of "irreversible environmental negative impacts" is considered as follows;

- Unexpected large scale involuntary resettlement will be necessary
- Identification of many endangered species in the condition where any appropriate mitigation measures could not established (ex. "Key species " such as large scale mammals are occurred in the site and their habitat will be destroyed by the project, in addition, they could not find any forest body which has roles for evacuation corridor to another areas）
- Identification of vulnerable group such as indigenous people or minorities who might be affected

The environmental study was conducted based on sub-contract base during middle of October – middle of November. The environmentalists of JST joined the field observation and they gave necessary suggestions to them.

21.2 ENVIORNMENTAL SCOPING

21.2.1 PRELIMINARY FINDINGS FOR MASANG-2

The preliminary findings for Masang-2 based on the field reconnaissance conducted in the process of the selection of priority project site are as follows.

(1) Intake

- No residential houses were identified.
- Forest around the site is designated as “Production Forest”.

Photo 21.2.1 View of the intake point at 1km upstream

(2) Power House

- Forest around the site is designated as “Production Forest”.
- Practice of gathering of forest products such as rubber and fruits by local people was observed in the forest (see below pictures)

Photo 21.2.2 View of the power house point from 2km downstream

Photo 21.2.3Rubber plant

Photo 21.2.4Durian tree

(3) General Comments

- The length of the section of water recession is approximately 6.4km.
- Confirmation for land use and water use at the section of water reession were not conducted.
- In order to construct the power plant at this location, official procedure for alteration of forest function will be necessary.

21.2.2 PRELIMINARY ENVIRONMENTAL SCOPING

Based on the findings during field reconnaissance, the preliminary environmental scoping was conducted. Environmental scoping for Simanggo-2 is shown in Table 21.2.1.

Table 21.2.1 Environmental Scoping for Masang-2

Item	Stage	Rating	Description
Social Environment			
Involuntary Resettlement	P	B-	Involuntary resettlement at the proposed sites of intake and powerhouse site is not expected. There is a possibility of involuntary resettlement due to expand of existing road for access road though its impact is considered as not significant.
Daily life of people in surrounding areas	C	C	Some temporal impact is expected on the people in surrounding area due to noise and vibration caused by the construction activities. On the other hand, positive impact such as improvement of convenience due to expansion of road is expected. However, impact to local people on their water use and land use is unknown at this stage.
Local economy such as employment and livelihood, etc.	C	C	Employment opportunity might be increased due to the project implementation, and improvement of transportation condition will be improved due to arrangement of access road. On the other hand, there might be some negative impact to local economy due to land acquisition of agricultural land by project implementation.
Land Use	C,O	C	The water intake and power house of the Project will not disturb existing

			land use. However, the present status of land use of the section of water recession (L: approx. 7.8km) was not confirmed.
Physical community division	-	D	Physical community division is not expected due to project implementation including access road construction.
Existing social infrastructures and services	C,O	C	There is no social infrastructure and service at the point of water intake and power house. However, the present status of social infrastructures and services in the section of water recession (L: approx. 7.8km) was not confirmed.
The poor, indigenous and ethnic people	C,P,O	C	It seemed that no ethnic minority lived around the project site. However, further examination on the poor, indigenous and ethnic people through socio-economic study will be necessary.
Misdistribution of benefit and damage	-	D	Misdistribution of benefit and damage is not expected.
Local conflict of interests	-	D	Local conflict of interests due to project implementation is not expected.
Water Usage or Water Rights and Rights of Common		C	Water use of Shimango River could not be confirmed in the field survey. So, further confirmation is necessary.
Sanitation	C	B-	Some negative impacts on the local sanitary condition are expected, due to the mobilization of construction work force and/ or workers' site camps, although the expected impacts will be temporary during the construction stage.
Hazards (Risk), Infectious diseases	C	B-	Increment of risks are probably expected on infectious diseases among the construction work force and/ or in the workers' site camps, although the risk increment will be temporary during the construction stage.
Cultural Heritage	-	D	Cultural heritage is not located in/near the project site.
Natural Environment			
Topography and Geographical features	-	D	Topographical condition is stable, and therefore negative impact to topography and geographical features is not expected.
Soil Erosion	C	B-	There is a risk of soil erosion due to cutting and embankment.
Groundwater	C,O	B-	There is a risk of recession of groundwater level due to construction of tunnels.
Hydrological situation		B-	It is expected that the project component or activity might cause some change or impacts on hydrological conditions in and around the Project area.
Coastal Zone	-	D	There is no impact to coastal zone.
Flora, Fauna and Biodiversity	C,O	C	According to IUCN classification, there are some possibilities of occurring of endangered species in and around the Project area. In addition, there is a possibility that generation of water recession section might affect aquatic environment though its impact level is unknown at the current study level. Therefore, further confirmation is necessary.
Meteorology	-	D	It is not expected that the Project will cause the significant change on the regional meteorological condition.
Landscape	C,O	B-	Landscape will be changed in a certain extent due to construction of necessary facility and transmission line.
Global Warming	C	B-	Probability of increment of GHG emission is expected due to the operation of heavy vehicles as well as traffic jam incidental to the construction works at the construction stage. As for the operation stage, increment of GHG emission would be expected related to operation and maintenance works of facilities though its impact would not be serious.
Pollution			
Air Pollution	C	B-	Some negative impacts on air quality are expected due to operation of heavy equipment/ vehicles as well as traffic jam incidental to construction works, although the expected impacts will be temporary during the construction stage.
Water Pollution	C	B-	There is a risk of temporal water pollution due to excavation and cutting as well as wastewater discharge from worker's camp during construction. In

			addition, water pollution due to generation of water recession section might be occurred at the operation stage.
Soil Contamination	-	D	Soil contamination due to project implementation is not expected.
Waste	C	B-	There is a possibility that the construction work generates the construction waste in the construction stage.
Noise and Vibration	C	B-	Temporal impact of noise and vibration during construction are expected.
Ground Subsidence	-	D	There is no activity which causes ground subsidence.
Offensive Odor	-	D	There are no project components or activities which may cause the offensive odor.
Bottom Sediment	C	B-	Although there is no activity to generate some impact to bottom sediment, there might be some risk to downstream area due to flushing bottom sediment.
Accidents	C	B-	There is a risk of accidents during construction work and transportation of heavy vehicles.

Project Stage
P: Planning C: Construction O: Operation

Legend of Evaluation
A-: Serious impact is expected. A+: Positive effect is expected.
B-: Some impact is expected. B+: Positive effect is expected to a certain extent.
C-: Extent of impact is unknown. Further examination would be necessary. Impact may become clear as study progresses.
D: No or negligible impact is expected. Further examination is unnecessary in EIA study.
Source: JICA Study Team

21.3 ENVIRONMENTAL STUDY

21.3.1 STUDY ITEMS

The study items were as follows. The confirmation of the present conditions was conducted focusing on those items which were evaluated as “B” or “C” in the environmental scoping.

(1) Social Environment

1) Socio-economic condition
2) Land use
3) Water use
4) Groundwater use
5) Consciousness of the project

(2) Natural Environment

1) Confirmation of flora and fauna
2) Confirmation of forest classification

Items such as sanitation, infectious diseases, landscape, and global warming are excluded from the study items, although evaluated as “B” or “C”. These items shall be examined in further stage of EIA.

21.3.2 METHDOLOGIES AND SUBJECT AREAS

(1) Methodologies

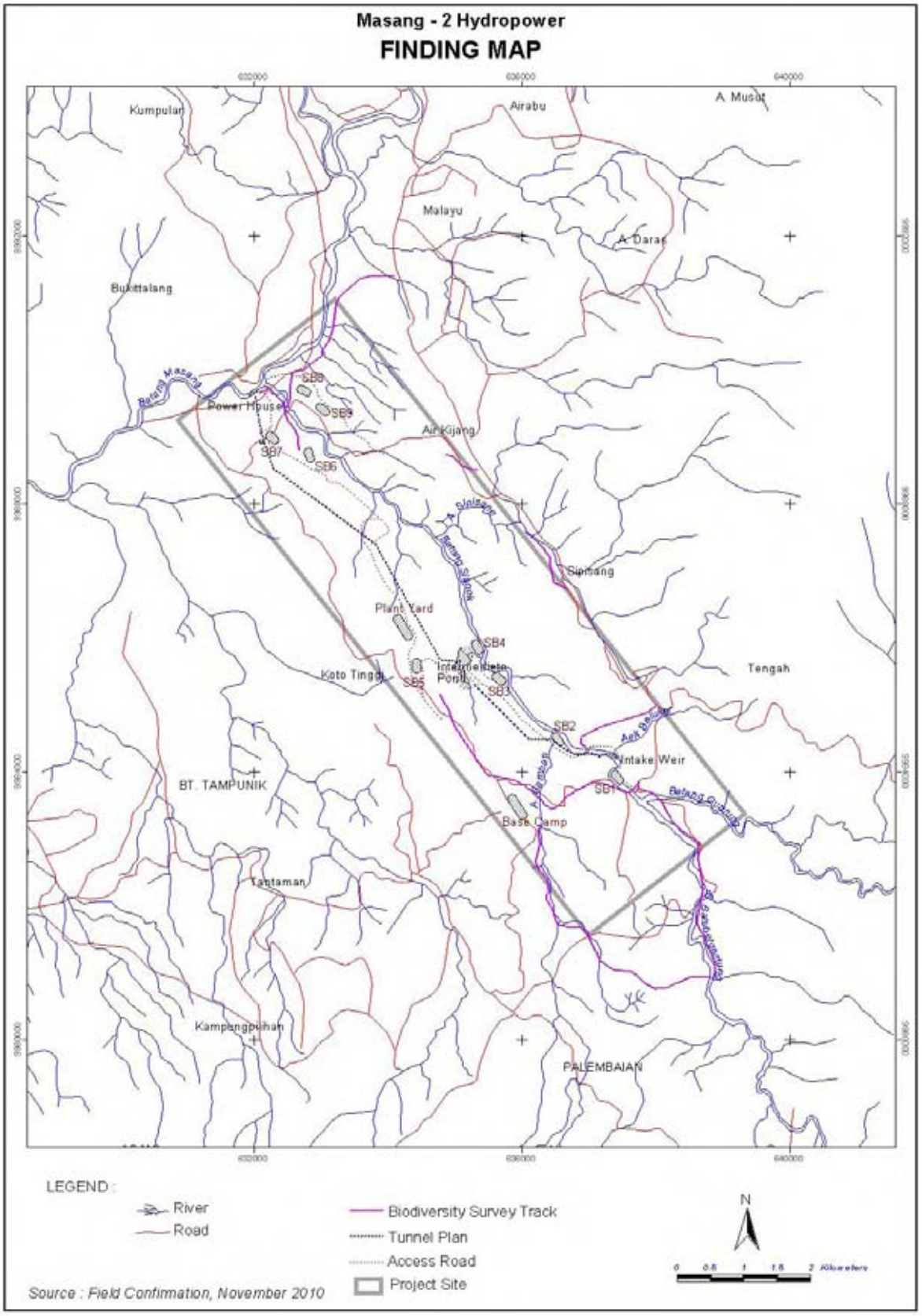
1) Social environment

Water and land use along the Masang river and its branches were observed by visual check in case that accessibility to the site was confirmed. In the case of difficult accessibility to the site, interview to local people was conducted to confirm the area. The same method was applied for the confirmation of land use and possibility of household relocation at the candidate area of permanent and temporal facilities. As for confirmation of prospects of the project, interview to the limited local people such as village leaders and key persons in a village as the representative of villagers was conducted by considering current study level and custom.

2) Natural Environment

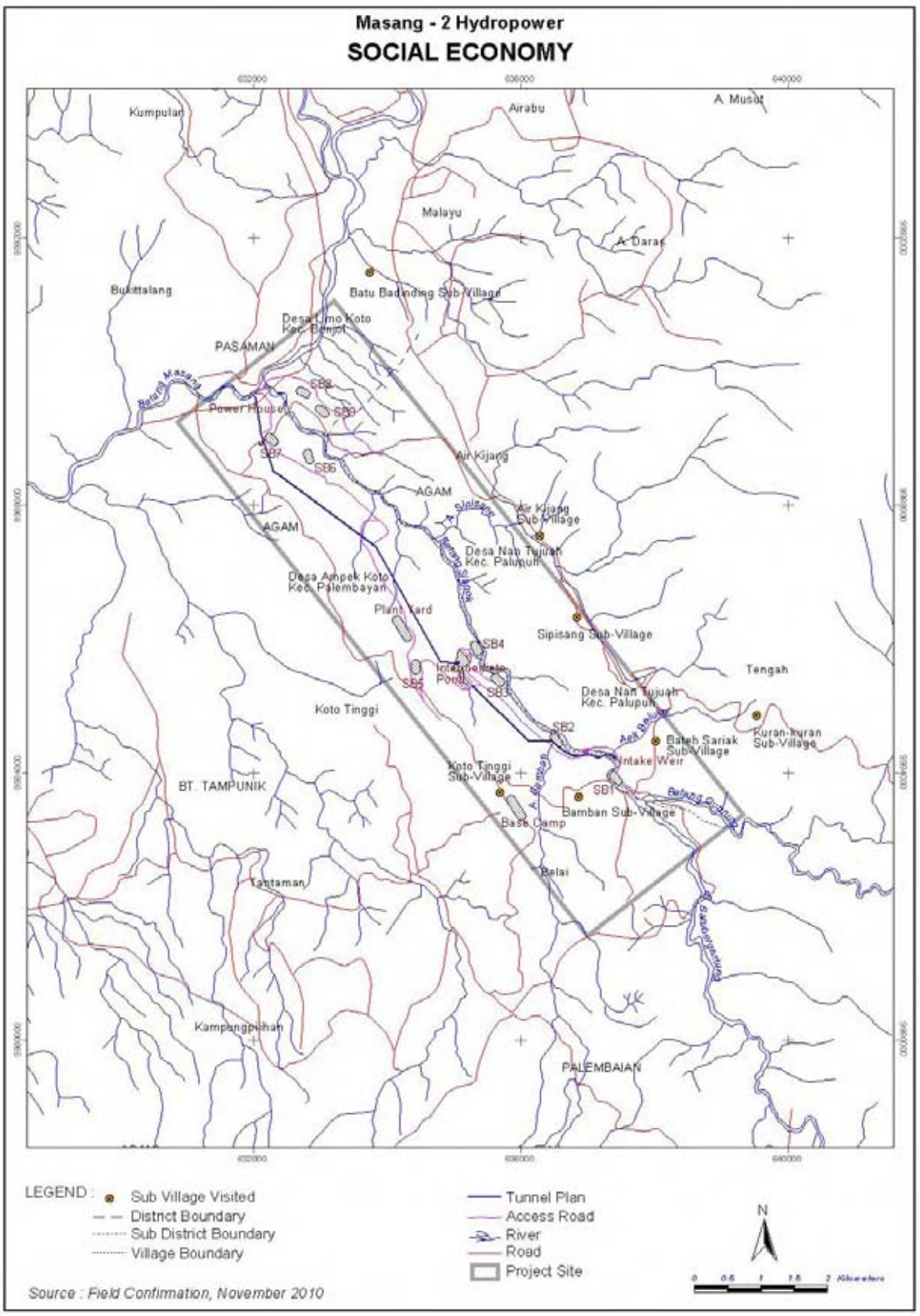
Based on the observation route which was examined in advance, the field observation was conducted. The flora and fauna was observed by basically by sight. Fauna were examined by the books of references also. In addition, interviews to local people were conducted to add information for present condition of flora and fauna. Several samples for flora were taken back to Jakarta to confirm the species accurately.

The subject area for the study is shown in the Figure 21.3.1.



Source: JICA Study Team

Figure 21.3.1 Study Area and Observation Route



Source: JICA Study Team

Figure 21.3.2 Villages Visited during Site Confirmation

21.3.3 THE RESULTS OF THE SYUDY

(1) Social Environment

1) Present condition of the socio-economic

Masang-2 project site stretches over three villages at three districts in Agam and Pasaman Regencies of West Sumatra Province as described in the Table 21.3.1.

Table 21.3.1 Location of the Project Area

Province	West Sumatra		
Regency	Agam		Pasaman
District	Palembayan	Palupuh	Bonjol

Source: JICA Study Team

Administrative information at each village is shown in the Table 21.3.2

Table 21.3.2 Administrative Information at Each Village in the Project Area

No	Items	Villages		
		Ampek Koto	**Nan Tujuah**	**Limo Koto**
1	Regency	Agam	Agam	Pasaman
2	District	Palembayan	Palupuh	Bonjol
3	Village Area (ha)	8,551	8,509	2,424
4	Number of community	7	13	5
5	Number of Community in Project Area	2	4	1
6	Name of Community	1. Bamban 2. Koto Tinggi	1. Air Kijang 2. Sipisang 3. Bateh Sariak 4. Kuran-kuran	1.Batu Badinding Selatan

Sources: Monographic or Profile of the Nagari, 2009

Demographic information at each village is shown in the Table 21.3.3.

Table 21.3.3 Demographic Information at Each Village in the Project Area

No	Indicator	Name of Villages			Total
		Ampek Koto	**Nan Tujuah**	**Limo Koto**	
1	Number of Population (unit: person)	4,614	5,480	5,317	15,411
	a. Male	2,319	2,787	2,712	7,818
	b. Female	2,295	2,693	2,605	7,593
2	Number of Population by Age Group (unit: person)				
	a. < 15	1,241	1,180	1,712	4,133
	b. 16 - 60	2,664	3,421	3,427	9,512
	c. > 60	709	879	178	1,766
3	Number of Household	1,229	1,328	1,193	3,750
4	Demography Indicators				**Average**
	a. Population Density (man/km^2)	53.96	64.40	219.35	112.57
	b. Number of Household Member	3.75	4.13	4.46	4.11
	c. Dependency Ratio (%)	73.20	60.19	55.15	62.85

Source: Monographic or Profile of the Nagari, 2009

2) Ethnic Distribution and Religion

The ethnic majority group at the project area is Minankabau. Java and Batak ethnics are

considered as minority groups in this area. The local authorities protect the right of minority group, and communication among communities is based on the rule called "*Adat Basandi Sarak, Sarak Basandi Kitabullah*" which is compiled of traditional and religious norms. Thus, it is found from the interview at the site that conflict among different ethnics or religions was not occurred. Muslim is the dominant religion in this area following small number of Christians, approximately 0.5%.

3) Administrative Structure

The small administrative unit in West Sumatra is a village called *Nagar*. There is a sub-village called *Jorong* under a village, and four or five *Jorongs* composes a village. At each *Jorong*, there is a leader called *Datuk*. Each village in the project area has a same structure, one village leader who is selected by villagers and appointed by local authorities. A village leader has a role to provide administrative service to villagers. In addition, there are several informal leaders such as religious leader, ethnic leader, society leader, women leader, etc.

4) Economic Activity

The major economic activity in the project area is agriculture mainly rice cultivation and plantation, which are main income source of local people. In addition, livestock farming is held for their additional income. The average income at the project area is calculated Rp.3,567,000/month/household in Ampek Koto village, Rp. 2,113,000/month/household in Nan Tujuah village, and Rp. 3,642,000/month/household in Limo Koto village, based on the statistic data in Monographic or Profile of the Nagari, 2009. In addition to the statistic data, it was observed from the interview to village leaders and key persons as well as visual check of livelihood in a village that economic condition at the study area might be slightly middle to middle level.

5) Cultural Heritage

According to the inventory report of cultural heritage issued by the authority for heritage maintenance at West Sumatra province in 2009, no cultural heritages were recorded in the study area.

6) Public Infrastructure

The area has several public facilited at each village listed in Table 21.3.4. Although relocation of public facility due to project implementation does not occur, there are mosques and elementary schools in the study area especially along or close to the main road in villages.

Table 21.3.4 Public Infrastructure at Each Village in the Project Area

Public Facilities	Name of Villages		
	Ampek Koto	Nan Tujuah	Limo Koto
1. Education			
a. Kindergarten	4	3	2
b. Elementary school	8	7	4

c. Junior high school	1	1	1
d. Senior high school	3	-	1
e. Informal (Moslem School)	1	23	-
2. Health			
a. Local government clinic	1	3	1
b. Unit local government clinic	1	1	-
c. Integrated public service	13	9	10
3. Religion			
a. Mosque	12	13	6
b. Private mosque	32	29	27

Source: Monographic or Profile of the Nagari, 2009

7) Present Condition of Land Use

In the administrative land use classification, the project area stretches over protection forest (*Hutan Lindung*), production forest (*Hutan Produksi*) and outside of forest classification area. Although the classified forest area is defined its land use according to the relevant regulations as mentioned in the Chapter 5, the actual condition of the protected forest in the study area is the mixed forest including plantation and small scale paddy field as shown in the land use map of Figure 21.3.3. Current land use at particular area is shown in the Table 21.3.5.

Table 21.3.5 Current Land Use in the Project Area

Facility Construction Plan	Necessary Area (ha)	Confirmed Land Use	Expected No. of Displaced Household (HH)	Location (village)
Intake	1.5	- Secondary forest - Plantation (sugar palm, candlenut)	0	Ampek Koto
Regulation Pond	9.3	- Paddy field - Mixed forest - Plantation (rubber)	0	Ampek Koto
Powerhouse	3.0	- Secondary forest - Plantation (rubber, durian, sugar palm)	0	Limo Koto
Spoil Bank	19	- Plantation (rubber, durian, cacao) - Secondary forest	0	Limo Koto, Ampek Koto
Office/ Plant	1.8	- secondary forest - plantation (rubber, cacao, candlenut)	0	Ampek Koto
Construction Road	30	- Secondary forest - Plantation - Paddy field	0	Limo Koto, Ampek Koto

Source: JICA Study Team

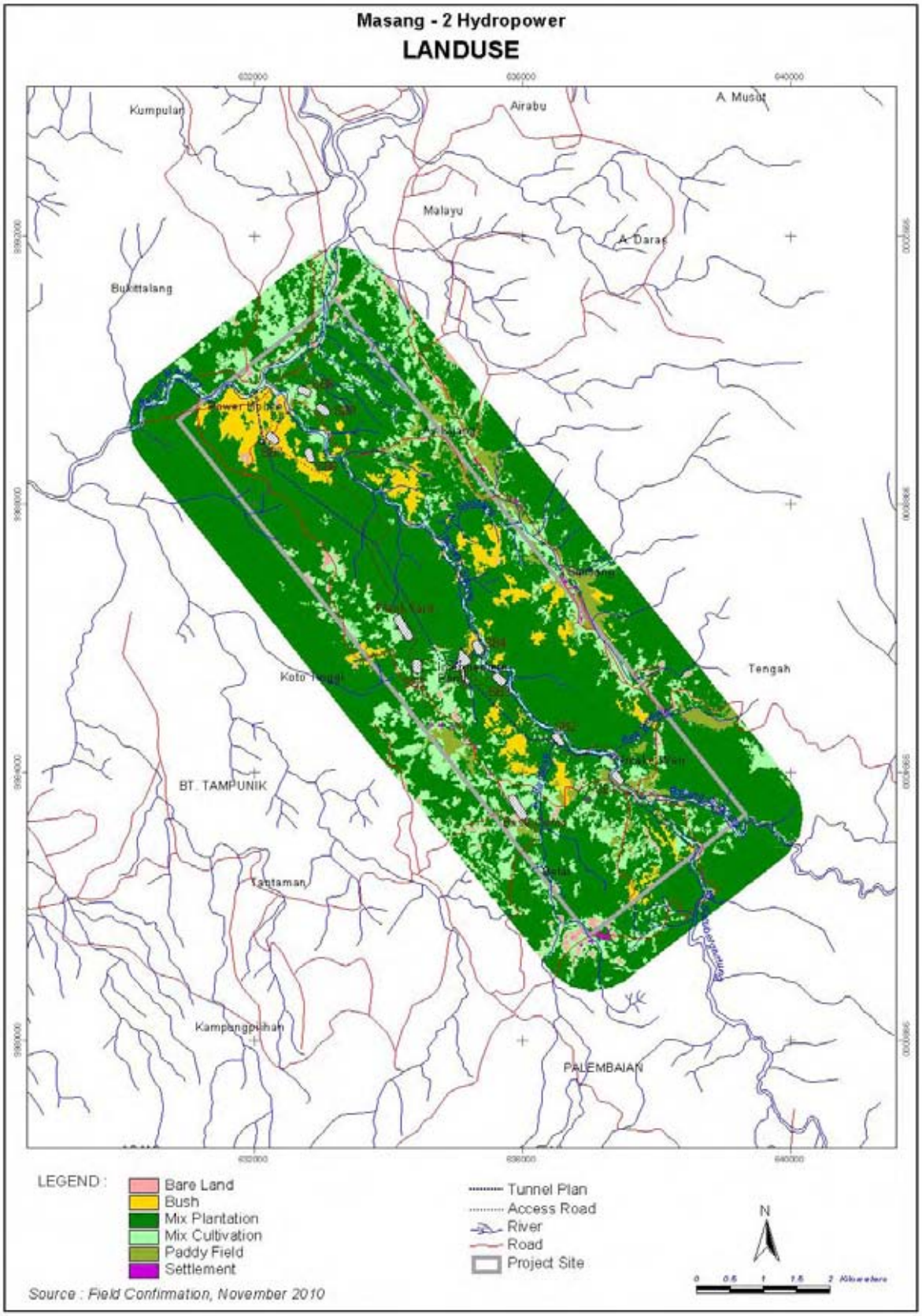


Figure 21.3.3 Land Use

8) Land Ownership

The area defined as protected forest and production forest is generally public land, and local people is the users of such forest. As the actual situation, protected forest and production forest in the study area is recognized as community land (*Tanah Ulayat*; land owned by ethnic group/community) for local people though community land is still regarded as public land. With respect to open area, it is also regarded as *Tanah Ulayat.* A project proponent is requested to obtain approval of land acquisition from all components in a community such as land owner, ethnic leader and community member if land acquisition of *Tanah Ulayat* is necessary for project implementation.

9) Present Condition of Water Use

Water use at Masang river was observed from 3km upstream of the intake area up to 5km downstream of the powerhouse area. Major water use at the observed section was occasional bathing and fishing for domestic consumption. No economic activity such as professional inland fishery or rafting for leisure was confirmed by visual check and interview to local people though some people fishing for daily consumption earned supplemental income from fishing. Furthermore, domestic use such as irrigation or sanitary was not confirmed by same observation method. Water source for drinking water and irrigation was from a mountain (i.e., small branches flowing into the Masang river).

