PRE-FEASIBILITY STUDY

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PART 4 PRAMAOY ELECTRIFICATION PROJECT

1 LOCATION AND PRINCIPAL FEATURES

Target electrification area of Pramaoy Electrification Plan is located at Pramaoy Commune of Veal Veng District in Pursat Province.

Pramaoy village is a center of Veal Veng District, but the village is located about 110 km away westward from provincial town of Pursat. Because of that distance from provincial capital, Pramaoy Village, as the district town of Veal Veng District, it is economically difficult to electrify the village by grid extension.

Xtung Tun Po River flows through Stung Thmei Village, the neighbouring village to Pramaoy Village. Xtung Tun Po River is a tributary of Purast River, and has potential of micro hydro for village electrification. In Pramaoy Village also, there is a tributary of Pursat River, but it has no micro hydro potential identified.

Stung Thmei and Pramaoy villages are in 8 to 9 km distance each other. Another village called “Tumpor” is located about 9 km from Pramaoy Village. But the number of households are as small as 34 (Seila 2003), therefore the cost burden of distribution lines becomes economically inefficient.

In this connection, target electrification villages are limited only to Stung Thmei and Pramaoy.

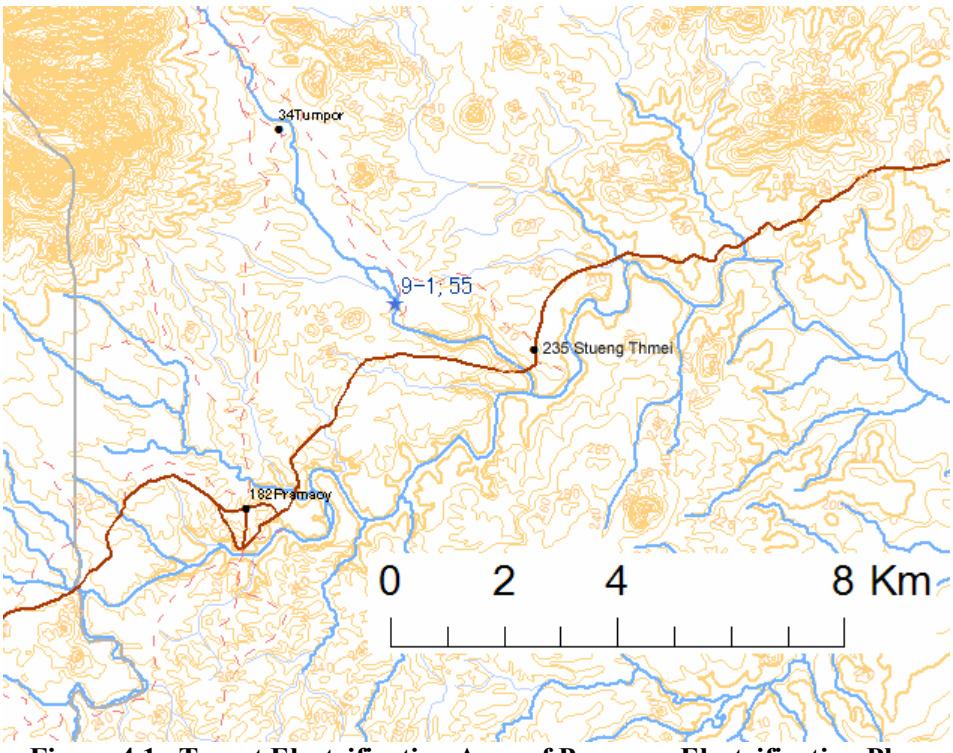


Figure 4.1 Target Electrification Area of Pramaoy Electrification Plan

2 SOCIO-ECONOMIC SITUATION IN THE STUDY AREA

2.1 BASIC INFORMATION ON PRAMAOY

Household number	Population	Number of TV –owned households	Literacy rate
475	2,325	82	73 %
2 primary schools (unelectrified), 1 lower primary school (electrified), 1 health post			

Source: Seila Commune Database 2004
Note : More recent data in September 2005 is 479 households.

The study area of Pramaoy electrification project is represented by Stung Thmei and Pramaoy villages in Pramaoy commune in Veal Veng district located in Pursat province. It is located in about 110 km western bound from the provincial town. The population consists of 60% new migrants from other provinces as the more migrants arrive after clearing mines.

2.2 CURRENT HOUSEHOLD SITUATION IN PRAMAOY BY THE SOCIOECONOMIC SURVEY.

The economic situation with details of the energy usage of the households and willingness to pay for electricity service in the Xtung Tun Po was shown by the socio-economic survey conducted under this study, where 50 sample households in the two villages (Stung Thmei and Pramaoy villages) are interviewed.

(1) Household Economy

1) Major income sources (%)

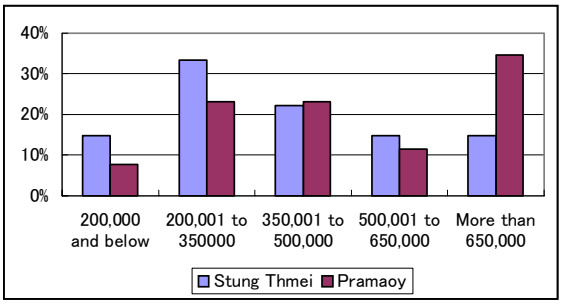
The main sources of income are agriculture and livestock. However, the villagers diversify the income sources as shown in table.