The Masang river has several branches despite of their scale, and all of them were inflow to the Masang river. Among them, five branches were confirmed of their water use. At the upstream section (3km upstream from the intake area), there were two big rivers; Guntung and Batubegantung rivers. Guntung river will be used for micro-hydropower project, which is under construction as of January 2011. Regarding Batubegantung river, it is used for sand mining. Three branches; Bamban river, Belukar river and Sipisang river were checked at the water recession section, and they were used for occasional bathing and fishing for domestic consumption.

10) Present Condition of Groundwater Use

No groundwater use was confirmed.

11) Consciousness of Local People for the Project

Interview with village leaders and key persons were held at each village in the study area. Villages visited and interviewees list during field observation and photos of interview are enclosed in Appendix 2. The following questions were mainly discussed at the interview.

a) Agree/disagree to the project

b) Prospects to the project

c) Water use in the project area

d) Socio-economic condition in a village

f) Particular culture in a village

g) Practices on land acquisition procedure in a village

Opinions obtained from the discussion were summarized below.

- Accessibility to electricity is limited in this area. Thus, it is preferable that the project will provide sufficient electricity to the area.
- It is considered that the project has a potential to provide job opportunities to the local people.
- It is expected that the project will bring secondary economic benefits to local people such as easy access within the area by arrangement of road connection.
- Land acquisition shall follow the local procedure.

12) Summary of Social Environment

- 13.8ha of land in total is necessary for construction of permanent facilities such as intake, regulation pond and powerhouse. In addition, 50.8ha of land in total is necessary for construction of temporal facilities such as spoil bank, office/plant and construction road. Main land use of these area is secondary forest, paddy field and plantation (rubber, durian and cacao). Although land acquisition might be required, involuntary resettlement is not expected.
- There is no typical industry in the study area, and main income source is agriculture (rice cultivation and plantation).
- Professional inland fishery and local people who depended their livelihood on the Masang river were not observed during site confirmation. However, there found some people fishing at Masang river for their domestic consumption, supplemental income and/or pleasure.
- The project will require land acquisition at paddy field and/or plantation. Since necessary land will be small, impact to livelihood of local people would be probably not serious.
- A job opportunity in the study area is not sufficient. Thus, local people expect the project to increase job opportunities in the area and to contribute for improvement of regional economy.
- Local people expect the project to contribute for improvement of transportation condition as well as improvement of livelihood due to easy access within the area accordingly.
- The project will require land acquisition at *Tanah Ulayat*. Explanation to local people as

well as involvement and participation of them to project is necessary.

(2) Natural Environment

1) Present Condition of Flora

Ecosystem types in the area of hydropower development plans Simanggo II can be divided into five types, namely:

a) Primary forest with secondary growth

A small patch of primary forest with secondary growth is found at north of Koto Tinggi. The dominant tree spcies are Lithocarpus sp., Bischofia javanica, Ficus glomerata etc.

Source: JICA Study Team

b) Secondary Forest

The secondary forest was found at the intake site where the phisiographical characterists is undulating. The dominant tree spcies are Durio zibethinus, Hevea brasiliensis, Lithocarpus sp., Bischofia javanica etc.

Source: JICA Study Team

c) Agro-forests

Source: JICA Study Team

This type is a mixture of economically important species of plants with forests vegetation. The fruit spces such as Durio zibethinus, Garcinia mangostana, Artocarpus heterophylla, Lansium domesticum, Syzygium aqueu, Cocos nucifera are cultivating in the forest consisitng of trees such as Hevea brasiliensis, Areca catechu, Theobroma cacao, Aleurites moluccana, Pangium edule, Cinnamomum burmannii, Syzygium aromaticum, *Toona sureni*, *Arenga pinnata* etc.

d) Mix Cultivation and garden

Source: JICA Study Team

This type consists of paddy fields cultivating rice (Oryza sativa) in flat or terraced land with mix cultivation of Elettaria cardamomum, Cymbopogon nardus, eggplant, chili, beans, Theobroma cacao, Cocos nucifera, Aleurites moluccana, Areca catechu, Saccharum officinarum etc.

e) Open Land & Shrubs-grove

This type consists of Imperata cylindrica and shurubs.

Source: JICA Study Team

Number of vegetation species found in the study sites is 164 species (refer to 21.1 in

Appendix 2). Note that no species included in the category of “endangered” or “vulnerable” according to IUCN were identified.

2) Present Condition of Fauna

The total number of species of fauna including mammals, birds, reptiles, and amphibians found at the sites were 110 species. (refer to 21.2-5 in Appendix 2)

a) Mammals

7 species of wildlife mammals were directly found including the footprint and 11 species were confirmed through interviews to local people.

Out of the 7 species identified directly, the following three(3) species are included in the category of endangered according to IUCN.

Footprint of Tapirus indicus

Source: JICA Study Team

- Presbytis melalophos
- Hylobates agilis
- Tapirus indicus

The following two species are included in the category of vulnerable according to IUCN.

Source: JICA Study Team

- Macaca nemestrina
- Macaca fascicularis

b) Birds

The number of bird species found is 43 species. In aadtion, 28 species were identified through inteview to local pepol. Note that no species included in the category of "endangered" or "vulnerable" according to IUCN were identified.


Alcedo menintin


Lonchura striata

Source: JICA Study Team

c) HerpeTofauna

The number of herpetofauna species of wildlife found with mainly secondary data and interview to local people is 20 species. Note that no species included in the category of "endangered" or "vulnerable" according to IUCN were identified.

d) Freshwater Fishes

The common fish species found in running water of Masang River is fish species belongs to the family Cyprinidae and Gobiidae that correlation to its conditions of swift-flowing river waters and rocky bottom, where conditions such as these waters are preferred by the fish belong to the family of Cyprinidae and Gobiidae.

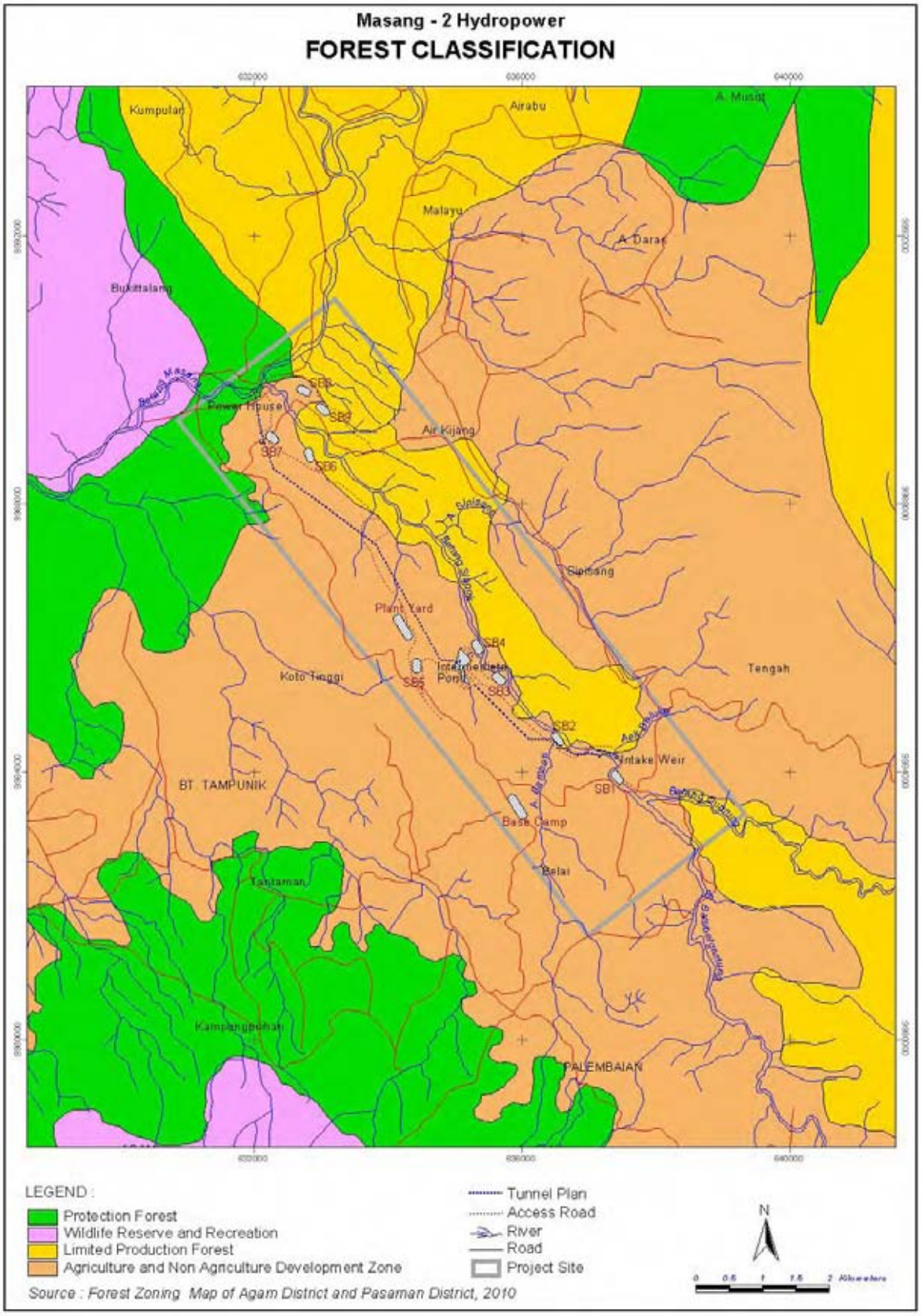

Osteochilus vittatus

Source: JICA Study Team

According to the secondary data based on the interview to local people, the fish species could be found in the Simanggo River are shown in 21.5 in Appendix 2. Those species include the species for fish culture or selling at the local market such as Cyrinus carpio, Oreochromis mossambicus, Oreochromis niloticus, Puntius binotatus, Osteochilus vittatus、Clarias batrachus etc. Note that catching the Osteochilus vittatus is systematically controlled through setting the prohibition period of fishing from the viewpoint of natural resource preservation.

3) Forest Classification

Forest classification for the study area is as shown in the Figure 21.3.4. This figure indicates that the intake point is inside of limited production forest and the power house site is located inside of protected forest.



Source: JICA Study Team

Figure 21.3.4 Forest Classification

21.3.4 EXAMINATION OF THE ALTERNATIVES

The basic concept of this study is to take environmental consideration into account for project planning in order to reduce environmental and social risks from the early stage of project planning at technically and economically feasible level. The following issues were mainly discussed in the course of layout designing.

- Location of permanent and temporal facilities shall be designed to avoid protection forest, residential area and irrigation area.
- Route of construction road shall be designed to avoid residential and irrigation area.
- The route of transmission line shall be planned to avoid protection forest.

The comparison between Alternative A, B and C on environmental and social aspects was made qualitatively based on map study and field confirmation. The following findings were incorporated into the engineering design.

Table 21.3.6 Comparison among Three Alternatives of Intake Area

Alternative A	Alternative B	Alternative C
- The intake area is in the non-forest area. - The intake area is covered with the paddy field at both banks, and therefore, the largest area of paddy field might be necessary to be acquired in three alternatives. - There is no residential area.	- The intake area is in the non-forest area. - Left side bank of intake area is covered with the paddy field, and right side bank is mixed forest with scattered plantation. - There is no residential area.	- The intake area was in the non-forest area. - The intake area was in the mixed forest area including scattered plantation. - There is no residential area.

Source: JICA Study Team

Natural environmental aspects at three plans are same since all of plans locate in the same area. Considering social environmental aspects, Alternative A might cause much impact compared with other two alternatives since it might require acquisition at the largest area of paddy field in three alternatives. Based on the examination, it is considered that Alternative C is less environmental impact among the three plans.

21.3.5 DISCUSSION

(1) Procedure of Land Acquisition

There was a mini-hydro power project close to the Masang-2 project area. Land acquisition was smoothly conducted in this project due to following to the local procedure and involving local people. Since the project locates in the *Tanah Ulayat*, sufficient socialization before going to the field study is indispensable as the next step.

(2) Confirmation of Household Socio-Economic Condition

The project will require land acquisition at paddy field and plantation though necessary area is considered as small. Although acquired area is expected as small, it may cause a loss or reduce of livelihood means for local people. Same as land acquisition, the project also has a possibility to affect socio-economic and nutritional condition to those who obtain supplemental income and nutrition from fishes they caught due to generation of water recession section by project implementation though impact is considered as not significant based on the site confirmation and interview to key persons.

In order to examine appropriate compensation and necessary assistance for livelihood stabilization, impact caused by the project is necessary to be understood. For this purpose, detailed examination of socio-economic and nutritional condition of local people in the project area including confirmation of income source and property loss shall be done.

(3) Flora/Fauna

The following species of fauna which categorized as endangered or vulnerable its conservation status according to IUCN were found in the study at surround area of the site of Masang-II.

Fauna：”Endangered” 3species of Mammal (Presbytis melalophos, Hylobates agilis, Tapirus indicus)

“Vulnerable”2species of Mammal（Macaca fascicularis, Macaca nemestrina,）

Regarding for identified endangered or vulnerable fauna species, the habitat characteristics of those species are as shown below.

Table 21.3.7 Habitat Characteristics of Endangered Fauna Species

Species	habitat characteristics
Presbytis melalophos	They inhabit lowland and submontane dipterocarp and evergreen forests. They are also found on the margins of rivers. They prefer understory at approximately ninety feet from the ground.
Hylobates agilis	They predominantly live arboreally in rain forests and rarely come to the ground.
Tapirus indicus	Dense tropical lowland rainforest in the Indochinese peninsula.
Macaca fascicularis	Macaca fascicularis is found in a wide variety of habitats, including primary lowland rainforests, disturbed and secondary rainforests, and riverine and coastal forests of nipa palm and mangrove. They also easily adjust to human settlements. While a pest when around farms and villages.
Macaca nemestrina,	Macaca nemestrina, omnivorous macaque, is mostly found in forest, but will

	also enter plantations and gardens.

Source: JICA Study Team

As shown the above, the all species greatly rely on the existence of forest. Therefore, it is considered as effective mitigation measure to conserve the existing forest as much as possible. In order to minimize the negative impact caused by the project the following mitigation measures are proposed.

- Restrict land clearing for the project , according to the minimum need
- Not interrupt the series of forest distribution to ensure the corridor for movement of fauna species
- Restrict and manage the use and control of access roads, to prevent logging and poaching
- Conduct reforestation on degraded forest areas in the vicinity of the location of Hydroelectric Power
- Implement local community empowerment program to prevent the extraction of forest surrounding the hydropower and water conservation in the upstream catchment area

(4) Amount of Stream Flow for Maintenance

The amount of stream flow for maintenance has been decided as approximately 0.39 m^3/s in this Pre-FS. The length of water recession section of Masang II is approximately 8km. Given that the tributary will be joined to Masang River at just downstream of intake point and the additional tributary will be joined at approximately 1km downstream of the river joint, substantial amount river water will be inflow to the water recession section of the Simanggo River. Therefore, the drawing river water at the intake will not cause serious negative impact on river environment. It has been already confirmed that there is no water use by irrigation and local people for dairy use in the water recession section in the environmental study.

Maximum plant discharge	: 32.0 m^3/s
River discharge	: 17.71m^3/s in average、 10.05m^3/s at 95% probability
Flow for maintenance	: 0.39 m^3/s from intake weir
Water recession section	: 8km in total, confluence with AlahanPanjang River at u/s of P/H

(5) Procedures for Forest Use

As mentioned already, the project components are located inside limited production forest and protected forest. The following procedures for the forest use should be taken to use for development infrastructure which not related with forestry activities.

1) Forest Use

The use of forest areas to development infrastructure which not related with forestry activities can only be done in the area of production forest and protected forest areas (Act No. 41 of 1999 Regarding Forestry). This means the conservation forest could be used only for forestry activities.

The Government Regulation (No. 24/2010) stipulates the use of forest areas to development infrastructure which not related with forestry activities. The development infrastructure includes

installation of generators, transmission, and distribution of electricity, as well as new and renewable energy technologies.

2) Procedures for Forest Use

The use of forest areas is based on forest use permit approval by Ministry of Forestry. The application should be submitted by following person.

a. ministers or ministerial-level officials;
b. governor;
c. regent / mayor;
d. leadership of a business entity; or
e. chairman of the foundation

In the case of this Project, MEMR will be applicant for the forest use. Given that the procedures of Ministry of Forestry will be take rather long time, it will be recommended to start the necessary actions as early as possible.

(6) Fluctuation of Water Level at Downstream of Powerhouse

Water level fluctuation at peak/off-peak power generation will occur at downstream of the powerhouse. It is confirmed in this study that there exists no irrigation intake within 5km distance downstream from the powerhouse. As a rather big river (Rembe River) joins with the Simanggo River at the water recession section, it is anticipated that the environmental impact due to water level fluctuation will not be serious. However, necessity of warning siren shall be examined in the further stage of the study.

21.3.6 CONCLUSION AND RECOMMNEDATIONS

(1) Necessary Items to be Studied for Preparation of LARAP

Based on the result of the site confirmation, project implementation might require 64.6ha of land acquisition in total (13.3ha for permanent facilities construction and 50.8ha for temporal facilitates construction) though involuntary resettlement is not expected. Accordingly, it was concluded that there is no “irreversible environmental negative impacts” to social environment caused by project implementation. Information obtained at the site in the Pre-Feasibility Study is very much limited, and therefore further examination and considerations to the items described below are requested at the next study stage such as feasibility study.

1) Conducting Detailed Household Survey

It was identified at Pre-Feasibility study that involuntary resettlement due to project implementation might not be caused. However, there might be some negative impact to livelihood stabilization due to acquisition of cultivated area or generation of water recession section. Thus,

impact level is necessary to be confirmed in detail. For this purpose, it is recommended to conduct detailed household survey described below as the first step to understand impact due to project implementation as well as baseline information to prepare LARAP;

i) Population census for confirmation of project affected persons

ii) Inventory of loss survey for confirmation of property loss due to project implementation, and

iii) Socio-economic survey to all project affected persons for understanding socio-economic condition (this survey includes confirmation of monthly/annual income, income source, nutrition source, fishing condition and frequency, confirmation of prospects to the project)

Land acquisition might be requested though involuntary resettlement will not be expected at the pre-Feasibility Study. It brings a possibility that socially vulnerable group such as ethnic minority groups will be the target of land acquisition. Thus, confirmation of property ownership and use by socially vulnerable groups at the time of inventory loss survey and socio-economic survey is indispensable. When expected loss might be identified by conducting these surveys, compensation policy including livelihood rehabilitation program is necessary to be examined carefully. In addition, cut-off[1] date is better to be established at the time of census begins in order to prevent influx of illegal squatters into the project area.

2) Preparation of LARAP

In the case of Japanese ODA project, preparation and disclosure of Resettlement Action Plan (RAP) is necessary if a project requires land acquisition and/or involuntary resettlement in large scale. In the course of preparation of RAP, consultation with PAPs on project description including expected magnitude due to project implementation and compensation policies shall be made in timely manner.

As for Masang-2 project, PLN as the project proponent is requested to prepare Land Acquisition and Resettlement Action Plan (LARAP)[2] if it is realized by Japanese ODA. PLN has experience to prepare LARAP for donor funding projects as described in Chapter 8. Thus, PLN is considered as capable of preparing LARAP by considering JICA guidelines (April, 2010) and World Bank Safeguard Policy OP4.12[3] as well as reflecting consultation result with PAPs if the final layout of Masang-2 requires land acquisition and/or involuntary resettlement. Necessary items to be studied in LARAP are outlined in the Table 21.3.8.

[1] OP4.12 states “Normally, this cut-off date is the date census begins. The cut-off date could also be the date the project area was delineated, prior to the census, provided that there has been an effective public dissemination of information on the area delineated, and systematic and continuous dissemination subsequent to the delineation to prevent further population influx”

[2] LARAP is generally prepared in the case of donor funding projects in Indonesia.

[3] The concept of land acquisition and resettlement in JICA Guidelines (April 2010) applies for the idea of World Bank Safeguard Policy OP4.12. Thus, a project requesting land acquisition and/or resettlement and supported by Japanese ODA is requested to prepare necessary documents to satisfy both of JICA Guidelines and OP4.12.

Table 21.3.8 Necessary Items to be Described in LARAP

Item	Contents to be Described
1. Description of the Project	General description of the project and identification of the project area
2. Potential Impact	Identification of potential impacts and establishment of minimizing potential impact
3. Objectives	Objectives to prepare LARAP
4. Socio-Economic Studies	Description of results about census survey and socio-economic survey
5. Legal Framework	Description of relevant regulations and gaps between national regulations and donor policies
6. Institutional Framework	Findings of analysis of the institutional framework to implement land acquisition and resettlement
7. Eligibility	Definition of displaced persons and criteria for determining their eligibility for compensation and other assistance including cut-off dates
8. Valuation of and Compensation for Losses	Methodology to be used in valuing losses to determine their replacement costs, and description supplementary measures to achieve replacement cost if compensation under national law does not meet replacement cost
9. Resettlement Measures	Description of compensation and other resettlement measures
10. Site Selection, Site Preparation, and Relocation(*1)	Preparation of site for relocation if relocation of household is occurred.
11. Housing, Infrastructure, and Social Service(*1)	Description of plans to provide necessary infrastructure and social service at the new site if necessary
12. Environmental Protection and Management(*1)	Examination of environmental assessment and environmental management plan for the new site
13. Community Participation	Strategies of community participation from planning to implementation of resettlement
14. Integration with Host Population	Measures to mitigate the impact to resettlement on any host communities
15. Grievance Procedures	Accessible procedures and mechanism for third-party settlement of disputes arising from resettlement
16. Organizational Responsibility	Organizational framework for implementing resettlement
17. Implementation Schedule	Implementation schedule covering all resettlement activities from preparation through implementation
18. Costs and Budget	Estimated cost for all resettlement activities
19. Monitoring and Evaluation	Arrangements for monitoring of resettlement activities by the implementing agencies supplemented by independent monitors

Remark: Items marked in *1 are necessary to be examined if relocation and site preparation are necessary.
Source: JICA Study Team based on World Bank OP4.12 Annex A

The draft scope of works for preparation of LARAP which is prepared based on available information at the current study level is enclosed at the Appendix 2 just for referential information though further examination of each work item is necessary at the next study stage.

(2) Necessary Items to be Studied at AMDAL

It was concluded that there is no “irreversible environmental negative impacts” in the stage of Pre-Feasibility Study for the project based on the environmental study. However, the following items should be considered at next step (AMDAL in Feasibility Study for the Project).

1) Detailed field survey for flora and fauna

Five (5) fauna species which categorized as endangered or vulnerable according to IUCN were identified through the environmental study. There are certain possibilities that the number of those rare species will be increased with more detailed field survey for flora and fauna.

The additional field survey will be necessary to prepare appropriate environmental mitigation

measures against the environmental impact in both construction and operation stages.

Attention shall be paid not only to the rare species, but also the species that are treated as resources for living of the local inhabitants.

2) Detailed Study on Aquatic Environment

It will be necessary to grasp project impact caused by change of the water level in the "water recession section" on aquatic fauna in detail. In addition, actual condition of inland fisheries by local people should be also confirmed in detail.

3) Stake Holders Meeting

The limited interviews to specific persons such as village chiefs were conducted to absorb their preliminary opinions to the project in the environmental study. It is anticipated, however, that opinions of the local people may be variant if their position are different.

Therefore, it is essential that the stake holders meeting with local people from various positions shall be held to obtain their different opinions to the project properly in the stage of Feasibility Study. Local people shall be invited not only from within the project site, but also from the outside but affected by the project, such as downstream of the powerhouse or beneficiary area of power distribution.

PART IV CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 22 CONCLUSIONS AND RECOMMENDATIONS

22.1 MASTER PLAN STUDY

22.1.1 CONCLUSIONS (M/P)

While hydropower development has been stalling in recent years, the Government has advocated ambitious targets for hydropower development. In this background, keeping the the hydro potential and the electricity demand in mind, three development scenarios, i.e. Policy Oriented Scenario, Realistic Scenario and Zero Option were examined.

Each scenario has advantages and disadvantages derived from the characteristics of hydropower generation, and it is difficult to weigh such advantages and disadvantages in a balance. In this background, realistic scenario is well-balanced, and remarkably the number of involuntary resettlement, the number of projects violating protected area, which are selected as screening criteria in this study, are well managed unproportional to the amount of hydro development, while other items are almost proportional to them. Consequently, we took realistic scenario as the recommendable scenario as seen in below.

Hydro development in Realistic Scenario to 2027

Region	Total			
	Loc	Capacity (MW)	Energy (GWh)	Capital Cost (mil. $)
Sumatra	44	3,548	14,222	7,510
Kalimantan	2	366	2,478	935
Sulawesi	16	3,137	13,232	5,662
Maluku	4	156	872	342
Papua	1	49	248	154
Nusa Tenggara	1	11	59	33
Java-Bali	6	773	2,081	1,435
Total	**74**	**8,040**	**33,193**	**16,070**

22.1.2 RECOMMENDATIONS (M/P)

(1) Public vs. Private

Capacity of the public investment in hydropower development is not enough. Accordingly, private

investment in hydropower needs be maximized.

Hydropower projects that expect high return shall be developed by private investors, so that public budgets can be saved. A return on equity (ROE) can be an indicator to which extent the in-question hydropower is profitable. If ROE is 18% or greater, it may be good enough for private investors to develop the in-question hydropower as an IPP. If the project economy is less, such project shall be implemented by PPP or ODA basis.

For a hydropower IPP, an electricity tariff should be set to a level such that a private investor can expect reasonable return from it. The reasonable tariff level can be estimated to be the average generation cost by PLN in the area concerned.

(2) Different development plans to a single potential site

PLN, as the public utility company, should place a hydro plant as one of its many elements of the electricity system, while a private investor does it as an investment opportunity. One instance is the fact that PLN needs a peak hydro, which is more expensive than an off-peak hydro but can contribute to stabilizing the electricity system. For example, a 50 MW off-peak hydro can possibly be re-designed to be a 100 MW peak hydro by adding a regulating pond and increasing the machine capacity. Despite a significant difference in capacity, the annual energies expected by the two different hydropower plans are nearly equal, because the in-coming river water never changes. A peak hydro can benefit PLN in the form of the system stabilization, while it can bring less profit to a private investor unless special considerations are paid in a PPA.

The Public Sector should encourage private investors in hydropower development, because the public budget cannot be allocated enough to develop all of hydropower potential in the country. In this context, the private investors should not be pressurized to add a peaking power function in their hydropower development proposals, if such addition does not substantially contribute to the power system. Instead, for the projects which have substantial scale to contribute the system if developed as an peak hydro, best effort should be made to maximize the potential in the hydropower development plans.