Income Source	Primary	Secondary	Tertiary
Agricultural produce (crops)	73.6	11.8	6.7
Livestock & poultry	-	47.1	43.3
Forestry (timber non-timber forest products)	-	5.9	6.7
Fishery	-	2	3.3
Bakery/ grocery	3.8	5.9	3.3
Food/ Restaurant business	5.7		6.7
Salary from private business/ NGO	1.9	11.8	
Salary from public service	5.7	7.8	20
Wage from seasonal labor	-	-	3.3
Make vine	3.6	-	-
Drug store	1.9	-	-
Sell vegetable	1.9	-	-
Raparing moto	1.9	-	-
House rent	-	2.0	-
Construction	-	2.0	-
Moto taxi	-	2.0	3.3
Charging batteries	-	2.0	-
Rent VCD	-	-	3.3
Total	100.0	100	100

2) Land ownership and Assets

Irrigated paddy land owner is limited to less than 2%. Majority of the households depend on the field. More than 85% households own their home lot. Motor bicycle is owned by more than 50%. There are owner of generators, rice mill, sewing machine, diesel water pump.

3) Monthly expenditure (Riel)



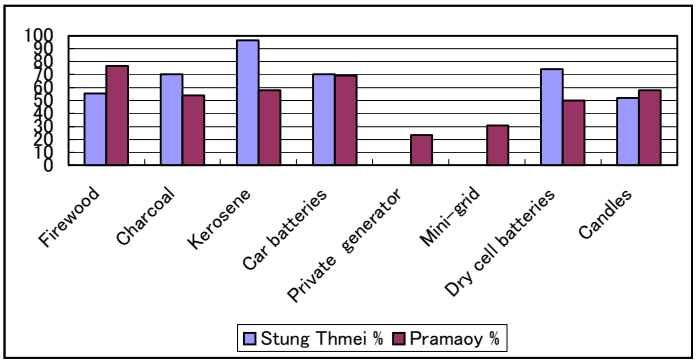
The monthly expenditure showed the community's economic structure. In Pramaoy village, nearly half of respondents spend more than US$100 per month. The average expenditure is 451,200Riel, which is equivalent to more than US$100. The poorest spends 95,000 Riel (about less than US25$) and the richest spends 1,934,400 Riel (nearly US$500). Thanks to diversified income from the service sector, their expenditure level is regarded more than average rural Cambodia (US$74.56 in CSES1999). Approximately 53% of respondents experienced to obtain loans, of which 58% borrowed from relative, 30% from NGOs and women organization. Nearly half of the respondents save regularly. Those who save regularly save money at home and a few with NGO. Credit and saving organization is reported to exist.

4) Household monthly expenses by items (Riel)

Expense item	n	%	Minimum	Median	Maximum
Food	53	100.0	50,000	212,100	600,000
House (rent/repairs)	2	3.8	20,000	110,000	200,000
Clothing	25	47.2	8,000	50,000	200,000
Child care	14	26.4	2,000	19,500	150,000
Education	37	69.8	5,000	30,000	150,000
Medical treatment/medicines	45	84.9	1000	15,000	300,000
Transportation	35	66.0	3,000	40,000	600,000
Amusement/recreation	25	47.2	2,700	30,000	300,000
Fuel for lighting/cooking	40	75.5	1,500	5,000	240,000
Personal care	51	96.2	1,500	10,000	70,000
Water	10	18.9	7,000	17,750	120,000
Gambling	1	1.9	10,500	10,500	10,500
Payment of debt/loan	12	22.6	1,000	75,000	1,000,000
Saving	25	47.2	3,000	30,000	300,000
Lending	2	3.8	150,000	325,000	500,000
Others	10	18.9	5,000	17,500	700,000
Total expenses of each sample household	53	100.0	95,000	451,200	1,943,200

(2) Current Situation of Energy Use and Needs

1) Energy usage



For lighting source, car battery is widely used as 70 % of respondents in both villages. As Pramaoy village has two mini-grid service as well as BCS, less depend on kerosene.

Average household consumed 4,200 Riel per month and normally uses 4 hours a day and owned 1.8 lamps. Car battery is owned by 70 % and recharged 3.54 times and spend 5,980 Riel per month. 12Vol 50Ah and 70Ah type are

widely used. According to the interview, some villagers use multiple sources of energy. Average cost for using kerosene and car battery are more or less 1 US$. 5 Karaoke shops are heavy users for the electricity.

The BCS and Mini grid systems in Pramaoy village have following features.

	BCS	Mini-grid for 30HH	Mini-grid for 60HH
Tariff	70Ah-2,000R(10batteries /day) 50Ah-1,500R (10batteries /day) 40Ah-1,000R(4 batteries /day) 5Ah-500 R(20batteries /day)	*Monthly flat rate* 1 lamp -12,000R 1 lamp ＋ 1 TV - 15,000 R	*Monthly flat rate* 1 TV and 1 VCD -15,000 R
Service hours	7:30am -3 pm.	6 pm to 9:30 pm 4:30 am to 6:30 am	6 pm to 9:30 pm

20% of respondents also show interest in solar energy. Previously, there were 3 BCS in the area, but only one is operational due to the profitability. It is reported that 2 houses have SHS.