(3) Two Regulators

The land and water required for hydro plants are regulated by the local government(s), while the electricity business is regulated by MEMR. A mini hydro proposal may possibly exclude a large hydro potential, if different plans are developed in a same river.

MEMR, as the sole legal regulator of the electricity, should confirm his regulatory power, to which extent it can be exercised. If it is powerful enough not to issue an electricity business license, any private proposals that may enormously hamper the hydropower potential of the country may be rejected. From the regional autonomy policy, however, all of hydropower development plans raised up

through regional governments should be respected maximum.

It is highly recommended that all of hydropower development plans (even if they are for 10 MW or less) should be listed up in the Electricity Supply Plan (RUPTL) prepared by PLN and approved by MEMR, so that both of private investors and regional government can be motivated to have mutual understanding to the hydropower development.

22.2 PRE-FEASIBILITY STUDIES FOR SIMANGGO-2 AND MASANG-2 HEPPS

22.2.1 CONCLUSIONS (PRE-F/S)

The two sets of the pre-feasibility studies have revealed that both the Simanggo-2 and Masang-2 HEPPs are viable from technical, economical, and financial point of view.

Financial Indicators of Simanggo-2 and Masang-2 Hydropower Projects

Analysis Cases	Simanggo-2		Masang-2		
	FIRR	ROI	FIRR	ROI	
0. Base Case	10.7%	24.5%	6.6%	15.0%	the base case
1. +CDM	11.2%	25.5%	7.0%	15.9%	CDM benefit added to the base case
2. –10% Tariff	9.5%	22.0%	5.6%	12.5%	electricity tariff 10% less
3. –10% Energy	9.5%	22.0%	5.6%	12.5%	less annual energy by 10%
4. +10% CAPEX	9.7%	22.5%	5.8%	12.8%	greater cost by 10%
5. COD Delayed by 1 yr	9.9%	21.4%	6.2%	13.4%	commissioning delayed by 1 year

Source: Study Team

It is also concluded that there is no “irreversible environmental negative impacts” identified in this stage. It is therefore recommended that the projects should soon proceed to the further implementation in accordance with the plans and design principles proposed.

Installation of the Simanggo-2 and Masang-2 HEPPs will contribute to the power system in Sumatra by supplying economical and reliable peak power. Furthermore, using the energy generated by these projects instead of other thermal plants can be in line with the national policy to save non-renewable and exportable energy resources.

The Simanggo-2 Hydropower Project should be developed under either a conventional PLN project scheme with the soft loans or a DBFO (Design-Build-Finance-Operate) based hybrid scheme, while the Masang-2 Hydropower Project should be developed as one of the conventional PLN projects.

22.2.2 RECOMMENDATIONS (PRE-F/S)

The proposed implementation programs of the Simanggo-2 and Masang-2 HEPPs indicate that the possible earliest commissioning of the projects will be at the year of 2017.

Considering the lead time up to installation such as financing for the detailed design and construction, engineering services for detailed design, bidding and construction, successful implementation will thus require immediate commencement of an additional survey to supplement and upgrade this pre-feasibility study to the feasibility study level.

Especially for the Simanggo-2 HEPPs, conducting additional geological survey such as core boring is mandatorily required.

Environmental survey in the next stage shall be conducted especially emphasizing the followings.

(1) Necessary Items to be Studied for Preparation of LARAP

It was concluded that there is no significant adverse impact to social environment caused by project implementation from the site confirmation. However, information obtained at the site in the Pre-Feasibility Study is very much limited, and therefore further examination and considerations to the items described below are requested at the next study stage such as feasibility study.

1) Conducting Detailed Household Survey

It was identified at Pre-Feasibility study that involuntary resettlement due to project implementation might not be caused. However, there might be some negative impact to livelihood stabilization due to acquisition of cultivated area or generation of water recession section. Thus, impact level is necessary to be confirmed in detail. For this purpose, it is recommended to conduct detailed household survey described below as the first step to understand impact due to project implementation as well as baseline information to prepare LARAP.

2) Preparation of LARAP

In the case of Japanese ODA project, preparation and disclosure of Resettlement Action Plan (RAP) is necessary if a project requires land acquisition and/or involuntary resettlement in large scale. In the course of preparation of RAP, consultation with PAPs on project description including expected magnitude due to project implementation and compensation policies shall be made in timely manner. PLN has experience to prepare Land Acquisition and Resettlement Action Plan (LARAP) for donor funding projects. Thus, PLN is considered as capable of preparing LARAP by considering JICA guidelines (April, 2010) and World Bank Safeguard Policy OP4.12 as well as reflecting consultation result with PAPs.

(2) Necessary Items to be Studied at AMDAL

It was concluded that there is no "irreversible environmental negative impacts" in the stage of Pre-Feasibility Study for the project based on the environmental study. However, the following items should be considered at next step (AMDAL in Feasibility Study for the Project).

1) Detailed field survey for flora and fauna

Species which categorized as endangered or vulnerable according to IUCN were identified through the environmental study. There are certain possibilities that the number of those rare species will be increased with more detailed field survey for flora and fauna.

The additional field survey will be necessary to prepare appropriate environmental mitigation measures against the environmental impact in both construction and operation stages.

Attention shall be paid not only to the rare species, but also the species that are treated as resources for living of the local inhabitants.

2) Detailed Study on Aquatic Environment

It will be necessary to grasp project impact caused by change of the water level in the "water recession section" on aquatic fauna in detail. In addition, actual condition of inland fisheries by local people should be also confirmed in detail.

3) Stake Holders Meeting

The limited interviews to specific persons such as village chiefs were conducted to absorb their preliminary opinions to the project in the environmental study. It is anticipated, however, that opinions of the local people may be variant if their position are different.

Therefore, it is essential that the stake holders meeting with local people from various positions shall be held to obtain their different opinions to the project properly in the stage of Feasibility Study. Local people shall be invited not only from within the project site, but also from the outside but affected by the project, such as downstream of the powerhouse or beneficiary area of power distribution.

CHAPTER 23 RECORDS OF STUDY PROCESS

23.1 SUBLETTING WORKS

23.1.1 GENERAL

The Study Team entered into contract with PT. Connusa Energindo, a local Indonesian firm, to conduct Topographic, Geological, Hydrological and Environmental Surveys for Pre-Feasibility Studies of Simanggo-2 and Masang-2 HEPPs on 2nd September, 2010. All the survey activities by the firm completed on 18th February, 2011.

23.1.2 TOPOGRAPHIC SURVEY

With usage of the existing aerial photograph, digital maps with scales 1:10,000 were produced by a local contract. In addition, terrestrial map by spot survey with a scale of 1:2,000, and river profile and cross section survey were conducted. Final quantities of the survey were as follows.

Table 23.1.1Study Items at Subletting Works (Topographic Survey)

Items	Simanggo-2	Masang-2
Photogrammetry to prepare 1/10,000 topo map	30 km^2	30 km^2
Terrestrial map by spot survey with 1/2000 scale	2.5 km^2	4.0 km^2
River cross section survey	10 km	10 km

23.1.3 GEOLOGICAL SURVEY

Geological survey, such as geological mapping based on field survey, seismic exploration, core drilling, standard penetration test, permeability test, provision of boring core storage, laboratory tests for foundation rock and concrete aggregates, were conducted by a local contract. Final quantities of the survey were as follows.

Table 23.1.2Study Items at Subletting Works (Geological Survey)

Items	Simanggo-2	Masang-2
Geological mapping based on field survey	25 km^2	25 km^2
Seismic exploration	7.44 km	6.92 km
Core drilling	0 m	460 m
Standard penetration test	0 times	35 times
Permeability test	0 times	92 times
Boring core storage	0 nos.	1 nos.
Laboratory test for foundation rock	0 samples	10 samples
Laboratory test for concrete aggregate	10 samples	10 samples

23.1.4 HYDROLOGICAL SURVEY

Hydrological survey which consists of staff gauge installation, water level observation, streamflow measurement, suspended load testing, riverbed material survey, and water quality test were be conducted by a local contract. Final quantities of the survey were as follow.

Table 23.1.3Study Items at Subletting Works (Hydrological Survey)

Items	Simanggo-2	Masang-2
Installation of water level staff gauge	1 nos.	1 nos.
Water level observation and recording (2 times/day)	3 months	3 months
Stream flow measurement	30 times	30 times
Suspended load sampling and testing	30 times	30 times
Riverbed material survey, with sampling and testing	5 times	5 times
Water quality test	3 times	3 times

23.1.5 ENVIRONMENTAL SURVEY

As described in Chapter 15 and Chapter 21 respectively, the environmental survey at the site was carried out with the two main purposes; i) to confirm a possibility of irreversible environmental negative impact caused by project implementation, and ii) feed-back of environmental findings at the site for advancement of the design accuracy of Pre-feasibility study.

The environmental survey was conducted from 28th October 2010 to 5th November 2010 for Masang-2 site and 19th to 26th November, 2010 for Simanggo-2 site. Both studies were carried out by the local consultant, PT Connusa Energindo, with total six team members consisted of one environmentalist/team leader, one flora expert, one fauna expert, one socio-culture expert, one socio-economic expert and one coordinator respectively. Environmental experts in JICA Study Team joined the environmental study in order to provide instruction as necessary. The items listed in the Table 23.1.4 which were identified as “some impact is expected” or “expect of impact is unknown, and further study is necessary” in the preliminary scoping were studied through field observations, literacy reviews and interviews to the related people as showing in Chapter 15 and Chapter 21 in detail.

Table 23.1.4Study Items at Subletting Works (Environmental Survey)

	Natural Environment	Social Environment
1	Confirmation of flora and fauna condition	Confirmation of socio-economic condition
2	Confirmation of forest classification	Confirmation of land use
		Confirmation of water use
		Confirmation of groundwater use
		Confirmation of consciousness of the project

Source: JICA Study Team

23.2 HYDRO INVENTORY DATABASE UPDATE

23.2.1 INTRODUCTION

The Hydro Inventory Database was developed under the Hydro Inventory and Pre-feasibility Studies (World Bank) in 1999. The purpose of the Hydro Inventory Database development was to store corrected data, information, and analysis result of the Hydro Inventory Study in database. The database is classified into character, numeric information and graphic information. The data items in the Hydro Inventory Database are shown in Table 23.2.1.

The Hydro Inventory Database can have been easily operated by customizing the program. The database software and the customizing language are MapInfo and MapBasic products by MapInfo Corporation.

Update of the Hydro Inventory Database is assumed to be hydrological data at the Masang River and Simanggo River basins in the Sumatera Island that is the objective area of this Project.

23.2.2 COMPOSITION OF HYDRO INVENTORY DATABASE

The structures of the Hydro Inventory Database are composed of the 1) MapBasic program, 2) MapInfo map data, and 3) MapInfo table data. The meaning of MapInfo map data is graphic information, and MapInfo table data is character and numeric information.

The MapBasic program was a program language of customized MapInfo, and it was developed by combining Basic, structured query language (SQL), and macro of Microsoft Excel. The SQL is a program language of database. The MapBasic customize program is subdivided to 31 subroutines, and the number of total step is about 24,000 lines. The program description of 31 subroutines and number of program step are shown in Table23.2.2.

The MapInfo map data and MapInfo table data divided Indonesia into seven (7) as shown in the following table:

Division of Indonesia into Seven for Hydro Inventory Database

No.	Name of Division	Major Island
1	Sumatera	Sumatera
2	Jawa	Jawa
3	Kalimantan	Kalimantan
4	Sulawesi	Sulawesi
5	Papua	Papua (Irian Jaya)
6	Bali, Nusa Tenggara and Tomor	Bali, Lombok, Sumbawa, Sumba Flores, Tomor
7	Maluku	Halmahera, Baru, Seram

Source: JICA Study Team

MapInfo map data and MapInfo table data are composed of 53 layers such as river, road, city, etc. per one (1) division as shown in Table 23.2.3.

The figure below shows the start-up window of the Hydro Inventory Database.

Source: Hydro Inventory and Pre-Feasibility Study, 1999

Start-up Window of Hydro Inventory Database

As for graphic information of Hydro Inventory Database, six (6) kinds of data such as 1) General, 2) Hydrology, 3) Project, 4) Electrical System, 5) Geological Map, and 6) Environmental Map are stored.

23.2.3 REVISION OF HYDRO INVENTORY DATABASE

The Hydro Inventory Database was developed in 1999 and passed 11 years afterwards. Meanwhile, the revision of the Hydro Inventory Database was executed as following items:

(1) Change of Font

When the Hydro Inventory Database was developed, "Univers Condensed" and "Monotype Sorts" were included in computer font. Both fonts were used for computer screen of Graphic Information System (GIS) and output file of Microsoft Excel. However, these fonts are not included in present computer operating system, such as Microsoft Windows XP, Windows VISTA, and Windows 7. Therefore, font of "Univers Condensed" was revised to "Arial Narrow" and font of "Monotype Sorts" was revised to "Poplar Std".

(2) Change of Organization Name

The name of agency in charge of Meteorology and Geophysical in an Indonesia was changed from BMG (Badan Metereologi dan Geofisika) to BMKG (Badan Meteorologi Klimatologi dan Geofisika) on several years ago. Therefore, the organization name of the Hydro Inventory Database was changed from BMG to BMKG.

(3) Change of Place Name

The name of place (island) was changed from Irian Jaya to Papua in 2004. Therefore, the place name of the Hydro Inventory Database was changed from Irian Jaya to Papua.

(4) Version of Microsoft Excel

The Hydro Inventory Database has the command that activates Microsoft Excel from the program of MapBasic. The version of Microsoft Excel is different between the past and the present. To correspond to present Microsoft Excel, the program of MapBasic was revised.

23.2.4 UPDATE OF HYDRO INVENTORY DATABASE SYSTEM

The hydrological data of the Masang River and Simanggo River basins are collected by this Project. The rainfall data was collected from BMKG, and discharge data was collected from Pusat Litbang Sumber Daya Air (PUSAIR). The database was updated from the Hydro Inventory and Pre-Feasibility Study in 1999 the following rainfall and discharge data:

Updated Hydro Inventory Database

No.	Data Type	Station ID	Station Name	Collected Data Period		Updated Years
				HPPS2	This Project	
Masang River Basin						
1	Rainfall	22-52-2	Maninjau (52B)	1969-1986	1973-1993	8 years
2	Rainfall	22-52-3	Limau Purut (52C)	1973-1986	1973-1993	5 years
3	Rainfall	22-54-0	Bukit Tinggi (54)	1961-1988	1972-1993	5 years
4	Rainfall	22-54-1	Baso (54A)	1969-1988	1969-1992	4 years
5	Rainfall	22-54-3	Padang Mangatas (54C)	1965-1988	1969-1993	5 years
6	Rainfall	22-56-2	Suliki (56B)	1923-1993	1973-2007	14 years
7	Rainfall	22-57-0	Kota Baharu (57)	1973-1988	1972-1992	5 years
8	Rainfall	22-58-3	Bonjol (58C)	1973-1988	1973-1993	5 years
9	Rainfall	22-58-6	Jambak (58F)	1978-1993	1973-1993	5years
10	Discharge	1-163-1-1	Sipisang	1975-1993	1975-2008	15 years
Simanggo River Basin						
1	Rainfall	24-84-0	Tarutung (84)	1954-1988	1977-2000	12 years
2	Rainfall	24-84-3	Hutaraya (84C)	1954-1988	1969-1999	11 years
3	Rainfall	24-85-0	Barus (85)	1962-1988	1977-2008	20 years
4	Rainfall	24-86-0	Siborong-borong (86)	1953-1988	1973-1997	9 years
5	Rainfall	24-86-1	Dolok Sanggul (86A)	1954-1989	1973-2000	11 years
6	Rainfall	24-86-2	Gugur Balige (86B)	1972-1986	1971-1999	14 years
7	Rainfall	24-90-0	Paguruan (90)	1973-1988	1972-2001	14 years
8	Rainfall	24-90-3	Salak (90C)	1951-1988	1984-1999	11 years
9	Rainfall	24-91-0	Sidikalang (91)	1951-1988	1978-1999	11 years
10	Discharge	1-178-2-1	Pasar Sironggit	1972-1993	1982-2008	15 years
11	Discharge	1-184-0-1	Dolog Sanggul	-	1991-2008	18 years
12	Discharge	1-186-0-1	Marade	-	1983-2008	26 years

Source: JICA Study Team

The updated rainfall and discharge data of the Masang River basin were 56 years and 15 years, respectively, and the Simanggo River basin were 113 years and 59 years, respectively. The Dolog Sanggui and Marade discharge stations in the Simanggo River basin were new additional data.

Table 23.2.1 Data Items of Hydro Inventory Database System

Character and Numeric Information

No.	Data Item	Description	Remarks			
1	General	1) Island	(1) Island Name			
		2) Wilayah	(1) PLN Wilayah No.	(2) Zone Name	(3) Region Name	
		3) Province	(1) Province Name			
		4) BMKG Region	(1) BMKG Region No.	(2) Region Name		
2	Map	1) BAKOSURTANAL 1/250,000 Scale Map	(1) Map No.	(2) Map Name	(3) Map coordinates	
		2) BAKOSURTANAL 1/100,000 Scale Map	(1) Map No.	(2) Map Name	(3) Map coordinates	
		3) BAKOSURTANAL 1/50,000 Scale Map	(1) Map No.	(2) Map Name	(3) Map coordinates	
		4) JANTOP 1/250,000 Scale Map	(1) Map No.	(2) Map Name	(3) Map coordinates	
		5) JANTOP 1/50,000 Scale Map [HIND 1090 map]	(1) Map No.	(2) Map Name	(3) Map coordinates	
		6) JANTOP 1/50,000 Scale Map [Gading map]	(1) Map No.	(2) Map Name	(3) Map coordinates	
		7) JANTOP 1/50,000 Scale Map [Mandau map]	(1) Map No.	(2) Map Name	(3) Map coordinates	
3	Hydrology	1) Rainfall Station	(1) Station Name (5) Data Period	(2) Island Name (6) Coordinates	(3) BMKG Region No.	(4) BMKG Station ID
		2) Runoff Station	(1) Station ID (5) Sub-basin Name (9) Coordinates	(2) Station Name (6) River Name	(3) Island Name (7) Catchment Area	(4) Basin Name (8) Data Period
		3) River Basin	(1) River Basin No.	(2) River Basin Name		
4	Hydropower Scheme	1) Identified/Existing Schemes	(1) Name of Scheme (5) Province Name (9) Coordinates	(2) Scheme ID No. (6) River Basin Name (10) Catchment Area	(3) Island Name (7) River Name (11) Installed Capacity	(4) PLN Wilayah Name (8) Development Type (12) Study Level
		2) Pumped Storage Schemes	(1) Scheme ID No.	(2) Name of Scheme	(3) Province Name	(4) River Name
5	Screening	1) 1st Screening, 2nd Screening, 3rd Screening	(1) Name of Scheme (5) River Basin Name (9) Catchment Area (13) Total Cost	(2) Scheme ID No. (6) River Name (10) Installed Capacity (14) Cost/kW	(3) Island Name (7) Development Type (11) Firm Energy (15) Cost/kWh	(4) PLN Wilayah Name (8) Coordinates (12) Secondary Energy (16) kWh Cost
6	CAD Drawing	1) List of CAD Drawing	(1) Scheme ID No.	(2) Scheme Name	(3) Development Type	

Data Source: Hydro Inventory and Pre-Feasibility Study, 1999

Graphic Information

No.	Data Item	Description	Remarks			
1	General	1) Boundary	(1) Province	(2) Kabupaten	(3) BMKG Region	
		2) General	(1) River (5) Island Name	(2) River Name (6) Sea and Lake Name	(3) Road	(4) Major City
		3) Map (BAKOSURTANAL)	(1) 1/250,000 Map Grid (5) 1/50,000 Map Grid	(2) 1/250,000 Map Name (6) 1/50,000 Map Name	(3) 1/100,000 Map Grid	(4) 1/100,000 Map Name
		4) Map (JANTOP)	(1) 1/250,000 Map Grid	(2) 1/250,000 Map Name	(3) 1/50,000 Map Grid	(4) 1/50,000 Map Name
2	Hydrology	1) Rainfall Gauge	(1) BMKG Station Point	(2) BMKG Station ID No.		
		2) Runoff Gauge	(1) Station Point	(2) Station ID No.		
		3) Isohyetal Map	(1) Isohyetal Map			
		4) River Basin	(1) Boundary of River Basin	(2) Basin No.		
		5) River Basin Diagram	(1) Island Name	(2) Basin No.		
3	Project	1) Identified Scheme	(1) Point	(2) ID No.		
		2) Pre-Feasibility Study	(1) Point	(2) ID No.		
		3) Feasibility Study	(1) Point	(2) ID No.		
		4) Detailed Design	(1) Point	(2) ID No.		
		5) Under Construction	(1) Point	(2) ID No.		
		6) Completed	(1) Point	(2) ID No.		
		7) Pumped Storage Scheme (only Jawa)	(1) Point	(2) ID No.		
4	Electorical System	1) Transmission Line	(1) 500kV	(2) 275kV	(3) 150kV	(4) 70kV
		2) Power Station/Substation	(1) Power Station	(2) Substation	(3) PS/SS Name	
5	Geological Map	1) Geological Map	(1) Geological Map	(2) Fault		
6	Environmetal Map	1) Environmetal Map	(1) Nature Forest Reserve and Tourism/Recreation Forest (Determined by Law)			
			(2) Nature Forest Reserve and Tourism/Recreation Forest (Proposed by Ministry Forestry)			
			(3) Protection Forest			

Data Source: Hydro Inventory and Pre-Feasibility Study, 1999

Table 23.2.2 Description of Subroutine and Program Step

No.	Program Subroutine Name	Description	Program Step
1	Global.def	Specification statement of variable	274
2	Main.mb	System Setting, Creation of Startup Screen	878
3	CreateMenu.mb	Custamize from MapInfo menu to Hydro Inventory Database menu, Display of "Information"-"General" and "Information"-"Map"	889
4	OpenTab.mb	Open Database File, Leyer Setting	224
5	General_View.mb	Creation of "View"-"General" menu, Display of "View"-"General" data	671
6	Hydro_View.mb	Creation of "View"-"Hydrology" menu, Display of "View"-"Hydrology" data	630
7	Rainfall_1.mb	Creation of "Information"-"Hydrology"-"Rainfall Station" dialog, Display of retrieval result	936
8	Rainfall_2.mb	Creation summary information dialog of rainfall station (from database screen), Data transmitted to MS Excel	733
9	Runoff_1.mb	Creation of "Information"-"Hydrology"-"Runoff Station" dialog, Display of retrieval result	746
10	Runoff_2.mb	Creation summary information dialog of runoff station (from database screen), Data transmitted to MS Excel	515
11	Project_View.mb	Creation of "View"-"Project" menu, Display of "View"-"Project" data	673
12	Project_1.mb	Creation of "Information"-"Hydropower Schemes"-"Identified and Existing Schemes" dialog, Display of retrieval result	1,563
13	Project_2.mb	Retrieval data of pumped storage scheme from database	25
14	EX_Dam.mb	Creation summary information dialog of existing dam (from database screen), Data transmitted to MS Excel	1,007
15	ScreeningInfo.mb	Creation of "Information"-"Screening" dialog, Display of retrieval result	984
16	Analysis.mb	Creation summary information dialog of identified Scheme (from database screen), 1st screening data transmitted to MS Excel, Display of CAD data	1,514
17	BasnPlan.mb	2nd screening data transmitted to MS Excel	825
18	ConsCost.mb	Main program of 3rd screening data	923
19	ConsCos2.mb	Retrieval data of 3rd screening from database	884
20	ConsCos3.mb	3rd screening data transmitted to MS Excel	1,031
21	ConsCos3_COST.mb	Main program of 3rd screening cost data	652
22	ConsCos3_COST1.mb	Retrieval cost data of 3rd screening from database, Cost data transmitted to MS Excel (run-of-river type)	780
23	ConsCos3_COST2.mb	Retrieval cost data of 3rd screening from database, Cost data transmitted to MS Excel (reservoir type)	928
24	Pump_Dam.mb	Creation summary information dialog of pumped stotage scheme, Data transmitted to MS Excel	1,100
25	Pump_Cost.mb	Cost data of pumped storage scheme transmitted to MS Excel	1,019
26	CADList.mb	Display of CAD drawings list	70
27	TML_View.mb	Creation of "View"-"Electrical System" menu, Display of "View"-"Electrical" data	373
28	Geo_View.mb	Creation of of "View"-"Geological Map" menu, Display of "View"-"Geological Map" data	88
29	Reserve_View.mb	Display of environmental map	29
30	Icon_Back1.mb	Initialize of Layer Information, Creation of Button Menu	1,186
31	SelChanged.mb	Creation of "Select Island" menu, Re-setting of layer condition	1,959
Source: Project			24,109

Table 23.2.3 Composition of Map Layer

No.	Table Name	File Name	Description
1	L1	Map_B25_Grid	Bakosurtanal 1:250,000 Map Grid
2	L2	Map_B25_Name	Bakosurtanal 1:250,000 Map Name
3	L3	Map_B10_Grid	Bakosurtanal 1:100,000 Map Grid
4	L4	Map_B10_Name	Bakosurtanal 1:100,000 Map Name
5	L5	Map_B05_Grid	Bakosurtanal 1:50,000 Map Grid
6	L6	Map_B05_Name	Bakosurtanal 1:50,000 Map Name
7	L7	Map_J25_Grid	JANTOP 1:250,000 Map Grid
8	L8	Map_J25_Name	JANTOP 1:250,000 Map Name
9	L9	Map_J05_Grid_H	JANTOP 1:50,000 HIND 1090 Map Grid
10	L10	Map_J05_Name_H	JANTOP 1:50,000 HIND 1090 Map Name
11	L11	Map_J05_Grid_G	JANTOP 1:50,000 Gading Map Grid
12	L12	Map_J05_Name_G	JANTOP 1:50,000 Gading Map Name
13	L13	Map_J05_Grid_M	JANTOP 1:50,000 Mandau Map Grid
14	L14	Map_J05_Name_M	JANTOP 1:50,000 Mandau Map Name
15	L15	SeaName	Small Island and Sea and Lake Name (Scale 1:250,000)
16	L16	IslandName	Island Name
17	L17	City	Major City Name
18	L18	Lake	Lake
19	L19	RiverName	River Name
20	L20	River	River
21	L21	Road	Road
22	L22	Prov	Provincial Boundary
23	L23	Coast	Cosat Line
24	L24	Kab	Kabupaten Boundary
25	L25	250000	1:250,000 Map
26	L26	BMG	BMG Region
27	L27	B_SeaName	Sea Name (Whole Island)
28	H1	R_Point	Rainfall Station Point
29	H2	R_Name	Rainfall Station Name
30	H3	Q_Point	Runoff Station Point
31	H4	Q_Name	Runoff Station Name
32	H5	I_Data	Isohyetal Map Line
33	H6	I_Name	Isohyetal Map Number
34	H7	B_Data	Basin Boundary Line
35	H8	B_Name	Basin Boundary Number
36	H9	B_Circle	Basin Boundary Number Circle
37	D1	PR_Point	Identification Dam Point
38	D2	PR_Name	Identification Dam Name
39	D3	EX_Point	Existing Dam Point
40	D4	EX_Name	Existing Dam Name
41	D5	PS_Point	Pumped Storage Dam Point
42	D6	PS_Name	Pumped Storage Dam Name
43	D7	PS_Line	Pumped Storage Dam Line
44	E1	TML_500kV	500kV Transmission Line
45	E2	TML_275kV	275kV Transmission Line
46	E3	TML_150kV	150kV Transmission Line
47	E4	TML_70kV	75kV Transmission Line
48	E5	TML_Power	Power Station
49	E6	TML_Substation	Substation
50	E7	TML_Name	Power Station/Substation Name
51	G1	Geo_Formation	Geological Map
52	G2	Geo_Structure	Fault
53	V1	Environment	Environmental Map

Source: Project

23.3 TRANSFER OF KNOWLEDGE TO COUNTERPARTS

23.3.1 HYDRO INVENTORY DATABASE

The lecture of the Hydro Inventory Database was four (4) times executed to PLN staffs. The transfer knowledge of database was operation of the Hydro Inventory Database and update data of database. The date, description and participants of the lectures are shown in the following table:

Lecture of Hydro Inventory Database

No.	Date	Lecture Description	Participants
1	Nov. 19, 2010 (Fri)	Explanation of Hydro Inventory Database (1)	2 persons
2	Nov. 24, 2010 (Wed)	Explanation of Hydro Inventory Database (2)	7 persons
3	Dec. 1, 2010 (Wed)	Update of Database, Study of SQL Language	5 persons
4	Dec. 13, 2010 (Mon)	Explanation of Hydro Inventory Database (3)	19 persons

Source: JICA Study Team

The lectures were executed the operation of the Hydro Inventory Database, update data of rainfall and discharge, and explanation of SQL language. The photographs of the lecture were shown below:

Photograph of the Lecture

23.3.2 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

The purpose of transferring knowledge to counterparts in environmental and social considerations was to deepen understanding of JICA Guideline and methodology of environmental study such as environmental scoping. In order to transfer knowledge, mini-workshop was conducted on 14th December 2010 by inviting members of counterpart team. In the mini-workshop, i) the outline of JICA Guidelines, ii) main points of gaps between JICA Guidelines and Indonesian regulations related to land acquisition and resettlement, iii) the outline of findings at Pre-FS at Simanggo-2 and Masang-2 including methodology of environmental scoping were discussed. In addition to the aforementioned explanation, necessary actions to be taken by PLN and their schedule in order to satisfy JICA Guidelines were discussed based on the finding of Pre-FS.

Another workshop concerning Japanese experience of environmental aspects for power plants operation was held on 17th June 2011 for transferring technical and practical environmental knowledge.

23.4 PHOTOGRAPHS

Coordination Committee

1st Stakeholder Meeting

1st Stakeholder Meeting

Sirahar (View from Upstream)

Sirahar（Weir Site）

Simanggo-2（Downstream of Weir）

Simanggo-2（Weir～Powerhouse）

Gumanti-1（Regulating Pond Site）

Gumanti-1（Weir Site）

Anai-1（Weir～Powerhouse）

Anai-1（Powerhouse Site）

Endikat-2（Weir～Powerhouse）

Cibareno-1（Weir Site）

Cibareno-1（Weir Site）

Cimandiri-1（Weir Site）

Masang-2（Weir～Powerhouse）

Masang-2（Weir～Powerhouse）

2nd Stakeholder Meeting

Stakeholder Meeting in Medan

Stakeholder Meeting in Bukit Tinggi

3rd Stakeholder Meeting

23.5 JICA STUDY TEAM MEMBERS AND MANNING SCHEDULE

The following fourteen (14) members were assigned as specialists for the Study.

No.	Name	Position
1	WADA Masaki	Team Leader / Power Development Planning
2	NAKANISHI Hirokazu	Hydropower Planning / Civil Engineering (A)
3	YAMAZAKI Kiyohito	Hydropower Planning / Civil Engineering (B)
4	SHINZAWA Masayuki	Hydropower Planning / Civil Engineering (C)
5	YANG Pucai	Geology (A)
6	HARADA Madoka	Geology (B)
7	UEDA Yuichi / WASA Morihiro	Hydrological / Meteorological Analysis
8	TAKEYAMA Yoshihide	Power System Planning / Analysis
9	TSUCHIYA Eiji	Electrical Equipment
10	WAKABAYASHI Tadaji	Economic and Financial Analysis / Investment Planning
11	SAI Shigeru	Environmental and Social Considerations (A)
12	OTA Tomoko	Environmental and Social Considerations (B)
13	HIROTA Shuji	Hydro Inventory Database Update

The staffing schedule of the Study is shown below.

Project for the Master Plan Study of Hydropower Development in Indonesia

Staffing Schedule

Works	No.	Position	Name	Organization	FY2009	FY2010	FY2011	M/M									
								FY2009		FY2010		FY2011		Total	
								Field	Home	Field	Home	Field	Home	Field	Home
Field Survey	1	Team Leader / Power Development Planning	WADA Masaki	Nippon Koei				1.5	-	4.8	-	0.9	-	7.2	-
	2	Hydropower Planning / Civil Engineering (A)	NAKANISHI Hirokazu	Nippon Koei (CEPCO)				1.5	-	4.4	-	0.6	-	6.5	-
	3	Hydropower Planning / Civil Engineering (B)	YAMAZAKI Kiyohito	Nippon Koei				0.5	-	3.3	-	0.0	-	3.8	-
	4	Hydropower Planning / Civil Engineering (C)	SHINZAWA Masayuki / WADA Masaki	Nippon Koei				0.0	-	4.5	-	0.0	-	4.5	-
	5	Geology (A)	YANG Pucai	Nippon Koei				1.2	-	4.9	-	0.0	-	6.1	-
	6	Geology (B)	HARADA Madoka	Nippon Koei (J-Power)				1.0	-	1.6	-	0.0	-	2.6	-
	7	Hydrological / Meteorological Analysis	UEDA Yuichi / WASA Morihiro / WADA Masaki	Nippon Koei				1.5	-	4.8	-	0.0	-	6.3	-
	8	Power System Planning / Analysis	TAKEYAMA Yoshihide	Nippon Koei (CEPCO)				1.0	-	3.7	-	0.6	-	5.3	-
	9	Electrical Equipment	TSUCHIYA Eiji	Nippon Koei (J-Power)				0.0	-	2.9	-	0.0	-	2.9	-
	10	Economic and Financial Analysis / Investment Planning	WAKABAYASHI Tadaji	Nippon Koei				0.5	-	2.5	-	0.9	-	3.9	-
	11	Environmental and Social Considerations (A)	SAI Shigeru	Nippon Koei (JDS)				1.0	-	3.9	-	0.8	-	5.7	-
	12	Environmental and Social Considerations (B)	OTA Tomoko	Nippon Koei				0.7	-	5.4	-	0.8	-	6.9	-
	13	Hydro Inventory Database Update	HIROTA Shuji	Nippon Koei				0.0	-	1.0	-	0.0	-	1.0	-
								10.4	-	47.7	-	4.6	-	62.7	-
Home Work	1	Team Leader / Power Development Planning	WADA Masaki	Nippon Koei				-	0.4	-	0.8	-	0.2	-	1.4
	2	Hydropower Planning / Civil Engineering (A)		Nippon Koei				-	0.4	-	0.6	-	0.2	-	1.2
	3	Hydropower Planning / Civil Engineering (B)		Nippon Koei				-	0.2	-	0.0	-	0.0	-	0.2
	4	Hydropower Planning / Civil Engineering (C)		Nippon Koei				-	0.0	-	0.2	-	0.0	-	0.2
	5	Geology (A)		Nippon Koei				-	0.2	-	0.2	-	0.0	-	0.4
	6	Geology (B)		Nippon Koei				-	0.2	-	0.0	-	0.0	-	0.2
	7	Hydrological / Meteorological Analysis		Nippon Koei				-	0.2	-	0.67	-	0.0	-	0.87
	8	Power System Planning / Analysis		Nippon Koei				-	0.2	-	0.6	-	0.2	-	1.0
	9	Electrical Equipment		Nippon Koei				-	0.2	-	0.2	-	0.0	-	0.4
	10	Economic and Financial Analysis / Investment Planning		Nippon Koei				-	0.2	-	0.2	-	0.2	-	0.6
	11	Environmental and Social Considerations (A)		Nippon Koei				-	0.2	-	0.0	-	0.0	-	0.2
	12	Environmental and Social Considerations (B)		Nippon Koei				-	0.2	-	0.6	-	0.2	-	1.0
	13	Hydro Inventory Database Update		Nippon Koei				-	0.0	-	0.4	-	0.0	-	0.4
								-	2.6	-	4.5	-	1.0	-	8.1
								10.4	2.6	47.7	4.5	4.6	1.0	62.7	8.1
								13.0		52.17		5.6		70.77	

Legend

: Field Survey (Work in Indonesia)

: Home Work (Work in Japan)

: Local Subletting Survey

Reports: Ic/R, It/R, DF/R, F/R

Stake Holder Meeting: 1st SHM, 2nd SHM, 3rd SHM

Works: Field Survey (1st Field Survey, 2nd Field Survey, 3rd Field Survey, 4th Field Survey, 5th Field Survey, 6th Field Survey); Home Work (Home Prep. Work, 1st Home Work, 2nd Home Work, 3rd Home Work, 4th Home Work, 5th Home Work, 6th Home Work); Local Subletting Survey ((1) Hydrological Survey, (2) Topographic Survey, (3) Geological Survey, (4) Environmental and Social Consideration Survey)

Appendix 1 Policy Oriented Scenario

List of Contents

1. Introduction

The candidate hydro schemes considered in this study were 176 with the total capacity of 21,983 MW. Among them, some hydro projects in Kalimantan, Sulawesi, and Papua were discarded due to the constraint of the power system demand in those regions before investigating the Policy Oriented Scenario. The study principally followed the power demand forecast indicated in RUKN 2008, and the power development plan up to 2019 in RUPTL 2010-2019, but the discarded projects in this study will be probably required again in the future when the demand forecasts are revised upward or other generation development projects are slipped. More importantly, the project classification was conducted automatically using criteria on environmental concerns and economy in principle to pick out the schemes with less difficulties and formulate the Master Plan (Realistic Scenario), not to exclude the possibilities of schemes with more difficulties. In some cases, some schemes which were discarded in the Realistic Scenario, could be possibly revived especially after detailed investigation on the actual site condition.

For this reason, the schemes which were not included in the Realistic Scenario, but included in the Policy Oriented Scenario were reviewed in this Appendix.

2. Preliminarily screened-out projects from the system demand

Before investigating the Policy Oriented Scenario in which as many the potential projects as possible were taken into consideration, the rooms for hydro development in each region were preliminarily examined in view of the power system demands. At first, future demand forecasts were taken from RUKN 2008, and the required generation capacities in the year 2027 were focused which included 40 percent of reserve margin against the peak loads. Then, existing generation capacities net of degradation as of 2027, and the capacities of generation projects other than hydro during 2010 to 2019 scheduled in RUPTL 2010-2019 without considering degradation, were deducted from the required generation capacities, and the difference were considered as the rooms (capabilities) for hydro development. When the capability in a region was less than the potential there, the maximum amount of hydro development was limited to the capability and extra potential was curtailed. As discussed in Chapter 7, the relevant regions were Kalimantan, Sulawesi, and Papua, and the exploitable hydro capacity was diminished from 21,983 MW to 14,641 MW in total as indicated in Table 1, considering the future power demand situation. More strictly, the demand of each power system should have been examined. Maluku and Nusa Tenggara comprise of hundreds of islands, and most of them have so far no power interconnection each other. Much the same is true on the other regions than Java-Madura-Bali and Sumatra where interconnected power systems have been established. Detailed discussion on the relationship between the scale of transmission systems and the hydro capacities acceptable in each region was made in Chapter 7.

The results of preliminary screening in terms of future system demand on Kalimantan, Sulawesi,

and Papua are described below.

Table 1 Hydro Capacity focused in this study (repeat of Table 7.1.11)

(Unit: MW)

Region	Existing Hydro Capacity	Planned & Ongoing	Screened in HPPS2	Total	Hydro Capability*	Focused in this Study	Total
	(A)	(B)	(C)	(D)=(B)+(C)	(E)	(F)=min (D, E)	(A)+(F)
Sumatera	1,443	2,110	3,586	5,696	9,862	5,696	7,139
Kalimantan	30	1,038	5,456	**6,493**	**3,605**	3,605	3,635
Sulawesi	352	1,050	4,357	**5,407**	**3,004**	3,004	3,356
Maluku	--	66	132	198	232	198	198
Papua	--	72	2,273	**2,345**	**293**	293	293
Nusa Tenggara	--	38	146	184	549	184	184
Java-Bali	2,513	1,583	78	1,662	4,200	1,662	4,174
Total	**4,338**	**5,956**	**16,027**	**21,983**	**21,745**	**14,641**	**18,979**

* Hydro capability under the constraint of demand or potential indicated in Table 7.1.7.

(1) Kalimantan

In Kalimantan, the hydro capability as of 2027 is 3,605 MW while the total capacity of potential schemes is 6,493 MW, and 2,888 MW should be accordingly curtailed roughly estimating. Giving higher priorities to the eight hydro schemes for which D/D, F/S, or pre-F/S were conducted, and then screening the schemes which passed the third screenings in HPPS2 in 1999 with prioritizing in the descendent order of “Environment” first, and then “Project EIRR”, 12 schemes (highlighted in Table 2) were selected in the Policy Oriented Scenario.

All the potential schemes in Kalimantan are reservoir type development, and each capacity is comparatively large. The predicted peak load in RUKN 2008 was 4,584 MW in the whole Kalimantan as of 2027. The sizes of Boh-2 (1,196 MW), Sesayap-20 (949.2 MW), Kelai-1 (952.8 MW) etc. seem too big even though the current three large power systems (*Khatulistiwa* in West Kalimantan, *Barito* in Central and South Kalimantan, and *Mahakam* in East Kalimantan) are interconnected one another by the year 2027. Further discussion on the transmission systems and unit capacities of generation in Kalimantan was undergone in Chapter 7.

Corresponding to reservoir type development with large capacities, most of the schemes will require large inundated area, which may have positive correlation with the likelihood of development in restricted forest areas, large resettlement and other environmental impacts. The environmental evaluations for the hydro schemes in Kalimantan are thereby low as a whole. Moreover, most of the schemes have low economic feasibilities.

Table 2 Evaluation of candidate hydro schemes in Kalimantan

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2											
1058	Boh-2	RES	Kaltim	1,119.6	3,299.2	1,832.65	16.3%	B	A	C	**C**
1060	Sesayap-20	RES	Kaltim	949.2	2,633.3	1,656.91	14.7%	A	A	C	**C**
1063	Sesayap-15	RES	Kaltim	313.2	956.7	848.89	9.4%	B	A	C	**C**
1064	Telen	RES	Kaltim	193.2	544.4	552.85	8.4%	B	A	C	**C**
1057	Mandai-5	RES	Kalbar	140.7	351.8	548.70	5.3%	B	A	C	**C**
1059	Kelai-1	RES	Kaltim	952.8	2,106.4	1,532.14	14.4%	B	A	**D**	**D**
1056	Melawi-9	RES	Kalbar	590.4	1,324.8	1,095.68	12.4%	B	A	**D**	**D**
1061	Sesayap-11	RES	Kaltim	624.0	2,035.3	1,399.66	12.1%	**D**	A	B	**D**
1062	Sembakung-3	RES	Kaltim	572.4	1,268.3	1,444.74	8.7%	A	B	**D**	**D**
4	**TOTAL**			**2,575.2**	**7,433.6**	**4,891.3**					
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted											
3039	Amandit-2	RES	Kalsel	2.5	20.1	39.96	--	B	C	B	**C**
3040	Kayan-2	RES	Kaltim	500.0	3,832.5	588.12	42.9%	C	**D**	**D**	**D**
3038	Kelai-2	RES	Kaltim	168.0	1,102.9	331.69	22.6%	A	A	**D**	**D**
3041	Pinoh	RES	Kalbar	198.0	1,374.8	602.91	16.1%	A	A	**D**	**D**
3036	Kusan-3	RES	Kalsel	68.0	100.5	156.89	6.7%	C	A	C	**D***
3042	Silat	RES	Kalbar	29.0	129.5	165.41	5.7%	A	**D**	**D**	**D**
3035	Riam Kiwa	RES	Kalsel	42.0	151.6	247.98	3.7%	A	**D**	**D**	**D**
3037	Pade Kembayung	RES	Kalbar	30.0	235.0	336.17	--	**D**	A	B	**D**
8	**TOTAL**			**1,037.5**	**6,946.9**	**2,469.1**					

(2) Sulawesi

The hydro capability in Sulawesi will be 3,004 MW as of 2027 while the total capacity of potential schemes is 5,407 MW, and 2,403 MW will be unnecessary up to 2027. As is the case with Kalimantan, higher priorities were given to the 10 hydro schemes for which D/D, F/S, or pre-F/S were conducted, and then the schemes which passed the third screenings in HPPS2 in 1999, were screened with prioritizing in the descendent order of "Environment" first, and then "Project EIRR". As a result, seven schemes (highlighted in Table 3) were selected in the Policy Oriented Scenario.

Sulawesi has two large power systems; *Sulsel* system and *Minahasa-Kotamobagu* system, and dozens of small systems, which will be interconnected with Sulsel system or Minahasa-Kotamobagu system step by step according to their locations. However, interconnection of two large systems will bring in little benefit since the respective demand centers Manado and Makassar are located at the north and south ends of the Sulawesi island, according to the former JICA study[1]. Most of the hydro potentials are distributed in the central

[1] "The Study on Optimal Electric Power Development in Sulawesi in the Republic of Indonesia", August 2008.

part of Sulawesi; South Sulawesi Province (*Provinsi Sulawesi Selatan*) and Central Sulawesi Province (*Provinsi Sulawesi Tengah*), and those schemes will be connected to Sulsel system[2]. Among the hydro schemes listed in Table 3, Sawangan, Poigar-3 and Bone-3 in the North Sulawesi Province (*Provinsi Sulawesi Utara*) are supposed to be connected to Minahasa-Kotamobagu system.

Table 3 Evaluation of candidate hydro schemes in Sulawesi

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2											
1065	Poso-2	ROR	Sulteng	132.8	1,125.4	208.93	43.6%	A	A	A	**A**
1066	Poso-1	ROR	Sulteng	204.0	1,341.0	300.61	37.6%	A	A	A	**A**
1079	Watunohu-1	ROR	Sultra	57.0	309.0	142.29	15.6%	C	A	A	**C**
1068	Lariang-6	RES	Sulteng	209.4	616.2	382.13	14.3%	C	A	B	**C**
1075	Karama-1	RES	Sulsel	800.0	2,147.1	1,481.11	13.5%	C	A	B	**C**
1076	Masuni	RES	Sulsel	400.2	930.2	714.01	13.1%	B	A	C	**C**
1077	Mong	RES	Sulsel	255.6	618.9	474.22	12.8%	A	B	C	**C**
1070	Bongka-2	RES	Sulteng	187.2	451.3	407.24	10.6%	B	A	C	**C**
1080	Lalindu-1	RES	Sultra	193.6	544.1	472.50	10.1%	B	A	C	**C**
1073	Karama-2	RES	Sulsel	762.3	1,796.1	983.86	18.9%	C	B	C	**C**
1067	Lariang-7	RES	Sulteng	618.0	1,489.6	896.58	16.8%	C	A	C	**C**
1081	Pongkeru-3	RES	Sulsel	227.6	556.6	562.06	9.3%	B	A	C	**C**
1072	Lariang-8	ROR	Sulteng	12.8	85.4	59.48	8.7%	C	A	A	**C**
1069	Bone-3	ROR	Sulut	20.4	148.3	78.67	12.2%	**D**	A	A	**D**
1071	Solato-1	ROR	Sulteng	26.6	176.1	110.53	10.0%	**D**	A	A	**D**
7	**TOTAL**			**2,059.0**	**7,087.7**	**3,703.3**					
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted											
3020	Malea	ROR	Sulsel	182.0	1,477.0	298.73	39.6%	A	A	A	**A**
3016	Bakaru (2nd)	ROR	Sulsel	126.0	471.0	184.16	24.9%	A	A	A	**A**
2030	Sawangan	ROR	Sulut	16.0	73.5	26.01	24.8%	A	A	A	A
3019	Poko	RES	Sulsel	233.0	760.0	350.28	18.6%	B	B	B	**B**
1074	Tamboli	ROR	Sultra	25.8	158.9	47.79	26.3%	C	A	A	C
3017	Lasolo-4	RES	Sulteng	100.0	770.0	232.00	22.8%	C	B	C	**C**
3023	Batu	RES	Sulsel	271.0	1,740.2	563.96	21.1%	C	B	C	**C**
3021	Konaweha-3	RES	Sulteng	24.0	116.0	55.68	16.3%	C	C	C	**C**
3018	Palu-3	LOT	Sulteng	75.0	510.0	121.80	28.4%	**D**	B	A	**D**
3022	Poigar-3	ROR	Sulut	14.0	98.6	33.49	21.3%	**D**	A	A	**D**
10	**TOTAL**			**977.8**	**5,566.6**	**1,758.6**					

[2] Sulawesi Tengah is the jurisdiction of PLN North Sulawesi Office (*Wilayah Suluttenggo*), but the transmission line of Minahasa-Kotamobagu system will not reach the southern part of the Central Sulawesi Province where most of hydro potentials are distributed.

(3) Papua

In Papua, the hydro capability will remain no more than 293 MW as of 2027 while the total capacity of potential schemes is 2,345 MW. Warsamson is a possible scheme which is expected to start operation in 2016/17 according to the latest RUPTL, and the room for additional hydro development up to 2027 will be 244 MW at most in the whole Papua.

In addition to the low power demand in total, underdeveloped power delivery system will be obstructive to hydropower development. RUPTL 2010 indicated no interconnection plan among the existing 10 small grids up to 2019 at earliest. Table 4 is the future demand forecast of each small grid in Papua and West Papua Provinces, representing that large hydro development will not be suitable in Papua for the time being despite the potential. For instance, Warsamson scheme is located in Sorong Regency in West Papua Province, where the peak load of the system was around 27 MW in of 2010, and PLN has a plan to develop 2 x 15.5 MW less than its full potential possibly bringing about lower economic efficiency. Genyem was the other project in Papua listed in the latest RUPTL with the capacity of more than 10 MW, which will contribute 2 x 10 MW of power to Jayapura system, and start operation in 2012.

Table 4 Future peak load in Papua

(Unit: MW)

System	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Remarks
Papua											
Jayapura	48.7	52.8	57.6	63.9	71.1	77.2	83.9	91.1	99.0	107.6	
Wamena	2.9	3.1	3.4	3.7	4.1	4.4	4.7	5.1	5.5	5.9	
Biak	11.3	12.1	13.1	14.5	16.0	17.3	18.6	20.1	21.7	23.4	remote island
Serui	4.8	5.0	5.3	5.6	6.0	6.3	6.6	6.9	7.3	7.6	remote island
Merauke	11.5	12.6	14.0	15.7	17.7	19.5	21.4	23.6	26.0	28.6	
Nabire	10.0	10.7	11.4	12.4	13.5	14.4	15.3	16.3	17.3	18.5	
Timika	12.3	13.7	15.3	17.4	19.8	22.0	24.5	27.2	30.2	33.6	
West Papua											
Sorong	27.1	30.2	34.8	38.8	42.7	47.1	52.1	57.7	63.7	70.3	
Manokwari	11.4	12.5	14.0	15.3	16.5	17.8	19.3	20.8	22.5	24.3	
Fak-Fak	4.4	4.7	5.2	5.6	5.9	6.2	6.6	7.0	7.5	7.9	

Source: RUPTL 2010-2019, PT. PLN (Persero).

Hydro schemes were arranged in the descendent order of the installed capacities, as indicated in Table 5 and for this reason five schemes were picked up for the Policy Oriented Scenario, not to exceed the hydro capability. As a result, some of the selected schemes have low economic feasibility, and can be replaced by more economical ones with paying attention to the scale of system where the schemes are located.

Table 5 Evaluation of candidate hydro schemes in Papua

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2											
1102	Maredrer	ROR	Papua	8.7	62.4	39.27	9.6%	A	A	A	**A**
1103	Muturi-1	ROR	Papua Barat	45.8	288.3	164.16	11.3%	B	A	A	**B**
1101	Titinima-3	ROR	Papua	55.6	402.2	234.33	10.7%	C	A	A	**C**
1098	Gita/Ransiki-1	LOT	Papua Barat	56.2	136.2	142.03	8.9%	C	A	C	**C**
1104	Siewa-1	ROR	Papua	58.4	330.5	246.76	8.7%	C	A	A	**C**
1091	Endere-2	ROR	Papua	87.0	727.8	280.16	17.0%	C	A	A	**C**
1099	Baliem-6	ROR	Papua	88.2	754.2	472.23	9.3%	B	A	A	**B**
1096	Waryori-4	ROR	Papua Barat	94.2	598.8	249.43	16.8%	C	A	A	**C**
1093	Jawee-2	ROR	Papua	94.2	755.9	351.39	13.7%	C	A	A	**C**
1094	Baliem-7	ROR	Papua	97.8	834.7	479.85	10.3%	C	A	A	**C**
1105	Baliem-8	ROR	Papua	138.4	1,007.0	664.01	9.2%	C	A	A	**C**
1090	Endere-1	ROR	Papua	144.8	1,033.5	323.76	23.5%	C	A	A	**C**
1089	Jawee-3	ROR	Papua	147.2	1,163.6	373.19	21.9%	C	A	A	**C**
1088	Derewo-7	ROR	Papua	148.8	1,180.5	339.26	25.3%	C	A	A	**C**
1087	Jawee-4	ROR	Papua	152.6	1,308.6	366.95	25.4%	C	A	A	**C**
1092	Derewo-6	ROR	Papua	170.0	1,128.4	502.18	15.5%	C	A	A	**C**
1095	Baliem-5	ROR	Papua	189.2	1,401.4	670.06	13.5%	B	A	A	**B**
1100	Kladuk-2	RES	Papua Barat	229.0	567.4	503.95	10.7%	B	B	C	**C**
1097	Ulawa	ROR	Papua	34.6	194.6	110.98	12.1%	**D**	A	A	**D**
1086	Warasai	ROR	Papua	231.9	1,314.0	326.35	35.0%	**D**	A	B	**D**
5	**TOTAL**			**224.7**	**1,219.6**	**826.6**					
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted											
3052	Warsamson	RES	Papua Barat	49.0	248.0	153.70	11.3%	B	A	C	**C**

(4) Other regions

In other regions, all the candidate schemes were considered in the Policy Oriented Scenario so as to meet the energy policy requirement, regardless of environmental concern or economic evaluation.