2) Current usage of major lighting sources, kerosene and car battery

Kerosene (N. of users: 41 share 77%)		Car battery (N. of users:37, share 70%)	
Cost of kerosene per liter		Number of baterries owned /household	
Mean	2,604.9	Mean	1.2
Standard Error of Mean	54.3	Standard Error of Mean	0.1
Minimum	2,000.0	Minimum	1
Maximum	3,200.0	Maximum	3
Liters consumed per month		Number of times recharging batteries per month	
Mean	1.7	Mean	3.54
Standard Error of Mean	0.1	Standard Error of Mean	0.31
Minimum	0.5	Minimum	1
Maximum	3.0	Maximum	10
Monthly expenses for month		Expenses for recharging batteries per month	
Mean	4,285.4	Mean	5,981.1
Standard Error of Mean	255.1	Standard Error of Mean	835.4
Minimum	1,500.0	Minimum	1,000
Maximum	8,400.0	Maximum	28,000

Type of battery	Number	Share	Cost of battery
12 Volt - 100 Ah	1	3%	120,000
12 Volt - 70 Ah	14	38%	106,929
12 Volt - 50 Ah	19	51%	119,053
6 Volt - 5 Ah	8	22%	16,688

3) Present ownership and future demand of electric appliances

More than 50% respondents own electric lighting, and 30% own radio, color and black and white-TV, VCD. After electrification, not only lighting, but fan, TV will be widely purchased.

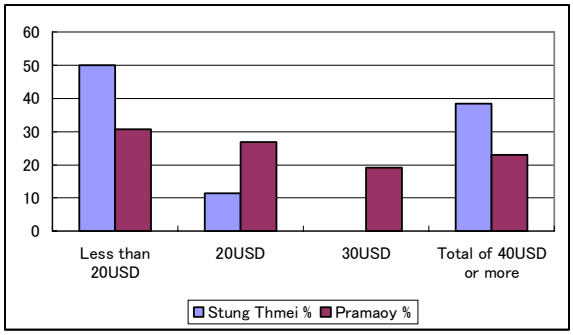
APPLIANCE	Currently owned		Want to buy	
	n	%	n	%
Electric lighting	28	52.8	45	84.9
Electric rice cooker	1	1.9	29	54.7
Television (color)	17	32.1	32	60.4
Television (black and white)	15	28.3	2	3.8
Video (VHS/VCD)	16	30.2	16	30.2
Radio/radio cassette	21	39.6	15	28.3
Electric fan	8	15.1	38	71.7
Electric water pump for drinking/household	1	1.9	31	58.5
Electric water pump for irrigation	3	5.7	23	43.4
Iron	3	5.7	20	37.7
Refrigerator	-	-	18	34.0
Washing machine	-	-	13	24.5
Video game	3	5.7	3	5.7
Karaoke	-	-	12	22.6
Grain/cereal/meat grinder	1	1.9	13	25.0
Others	-	-	1	1.9
Electrical pot	-	-	1	1.9

(3) Economic activities

The Xtung Tun Po project area is also agro-based economy with rice and beans as main crops. There are 7 rice husking diesel powered machines. In Pramaoy village, grocery stores, restaurants, furniture shops utilizing lumber from the nearby forests are also present. The area was once heavily mined area during the war. New settlers consist of 60% in the sampled survey. Income generation activity is one of various developing activities conducted by NGO. They provided cash crop seeds and trained basket making. Collecting NTFP is also an important income source.

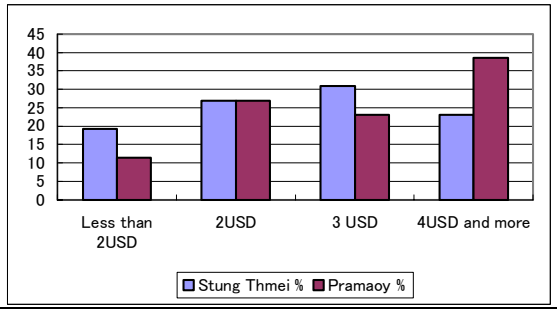
(4) Willingness and ability to pay for the electricity services

1) Willingness to pay for initial connecting fees



During the household survey, the willingness to pay was not so high as nearly 50% of Stung Thmei village respondents agreed to pay less than US$20. Yet, after the workshop, villagers understand the cost burden and agreed to pay as much as US$50 for the initial connecting fees by instalments.

2) Willingness to pay for monthly tariff for the electricity



Since many reiterates concern over current fuel cost for current energy sources, there is strong expectation toward electricity by hydropower. Over 50% respondents are willing to pay more than US$3.

3) Expected demand for the MHP

The interview regarding the possible businesses that can be started if households are electrified, 40% interest in food / restaurant business, followed by not engaged any (26%), store, water vending, repair shops are followed. The daytime demand can be expected for these purposes. Besides the household demand which is targeted to 80 % of the total 475 households, the demand from the public utility offices such as schools (2 primary, 1 lower secondary, and 1 health post) needs to be considered.

4) Appropriate tariff for the village for sustainable operation

There are already operational mini-grid systems and sufficient willingness to pay for monthly charge as US$3. Special tariff for poorer households might be prepared in order to expand the service areas.