3. Hydro schemes in the Policy Oriented Scenario

In this section, all the hydro schemes included in the Policy Oriented Scenario which included the schemes screened out from the Realistic Scenario are listed region by region with the evaluation in light of screening criteria, and the reasons for discard are stated.

(1) Sumatra

Exclusively in Sumatra, some good hydro schemes are geographically interfering with the private development schemes which are planned to have the capacity less or equal to 10 MW to enjoy fiscal benefit entitled to small and medium scale renewable energy power generation. It will be so difficult to cancel the private projects which are at the stage of operation, construction, and conclusion of PPA that the schemes interfering with such private projects were discarded in the Realistic Scenario: Five schemes in question are Ordi-1, Simmango-1, Gunung-2, Ordi-2, Silau-1, and Mauna-1. 15 schemes[3] may violate Conservation Forest (*Hutan Konservasi*) areas, and two reservoir type schemes (Rokan Kiri-1 and Jambu Aye-8) have the inundated areas more than 10,000 ha. Four schemes (Renun-3, Renun-4, Aceh-2, and Lamatang-4) were abandoned solely due to their less economies. Sirahar has little difficulties in Table 6, but the project economy was found to be insufficient after the field survey which was detailed in Chapter 9 in the Main Report (Table 9.8.1).

Table 6 Conventional hydro schemes in Sumatra

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1002	Jambo Papeun-3	ROR	NAD	25.4	206.1	80.60	16.9%	C	A	A	**C**	
1003	Woyla-2	RES	NAD	242.1	664.6	367.45	17.0%	C	A	B	**C**	
1005	Teunom-2	RES	NAD	230.0	595.3	370.81	15.4%	C	A	C	**C**	
1006	Kluet-1	ROR	NAD	40.6	231.9	106.39	15.8%	C	A	A	**C**	
1007	Meulaboh-5	ROR	NAD	43.0	271.1	127.55	14.8%	C	A	A	**C**	
1008	Kluet-3	ROR	NAD	23.8	194.0	103.40	11.6%	C	A	A	**C**	
1009	Ramasan-1	RES	NAD	119.0	291.9	237.40	11.8%	C	A	B	**C**	
1010	Sibubung-1	ROR	NAD	32.4	207.3	102.93	13.7%	C	A	A	**C**	
1011	Seunangan-3	ROR	NAD	31.2	179.3	93.41	13.4%	C	A	A	**C**	
1012	Teripa-4	RES	NAD	184.8	503.6	394.68	11.5%	C	B	B	**C**	
1013	Teunom-3	RES	NAD	102.0	303.2	226.37	11.5%	C	A	B	**C**	
1014	Meulaboh-2	ROR	NAD	37.0	212.5	123.74	11.7%	C	A	A	**C**	
1015	Sibubung-3	ROR	NAD	22.6	144.9	87.26	10.8%	C	A	A	**C**	
1020	Kumbih-3	ROR	Sumut	41.8	269.6	105.52	18.7%	B	A	A	**B**	
1021	Simanggo-2	ROR	Sumut	59.0	366.9	145.64	18.8%	A	A	A	**A**	

[3] Mamas-2, Ketambe-2, Sangir, Air Tuik, Sirantih-1, Taratak Tumpatih-1, Langkup-2, Merangin-4, Menula-2, Tebo-2, Lawe Alas-4, Bayang-1, Bayang-2, Masang-3, and Ketaun-1.

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
1022	Raisan-1	ROR	Sumut	26.2	167.9	73.62	16.4%	C	A	A	**C**	
1024	Toru-2	ROR	Sumut	33.6	237.1	102.29	16.2%	C	A	A	**C**	
1026	Sibundong-4	ROR	Sumut	31.6	203.6	92.94	15.6%	B	A	A	**B**	
1028	Ordi-5	ROR	Sumut	26.8	173.7	79.46	15.5%	B	A	A	**B**	
1029	Bila-2	ROR	Sumut	42.0	300.6	106.68	19.9%	C	A	A	**C**	
1030	Ordi-3	ROR	Sumut	18.4	119.1	59.49	13.9%	B	A	A	**B**	
1033	Siria	ROR	Sumut	16.5	105.8	59.61	12.1%	C	A	A	**C**	
1034	Toru-3	RES	Sumut	227.6	516.1	413.90	12.7%	C	B	C	**C**	
1036	Sinamar-2	ROR	Sumbar	25.6	217.1	83.58	16.9%	A	A	A	**A**	MOU
1039	Batang Hari-4	RES	Sumbar	216.0	544.9	352.69	15.0%	C	B	C	**C**	
1041	Sinamar-1	ROR	Sumbar	36.6	254.9	99.69	17.7%	A	A	A	**A**	MOU
1042	Masang-2	ROR	Sumbar	39.6	256.1	120.32	14.6%	B	A	A	**B**	
1043	Gumanti-1	ROR	Sumbar	15.8	85.4	45.36	13.4%	A	A	A	**A**	MOU
1044	Anai-1	ROR	Sumbar	19.1	109.2	55.39	13.9%	A	A	A	**A**	MOU
1046	Kuantan-2	RES	Sumbar	272.4	734.1	467.03	14.7%	C	B	C	**C**	
1051	Padang Guci-2	ROR	Bengkulu	21.0	145.1	70.56	13.7%	C	A	A	**C**	MOU
1052	Endikat-2	ROR	Sumsel	22.0	179.8	85.62	13.1%	A	A	A	**A**	
1053	Semung-3	ROR	Lampung	20.8	146.9	70.45	13.6%	C	A	A	**C**	
1001	Mamas-2	ROR	NAD	51.0	327.7	132.52	18.1%	**D**	A	A	**D**	
1004	Ketambe-2	ROR	NAD	19.4	124.9	62.85	13.8%	**D**	A	A	**D**	
1016	Sirahar	ROR	Sumut	35.4	228.3	83.91	20.2%	A	A	A	**A**	
1017	Ordi-1	ROR	Sumut	40.8	263.0	93.55	21.1%	C	A	A	**C**	PPA
1018	Simanggo-1	ROR	Sumut	44.4	285.8	106.27	20.0%	A	A	A	**A**	Operation
1019	Renun-3	ROR	Sumut	19.8	33.8	52.15	5.7%	A	A	A	**A**	
1023	Gunung-2	ROR	Sumut	22.6	145.3	63.68	16.4%	A	A	A	**A**	PPA
1025	Renun-6	ROR	Sumut	22.4	117.9	61.66	14.3%	A	A	A	**A**	
1027	Ordi-2	ROR	Sumut	26.8	172.8	82.25	14.8%	C	A	A	**C**	PPA
1031	Silau-1	ROR	Sumut	27.4	147.9	72.56	15.0%	B	A	A	**B**	Operation
1032	Renun-4	ROR	Sumut	20.8	66.9	70.68	7.2%	A	A	A	**A**	
1035	Sangir	ROR	Sumbar	41.8	331.7	102.71	23.0%	**D**	A	A	**D**	
1037	Air Tuik	ROR	Sumbar	24.8	161.4	66.40	17.1%	**D**	A	A	**D**	
1038	Sirantih-1	ROR	Sumbar	18.3	153.3	76.96	12.2%	**D**	A	A	**D**	
1040	Taratak Tumpatih-1	ROR	Sumbar	29.6	192.6	82.66	16.2%	**D**	A	A	**D**	
1047	Rokan Kiri-1	RES	Sumbar	183.0	431.9	331.16	12.9%	B	B	**D**	**D**	
1048	Mauna-1	ROR	Bengkulu	103.0	814.0	208.25	29.4%	A	A	A	**A**	Construction
1049	Langkup-2	ROR	Bengkulu	82.8	700.5	197.50	25.3%	**D**	A	A	**D**	
1050	Merangin-4	RES	Jambi	182.0	491.9	314.94	14.5%	**D**	A	B	**D**	
1054	Menula-2	ROR	Lampung	26.8	152.2	85.32	12.3%	**D**	A	A	**D**	
1055	Tebo-2	ROR	Jambi	24.4	188.7	123.21	9.3%	**D**	A	A	**D**	
53	**TOTAL**			**3,393.6**	**14,672.0**	**7,583.0**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3002	Tampur-1	RES	NAD	330.0	1,067.0	668.16	13.5%	C	A	C	**C**	
3007	Teunom-1	RES	NAD	24.3	212.4	115.63	10.1%	C	A	B	**C**	
3009	Peusangan-4	ROR	NAD	30.9	234.2	64.59	27.2%	A	A	A	**A**	
3004	Wampu	ROR	Sumut	84.0	475.3	147.52	26.3%	C	A	A	**C**	

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
3001	Merangin-2	ROR	Jambi	350.0	1,464.5	559.87	23.3%	A	A	A	**A**	
3012	Merangin-5	RES	Jambi	23.9	196.8	92.02	12.5%	A	B	C	**C**	
	Besai-2	ROR	Lampung	44.0	160.0	100.00	13.0%	C	A	A	**C**	
3003	Jambu Aye-8	RES	NAD	160.0	650.0	502.23	10.9%	A	B	**D**	**D**	
3008	Aceh-2	RES	NAD	7.3	64.3	65.26	4.2%	A	A	A	**A**	
3010	Lawe Alas-4	RES	NAD	322.0	1,549.1	549.07	22.0%	**D**	B	C	**D**	
3011	Toru-1	ROR	Sumut	38.4	308.1	73.36	31.2%	A	A	A	**A**	PPA
3013	Bayang-1	ROR	Sumbar	13.2	71.3	51.10	8.8%	**D**	A	A	**D**	
3014	Bayang-2	ROR	Sumbar	30.9	202.7	61.40	25.4%	**D**	A	A	**D**	
1045	Masang-3	RES	Sumbar	88.6	326.3	188.23	13.7%	**D**	A	B	**D**	
3006	Ranau	LOT	Sumsel	60.0	146.0	264.06	3.7%	A	A	A	**D***	
3015	Lamatang-4	RES	Sumsel	12.2	106.5	171.11	--	A	B	B	**B**	
3005	Ketaun-1	RES	Bengkulu	84.0	308.1	148.79	16.3%	**D**	C	B	**D**	
17	**TOTAL**			**1,703.7**	**7,542.6**	**3,822.4**						

Note) Highlighted schemes are taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(2) Kalimantan

As discussed in the previous section, low demand and underdeveloped transmission network are the main causes for hydro development in Kalimantan, along with environmental and economical concerns. Out of 12 schemes, seven schemes have less economic feasibilities, and three schemes with sufficient economic feasibilities have more than 10,000 ha inundated areas. Boh-2 and Sesayap-20 with little difficulties in terms of environment and economy were discarded due to their too large capacities for the transmission system.

Table 7 Conventional hydro schemes in Kalimantan

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1058	Boh-2	RES	Kaltim	1,119.6	3,299.2	1,832.65	16.3%	B	A	C	**C**	
1060	Sesayap-20	RES	Kaltim	949.2	2,633.3	1,656.91	14.7%	A	A	C	**C**	
1063	Sesayap-15	RES	Kaltim	313.2	956.7	848.89	9.4%	B	A	C	**C**	
1064	Telen	RES	Kaltim	193.2	544.4	552.85	8.4%	B	A	C	**C**	
4	**TOTAL**			**2,575.2**	**7,433.6**	**4,891.3**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3041	Pinoh	RES	Kalbar	198.0	1,374.8	602.91	16.1%	A	A	**D**	**D**	
3038	Kelai-2	RES	Kaltim	168.0	1,102.9	331.69	22.6%	A	A	**D**	**D**	

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
3042	Silat	RES	Kalbar	29.0	129.5	165.41	5.7%	A	**D**	**D**	**D**	
3037	Pade Kembayung	RES	Kalbar	30.0	235.0	336.17	--	**D**	A	B	**D**	
3039	Amandit-2	RES	Kalsel	2.5	20.1	39.96	--	B	C	B	**C**	
3036	Kusan-3	RES	Kalsel	68.0	100.5	156.89	6.7%	C	A	C	**D***	
3035	Riam Kiwa	RES	Kalsel	42.0	151.6	247.98	3.7%	A	**D**	**D**	**D**	
3040	Kayan-2	RES	Kaltim	500.0	3,832.5	588.12	42.9%	C	**D**	**D**	**D**	
8	**TOTAL**			**1,037.5**	**6,946.9**	**2,469.1**						

Note) Highlighted schemes are taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(3) Sulawesi

All the hydro schemes in Sulawesi have obtained good environmental and economical evaluation except Poigar-3 in North Sulawesi and Palu-3 in Central Sulawesi both of which may violate Conservation Forest areas. In addition to the schemes in Table 8, Bonto-Batu scheme (100 MW) which was modified from a reservoir scheme to a run-of-river scheme, was selected in the Realistic Scenario.

Table 8 Conventional hydro schemes in Sulawesi

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1065	Poso-2	ROR	Sulteng	132.8	1,125.4	208.93	43.6%	A	A	A	**A**	Construction
1066	Poso-1	ROR	Sulteng	204.0	1,341.0	300.61	37.6%	A	A	A	**A**	Construction
1068	Lariang-6	RES	Sulteng	209.4	616.2	382.13	14.3%	C	A	B	**C**	
1075	Karama-1	RES	Sulsel	800.0	2,147.1	1,481.11	13.5%	C	A	B	**C**	
1076	Masuni	RES	Sulsel	400.2	930.2	714.01	13.1%	B	A	C	**C**	
1077	Mong	RES	Sulsel	255.6	618.9	474.22	12.8%	A	B	C	**C**	
1079	Watunohu-1	ROR	Sultra	57.0	309.0	142.29	15.6%	C	A	A	**C**	
7	**TOTAL**			**2,059.0**	**7,087.7**	**3,703.3**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3020	Malea	ROR	Sulsel	182.0	1,477.0	298.73	39.6%	A	A	A	**A**	
3016	Bakaru (2nd)	ROR	Sulsel	126.0	471.0	184.16	24.9%	A	A	A	**A**	
3019	Poko	RES	Sulsel	233.0	760.0	350.28	18.6%	B	B	B	**B**	
3023	Batu	RES	Sulsel	271.0	1,740.2	563.96	21.1%	C	B	C	**C**	
3017	Lasolo-4	RES	Sulteng	100.0	770.0	232.00	22.8%	C	B	C	**C**	
3021	Konaweha-3	RES	Sulteng	24.0	116.0	55.68	16.3%	C	C	C	**C**	

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
1074	Tamboli	ROR	Sultra	25.8	158.9	47.79	26.3%	C	A	A	C	
2030	Sawangan	ROR	Sulut	16.0	73.5	26.01	24.8%	A	A	A	**A**	
3022	Poigar-3	ROR	Sulut	14.0	98.6	33.49	21.3%	**D**	A	A	**D**	
3018	Palu-3	LOT	Sulteng	75.0	510.0	121.80	28.4%	**D**	B	A	**D**	
10	**TOTAL**			**1,066.8**	**6,175.2**	**1,913.9**						

Note) Highlighted schemes are taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(4) Maluku

Out of seven, three hydro schemes were discarded in the Realistic Scenario. Lamo-1 and Talawi which are both located in the Halmahera Island in the North Maluku Province (*Provinsi Maluku Utara*), were automatically discarded due to their small capacities (less than 10 MW) in this study. However, they will be prospective considering the demand scale of their supply areas although Talawi has low economical feasibility along with Mala-1 in the Seram Island in the Maluku Province.

On the contrary, Mala-2, Isal-2 and Tala which were selected in the Realistic Scenario, are all located in the Seram Island, and three hydro schemes with the total capacity of 144 MW seem excessive for the system demand in the current decade even if the islands of Ambon and Seram are interconnected with 150 kV transmission lines in 2017. PLN have a plan to develop only Isal-2 with 2 x 20 MW capacity in 2017 & 2018 in RUPTL, which seems rather reasonable.

Table 9 Conventional hydro schemes in Maluku

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1082	Mala-2	ROR	Maluku	30.4	209.0	73.15	20.5%	C	A	A	**C**	
1083	Mala-1	RES	Maluku	27.8	65.4	92.83	6.1%	C	A	C	**C**	
2	**TOTAL**			**58.2**	**274.4**	**166.0**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3050	Isal-2	RES	Maluku	60.0	447.0	116.09	25.6%	C	A	B	**C**	
1084	Tala	RES	Maluku	54.0	167.0	118.61	12.0%	B	B	C	**C**	
1085	Tina	ROR	Maluku	12.0	49.3	33.83	11.3%	B	A	A	**B**	
3051	Lamo-1	RES	Malut	5.7	25.0	13.22	13.3%	--	--	--		
	Talawi	RES	Malut	7.5	26.4	39.08	4.1%					

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
5	**TOTAL**			**139.2**	**714.6**	**320.8**						

Note) Highlighted schemes are taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(5) Papua

Only a single scheme Warsamson (49.0 MW) was selected in Papua region in the Realistic Scenario, which is also listed in the latest RUPTL and expected to start operation in 2016/17 with capacity 31 MW capacity. Muturi in West Papua and Titinima-3 in Papua have little difficulties in environment and economy, but their capacities seem too large for the demand and the delivery system of their supply area. Although Maredrer was discarded due to the small capacity and low economy, it may be prospective in light of its capacity while its EIRR is a little lower.

Table 10 Conventional hydro schemes in Papua

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1103	Muturi-1	ROR	Papua	45.8	288.3	164.16	11.3%	B	A	A	**B**	
1101	Titinima-3	ROR	Papua Barat	55.6	402.2	234.33	10.7%	C	A	A	**C**	
1102	Maredrer	ROR	Papua	8.7	62.4	39.27	9.6%	A	A	A	**A**	
1098	Gita/Ransiki-1	LOT	Papua Barat	56.2	136.2	142.03	8.9%	C	A	C	**C**	
1104	Siewa-1	ROR	Papua	58.4	330.5	246.76	8.7%	C	A	A	**C**	
5	**TOTAL**			**224.7**	**1,219.6**	**826.6**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3052	Warsamson	RES	Papua Barat	49.0	248.0	153.70	11.3%	B	A	C	**C**	

Note) The highlighted scheme is taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(6) Nusa Tenggara

Only a single scheme Wai Ranjang (11.1 MW) was selected in Nusa Tenggara in the Realistic Scenario. Watupanggantu was discarded due to its small capacity, and other schemes have some difficulties in environment or economy. Considering the demand scale in Nusa Tenggara Timur, the development of Watupanngantu seems to be appropriate.

Table 11 Conventional hydro schemes in Nusa Tenggara

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1106	Parainglala	ROR	NTT	14.9	85.6	43.82	13.8%	**D**	A	A	**D**	
1108	Watupanggantu	ROR	NTT	7.1	40.5	26.92	10.0%	A	A	A	**A**	
1109	Karendi-1	RES	NTT	21.4	49.5	57.60	7.9%	A	B	B	**B**	
3	**TOTAL**			**43.4**	**175.5**	**128.3**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre FS were conducted												
1112	Wai Ranjang	ROR	NTT	11.1	59.4	32.60	12.7%	C	A	A	**C**	
3046	Beburung	ROR	NTB	22.0	90.6	55.94	14.6%	**D**	A	A	**D**	
3047	Putih-1	ROR	NTB	5.6	29.0	20.87	9.5%	--	--	--		
3048	Putih-2	ROR	NTB	4.1	22.0	15.28	9.8%	--	--	--		
3049	Putih-3	ROR	NTB	6.1	32.0	22.73	9.8%	--	--	--		
1111	Kambera-2	RES	NTT	17.0	65.2	52.84	9.1%	A	B	B	B	
	Sitoto	RES	NTT	15.2	46.5	118.54	--	C	A	B	C	
7	**TOTAL**			**81.1**	**344.6**	**318.8**						

Note) The highlighted scheme is taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

(7) Java-Madura-Bali

Out of 18, 14 hydro schemes were discarded in the Realistic Scenario. 10 schemes (Cikaso-3, Gintung, Rawalo-1, Grindulu-2, Kesamben, Ayung-1, Ayung-2, Ayung-3, and Teldewaja) have low economic feasibilities (*i.e.* EIRR is less than 10 percent), among which five schemes (Gintung, Grindulu-2, Ayung-1, Ayung-2, and Ayung-3) have environmental difficulties at the same time. In case of Java-Madura-Bali region, the number of involuntary resettlement is liable to be the most serious concern due to its high population density, and all the seven schemes given the worst evaluation in environment were supposed to require more than 1,000 household resettlement. Cimandiri -1 has little difficulties in Table 12, but the project economy was found to be less after the field survey which was detailed in Chapter 9 in the Main Report (Table 9.8.1).

Table 12 Conventional hydro schemes in Java-Madura-Bali

Working No.	Scheme Name	Type	Province	Installed Capacity (MW)	Annual Total Energy (GWh)	Project Cost (2011 US$)	Project EIRR	Forest Classification	Resettlement	Reservoir Area	Environment	IPP
CONVENTIONAL HYDROPOWER SCHEMES which passed the 3rd Screening in HPPS2												
1115	Cibareno-1	ROR	Jabar	17.5	117.0	64.10	11.8%	A	A	A	**A**	
1116	Cimandiri-1	ROR	Jabar	24.4	167.5	98.87	10.7%	A	A	A	**A**	
1110	Teldewaja	ROR	Bali	7.0	44.2	36.48	7.8%	A	A	A	**A**	
3	**TOTAL**			**48.8**	**328.8**	**199.4**						
CONVENTIONAL HYDROPOWER SCHEMES for which D/D, F/S or pre F/S were conducted												
3025	Rajamandala	ROR	Jabar	58.0	215.9	134.56	13.5%	A	B	B	**B**	
3026	Jatigede	RES	Jabar	175.0	777.0	406.00	15.8%	A	**D**	C	**D**	
3024	Maung	RES	Jateng	360.0	534.9	593.41	10.5%	A	C	B	**C**	
3027	Cibuni-3	RES	Jabar	172.0	568.0	421.39	11.0%	A	**D**	C	**D**	
3028	Cipasang	RES	Jabar	400.0	751.1	559.58	14.7%	A	**D**	C	**D**	
3029	Cimandiri-3	RES	Jabar	238.0	600.0	406.67	13.9%	A	**D**	C	**D**	
3032	Cibuni-4	RES	Jabar	71.0	207.3	136.80	13.5%	A	C	B	**C**	Construction
3033	Cikaso-3	RES	Jabar	30.0	188.9	174.35	5.8%	A	A	B	**B**	
3030	Gintung	RES	Jateng	19.0	81.4	133.34	2.7%	A	**D**	C	**D**	
3031	Rawalo-1	LHD	Jateng	0.6	5.2	3.52	7.7%	A	A	B	**B**	
3034	Grindulu-2	RES	Jatim	16.0	51.3	96.79	2.7%	A	**D**	B	**D**	
1113	Kesamben	LHD	Jatim	37.0	60.0	96.06	5.9%	A	B	A	**B**	
3043	Ayung-1 (Sidan)	ROR	Bali	23.0	68.0	76.46	7.4%	A	A	A	**D***	
3044	Ayung-2 (Selat)	ROR	Bali	19.0	51.6	53.51	8.8%	A	A	A	**D***	
3045	Ayung-3 (Buangga)	LHD	Bali	1.8	12.1	24.01	--	A	A	A	**D***	
15	**TOTAL**			**1,620.4**	**4,172.7**	**3,316.5**						

Note) Highlighted schemes are taken into account in the Realistic Scenario, and underlined parts indicate the reasons why the schemes were discarded in the Realistic Scenario.

Appendix 2 Environmental Data and Information

LIST OF CONTENTS

Background and Current Situation of National Strategy of Biodiversity in Indonesia

Indonesia prepared the national strategy on biodiversity in 1993 namely Biodiversity Action Plan for Indonesia (BAPI) in order to satisfy the following three objectives before ratifying United Nation "Convention on Biological Diversity" in 1993

- To reduce the rate degradation in primary forest, wetlands, coral reefs and other terrestrial and marine habitats
- To develop the availability of data and information o the richness of national biodiversity to be used by decision makers and he public to make informed decisions
- To encourage a more sustainable and environmentally friendly use of natural resources

BAPI was prepared by BAPPENAS, Ministry of Forestry, Ministry of Environment, Ministry of Agriculture, Ministry of Internal Affairs, research institutes and NGOs. However, it was not effectively implemented due to limited ownership and commitment among stakeholders since BAPI was centralized top-down as well as no legal effectiveness. BAPI was revised in order to achieve the objectives of CBD such as conservation of biodiversity comprehensively and sustainable utilization of biological resources, and Indonesian Biodiversity Strategy and Action Plan (IBSAP) was established in 2003 with the five objectives and goals for these objectives. IBSAP recommended to develop strategy at regional level based on IBSAP since IBSAP was national level strategy.

- To develop the quality of Indonesian individuals and society who are concerned with the conservation and sustainable use of biodiversity
- To strengthen resources for supporting the development of science, technology and the application of local wisdom for the conservation and sustainable use of biodiversity
- To reduce and stop the rate of biodiversity degradation and extinction at the national, regional and local level within the 2003-2020 period, along with rehabilitation and sustainable use efforts.
- To empower institutional, policy and law enforcement arrangements at the national, regional, local, as well as customary level so as to be effective and conducive for the management of biodiversity in a synergic, responsible, accountable, fair, balanced and sustainable manner
- To achieve fair and balance of roles and interests of Indonesian society, as well as to reduce conflict potential among all relevant sectors in a conducive, synergic, responsible, accountable manner in the sustainable use and conservation of biodiversity

Appendix 15.1 List of Flora

No.	Scientific Name	Local Name	Status
I.	**Woody Plant Species**		
1	*Macaranga javanica* Muell. Arg.	Acilmong	-
2	*Vitex quinata* Druce	Alban	-
3	*Neonaucle calycina* (Bart.) Merr.	Alngit	-
4	*Trichospermum javanicum* Bl.	Andilo	-
5	*Adinandra sarosanthera* Miq.	Api-api	-
6	*Litsea lanceolata* (Blume) Kosterm.	Baking-baking	-
7	*Timonius wallichianus* Valet.	Besi-besi	-
8	*Vernonia arborea* Buch.-Ham.	Burnaik	-
9	*Macaranga maingayi* Hook. f.	Coping-coping	-
10	*Durio zibethinus* Murr.	Durian	-
11	*Syzygium magnoliaefolium* DC.	Gacip	-
12	*Leptospermum flavescens* Cardwell	Gelam bukit	-
13	*Glochidion hypoleucum* (Miq.) Boerl.	Goring-goring	-
14	*Dyera costulata* (Miq.) Hook.f	Jelutung	-
15	*Garcinia rigida* Miq.	Kaantas	-
16	*Theobroma cacao* L.	Kakao	-
17	*Hevea brasiliensis* (Willd. ex A.Juss.) Muell.Arg.	Karet	-
18	*Bridelia glauca* Blume	Kati beno	-
19	*Rhodamnia cinerea* Jack	Kayu baja	-
20	*Quercus maingayi*	Kayu hoting	-
21	*Castanopsis javanica* A.DC.	Kecing-a	-
22	*Quercus subsericea* A.Camus	Kecing-b	-
23	*Styrax benzoin* Dryand.	Kemenyaan	-
24	*Lansium domesticum* Corr.	Langsat	-
25	*Symplocos rubiginosa* Wall.	Leba	-
26	*Syzygium* sp.	Lomas	-
27	*Commersonia bartramia* Merr.	Longa-longa	-
28	*Cordia dichotoma* Forst. f.	Lunan	-
29	*Litsea machilifolia* Gamble	Mandu amas	-
30	*Litsea resinosa* Blume	Medang baka	-
31	*Nothaphoebe umbelliflora* Blume	Medang landit	-
32	*Shorea faguetiana* Heim.	Meranti kuning	Endangered
33	*Shorea bracteolata* Dyer.	Meranti putih	Endangered
34	*Shorea dasyphylla* Foxw.	Meranti sabut	Endangered
35	*Parkia speciosa* Hassk.	Petai	-
36	*Arthrophyllum diversifolium* Blume	Piturup	-
37	*Nephelium lappaceum* L.	Rambutan hutan	-
38	*Cinnamomum iners* Reinw.ex Blume	Sabal putih	-
39	*Melicope lunu-akenda* (Gaert.) T.G.Hartley	Sitongkel, simartolu	-
40	*Macaranga triloba* Muell. Arg.	Sitorop	-
41	*Baccaurea pubera* Muell.Arg.	Tangir-tangir	-
42	*Lindera polyantha* (Blume) Boerl.	Tarsa	-
43	*Artocarpus elasticus* Reinw. ex Blume	Terep	-
44	*Buchanania sessilifolia* Blume	Tungus	-
II.	**Palms & Bamboos**		
1	*Areca catechu*	Pinang	-
2	*Arenga obtusifolia*	Langkok	-

3	*Arenga pinnata*	Enau	-
4	*Bambusa vulgaris*	Aur kuning	-
5	*Calamus* spp.	Rotan	-
6	*Cocos nucifera*	Kelapa	-
7	*Daemonorops* spp.	Rotan minyak	-
8	*Gigantochloa apus*	Bambu tali	-
9	*Korthalsia* spp.	Rotan	-
10	*Licuala ferruginea*	Daun palas	-
11	*Oncosperma tigillarium*	Nibung	-
12	*Pinanga* sp.	Pinang hutan	-
13	*Plectocomia griffithii*	Rotan badak	-
14	*Salacca zalacca*	Salak	-
15	*Schizostachyum zollingeri*	Tamiang	-
16	*Zalacca affinis*	Salak utan	-
III . Linias & Climbers			
17	*Nepenthes gracilis*	Takul-takul	-
18	*Dioscorea alata*	Gaduang	-
19	*Dioscorea esculenta*	Gaduang	-
20	*Mikania scandens*	Mikania	-
21	*Tetracera sacandens*	Liana	-
22	*Tetrastigma pedunculare*	Liana	-
IV. Herbs, grasses & shrubs			
23	*Alocasia spp.*	Kaladi	-
24	*Costus speciosus*	Sitawa	-
25	*Crotalaria mucronata*	Orok-orok	-
26	*Curculigo campanulata*	Bedur	-
27	*Curcuma aeruginosa*	Temu ireng	-
28	*Curcuma longa*	Kunyit	-
29	*Cymbopogon citratus*		-
30	*Cymbopogon nardus*	Sarai	-
31	*Cyperus spp.*	Rumput teki	-
32	*Etlingera coccinea*	Tepus	-
33	*Etlingera elatior*	Kincuang	-
34	*Globba sp.*	Lempuyang	-
35	*Hedychium coronarium*	Gandasuli	-
36	*Homalomena cordata*	Talas hutan	-
37	*Hornstedtia spp.*	Jahe hutan	-
38	*Imperata cylindrica*	Alang-alang	-
39	*Lantana camara*	Bungo cik ayam	-
40	*Mapania spp.*	Pandan rimbo	-
41	*Melastoma malabathricum*	Sikeduduk	-
42	*Musa acuminata*	Pisang utan	-
43	*Musa paradisiaca*	Pisang	-
44	*Oryza sativa*	Padi	-
45	*Saccharum officinarum*	Tibarau	-
46	*Saccharum spontaneum*	Tibarau	-
47	*Themeda gigantea*	Pimping	-
48	*Urena lobata*	Pulutan kebo	-
49	*Zanthoxylum acanthopodium*	Andaliman	-
V. Ferns			
50	*Angiopteris evecta*		-
51	*Antrophylum reticulatum*	*Paku palea*	-

52	*Archipteris sp.*	Pakis	-
53	*Asplenium nidus*	Pakis sarang burung	-
54	*Chingia ferox*	Pakis	-
55	*Cyathea contaminant*	Pakis pohon	-
56	*Diplazium esculentum*	Paku sayur	-
57	*Gleichenia linearis*	Paku rasam	-
58	*Gleichenia microphylla*	Paku rasam	-
59	*Plathycerium bifurcatum*	Sakek tanduk ruso	-
60	*Platycerium coronarium.*	Sakek tanduk ruso	-
61	*Selaginella spp.*	Sigaga	-
VI. Orchid			
62	Bulbophyllum spp.		-
63	Calanthe speciosum	Anggrek kalante	-
64	Colegyne spp.	Anggrek sulegin	-
65	Cymbidium finlaysonianum	Anggrek uncal	-
66	Dendrobium crumenatum	Anggrek merpati	-
67	Dendrobium spp.	Anggrek	-
68	Eria spp.	Anggrek	-
69	Eria latifolia	Anggrek	-
70	Flickingeria spp.	Anggrek	-
71	Spathoglottis triplicata	Anggrek	-
72	Polydota spp.	Anggrek	-

Source: Study Team, November, 2010.

Note: IUCN red list: EN: endangered

Appendix 15.2 List of Mammal Species

No.	Scientific Name	Local Name	Status	Data Source & Type of Encounter
1	*Rusa unicolor*	Rusa sambar	VU	Interview
2	*Neofelis nebulosa*	Macan dahan	VU	Interview
3	*Helarctos malayanus*	Beruang madu	VU	Interview
4	*Macaca fascicularis*	Monyet ekor panjang	VU	Primary: sight
5	*Macaca namestrina*	Beruk	VU	Primary: sight
6	*Aonyx cinerea*	Sero ambrang	VU	Primary: sight
7	*Sus barbatus*	Babi berjenggot	VU	Primary: track
8	*Trachypithecus cristatus*	Lutung kelabu	NT	Primary: sight
9	*Lariscus hosei*	Bajingtanah bergaris-empat	NT	Interview
10	*Prionailurus bengalensis*	Kucing kuwuk	LC	Interview
11	*Tragulus napu*	Pelanduk napu	LC	Interview
12	*Cynopterus brachyotis*	Codot krawar	LC	Primary: sight
13	*Aeromys tephromelas*	Bajing terbang hitam	DD	Interview
14	*Callosciurus notatus*	Bajing kelabu	LC	Interview
15	*Callosciurus orestes*	Bajing kelapa	LC	Primary: sight
16	*Petaurista petaurista*	Bajing-terbang	LC	Primary: sight
17	*Suncus murinus*	Munggis	LC	Primary: sight, voice,smell
18	*Paradoxurus hermaproditus*	Musang luwak	LC	Primary: sight

Source: Study Team, November, 2010

Note: IUCN red list: VU: vulnerable; LC: least concern; NT: near threatened

Appendix 15.3 List of Bird Sspecies

No.	*Scientific Name*	Local Name	Status	Data Source & Type of Encounter
1	*Elanus caeruleus*	Elang tikus	LC	Primary: sight
2	*Ictinaetus malayensis*	Elang hitam	LC	Primary: sight
3	*Pandion haliaetus*	Elang tiram	LC	Primary: sight, voice
4	*Spilornis cheela*	Elang ular-bido	LC	Primary: sight
5	*Alcedo atthis*	Raja udang erasia	LC	Primary: sight
6	*Alcedo coerulescens*	Raja udang biru	LC	Primary: sight
7	*Alcedo meninting*	Raja udang meninting	LC	Primary: sight
8	*Lacedo pulchella*	Cekakak batu	LC	Primary: sight, voice
9	*Todiramphus chloris*	Cekakak sungai	LC	Primary: sight, voice
10	*Collocalia esculenta*	Walet sapi	LC	Primary: sight
11	*Artamus leucorynchus*	Kekep babi	LC	Primary: sight
12	*Anorrhinus galeritus*	Enggang klihingan	LC	Primary: sight
13	*Anthracoceros malayanus*	Kangkareng hitam	NT	Primary: sight
14	*Megalaima haemacephala*	Takur ungkut-ungkut	LC	Primary: sight
15	*Chloropsis cyanopogon*	Cica daun kecil	NT	Primary: sight
16	*Chloropsis sonnerati*	Cica daun-besar	LC	Primary: sight
17	*Ducula aenea*	Pergam hijau	LC	Primary: sight
18	*Streptopelia chinensis*	Tekukur biasa	LC	Primary: sight
19	*Treron curvirostra*	Punai lengguak	LC	Primary: sight
20	*Eurystomus orientalis*	Tiong lampu biasa	LC	Primary: sight
21	*Corvus enca*	Gagak hutan	LC	Primary: sight, voice
22	*Cacomantis sonneratii*	Wiwik lurik	LC	Primary: sight
23	*Rhopodytes diardi*	Kadalan beruang	NT	Primary: sight
24	*Dicaeum chrysorrheum*	Cabai rimba	LC	Primary: sight
25	*Dicrurus paradiseus*	Srigunting batu	LC	Primary: sight
26	*Lonchura leucogastroides*	Bondol jawa	LC	Primary: sight
27	*Lonchura maja*	Bondol haji	-	Primary: sight
28	*Delichon dasypus*	Layang-layang rumah	LC	Primary: sight
29	*Hirundo tahitica*	Layang-layang batu	LC	Primary: sight
30	*Motacilla cinerea*	Kicuit batu	LC	Primary: sight
31	*Motacilla flava*	Kicuit kerbau	LC	Primary: sight
32	*Copsychus malabaricus*	Kucica hutan	LC	Primary: sight, voice
33	*Copsychus saularis*	Kucica kampung	LC	Primary: sight, voice
34	*Anthreptes simplex*	Burung madu polos	LC	Primary: sight
35	*Anthreptes malacensis*	Burung madu kelapa	LC	Primary: sight
36	*Passer montanus*	Burung-gereja erasia	LC	Primary: sight
37	*Chrysocolaptes lucidus*	Pelatuk tunggir-emas	LC	Primary: sight, voice
38	*Dendrocopos canicapillus*	Caladi belacan	LC	Primary: sight
39	*Meiglyptes tristis*	Caladi batu	LC	Primary: sight
40	*Loriculus galgulus*	Serindit melayu	LC	Primary: sight
41	*Pycnonotus aurigaster*	Cucak kutilang	LC	Primary: sight, voice
42	*Pycnonotus brunneus*	Merbah mata merah	LC	Primary: sight, voice
43	*Pycnonotus goiavier*	Merbah cerukcuk	LC	Primary: sight, voice
44	*Pycnonotus simplex*	Merbah corok-corok	LC	Primary: sight
45	*Otus lempiji*	Celepuk reban	-	Primary: voice
46	*Acridotheres javanicus*	Kerak kerbau	-	Primary: sight
47	*Gracula religiosa*	Tiong emas	LC	Primary: sight
48	*Orthotomus atrogularis*	Cinenen belukar	LC	Primary: sight

49	*Orthotomus cuculatus*	Cinenen gunung	LC	Primary: sight
50	*Orthotomus ruficeps*	Cinenen kelabu	LC	Primary: sight
51	*Prinia atrogularis*	Perenjak gunung	LC	Primary: sight
52	*Prinia familiaris*	Perenjak jawa	LC	Primary: sight
53	*Leiothrix argentauris*	Mesia telinga-perak	LC	Primary: sight
54	*Harpactes reindwartii*	Luntur gunung	-	Primary: sight
55	*Zosterops palpebrosus*	Kacamata biasa	LC	Primary: sight

Source: Study Team, November, 2010

Note: IUCN red list: LC: least concern; NT: near threatened

Appendix 15.4 List of Herpetofauna Species

No.	Scientific Name	Local Name	Status	Data Source & Type of Encounter
I.	Retiles			
1	*Draco volans*	Cicak terbang	LC	Primary: sight
2	*Naja sumatrana*	Ular sendok sumatra	-	Interview
3	*Gekko gecko*	Tokek rumah	-	Primary: voice
4	*Heosemys spinosa*	Kura-kura nanas	EN	Primary: sight
5	*Python reticulatus*	Ular sanca kembang	-	Interview
6	*Mabuya multifasciata*	Kadal kebun	-	Primary: sight
7	*Varanus salvator*	Biawak	LC	Primary: sight
8	*Trimeresurus albolabris*	Ular bungka	-	Primary: sight
II.	Amphibians			
1	*Ingerophrynus quadriporcatus*	Kodok puru hutan	LC	Interview
2	*Phrynoidis aspera*	Bangkong sungai	LC	Primary: sight
3	*Huia sumatrana*	Kongkang sumatra	LC	Interview
4	*Polypedates colletti*	Katak-pohon	LC	Interview
5	*Polypedates macrotis*	Katak-pohon telinga-gelap	LC	Interview
6	*Polypedates otilophus*	Katak-bertelinga kalimantan	LC	Interview
7	*Rhacophorus bifasciatus*	Cica daun-besar	NT	Interview

Source: Study Team, November, 2010

Note: IUCN red list: EN (Endangered), LC: least concern; NT: near threatened

Appendix 15.5 List of Fish Species

No.	Scientific Name	Local Name
1	*Osteochilus vittatus*	Pora-pora
2	*Tor tambroides*	Garing/jurung/batak
3	*Tor tambra*	Ikan batak
4	*Hampala macrolepidota*	Barau
5	*Tor soro*	Ikan batak
6	*Rasbora sumatrana*	Bada/Pantau
7	*Hampala macrolepidota*	Barau
8	*Mastacembelus armatus*	Tilan
9	*Osteochilus kappenii*	Selokan
10	*Mystacoleucus marginatus*	Masai
11	*Puntius binotatus*	Ikan Kapareh
12	*Rasbora trilineata*	Bada/Pantau
13	*Leiocassis micropogon*	Punti
14	*Chana chana*	Gabus

Source: Study Team(Interview and Secondary data,2010)

Appendix 21.1 List of Flora

No.	Scientific Name	Local Name	Status
I.	**Woody Plant Species**		
1	*Aleurites moluccana*	Kemiri/dama tondeh	-
2	*Alstonia scholaris*	Pulai	-
3	*Alstonia sp.*		-
4	*Artocarpus elasticus*	Tarok	-
5	*Artocarpus heterophylla*	Nangka	-
6	*Artocarpus integer*	Cempedak	-
7	*Averrhoa bilimbi*	Buluh	-
8	*Calliandra calothyrsus*		-
9	*Ceiba pentandra*	Kapuk	-
10	*Cinnamomum burmanii*	Kulit manis	-
11	*Coffea arabica*	Kopi	-
12	*Durio zibethinus*	Durian	-
13	*Syzygium aqueum*	Kalek jambu air	-
14	*Syzygium aromaticum*	Cengkeh	-
15	*Eugenia cymosa*	Kalek hitam	-
16	*Eugenia densiflora*	Kalek jambu	-
17	*Eugenia glauca*	Kalek	-
18	*Euria acuminata*		-
19	*Ficus ampelas*	Kayo aro	-
20	*Ficus fistulosa*	Kayo aro	-
21	*Ficus glomerata*	Kayo aro	-
22	*Ficus hispida*	Kayo aro	-
23	*Ficus padana*	Simantuang	-
24	*Ficus sinuata*	Kayo aro	-
25	*Ficus sp1.*	Kayo aro	-
26	*Ficus sp2.*	Kayo aro	-
27	*Ficus variegata*	Kayo aro	-
28	*Garcinia mangostana*	Manggis	-
29	*Garcinia forbesii*	Kandih rimbo	-
30	*Garcinia globulosa*	Kandih rimbo	-
31	*Gossypium sp.*		-
32	*Hevea brasiliensis*	Karet	-
33	*Lansium domesticum*		-
34	*Leea indica*		-
35	*Lithocarpus sp.*	Pasang	-
36	*Castanopsis rhamnifolia*	Barangan	-
37	*Lithocarpus ewyckii.*	Paniang paniang	-
38	*Macaranga gigantea*	Sapek gadang	-
39	*Macaranga peltata*	Sapek	-
40	*Macaranga tanarius*	Sapek	-
41	*Macaranga triloba*	Sapek sarang samuik	-
42	*Mallotus paniculatus*	Balik angin	-
43	*Mangifera foetida*	Bacang	-
44	*Melia azedarach*	Mindi	-
45	*Mussaenda erythrophylla*	Nusaindah rimbo	-
46	*Pangium edule*	Simawuang	-
47	*Parkia speciosa*	Patai	-
48	*Phyllanthus pulcher*	Sipadiah	-

49	*Piper aduncum*	Sirih hutan	-
50	*Piper ramipilum*	Sirih hutan	-
51	*Archidendron pauciflorum*	Jariang	-
52	*Poemetia pinnata*	Kasai	-
53	*Nepheleum lappaceum*	Rambutan hutan	-
54	*Polyscias sp.*	Mangkokan	-
55	*Schima wallicii*	Kayu puspa	-
56	*Swietenia mahagoni*	Mahoni	-
57	*Symplocos sp.*		-
58	*Terminalia sp.*	Ketapang	-
59	*Theobroma cacao*	Kakao	-
60	*Toona sureni*	Surian	-
61	*Aglaia trichostemon*	Kalek	-
62	*Dysoxylum acutangulum*	Ambalau	-
63	*Sandoricum koetjape*	Kecapi	-
64	*Bischofia javanica*	Bintungan	-
65	*Baccaurea recemosa*	Kapunduang	-
66	*Hopea mengarawan*	Kalek mandirawan	-
67	*Prashorea plicata*	Maranti	-
68	*Shorea sumatrana*	Maranti	-
69	*Dillenia suffruticosa*	Simpur	-
70	*Palaquium sp.*	Nyatuah	-
71	*Payena sp.*	Nyatuah	-
72	*Cassia alata*	Ketepeng cina	-
73	*Dendrocnide stimulans*	Jilatang	-
74	*Cyathea contaminant*	Pakis pohon	-
Palms & Bamboos			
75	*Areca catechu*	Pinang	-
76	*Arenga obtusifolia*	Langkok	-
77	*Arenga pinnata*	Enau	-
78	*Cocos nucifera*	Karambie	-
79	*Oncosperma tigillarium*	Nibuang	-
80	*Pinanga kuhlii*	pinang-pinangan	-
81	*Plectocomia griffithii*	Rotan badak	-
82	*Daemonorops spp.*	Rotan minyak	-
83	*Calamus spp.*	Rotan	-
84	*Korthalsia spp.*	Rotan	-
85	*Licuala ferruginea*	Daun palas	-
86	*Salacca zalacca*	Salak	-
87	*Zalacca affinis*	Salak utan	-
88	*Gigantochloa apus*	Bambu tali	-
89	*Schizostachyum zollingeri*	Tamiang	-
90	*Bambusa vulgaris*	Aur kuniang	-
III . Linias & Climbers			
91	*Rubus moluccanus*	Pancaringek	-
92	*Tetrastigma pedunculare*		-
93	*Derris scandens*	Urek tubo	-
94	*Mikania scandens*	Rumput PKI	-
95	*Tetracera sacandens*	Aka ampaleh	-
96	*Dioscorea alata*	Gaduang	-
97	*Dioscorea esculenta*	Gaduang	-
98	*Nepenthes ampullaria*	Cecerek	-

IV. Herbs, grasses & shrubs			
99	*Ageratum conyzoides*	Babandotan	-
100	*Alocasia macrorhiza*	Kaladi rimbo	-
101	*Alocasia spp.*	Kaladi	-
102	*Amorphophalus titanum*	Kembangbangkai	-
103	*Amorphophallus bulbifer*	Kembangbangkai	-
104	*Imperata cylindrica*	Alang-alang	-
105	*Cymbopogon nardus*	Sarai	-
106	*Cymbopogon citratus*		-
107	*Setaria palmifolia*	Rumpuik batuang	-
108	*Themeda gigantea*	Pimping	-
109	*Canavalia ensiformis*	Kacang pedang	-
110	*Canavalia microcarpa*	Kacang paga	-
111	*Clerodendrum japonicum*	Bunga pagoda	-
112	*Costus speciosus*	Sitawa	-
113	*Crotalaria mucronata*	Orok-orok	-
114	*Curculigo campanulata*	Bedur	-
115	*Curcuma longa*	Kunyit	-
116	*Curcuma aeruginosa*	Temu ireng	-
117	*Cyperus spp.*	Rumput teki	-
118	*Mapania spp.*	Pandan rimbo	-
119	*Elettaria cardamomum*	Kapulaga	-
120	*Etlingera coccinea*	Tepus	-
121	*Etlingera elatior*	Kincuang	-
122	*Globba sp.*	Lempuyang	-
123	*Hedychium coronarium*	Gandasuli	-
124	*Homalomena cordata*	Talas hutan	-
125	*Hornstedtia spp.*	Jahe hutan	-
126	*Lantana camara*	Bungo cik ayam	-
127	*Ludwigia ascendens*		-
128	*Melastoma malabathricum*	Sikeduduk	-
129	*Monochoria limnocharis*	Genjer	-
130	*Monocharia sagittata*		-
131	*Musa ornata*	Pisang keruak	-
132	*Musa paradisiaca*	Pisang	-
133	*Musa acuminata*	Pisang utan	-
134	*Saccharum officinarum*	Tibarau	-
135	*Saccharum edule*	Terubuk	-
136	*Saccharum spontaneum*	Tibarau	-
137	*Urena lobata*	Pulutan kebo	-
138	*Wedelia sp*	Bunga mentega	-
139	*Zingiber sp.*	Pua dasun	-
140	*Erechtites valerinaefolia*		-
V. Orchids & epiphytes			
141	*Bulbophyllum spp.*		-
142	*Calanthe speciosum*	Anggrek kalante	-
143	*Colegyne dayana*		-
144	*Colegyne asperata*		-
145	*Cymbidium finlaysonianum*	Anggrek uncal	-
146	*Dendrobium crumenatum*	Anggrek merpati	-
147	*Dendrobium spp..*	Anggrek	-
148	*Eria obliterata*	Anggrek	-

149	*Eria latifolia*	Anggrek	-
150	*Flickingeria spp.*	Anggrek	-
151	*Spathoglottis triplicata*	Anggrek	-
152	*Arachnis flos-aeris*	Anggrek kalajengking	-
153	*Polydota gibbosa*		-
154	*Angiopteris evecta*		-
155	*Asplenium nidus*	Pakis sarang burung	-
156	*Gleichenia linearis*	Paku rasam	-
157	*Gleichenia microphylla*	Paku rasam	-
158	*Platycerium coronarium.*	Sakek tanduk ruso	-
159	*Plathycerium bifurcatum*	Sakek tanduk ruso	-
160	*Selaginella spp.*	Sigaga	-
161	*Archipteris sp.*	Pakis	-
162	*Chingia ferox*	Pakis	-
163	*Diplazium esculentum*	Paku sayur	-
164	*Antrophylum reticulatum*	Paku palea	

Source: Study Team, November, 2010.

Appendix 21.2 List of Mammal Species

No.	*Scientific Name*	Local Name	Status	Data Source & Type of Encounter
1	*Presbytis melalophos*	Simpai	EN	Sight
2	*Macaca nemestrina*	Beruk, Baruak	VU	Sight
3	*Macaca fascicularis*	Karo	LC	Sight
4	*Hylobates agilis*	Ungko	EN	Voice
5	*Tapirus indicus*	Tapir	EN	Footprint
6	*Sus scrofa*	Babi hutan	LC	Footprint
7	*Pteropus* sp.	Kalong	-	Sight
1	*Helarctos malayanus*	Baribeh	VU	Interview
2	*Panthera tigris*	Datuk	EN	Interview
3	*Prionailurus bengalensis*	Kucing lalang	LC	Interview
4	*Panthera pardus*	Harimau dahan	NT	Interview
5	*Muntiacus muntjak*	Kijang	LC	Interview
6	*Tragulus kanchil*	Pelanduk	LC	Interview
7	*Hystrix javanica*	Landak	LC	Interview
8	*Paradoxurus hermaphroditus*	Tamaninjuak	LC	Interview
9	*Cervus timorensis*	Rusa	-	Interview
10	*Nycticebus coucang*	Kukang	VU	Interview
11	*Symphalangus syndactylus*	Siamang	EN	Interview

Source: Study Team, November, 2010.