2.3 DEVELOPMENT PLAN AND THE PRESENT DEVELOPMENT EFFORTS (COMMUNITY ACTIVITIES)

There is no specific commune development plans existed, yet development activities are currently executed under the some NGOs and Seila Commune Development Program. The key organization in both villages is the community forestry group which has about 80 members as there are on-going forest conservation efforts by the Department of Environment and NGOs.

Requested services prioritized by villagers are irrigation, education, road, electricity, and marketing for agriculture produces. At district level, there is mechanism of all NGOS and local authorities discuss the plans and activities regularly.

The below table is the summary of the existing activities in Pramaoy.

The assisted by international NGOs and consultants for implementation and monitoring.

	NGO Name	Sector - Description of work
1	Disability Cambodian Organization (DCO)	Education, Skill training, Road development, Seed, Malaria, etc.
2	Star and Kaseusahakamm	Technical support for agriculture in Stung Thmey;
3	Flora Fauna International (FFI)	Natural resource and environmental management;
4	ADDES	Agriculture support activities.
5	ADRA	Health
6	CMAC	Mine clearance.

Source: JICA Study Team

3 FORMULATION OF ELECTRIFICATION PLAN

3.1 MICRO HYDRO POTENTIAL

3.3.1 Map Study

In the target electrification area, micro hydro potential was identified through map study using 1:50,000 and 1:100,000 geographical maps

Details of micro hydro potential are as follows.

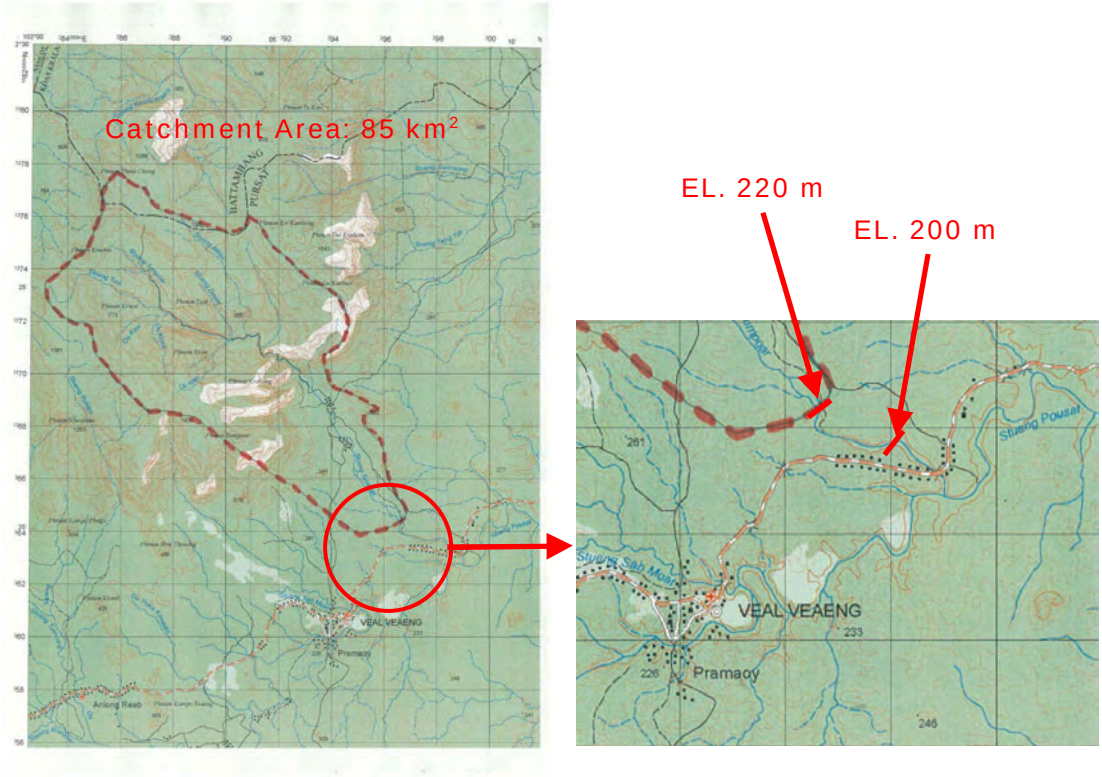


Figure 4.2 Micro Hydro Power Potential Identified through Map Study

Table 4.1 MHP Potential of Xtung Tun Po River by Map Study

Location	Catchment Area	Head	Length of Waterway
Xtung Tun Po	85 km^2	20 m (EL. 220 m ~ EL. 200 m)	2.5 km

With above features, potential can be calculated as 46.6 kW as follows.

Potential Power Output P (kW)= $9.8 * Q * H * \eta$

$= 9.8 * 0.34 * 20 * 0.7 = 46.6$ kW

where;

Q: Dry Season Discharge (m^3/sec), H: Head (m), η : Efficiency (= 0.7)

Dry season discharge was estimated as 0.34 m^3/sec by applying assumed representative specific discharge

of 0.004 $m^3/sec/km^2$.

3.3.2 Field Survey Works

After identification of potential during master plan stage, field survey works were conducted to confirm the potential as follows.

Table 4.2 Field Survey Works for MHP Potential in Xtung Tun Po River

No.	Study Stage	Date	Work Items
1	3rd Field Investigation	July 12, 2005	- General Survey and Interview - Discharge Measurement
2	4th Field Investigation	September 9 to 12, 2005	- Levelling Survey (Confirmation of Head) - Discharge Measurement
3	5th Field Investigation	November 21 & 22, 2005	- Discharge Measurement - Examination on Layout of Structures

(1) Survey for Confirmation of Head

Survey works were conducted during 4th Field Investigation in September to confirm head available for power generation. The target area is a mine danger zone and several caution marks were found along trunk road. Taking into account of information from DIME and village people, survey was conducted following existing foot path for villagers daily use along the left bank of Xtung Tun Po river. Survey works were done from downstream to upstream. Result of levelling survey is as shown in Figure 4.3.

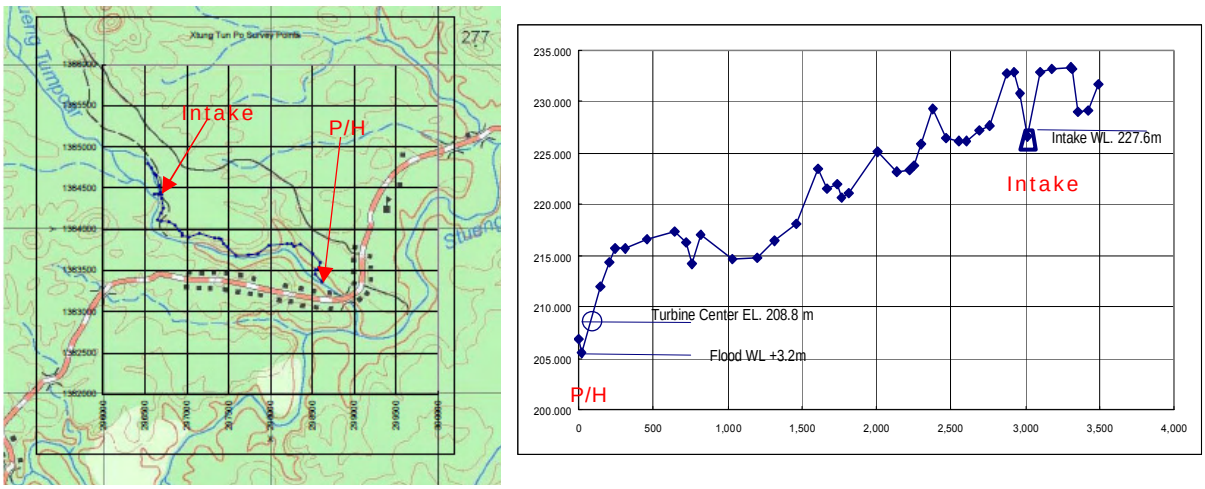


Figure 4.3 Result of Leveling Survey to Confirm Potential

(2) Discharge Measurement

The potential area was identified and prioritized in the end of June 2005, at the late stage of 3rd field investigation period. As discharge measurement during the driest period was not possible, estimation of dry season discharge was made by referring to limited discharge measurement result shown in Table 4.2, and through interview to village people.

During the 1st field survey in July 2005, interviews were made to villagers living along the river, about 500 m upstream of power house site. According to the interview, river discharge dried up in April, 2004. People dug riverbed to get water. That villager also mentioned that in April 2005, river water level

lowered down to 5 cm deep. From this interview, it is assumed that the driest period of the year is in April. Discharge measurement results are as shown in Table 4.3.

Table 4.3 Discharge Measurement Result of Xtung Tun Po River at its Intake Site

Date	Discharge (m^3/sec)	Catchment Area (km^2)	Specific Discharge (m^3/sec/ km^2)
July 12, 2005	0.19	85	0.00223 (2.23 lit/sec/km km^2)
September 11, 2005	0.28		0.00329 (3.29 lit/sec/km km^2)
November 21, 2005	1.34		0.0158 (15.8 lit/sec/km km^2)
November 22, 2005	1.83		0.0215 (21.5 lit/sec/km km^2)

Table 4.4 Result of Interview to Villagers on River Water Level in Xtung Tun Po River

Date of Interview	Contents	Location of Interview	Remarks
July 12, 2005 (3rd Field Investigation)	In April, 2004, river water dried up. People dug riverbed to get sub-ground water.	Villagers living near Xtung Tun Po river about 500 m upstream of power house site	
	River water level lowered down to 5 cm depth.		During 4th field investigation, river cross section survey was made. According to rough estimate of discharge, 5cm depth corresponds to less than 0.01 m^3/sec.
September 22, 2005 (4th Field Investigation)	In every year, river water discharge is the smallest in April. However, river water never dries up at Intake Site. In April some part of the river flows as sub-ground flow. Sub-ground flow condition continues down to Tun Po Bridge.	Villagers living near Intake Site	

3.3.3 Dry Season Discharge, Flood, Sediment

(1) Dry Season Discharge

From the result of discharge measurement and interviews to village people, river discharge may become less than 0.01m^3/secin the driest period. By using existing head, only less than 1.3 kW of power generation is possible, while electricity demand is in an order of 40 to 50 kW.

Considering dry season discharge, it seems difficult to formulate electrification plan with micro hydro power only.