Note: IUCN red list: EN: endangered; VU: vulnerable; NT: near treathened LC: least concern

Appendix 21.3 List of Bird Sspecies

No.	*Scientific Name*	Local Name	Status	Data Source & Type of Encounter
1	*Actitis hypoleucos*	Trinil pantai	LC	Sight
2	*Alcedo meninting*	Raja-udang meninting	LC	Sight
3	*Amaurornis phoenicurus*	Kareo padi	LC	Sight
4	*Anthreptes malacensis*	Burung-madu kelapa	LC	Sight
5	*Arachnothera longirostra*	Pijantung kecil	LC	Voice
6	*Buceros rhinoceros*	Rangkong badak	NT	Sight
7	*Buceros vigil*	Rangkong gading	NT	Sight
8	*Centropus sinensis*	Bubut besar	LC	Sight
9	*Cisticola juncidis*	Cici padi	LC	Sight
10	*Collocalia esculenta*	Walet sapi	LC	Sight
11	*Collocalia fuciphaga*	Walet sarang-putih	LC	Sight
12	*Cynniris jugularis*	Burung-madu sriganti	LC	Sight
13	*Dicaeum trigonostigma*	Cabai bunga-api	LC	Sight
14	*Dicaeum trochileum*	Cabai Jawa	LC	Sight
15	*Enicurus velatus*	Meninting kecil	LC	Voice
16	*Eurylaimus ochromalus*	Sempur hujan-darat	LC	Voice
17	*Halcyon smyrnensis*	Cekakak belukar	LC	Sight
18	*Hemiprocne longipennis*	Tepekong jambul	LC	Sight
19	*Hemipus hirundinaceus*	Jinjing batu	LC	Sight
20	*Hirundo tahitica*	Layang-layang batu	LC	Sight
21	*Lonchura striata*	Bondol tunggir-putih	LC	Sight
22	*Loriculus galgulus*	Serindit melayu	LC	Sight
23	*Megalaima australis*	Takur tenggeret	LC	Voice
24	*Megalaima chrysopogon*	Takur gedang	LC	Voice
25	*Megalaima mystacophanos*	Takur warna-warni	LC	Voice
26	*Merops leschenaulti*	Kirik-kirik senja	LC	Sight
27	*Motacilla cinerea*	Kicuit kelabu	LC	Sight
28	*Muscicapa dauurica*	Sikatan bubik	LC	Sight
29	*Nyctyornis amictus*	Cirik-cirik kumbang	LC	Sight
30	*Orthotomus ruficeps*	Cinenen kelabu	LC	Sight
31	*Passer montanus*	Burung gereja Erasia	LC	Sight
32	*Pernis ptilorhyncus*	Sikep-madu Asia	LC	Sight
33	*Pycnonotus aurigaster*	Cucak kutilang	LC	Sight
34	*Pycnonotus atriceps*	Cucak kuricang	LC	Sight
35	*Pycnonotus brunneus*	Merbah mata-merah	LC	Sight
36	*Pycnonotus goiavier*	Merbah cerukcuk	LC	Sight
37	*Pycnonotus melanicterus*	Cucak kuning	LC	Voice
38	*Prinia atrogularis*	Prenjak gunung	LC	Sight
39	*Prinia familiaris*	Prenjak Jawa	LC	Sight
40	*Spilornis cheela*	Elang-ular bido	LC	Sight
41	*Streptopelia chinensis*	Tekukur biasa	LC	Sight
42	*Todirhamphus chloris*	Cekakak sungai	LC	Voice
43	*Todirhamphus sanctus*	Cekakak suci	LC	Sight
1	*Aegithina viridissima*	Cipoh jantung/Culian	LC	Interview
2	*Alophoixus bres*	Empuloh janggut	LC	Interview
3	*Apus pacificus*	Kapinis laut	LC	Interview
4	*Argusianus argus*	Kuau raja	NT	Interview
5	*Cacomantis merulinus*	Wiwik kelabu	LC	Interview
6	*Chalcophaps indica*	Delimukan jamrud	LC	Interview
7	*Chloropsis aurifrons*	Cica-daun Dahi-emas	LC	Interview
8	*Chloropsis cochinchinensis*	Cica-daun Sayap-biru	LC	Interview
9	*Copsychus malabaricus*	Kucica hutan	LC	Interview
10	*Copsychus saularis*	Kucica kampung	LC	Interview
11	*Corvus enca*	Gagak kampung	LC	Interview
12	*Dicrurus remifer*	Srigunting bukit	LC	Interview
13	*Gallus gallus*	Ayam-hutan merah	LC	Interview
14	*Garrulax palliatus*	Poksai mantel	LC	Interview
15	*Geopelia striata*	Perkutut Jawa	LC	Interview
16	*Haliastus indus*	Elang bondol	LC	Interview
17	*Ictinaetus malayensis*	Elang hitam	LC	Interview
18	*Irena puella*	Kecembang gadung	LC	Interview
19	*Lanius schach*	Bentet kelabu	LC	Interview
20	*Lonchura maja*	Bondol haji	LC	Interview

21	*Lonchura punctulata*	Bondol peking	LC	Interview
22	*Meiglyptes tristis*	Caladi batu	LC	Interview
23	*Oriolus chinensis*	Kepodang kuduk-hitam	LC	Interview
24	*Otus* sp.	Celepuk	?	Interview
25	*Pitta sordida*	Paok hijau	LC	Interview
26	*Serilophus lunatus*	Madi dada-perak	LC	Interview
27	*Streptopelia bitorquata*	Dederuk Jawa	LC	Interview
28	*Turnix suscitator*	Gemak loreng	LC	Interview

Source: Study Team, October, 2010.
Note: IUCN red list: LC: least concern; NT: near threatened

Appendix 15.4 List of Herpetofauna Species

No.	*Scientific Name*	Local Name	Status	Data Source & Type of Encounter
I.	Retiles			
1	*Calotes cristatelus*	Kalalso	-	Interview
2	*Dendrelaphis pictus*	Ula Lidi	-	Interview
3	*Draco volans*	Ula Dakuak	-	Interview
4	*Dryopsis prasinus*	Ula Pucuak	-	Interview
5	*Mabouya multifasaciata*	Bingkaruang	-	Interview
6	*Natrix suscicator*	Ula Aia	-	Interview
7	*Phyton reticulatus*	Ula Sanca	-	Interview
8	*Trimeresurus sumatranus*	Ula Cantiak Manih	-	Interview
9	*Trionyx cartilagenus*	Labi-labi	-	Interview
10	*Varanus salvator*	Biawak	-	Interview
II.	**Amphibians**			
1	*Bufo asper*	Kangkuangn Kasek	-	Interview
2	*Bufo melanostictus*	Kangkuang kasek	-	Interview
3	*Bufo parvus*	Kangkuang kasek	-	Interview
4	*Ichtyophsis elongatus*	Lipai	-	Interview
5	*Leptophyrin borbonica*	Koncek Rancak	-	Interview
6	*Megophrys montana*	Koncek Tanduak	-	Interview
7	*Occidozyga sumatrana*	Koncek Licin	-	Interview
8	*Rana crancrivora*	Koncek Licin	-	Interview
9	*Rana hosii*	Koncek Licin	-	Interview
10	*Rana limnocharis*	Koncek Licin	-	Interview
11	*Rana macrodon*	Kodok Gadang		Interview

Source: Secondary Data & Data Interview, 2010

Appendix 21.5List of Fish Species

No.	*Scientific Name*	Local Name
1	*Anguilla sumatrana*	Ikan Panjang
2	*Awaous gramnepomus*	Mungkus
3	*Clarias batrachus*	Lele
4	*Cyprinus carpio*	Ikan Ameh/ Lambau
5	*Glossogobius biocellatus*	Mungkus
6	*Glyptosternum majus*	Lapu Minyak
7	*Hampala macrolepidota*	Barau
8	*Homaloptera gymogaster*	Mungkus
9	*Homaloptera tateregani*	Lapu Betung
10	*Labeobarbus soro*	Ikan Gariang
11	*Labeobarbus tambroides*	Ikan Gariang
12	*Labistes eticulates*	Pantau Buncik
13	*Leiocassis micropogon*	Punti
14	*Mastacembelus armatus*	Tilan
15	*Monopterus albus*	Belut
16	*Mystacoleucus marginatus*	Masai
17	*Mystus numerus*	Baung
18	*Mystus planiceps*	Baung
19	*Nemacheilus fasciatus*	Tali-tali
20	*Oreochromis mossambicus*	Ikan Mujaie
21	*Oreochromis niloticus*	Nila
22	*Osteocheilus hasseltii*	Ikan Paweh
23	*Osteochilus kappenii*	Selokan
24	*Osteochilus vittatus*	Lelan
25	*Puntius binotatus*	Ikan Kapareh
26	*Rasbora argyrotaenia*	Pantau Panjang
27	*Rasbora jacobsoni*	Bada/Pantau
28	*Rasbora sumatrana*	Bada/Pantau
29	*Rasbora trilineata*	Bada/Pantau
30	*Sicyopterus macrostetholepis*	Ikan Mungkuih
31	*Sicyopterus micrurus*	Mungkus
32	*Stiphodon micrurus*	Mungkus
33	*Tylognathus hispidus*	Kulari
34	*Tylognathus kajanensis*	Kulari

Source: Study Team(Interview and Secondary data,2010)

List of Interviewees in Environmental Survey

1. Simanggo-2 Area

No	Date	No. of Interviewee	Position of Interviewee	Interview Method	Remarks
1	24 Nov., 2010	2	The formal subvillage leader as well as religous leader of Sitanduk subvillage, Siantar Sitanduk Village, Kec. Tarabintang	Verval interview	- Conducted at the Catholic church of stasi Siantar Sitanduk - One local people participated
2	24 Nov., 2010	6	The Raja Huta of Rambung subvillage, Siantar Sitanduk Village, kec. Tarabintang	Verval interview	- Conducted at the coffee shop - Five local people participated
3	24 Nov., 2010	2	The Raja Huta of Anggoci subvillage, Siantar Sitanduk Village, Kec. Tarabintang	Verval interview	- Conducted at the coffee shop - One local people participated
4	24 Nov., 2010	7	The Raja Huta of Lae Maga subvillage, Siantar Sitanduk Village, Kec. Tarabintang	Verval interview	- Conducted at the house of the resident - Six local people participated
5	24 Nov., 2010	1	The formal village leader of Tarabintang, Kec. Tarabintang	Verval interview	- Conducted at the home-office of tarabintang village
6	24 Nov., 2010	1	The formal village leader of Sion Tonga, Kec. Parlilitan	Verval interview	- Conducted at the Kepala Desa resident
7	25 Nov., 2010	1	The Kepala Desa Sion Selatan, Kec. Parlilitan	Verval interview	- Conducted at the Kepala Desa resident
8	25 Nov., 2010	3	The Raja Huta of Huta Nangka subvillage, Sion Selatan village, Kec. Parlilitan	Verval interview	- Conducted at the cofee shop - Two local people participated
9	1 Feb., 2011	3	The formal village leader of Sion Tonga, Kec. Parlilitan	Verval interview	- Conducted at the coffee shop - Two local people participated
10	1 Feb., 2011	1	The Sion Runggu village administrator, Kec. Parlilitan	Verval interview	- Conducted at the home-office of village administrator
11	2 Feb., 2011	1	Raja Huta of Pea Balane subvillage Sion Selatan village, Kec. Parlilitan	Verval interview	- Conducted at the Raja Huta resident
12	2 Feb., 2011	3	Village Secrertary of Sihas Tonga, Kec. Parlilitan	Verval interview	- Conducted at the store - Two local people participated
13	2 Feb., 2011	1	Secrertary of Kec. Parlilitan	Verval interview	- Conducted at the Parlilitan sub-district office

2. Masang-2 Area

No	Date	No. of Interviewee	Position of Interviewee	Interview Method	Remarks
1	29 Oct., 2010	1	The formal and ethnic leader in Jorong Koto Tinggi, Nagari Ampek Koto, Kec. Palembayan, Kab. Agam.	Verval interview	- Conducted at the leader resident
2	29 Oct., 2010	1	The ethnic leader in Telang, Jorong Batu Badinding Selatan, Nagari Limo Koto, Kec. Bonjol, Kab. Pasaman	Verval interview	- Conducted at the coffee shop
3	29 Oct., 2010	1	The formal and ethnic leader in Jorong Sipisang, Nagari Nan Tujuah, Kec. Palupuh, Kab. Agam	Verval interview	- Conducted at the leaer resident
4	30 Oct., 2010	5	Formal leader of Nagari Ampek Koto, Kec. Pelembayan, Kab. Agam	Verval interview	- Conducted at the meeting room nagari office - Four jorong leaders attended
5	30 Oct., 2010	1	The intellectual and representative leader to Lariang in Jorong Bamban, Nagari Ampek Koto, Kec. Palembayan, Kab. Agam	Verval interview	- Conducted at the coffee shop
6	30 Oct., 2010	1	The formal and Informal Leader of the Jorong Bamban, Nagari Ampek Koto, Kec. Palembayan, Kab. Agam	Verval interview	- Conducted at the leader resident
7	31 Oct., 2010	1	Ssecretary of the Nagari Limo Koto, Kec. Bonjol, Kab. Pasaman	Verval interview	- Conducted at the secretary resident
8	31 Oct., 2010	1	Ex-formal and religion leader in Jorong Koto Tinggi, Nagari Ampek Koto, Kec. Palembayan, Kab. Agam	Verval interview	- Conducted at the coffee shop
9	31 Oct., 2010	5	The formal leader in Jorong Batasariak, Nagari Nan Tujuah, Kec. Palupuh, Kab. Agam.	Verval interview	- Conducted at the coffee shop - Four local people participated
10	1 Nov., 2010	6	Formal leader Jorong Batu Badinding Selatan, Nagari Lima Koto, Kec. Bonjol, Kab. Pasaman Timur.	Verval interview	- Conducted at the jurong office - Five local people participated
11	2 Nov., 2010	6	Informal leader Jorong Air Kijang, Nagari Nan Tujuah, Kec. Palupuh, Kab. Agam,	Verval interview	- Conducted at coffee shop - Five local people participated

3. Photos of Interview at Simanggo-2 Area

Inteview with Formal Village Leader at Sion Tonga, Kec. Palilitan (24th Nov, 2010)

Inteview with Raja Huta at Rambung Sub-village, Kec. Tarabintang (24th Nov, 2010)

Interview with Raja Huta at Anggoci sub-village, Kec. Tarabintang (24th Nov, 2010)

Interview with Raja Huta at Lae Maga sub-village, Kec. Tarabintang (24th Nov, 2010)

Interview with formal and religious leader at Sitanduk Sub-village, Kec. Tarabintang (24th Nov, 2010)

Interview with formal village leader at Tarabintang village, Kec. Tarabintang (24th Nov, 2010)

4. Photos of Interview at Masang-2 Area

Interview with formal and religious leader at Jorong Koto Tinggi, Kec. Palembayan (29th Oct 2010)

Interview with ethnic leader at Jorong Batu Badinging Selatan, Kec. Bonjol (29th Oct 2010)

Interview with formal leaders at Jorong Banban & Nagari Ampek Koto Kec. Palembayan (30th Oct, 2010)

Interview with secretary at Nagari Limo Koto Kec. Bonjol (31st Oct 2010)

Interview with formal leader at Jorong Batasariak, Kec. Palupuh (31st Oct, 2010)

Interview with formal and informal leader at Jorong Bamban, Kec. Palembayan (30th Oct, 2010)

Discussion in Stakeholder Meetings

No.	Inquiries/Comments by Participants	Reply by MEMR/PLN/the Study Team
1st Stakeholder Meeting in Jakarta		
1	Who are the counterparts in this Study?	MEMR and PLN are the counterparts of this Study
2	Is it possible that any other stakeholders participate in technology transfer scheme if they are interested in?	Possibility of participation by other stakeholders to technology transfer will be further discussed among MEMR, PLN and the Study Team.
3	What are the different points between the previous study (HPPS2) and the Study being conducted now?	As more than 10 years have passed after the HPPS2, circumstances of hydropower development such as power demand and supply balance, and environmental and social considerations have been changed. Thus, updating the data and prioritization criteria is necessary.
4	Why JICA guidelines shall be applied in this Study	JICA Guidelines describes to respect the environmental regulations at a recipient country. Thus, the Study is necessary to meet the requirements mentioned both in the Indonesian regulation and JICA Guidelines.
5	Does the Study take account of urgency of power need in rural areas?	The Study will select prioritized regions by examining comprehensively the transmission line conditions, power supply/demand balance, urgency, hydropower potential and environmental aspects. Such prioritized regions will be the basis for selecting the prioritized schemes.
6	Is it possible to participate in technology transfer scheme?	Possibility of participation by other stakeholders to technology transfer will be further discussed among MEMR, PLN and the Study Team.
7	Please describe criteria in detail.	The Study Team is now examining the method of ranking, which will be further discussed with the counterparts.
8	How the small size hydropower projects (10kW~30kW) will be treated in the Study?	The approach is different. This Study focuses on the large size hydropower projects, and the small size hydropower project might be examined in other studies
9	How do you examine when reservoir type will be converted into run-of-river (ROR) type?	In case the reservoir type is planned at the site of which longitudinal gradient is steep, examination from viewpoints of energy and environment will be conducted for changing reservoir type to ROR type.
10	Does this Study examine rehabilitation of existing hydropower plants?	It will be examined by another JICA study to be conducted soon. This Study examines additional power supply installation only
11	Please describe the method of technical transfer?	In the case of environmental considerations, the following three methods will be applied. • Method of environmental impact assessment (IEE level) • Preparation of checklist for environmental and social considerations • Preparation of guideline for holding

		stakeholder meeting
12	How the relevant authorities will be involved in this Study?	MEMR and PLN are the counterparts of the Study. In addition, information from relevant authorities will be indispensable in this Study such as from Ministry of Forests, Ministry of Environment or Ministry of Public Works. Close coordination with those authorities will be kept by the Study Team as well as the counterparts
13	Does this Study mention installation timing of the prioritized schemes?	Yes. Installation timing of the prioritized schemes will be mentioned in the mater plan in this Study
14	It is recommended to provide the list of 10 potential projects to stakeholders through establishing a website of this Study before holding 2nd stakeholder meeting to ask their opinion beforehand.	It is not sure at this moment to establish the website is appropriate or not, which will be further discussed with the counterparts
15	Which JICA Guidelines do you apply in this Study?	The JICA Guidelines issued in April 2004 is applied.
16	Is examination of environmental monitoring included in this Study?	Examination of environmental monitoring is not included in the scope of this Study.
2nd Stakeholder Meeting in Jakarta		
1	Some of potential sites which the Study Team examined are located in the west side of Sumatra where protection forests are widely extending. How is impact on those by the projects?	The Study Team has checked type of forest by the forestry maps. Two sites for Pre F/S; that is, Simanggo-2 and Masang-2 are both judged being out of protection forests and conservation forests. Further confirmation will be done in Pre F/S stage.
2	Does the Study Team take account of issues of rehabilitation of the catchment areas?	Rehabilitation of the catchment areas is an important issue in Indonesia. This issue will be further discussed with Ministry of Forestry and related agency in Pre F/S stage.
3	Permission for development in forest is required for access road and transmission line also.	Exact alignment of the access road and transmission line will be further studied in Pre F/S stage considering the forest type at the site.
4	Ministry of Forestry has much information related to endangered species that may contribute to the Study	Further consultation with Ministry of Forestry will be made in conducting Pre F/S.
5	Obtaining permission is required before conducting a survey within the protection forest.	PLN will take necessary action for obtaining survey permission in forest.
6	Hydropower development may induce social, economic, or cultural impact during its construction stage such as: poverty, loss of land due to land acquisition, loss of job, cleanliness of domestic water and availability of irrigation water.	Site survey in the Pre F/S will be conducted according to provisional scoping as seen in ANNEX 3. Especially the Study will confirm water use and water right at the water recession section.
7	Is the cost of the transmission line included in the cost estimate by the Study Team?	Yes, such cost is included in the cost estimate.
8	Many of hydropower plants suffer sedimentation problem. How about this issue for the projects in the Study?	In case of run-of-river type projects like in this Study, provision of sufficient dimensions of sluice gates is necessary for flushing the sedimentation in regulating ponds. Detailed examination will be conducted in preliminary design of Pre F/S.
9	It seems that priority is given to Sumatra for	Selection of the Pre F/S site was made by

	selection of Pre F/S sites. Why not Jawa Island?	comparison of schemes with respect of environment and project economy, not by giving priority to any specific regions.
10	The Study should take account of issues for conservation of catchment areas.	Consideration will be made on this issue by further consultation with Ministry of Forest.
11	Regulation of Ministry of Forestry No. 2, 2009 for tax of land use permit stipulates: - Rp. 1,250,000/year/ha for the production forest - Rp. 1,500,000/year/ha for the protected forest	Comments by the participant are noted.
12	Hydropower development planning is necessary to be integrated in management planning of watershed (DAS).	Comments by the participant are noted.
13	Ministry of Forestry is ready to provide information on land cover map of watershed.	Comments by the participant are noted.
Stakeholder Meeting in Medan		
1	There are some proposals by IPP for schemes which are located within the reach between the intake and powerhouse of Simanggo-2.	Sumatra power supply system definitely requires substantial amount of peak-hydro installation to cope with rapid growth of peak demand. Hydro potential of the Simanggo River should be developed with peak-hydro like Simanggo-2, not with small scale hydro which only would generate insecure base power.
2	Power generation by a set of small scale hydro would be larger than the one by Simanggo-2, as Simanggo-2 would generate electricity only for 5 hours per day.	Power generation by Simanggo-2 would not be limited to firm power for 5 hours, but secondary power would be generated by river discharge which exceeds the firm discharge. Annual average energy by Simanggo-2 is estimated at 416 GWh in Pre-F/S.
3	Application for Izin Prinsip would be required if PLN intended to proceed to subsequent stage; i.e. Feasibility Study for Simanggo-2. Also further coordination with department of forestry and environmental office of the Regency would be required in the subsequent stage.	Comments by the participant are noted.
4	It is suggested to communicate with traditional chiefs named as “Raja Huta” in the EIA (AMDAL) stage.	Comments by the participant are noted.
5	There was a kind of conflict between local inhabitant and IPP during its construction stage due to lack of mutual communication. Careful public involvement will be suggested in the subsequent stage of the study.	Comments by the participant are noted.
6	Implementation of Simanngo-2 will contribute improvement of public infrastructures at the areas.	Comments by the participant are noted.
7	It is suggested to enlarge the capacity of intermediate pond so as to obtain more power to be generated by Simanggo-2.	Necessitated capacity of the pond will be re-checked again in the subsequent stage, although optimization of the scale was already examined in this Pre-feasibility Study.
Stakeholder Meeting in Padang		
1	Cooperation among PLN, Regency and Sub-district is required in the socialization in AMDAL (EIA) stage.	Agreed.

2	Watershed management of the Masang River is necessitaed.	Comments by the participant are noted.
3	Socialization will be required in the subsequent stages for land acquisition, although social impact by implementing Masang-2 seems to be small.	Agreed.
4	Coordination would be required with Province with regard to water use of the Masang River, as the river ranges in several regencies	Agreed.
5	Classification of the forest should be checked jointly with Regency at the site.	Such joint checking world be held in the subsequent stage.
6	Is Masang-2 to be developed by IPP or PLN?	The project would be developed by PLN.
7	Does “Masang-1” exist?	A hydro potential had been identified as Masang-1 at the upstream of Masang-2. However this scheme was discarded as its project economy was less.
8	The project might induce increase of sedimentation due to its clearing activity. As Pasaman Regency is located at the downstream of the project site, coordination will be required.	Comments by the participant are noted.
9	Socialization would be required in AMDAL (EIA) which would be conducted in 2012 according to the schedule.	Agreed.
10	Sub-district Bonjol offen suffered inundation with water at his area, and asked if construction of the intake weir of Masang-2 would induce negative impact on this.	The pondage upstream of the intake weir will be with a limited scale in the river course, and thus will not cause substantial inundation.
11	Where is the position of the Masang-2 powerhouse?	The powerhouse will be located at the immediate downstream of the confluence between the Alahanpanjang River and the Masang (Sianoek) River.
12	How is the environmental impact due to water recession between the intake weir and powerhouse ?	The duty flow (river maintenance flow) will be discharged in downstream of the intake weir, and discharges from several tributaries will also flow in at this section. Detailed examination will be again conducted in AMDAL (EIA).
13	Will tributary water be utilized for power generation by Masang-2 ?	Tributary water will not be used.
14	Will any fish farming be possible in the intermediate pondage of Masang-2	It would not be possible.
15	As the project area ranges within two regencies, AMDAL will be supervised by Province. Publication by newspaper will be conducted in that stage.	Comments by the participant are noted.
3rd Stakeholder Meeting in Jakarta		
1	How is the sequence of implementation of the hydro projects proposed in the master plan?	Implementation of the hydro projects which has less environmental impact would precede the others.
2	It is suggested that the master plan will include mini-hydro.	Approaches for planning medium/large-scale hydro and mini-hydro are different, and this master plan targets on planning of medium/large-scale hydro.
3	Watershed management is important to prevent sedimentation. It is necessity to charge a fee for	Agreed on the importance of watershed management in general. Further discussion will

	that.	be necessitated as for the tolling.
4	How the maximum plant discharge was determined in Pre F/S ?	The maximum plant discharge was determined so as to ensure peak-power operation in case of firm discharge (95% dependability) would be available.
5	How the 2 schemes in Pre-F/S will contribute to power supply in the surrounding areas of the project site ?	Although the 2 schemes were mainly aimed to supply peak power to the Sumatra power supply system, those schemes would also contribute to improve the power supply condition in the surrounding area as the transmission facilities there would be also reinforced.
6	Clarification on the selected numbers of candidates for Pre F/S in the Study.	Initially 10 candidates were selected, but 2 candidates were then discarded as other IPP schemes had been already committed there. Thus the site reconnaissance surveys were conducted at the 8 candidate sites.
7	Is the hydro capacity to be developed in the Realistic Scenario (approx. 8,000MW) for Sumatra only, or for overall Indonesia ?	For overall Indonesia.
8	Involuntary resettlement does not necessarily mean resettlement to remote areas from the original domicile.	The issue would depend on specific conditions of each hydro scheme.
9	It is suggested that CDM will be considered for the 2 schemes of Pre-F/S.	CDM is considered in the sensitivity analysis in economical and financial analysis in Pre-F/S.
10	Socialization will be important in the next stage.	Agreed. Socialization will be further conducted by PLN in the subsequent AMDAL stage.
11	Cooperation will be further necessary with relevant authority related to forest conservation.	Agreed. It is expected that such cooperation would be continued among the parties concerned
12	If the project is sited in two Regencies, the Province would be in charge for the process of AMDAL.	Maang-2 would be the case for that.