(2) Flood Water Level

From the result of flood marks checking during field surveys, assumed flood water levels in intake and power house are as follows.

Table 4.5 Flood Water Levels Checked by Flood Mark

Flood Mark Check Point	Flood Water Level
Intake Site	+3 m from dry season water surface
Power House Site	+3.2 m from dry season water surface

(3) Sediment

During the third time field survey period, no turbid river water was observed in Xtung Tun Po River. This means that with less than 1.8 m^3/sec (maximum discharge observed through field survey), no significant sediment discharge to power generation facilities will be expected. Consideration should be made only for flood season to mitigate sediment flows from intake.

3.3.4 Demand

(1) Demand Estimate for Target Village

Electricity demand for target villages are mainly for night time use for five hours between 17:00 and 22:00. Several daytime demand is also recognized for furniture processing, rice mills etc. Referring to current electricity supply by REE, daytime demand is estimated as 10% of night time demand.

	A	B(= A * 80 %)	C(= B * 100 W * 1.3)
Target Village	Household	HHs to be electrified	Night Time Demand (17:00 - 22:00, 5 hr)
Pramaoy	182*	146	20 kW
Stueng Thmei	235*	188	25 kW
Total	417	334	45 kW

(*Household numbers are based on Seila 2003)

(2) Annual Supply Amount

Based on above demand, annual supply amount is estimated as follows.

a) For Pramaoy Village

Night time supply:	31.7 MWh
Day time supply:	11.0 MWh
Sub-total Supply for Pramaoy	42.7 MWh

b) For Stueng Thmei Village

Night time supply:	41.3 MWh
Day time supply:	14.3 MWh
Sub-total Supply for Stueng Thmei	55.6 MWh
Total Supply	98.3 MWh

3.3.5 Demand-Supply Balance and Electrification Plan

Considering the characteristics of micro hydro power potential identified through field survey, it seems difficult to formulate electrification plan with single energy source of micro hydro. Therefore possible alternatives are, (a) Micro Hydro with Diesel Backup, (b) Micro Hydro and Biomass Hybrid, (c) Biomass

only. By comparison study, it was realized that "(c) Biomass only" was the most economically efficient.

As Pramaoy Village is a district town and is densely populated, maturity and priority for electrification seems to be higher than rather sparsely populated Stung Thmei Village. Therefore, electrification of Pramaoy Village is the first priority and Stung Thmei Village is the second.

In this connection, electrification plan is formulated in two phases.

1st phase targets electrification for Pramaoy Village by biomass gasification power (BGP) station with its installed capacity of 20 kW. Distribution lines are also constructed to cover target electrification household of 146.

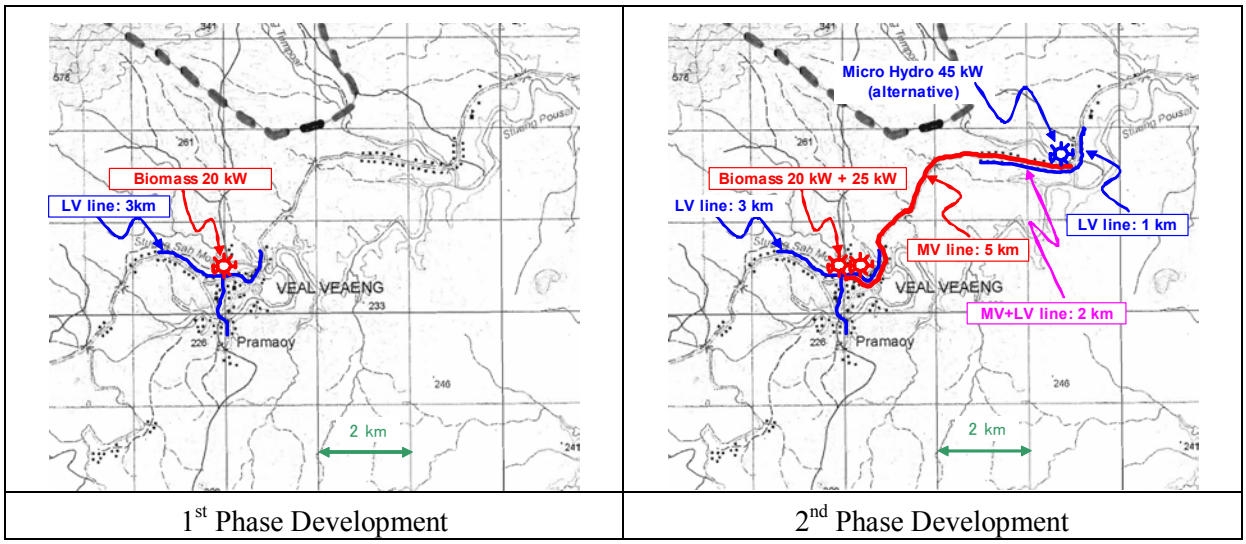
For the 2nd phase, additional BGP station would be installed to cover Stueng Thmei Village. Distribution lines are also extended from Pramaoy Village to Stueng Thmei Village. This is a selected option.

By the time of 2nd phase development, it is highly possible that demand size may increase for those two villages. Especially in case daytime demand shows significant increase, adoption of micro hydro power (MHP) will be advantageous, because of low operation cost. For this reason, adoption of MHP would be an alternative option.