【Final】
Good Practice for Holding Public Consultation

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TABLES

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND OF THIS REPORT

In Indonesia, conducting environmental study at the higher stage of project planning such as master plan level is not stipulated in the environmental related regulations. However, the JICA Project for Master Plan Study of Hydropower Development in Indonesia (hereafter the Study) applied for the concept of Strategic Environmental Assessment (SEA)[1] in order to understand and examine impact to environment and social from the higher stage of project planning. According to JICA Guidelines, higher stage is composed of the following three sub-stages;

i) Policy stage: stage of reviewing/making policies to be incorporated into the Master Plan

ii) Plan stage: stage of examining/planning stages, techniques and alternative scenarios for a Master Plan

iii) Program stage: stage of examining/planning project components and implementation schedule included in a Master Plan

As one of approaches of SEA, the Study held three times of public consultations with the following objectives;

i) Conducting environmental study by considering site information

ii) Examining public opinion for improving a project plan

One of aims of the Study is technology transfer to the counterparts through OJT. Thus, some points to hold public consultation are compiled as the good practice based on the Japanese examples of Public Involvement (PI) and experience of stakeholder meetings conducted in the Study. It is expected that PLN will utilize and develop the guideline through project planning.

1.2 OBJECTIVE OF THIS REPORT

Based on the Indonesian legal framework of information dissemination and public participation (i.e., Decree of Head of BAPEDAL (Environmental Impact Agency) No .8/2000: about People Involvement and Information Disclosure on the Analytical Process Concerning AMDAL), JICA Guidelines for Environmental and Social Considerations issued in April 2010 (hereafter JICA Guidelines) and Japanese example of Public Involvement (PI), effective methods of public participation/involvement is introduced to PLN as the guideline for holding public consultation through the Study.

[1] The JICA Guideline defines SEA as “a strategic environmental assessment is an assessment that is implemented in the policy, planning, and program level, but not a project-level EIA”.

The Good Practice for Holding Public Consultation is prepared in order to provide guidance or clue for realizing the following objectives;

i) Enhancement of public understanding and awareness to hydropower projects

ii) Enhancement of public participation to a project planning from the early stage

iii) Establishment of system about public participation

1.3 UTILIZATION OF THIS REPORT

Environmental and social consideration including public consultation at the higher stage of project planning is not mandatory under Indonesian regulations (i.e., AMDAL related regulations and land acquisition regulations) as described. Thus, this report focuses only for public consultation to be held prior to AMDAL study under the responsibility of a project proponent.

Under aforementioned circumstance, the guideline will be utilized to PLN projects which are considered to have potential adverse impact to environment and society at the higher stage of a project planning such as master plan preparation or preliminary feasibility study level. Public opinion to a project is able to be obtained and examined by conducting public consultation, which will be utilized to improve a project planning.

The contents of the report shall be modified and developed according to the project description and regional issues by cooperating relevant authorities for conducting effective public consultation.

CHAPTER 2 ACTUAL SITUATION ON PUBLIC CONSULTATION

2.1 INDONESIAN CASE

Public consultation is held within the two frameworks. One is in the AMDAL study process. According to the regulation on AMDAL, a project proponent is requested to hold public consultations at; i) delineate project design, ii) preparation of TOR for environmental study, iii) during ANDAL study, and iv) evaluation of ANDAL, RKL, and RPL reports. The objective and consultation method at each study stage are shown below.

Table 2-1 Methods of Public Consultation in AMDAL Procedure

Study Stage	Objective	Target	Consultation Method	PIC
Delineate project design	- Explaining general project plan - Opinion exchanging about general project plan	local government, institution, NGOs, village leaders, community leaders	- Interview - Focus group discussion	PLN
Preparation of TOR	- Project description - Expected environmental impact - TOR for environmental study	local government, institution, NGOs, village leaders, community leaders	- Interview - Focus group discussion	PLN
During ANDAL study	- Project description - Expected environmental impact	village leaders, community leaders, PAPs	- Interview - Focus group discussion	PLN
Evaluation of ANDAL, RKL, RPL	- Study result - Environmental management and monitoring plan	Local government, NGOs, village leaders, community leaders	Open style workshop	PLN

Source: Compiled by JICA Study Team based on PLN Information

The noticeable issues on the above public consultation are outlined below;

- Conducting public consultation prior to starting AMDAL study is not common practice.
- Community representatives participate to a public consultation and provide opinion instead of individual participation.
- Opinion obtained through public consultation in the process of AMDAL study is integrated into a project planning.

The other is in the process of land acquisition according to the Presidential Regulation No.36/2005, Presidential regulation No. 65/2006 (amendment of Presidential Regulation No.36/2005) and Regulation of Head of National Land Affairs Agency No.3/2007 showing below:

Table 2-2 Methods of Public Consultation for Land Acquisition

Study Stage	Objective	Target	Consultation Method	PIC
Land acquisition public consultation	- Project description - Compensation scheme - Compensation schedule	Land owner/title holder, village leader	Open style workshop	Land acquisition committee, PLN
Individual consolation for negotiation	Compensation assessment result	Land owner/ title holder	Individual consultation	Land acquisition committee

Source: Compiled by JICA Study Team based on PLN Information

2.2 JAPANESE EXAMPLE OF PUBLIC CONSULTATION

(1) Concept of Public Involvement

The concept of "Public Involvement (PI)" is involvement of public into a decision making process or providing an opportunity for public to participate into a project planning process. PI was originally introduced at United States of America in the process of planning the law "Intermodal Surface Transportation Efficiency Act of 1991". The important issues to be noticed about PI are highlighted below;

i) A project shall be planned by considering several aspects such as policy, engineering issues, financial benefit, environment as well as public opinion. PI is an aspect to understand public opinion.

ii) PI is an opportunity for public and administrative to understand needs to and concepts of a project mutually.

iii) PI is neither the place for decision making nor final decision for project planning. PI is one of approaches for better project planning and one of step for project planning.

iv) Conducting PI is not the objective itself but promoting transparency of project planning and public understanding.

The concept of PI was introduced to Japan in the middle of 1990's, especially to road construction projects. The system of PI was developed after that, and Ministry of Land,

Infrastructure, Transportation and Tourism (MLIT) established the guideline of public involvement for public interest projects in June 2004 with following main objectives;

i) Disseminating/ providing necessary information of a project to public

ii) Enhancement of public involvement into a project planning by promoting transparency of project planning

iii) Planning a project mutually by governmental administration and public

(2) Operational Method of PI

Several methods are applied for conducting PI based on study levels, project nature and regional feature, etc. It is observed that PI contributed for realizing projects delayed or unrealized, which is considered that PI has a function and capability to be an intermediary between public and the administration/ project designer.

In Japanese case, the following methods are generally applied.

Table 2-3 Japanese Example of PI Methods

Method	Description	Advantages/ Disadvantage
Leaflet/ Brochure	- Describing project outline and contents discussed/examined so far. - Distributing to public	- Distributing wide range of stakeholders - Misinterpretation of leaflet/brochure
Public Meeting	- Direct explanation of project description from project proponent to public, and opinion exchanging	- Direct mutual communication between project proponent and stakeholders - Sporadic discussion
Workshop	- Discussion issues according to a theme and find solution	- Providing an opportunity of open discussion about issues in detail and in depth - Biased attendants
Open-house	- Providing visual aids related to a project (i.e., minutia, board, video) at the place where people easily visit	- Able to participate whomever want - Securement of easy access place
Symposium	- Providing a lecture about a project from academic people	- Enhancement of people's understanding - One way communication
Media Advertisement	- Providing information of project by mass media such as webpage, newspaper or regional	- Easy to information accessibility - Easy to access by limited people
Site visit	- Visiting the project site	- Enhancement of understanding to a project as the first hand experience - Difficulty in arrangement

Source: Study Team

2.3 FINDINGS

There found some advantages and disadvantages on public consultation by examining Japanese examples of PI and stakeholder meetings conducted in the Study as summarized below;

(1) Advantages

- The risk of contrary opinion from public to a project or modification of project plan at the last stage of project plan could be minimized by involving public into a project planning process.
- It is possible to understand a current situation of a project area through communication with public, and able to modify a project plan according to a current situation of a project area.
- Public is able to understand concept of project plan.
- Both parties (i.e., public and project proponent/local government) can understand expectation to a project.

(2) Disadvantages

- There is a risk on conflict of interests if project description is disclosed.
- There is a risk that public consider their opinion is the final decision.
- There is a risk of land price increasing when project description is disclosed, which will be one of difficulties for a project implementation.
- There is a risk of influx illegal squatters when project description is disclosed.

CHAPTER 3 APPRICABLE METHOD

3.1 STAKEHOLDER ANALYSIS

In order to hold public consultation, the first and fundamental item to be done is stakeholder analysis. Stakeholder differs at each project due to project nature and location, and therefore involving varieties of stakeholder helps to prepare a useful project. Therefore, stakeholder analysis shall be conducted in the cycle of project planning since the level of stakeholder involvement differs as the study level of a project progressed. Following aspects shall be examined for identifying stakeholders of a project.

i) Sector/Kinds of stakeholder

ii) Position of the stakeholder on a project

iii) Level of influence to a project

iv) Level of interest

v) Groups/coalitions stakeholders belong to

3.2 FREQUENCY OF PUBLIC CONSULTATION

Public consultation is better to be held step by step in the cycle of project planning. As for holding public consultation at the higher stage of project planning, appropriate timing is considered as the following two study stages;

i) Preparation of draft layout of a project in the preliminary feasibility study level

ii) Finalization of draft layout of a project in the preliminary feasibility study level

Table 3-1 Example of Frequency on Public Consultation

Stage	Frequency	Purposes	Contents
Preparation of draft layout	At least 1 time in each project area respectively	- Enhancement of mutual understanding between public and administrative to a project planning and implementation	- Explaining the concept and description of a project - Understanding regional issues and public concerns/interest - Understanding administrative intention of a project
Finalization of draft layout	At least 1 time in each project area respectively	- Basic consensus on a project layout for further study	- Explaining the final project layout - Explaining the study result of the final project layout

Source: Study Team

3.3 METHOD OF PUBLIC CONSULTATION

By considering advantages/disadvantages of PI and Indonesian culture, the limited approaches at the stage of prior to AMDAL study is considered as appropriate as showing in the Table 3-2;

Table 3-2 Public Consultation Methods to be Introduced

Study Stage	Expected Target	Consultation Method	PIC
Preparation of draft layout	- relevant authorities - key persons in kabpaten and kechamantan - relevant private sectors - relevant public sectors - NGOs - academic persons	- focus group discussion - open-style discussion	PLN
Finalization of draft layout	- relevant authorities - key persons in kabpaten and kechamantan - relevant private sectors - relevant public sectors - NGOs - academic persons	- focus group discussion - open-style discussion	PLN

Source: Study Team

DRAFT TERMS OF REFERENCE

ON

PREPARATION OF LAND ACQUISITION AND RESETTLEMENT ACTION PLAN (LARAP)

1. Introduction

In the case of Japanese ODA project, preparation of Resettlement Action Plan (RAP) is requested according to JICA Guidelines for Environmental and Social Considerations (April, 2010) if a project requires large scale of involuntary resettlement.

These draft terms of reference were prepared to prepare Land Acquisition and Resettlement Acquisition Plan (LARAP, hereafter referred as the "Study") if a project (both/either of Masang-2 and/or Simanggo-2) is realized by Japanese ODA.

2. Survey Area

The Study area is described below:

(1) The project site entirely (Masang-2 project site and/or Simanggo-2 project site)

(2) Surrounding communities or villages at the project area

3. Work Items

The Study consists of the following work items.

(1) Collecting the latest relevant regulation and information on land acquisition and resettlement at national and regional level

(2) Preliminary identification of land ownership and project affected persons

(3) Holding socialization at the project site before conducting survey

(4) Conducting census survey, inventory of asset loss survey, and socio-economic survey

(5) Conducting replacement cost survey

(6) Examination of impact magnitude by project implementation

(7) Examination of compensation policy

(8) Supporting to hold public consultation meeting with project affected persons

(9) Preparation of LARAP report based on collected data

4. Scope of Works

(1) Collecting the latest relevant regulation and information on land acquisition and resettlement at national and regional level

The latest relevant regulation on land acquisition and resettlement at national and regional level (provincial and district level) in the study area shall be collected in order to confirm the latest

legal framework of the project area.

(2) Preliminary identification of land ownership and project affected persons

It is necessary to identify project affected persons and confirm their legal title. Thus, relevant information such as land ownership and project affected persons shall be confirmed and preliminary identified from land use map, cadastral map and/or satellite images.

(3) Holding socialization at the project site before conducting census survey, inventory of asset loss survey and socio-economic survey

Holding socialization meeting with stakeholders at the site is indispensable prior to conducting site survey. Thus, appropriate number of socialization meeting with stakeholders shall be held at each community or village by considering local custom.

(4) Conducting census survey, inventory of asset loss survey, and socio-economic survey

These three types of surveys are the baseline surveys to identify project affected persons and confirm baseline information of project affected persons as well as the project area. There is a possibility that the project may affect people surrounding the project area due to water recession though no professional inland fisherman was observed during preliminary feasibility study.

Survey	Study Target	Survey Content
Census Survey	Project affected persons identified preliminary by work item (2)	- Identification of number and address/location of project affected persons - Confirmation of habitation of ethnic minority groups in the study area
Inventory of Asset Loss	Project affected persons identified at Census Survey	Identification of legal title of affected land and physical structure as well as extent of loss
Socio-Economic Survey	All project affected persons	- Confirmation of socio-economic condition including income monthly/annual income, income source, nutrition source, fishing condition/frequency - Confirmation of prospects to the project (any opinion to compensation or livelihood stabilization)

(5) Conducting replacement cost survey

According to JICA Guidelines for Environmental and Social Considerations (April, 2010), compensation is requested to be paid base on replacement cost as much as possible. Thus, conducting replacement cost survey for land and physical structure described below is necessary.

Category	Study Items
Land (Agriculture)	- Confirmation of pre-project or pre-displacement market value of land equal productive potential or use located in the vicinity of the affected land - Confirmation of cost for preparing the land to similar level those of the affected land Confirmation of cost for any registration and transfer taxes
Structure	- Confirmation of market cost of the material to build a replacement structure with area and quantity similar to or better than those of the affected structure, - Confirmation of repair cost - Confirmation of cost of transporting building materials - Confirmation of cost of labor and contractors - Confirmation of cost of registration and transfer taxes

(6) Examination of impact magnitude by project implementation

Impact due to project implementation shall be examined based on collected baseline information at Work Item (4) and the latest project layout. At that time, necessary compensation amount based on replacement cost shall also be estimated.

(7) Examination of compensation policy

There are sometimes difference of a compensation policy on land acquisition and resettlement between the regulation of recipient countries and JICA Guidelines. Thus, such difference shall be identified, and compensation policies shall be examined by covering gaps if identified. In addition, special consideration shall be necessary if socially vulnerable groups such as ethnic minority groups, woman-headed family or the poor are identified as PAPs or their income source will be lost or decreased.

(8) Supporting to hold public consultation meeting with project affected persons

It is necessary to involve project affected persons into the planning and implementation of LARAP. Thus, consultation with project affected persons shall be held when the draft LARAP is available in order to ask compensation policy of the project to project affected persons.

(9) Preparation of LARAP report

Based on the Work Item (1) to (8), LARAP report shall be prepared to cover the following items requested in the JICA Guidelines for Environmental and Social Considerations (April, 2010).

Item	Contents to be Described
1. Description of the Project	General description of the project and identification of the project area
2. Potential Impact	Identification of potential impacts and establishment of minimizing potential impact
3. Objectives	Objectives to prepare LARAP
4. Socio-Economic Studies	Description of results about census survey and socio-economic survey

Item	Contents to be Described
5. Legal Framework	Description of relevant regulations and gaps between national regulations and donor policies
6. Institutional Framework	Findings of analysis of the institutional framework to implement land acquisition and resettlement
7. Eligibility	Definition of displaced persons and criteria for determining their eligibility for compensation and other assistance including cut-off dates
8. Valuation of and Compensation for Losses	Methodology to be used in valuing losses to determine their replacement costs, and description supplementary measures to achieve replacement cost if compensation under national law does not meet replacement cost
9. Compensation and Resettlement Measures	Description of compensation and other resettlement measures
10. Site Selection(*1)	Preparation of site for relocation if relocation of household is occurred.
11. Housing, Infrastructure, and Social Service(*1)	Description of plans to provide necessary infrastructure and social service at the new site if necessary
12. Environmental Protection and Management(*1)	Examination of environmental assessment and environmental management plan for the new site
13. Community Participation	Strategies of community participation from planning to implementation of resettlement
14. Integration with Host Population (*1)	Measures to mitigate the impact to resettlement on any host communities
15. Grievance Procedures	Accessible procedures and mechanism for third-party settlement of disputes arising from resettlement
16. Organizational Responsibility	Organizational framework for implementing resettlement
17. Implementation Schedule	Implementation schedule covering all resettlement activities from preparation through implementation
18. Costs and Budget	Estimated cost for all resettlement activities
19. Monitoring and Evaluation	Arrangements for monitoring of resettlement activities by the implementing agencies supplemented by independent monitors

Remark: Items marked in *1 is necessary to be examined if involuntary resettlement is caused.

5. Tentative Work Schedule

Tentative overall schedule of the Study is shown below.

Work Items	Month 1	Month 2	Month 3	Month 4
1) Confirmation of relevant regulations and information				
2) Holding socialization meeting				
3) Identification of project affected households from existing information				
4) Conducting baseline surveys				
5) Conducting replacement cost survey				
6) Examination of impact				
7) Examination of compensation policy				
8) Supporting to hold public consultation(s) with PAPs				
9) Reporting	IC/R	Pr/R	DF/R	FR

Note: IC/R: Inception Report, Pr/R: Progress Report, DF/R: Draft Final Report, F/R: Final Report

Environmental Check List for Simanggo-2

Environmental Item	Check Items	Check Results
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) In Pre-F/S, involuntary resettlement is not recognized. However this shall be again checked in further stages. (b) Not given in Pre-F/S. Actions shall be taken in further stages. (c) Resettlement plan is not yet prepared in Pre-F/S. Actions shall be taken in further stages. (d) Actions shall be taken in further stages. (e) Actions shall be taken in further stages. (f) Actions shall be taken in further stages. (g) Actions shall be taken in further stages. (h) Actions shall be taken in further stages. (i) Actions shall be taken in further stages. (j) Actions shall be taken in further stages.
(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?	(a) Some negative impact due to acquisition of cultivated area and generation of water recession section might occur. (b) Impact to the neighboring area might be less. Further confirmation is required. (c) Implementation of the project might improve conditions of traffic system. (d) Possibility cannot be denied. Consideration shall be taken in further stages. (e) In Pre-F/S, downstream water use is not recognized. However this shall be again

	(f) Is there any possibility that reductions in water flow downstream or seawater 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?	checked in further stages. (f) Impact on downstream water and land uses might be less. However, further confirmation is required. (g) Further confirmation is required. (h) In Pre-F/S, neither professional fishery nor water use for irrigation are identified. This shall be again checked in further stage.
(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) According to the inventory report, no cultural heritages are recorded. However, there might be the cultural relic called Gurih-gurih.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) Excavation for construction might adversely affect the local landscape. To minimize such effect, penstock is laid underground.
(5) Ethnic Minorities and Indigenous Peoples	(a) Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? (b) Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	(a) Actions shall be taken in further stages. (b) Actions shall be taken in further stages.
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) The project site is out of the conservation forest (hutan konservasi). No possibility is identified that the project will affect the conservation forest.
(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	(a) Most of the project site is within the secondary forest. (b) 3species of Flora and 5 species of Fauna are identified at the site as "endangered" or "vulnerable" according to IUCN category. (c) Maintenance flow of 1.0m^3/s at the downstream of intake weir is considered

	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?	in Pre-F/S. This shall be checked again in further stage. (d) Impact on migratory fish species shall be confirmed in further stage.
(3) Hydrology	(a) Is there a possibility that hydrologic changes 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) The project might affect the surface and ground water flows to some degree. However, the impact would be rather less as the areas related are less populated.
(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)?	(a) As the scale of the intake weir to be constructed is rather small, impact of the sedimentation would be also not significant. (b) Excavation for construction might alter the topographic features. However such impact is not significantly serious.
(5)Global Warming	(a) No emission of GHG(Methane) due to eutrophication of reservoir?	(a) Pond scale is small. Eutrophication of the pond would not be an issue.
Environmental Pollution		
(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? (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?	(a) Pond scale is small. Proliferation of plankton in the pond would not be an issue. (b) Pond scale is small. Degradation of water quality in the pond would not be an issue (c) Actions shall be taken in further stages. (d) Maintenance flow of 1.0m^3/s at the downstream of intake weir is considered in Pre-F/S. This shall be checked again

	(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 areas?	in further stage (e) Scale of the pond is small and difference of water temperature in the pond would not be an issue.
(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Actions shall be taken in further stages.
Others		
(1) Impacts during Construction	(a) Is there a possibility that temporary land occupation, quarrying, earth borrowing and waste disposal will impact on surface vegetation, and cause soil erosion? (b) Is there a possibility that construction disturbance will affect the habitats of terrestrial animals? (c) Is there a possibility that wastewater from production and living areas of construction will affect the surrounding water environment? (d) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (e) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (f) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) There is a possibility. Countermeasures shall be considered in further stages. (b) There is a possibility. Countermeasures shall be considered in further stages. (c) There is a possibility. Countermeasures shall be considered in further stages. (d) Actions shall be taken in further stages. (e) Actions shall be taken in further stages. (f) Actions shall be taken in further stages.
(2) Operation	(a) Fluctuation of water level in the river from off-peak time to peak time is not dangerous for local inhabitants? Are adequate measures considered to mitigate the impact, if any?	(a) Downstream of the powerhouse is not populated. However, measures such as warning siren shall be considered in further stages.
(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) Are the items, methods and frequencies included in the monitoring program judged to be appropriate? (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) Actions shall be taken in further stages. (b) Actions shall be taken in further stages. (c) Actions shall be taken in further stages. (d) Actions shall be taken in further stages.

Environmental Check List for Masang-2

Environmental Item	Check Items	Check Results
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?	(a) In Pre-F/S, involuntary resettlement is not recognized. However this shall be again checked in further stages.
	(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) Not given in Pre-F/S. Actions shall be taken in further stages.
	(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) Resettlement plan is not yet prepared in Pre-F/S. Actions shall be taken in further stages.
	(d) Are the compensations going to be paid prior to the resettlement?	(d) Actions shall be taken in further stages.
	(e) Are the compensation policies prepared in document?	(e) Actions shall be taken in further stages.
	(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?	(f) Actions shall be taken in further stages.
	(g) Are agreements with the affected people obtained prior to resettlement?	(g) Actions shall be taken in further stages.
	(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) Actions shall be taken in further stages.
	(i) Are any plans developed to monitor the impacts of resettlement?	(i) Actions shall be taken in further stages.
	(j) Is the grievance redress mechanism established?	(j) Actions shall be taken in further stages.
(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?	(a) Some negative impact due to acquisition of cultivated area and generation of water recession section might occur.
	(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?	(b) Impact to the neighboring area might be less. Further confirmation is required.
	(c) Is there any possibility that the project facilities adversely affect the traffic systems?	(c) Implementation of the project might improve conditions of traffic system.
	(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?	(d) Possibility cannot be denied. Consideration shall be taken in further stages.

	(e) Is the minimum flow required for maintaining downstream water uses secured? (f) Is there any possibility that reductions in water flow downstream or seawater 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?	(e) In Pre-F/S, downstream water use is not recognized. However this shall be again checked in further stages. (f) Impact on downstream water and land uses might be less. However, further confirmation is required. (g) Further confirmation is required. (h) In Pre-F/S, neither professional fishery nor water use for irrigation are identified. This shall be again checked in further stage.
(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) According to the inventory report, no cultural heritages are recorded.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) Excavation for construction might adversely affect the local landscape. To minimize such effect, penstock is laid underground.
(5) Ethnic Minorities and Indigenous Peoples	(a) Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? (b) Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	(a) Actions shall be taken in further stages. (b) Actions shall be taken in further stages.
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) The project site is out of the conservation forest (hutan konservasi). Possibility is less that the project will affect the conservation forest.
(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?	(a) Most of the project site is within the secondary forest. (b) 5species of Fauna are identified at the site as "endangered" or "vulnerable" according to IUCN category. (c) Maintenance flow of 0.39m^3/s at the downstream of intake weir is considered in Pre-F/S. This shall be checked again

	(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?	in further stage. (d) Impact on migratory fish species shall be confirmed in further stage.
(3) Hydrology	(a) Is there a possibility that hydrologic changes 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) The project might affect the surface and ground water flows to some degree. However, the impact would be rather less as the areas related are less populated.
(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)?	(a) As the scale of the intake weir to be constructed is rather small, impact of the sedimentation would be also not significant. (b) Excavation for construction might alter the topographic features. However such impact is not significantly serious.
(5)Global Warming	(a) No emission of GHG(Methane) due to eutrophication of reservoir?	(a) Pond scale is small. Eutrophication of the pond would not be an issue.
Environmental Pollution		
(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? (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?	(a) Pond scale is small. Proliferation of plankton in the pond would not be an issue. (b) Pond scale is small. Degradation of water quality in the pond would not be an issue (c) Actions shall be taken in further stages. (d) Maintenance flow of 0.39m^3/s at the downstream of intake weir is considered in Pre-F/S. This shall be checked again in further stage

	(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 areas?	(e) Scale of the pond is small and difference of water temperature in the pond would not be an issue.
(2) Wastes	(a) Are earth and sand generated by excavation properly treated and disposed of in accordance with the country's regulations?	(a) Actions shall be taken in further stages.
Others		
(1) Impacts during Construction	(a) Is there a possibility that temporary land occupation, quarrying, earth borrowing and waste disposal will impact on surface vegetation, and cause soil erosion? (b) Is there a possibility that construction disturbance will affect the habitats of terrestrial animals? (c) Is there a possibility that wastewater from production and living areas of construction will affect the surrounding water environment? (d) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (e) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (f) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) There is a possibility. Countermeasures shall be considered in further stages. (b) There is a possibility. Countermeasures shall be considered in further stages. (c) There is a possibility. Countermeasures shall be considered in further stages. (d) Actions shall be taken in further stages. (e) Actions shall be taken in further stages. (f) Actions shall be taken in further stages.
(2) Operation	(a) Fluctuation of water level in the river from off-peak time to peak time is not dangerous for local inhabitants? Are adequate measures considered to mitigate the impact, if any?	(a) Downstream of the powerhouse is not populated. However, measures such as warning siren shall be considered in further stages.
(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) Are the items, methods and frequencies included in the monitoring program judged to be appropriate? (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) Actions shall be taken in further stages. (b) Actions shall be taken in further stages. (c) Actions shall be taken in further stages. (d) Actions shall be taken in further stages.