Table 4.6 summarizes features of electrification plans for 1st and 2nd phases. Figure 4.4 shows layout of electrification plan.

Table 4.6 Summary of Electrification Plan for Pramaoy Scheme

1st Phase	Electrification Area: Relatively densely populated district town, Pramaoy Village Energy source: Biomass Gasification Power (BGP) Station (Installed Capacity: 20 kW) Distribution Line: LV line: 3.0 km (No MV line)
2nd Phase	Electrification Area: Extended to Stung Thmei Village Energy source: (Selected Source) BGP (Installed Capacity: 25 kW) (Alternative Source) Micro Hydro* (Installed Capacity: 45 kW) Distribution Line: MV line 5.0 km, LV line: 1.0 km, MV+LV dual use: 2.0 km (*Possibility of Micro Hydro should be examined considering growth of daytime demand.)



1st Phase Development | 2nd Phase Development

Figure 4.4 Layout of Pramaoy Electrification Plan for 1st and 2nd Phase

3.3.6 Construction Cost and Annual Operations and Maintenance (O&M) Cost

Construction costs are estimated for 1st and 2nd phases. Annual O & M costs are estimated for 1st phase development only, as O & M cost for 2nd phase is dependent of future demand.

(1) Construction cost for Power Stations and Distribution Lines

For the 1st Phase Development, Biomass Gasification Power (BGP) of 20 kW, and Distribution Lines are installed.

1) Cost of BGP

Construction cost for power generation facilities for biomass gasification in each phase is estimated as follows.

Table 4.7 Construction Cost for Biomass Gasification Power Plant

(Unit: US$)

	Phase 1	Total (Phase 1 and 2)
Generation facilities	$44,700	$99,900
Distribution facilities	$41,300	$93,300
Total	$86,000	$193,200

2) Cost of Distribution Lines

Cost of distribution lines and transformers are as estimated based on layout shown in Figure 4.4.

Results of estimate are shown in Table 4.7 for 1st phase and in Table 4.8 for 2nd phase, respectively.

For 1st phase, 3 km LV lines are constructed for Pramaoy Village. Electricity supply will be done directly from the power station.

Table 4.8 Quantities of Distribution Line and Transformer in 1st Phase

Distribution Line		
MV Line only	0.0	km
MV, LV Line dual use	0.0	km
LV Line only	3.0	km
Transformer		
25 kVA-Single Phase	0	set
25 kVA-Three Phase	0	set
50 kVA-Three Phase	0	set

For 2nd phase, additional 25 kWe biomass gasification power plant is installed. 7 km long MV line is installed from Pramaoy Village to Stung Thmei Village. Out of 7 km 2 km in Stueng Thmei Village is MV and LV lines dual use zone. Further, from Stueng Thmei Village, LV line is extended for 1 km to supply electricity to the northern part of the village. Taking into account of daytime demand, 25 kVA 3-phase transformers are installed in the center of Pramaoy and Stueng Themei, respectively.

For the 2nd phase layout, it is necessary to review the plan based on the latest household distribution and demand size.

Table 4.9 Quantities of Distribution Line and Transformer in 2nd Phase

Distribution Line		
MV Line only	5.0	km
MV, LV Line dual use	2.0	km
LV Line only	1.0	km
Transformer		
25 kVA-Single Phase	0	set
25 kVA-Three Phase	2	set
50 kVA-Three Phase	0	set

3) Cost of Micro Hydro

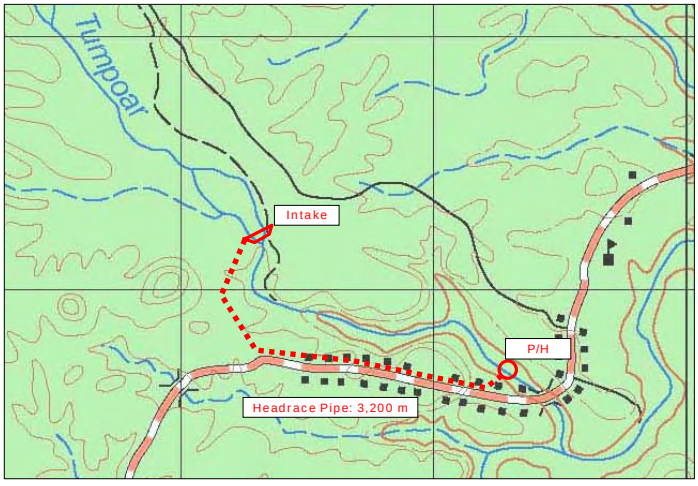


Figure 4.5 Layout of Micro Hydro Power Development

Based on field survey works so far conducted, micro hydro power development plan was formulated as laid out as Figure 4.5. Based on layout in Figure 4.5, quantities for construction were estimated.

For quantity estimate, "Guide Manual for Development Aid Program and Studies of Hydro Electric Power Projects" by NEF was used. However, in case of cost saving are possible by applying typical sections, dimensional measurement was carried out for cost estimate.

Work quantities by structures are shown in Table 4.9.

By summarizing quantities in Table 4.9 into major work items, and costs are estimated as shown in Table 4.10.

Table 4.10 Work Quantities by Work Items

Work Items	Unit	Quantity
Excavation	m^3	9,622
Embankment/Backfill	m^3	3,037
Mass Concrete	m^3	788
Structural Concrete	m^3	1,477
Reinforcement Bar	ton	116.74
Gate & Screen	ton	1.87
Pipe（HDPE OD:560mm）	m	3,200
Turbine & Generator	kW	45

(2) Annual Operations and Maintenance (O & M) Cost

Annual O & M cost for 1st phase development is hereby estimated, referring to an example of existing biomass gasification power (BGP) station of Anlong Tamei Village and based on other collected data.

1) O & M Cost for BGP

For generator and gaisifier, operation cost can be estimated as follows.

Table 4.11 Annual O & M Cost for BGP Station in 1st Phase

	Work Items	Cost
1	Personnel costs for CEC staff (Salary for operators etc.)	$2,520
2	Maintenance costs of gasifier and engine generator	$2,390
	Total	$4,910

Source: JICA Study Team

2) Fuel Cost for BGP

For 1st phase development for Pramaoy Village, planned electricity supply amount of 42.7 MWh is fully supplied by biomass. By multiplying unit fuel cost of $0.03/kWh, fuel cost is estimated as $1,300/year.

3) O & M Cost for Distribution Lines

Major O & M works for distribution lines are to cut branches of trees or grass before and after rainy season. In case of implementation by CEC, such works would be done by CEC members. However, referring to some examples of other developing countries, O & M cost for distribution lines are estimated as 0.5 % of construction cost as follows.

1st Phase Distribution Line and Transformer Construction Cost: $74,940

$41,3000 x 0.5% = $207 = $200 (rounded-up)

Therefore, total annual O & M cost can be summarized as follows.

Table 4.12 Annual O & M Cost for 1st Phase Development

Item	Annual Cost
O & M Cost for BGP	$4,910/year
Fuel Cost for BGP	$1,300/year
O & M Cost for Distribution Lines	$200//year
Total	$6,410/year

Source: JICA Study Team

3.4 RESULT OF WORKSHOP（ PRAMAOY）

3.4.1 Outline of Workshop

A workshop was conducted in Pramaoy. The outline of W/S is shown in the table below.

Outline of Workshop

Commune Name	Date	Time	No. of Participants
Pramaoy	Dec. 7, 2005	11:30 – 16:30	28

3.4.2 NGO Activity

There are several NGOs in the sectors of education, health, nature conservation, etc.

- DCO: health, handicraft, education, agriculture
- SCW（Saving Conservation Wild animal）: conservation of wild animal
- FFI: natural resource protection, forest protection, conservation of wild animal
- ADRA: health, water, medical services
- RACHA: health
- CIMAC: de mining

3.4.3 Community Based Organization

There is a traditional mutual help for poor people and starved people, and help for a family in funeral as a community activity. There is, however, no other community activity, which was initiated by community-

self. There are several community activities organized by NGO's support. These community activities started after 2004. They do not have long activities and experiences.

There are two community activities as follows:

- Forestry Community: This was organized by Ministry of Environment and has not yet started activities because of still new organization.
- Handicraft Association: organized by DCO (NGO). Making furniture of cane.

3.4.4 Micro Credit

There is no NGO providing micro credit. Therefore there are no one who have experience of micro credit.

3.4.5 Existing REE

There are two (2) REEs in Pramaoy village. One REE provides about 20-30 households. The other provides 6 households. It charges 12,000Riel per month for one light and 15,000Riel per month for one light and one TV. There are no other person who can operate REE here.

3.4.6 Situation of Battery Use

The situation of battery use is shown in the table below.

No one possess only 6V battery, however there seven (7) participants out of 28, who do not have battery and are using kerosene or candle. Therefore there is a gap between the people who have 12V battery and do not have battery. The reason of not to have battery is poverty.

Situation of Battery Use

Types of battery use		No.
Battery owner	Only 6V	0
	6V and 12V	2
	Only 12V	9
Connecting REE		8
Own generator		2
Using kerosene or candle without battery		7

The following table shows monthly expense for lighting.

Monthly Expense

Types	Amount (Riel)	No.
Battery	5,000	3
	7,500	8
	10,000	1
	More than 10,000	3
Kerosene/candle	3,000	2
	5,000	1
	7,000	6

There are two (2) REEs in Pramaoy village, however there is no REE in Stung Thmei village. The unit

price of battery charging is in the table below.

Charging Price

Types	Riel
50,40A	2,500
70A	3,000
100A	5,000
6V	1,000

3.4.7 Establishment of CEC

There are six (6) to seven (7) repairmen of tractor. They can be a candidate operator. Many people can be a candidate accountant. They are school teachers, business men,, students, and so on.

3.4.8 Biomass Fuel Wood

All participants have an available land more than 0.02ha for planting biomass fuel wood. One household have 2ha of land in an average and have 0.5ha of available land for planting biomass fuel wood.

There is commune land and it is a forest. It is impossible to use the forest for biomass fuel wood because of a large impact to the forest.

3.4.9 Demand Power Amount and Charge

Six (6) types of demand power amount and its charges were shown in the workshop. Participants chose the types, which they want to use and can afford to pay the charge as shown in the table below.

Participants are divided into two types of No.1 and No.4.

Demand Power Amount and Charge

No.	Amount of Daily Use	Watt	monthly amount	Estimated Monthly Charge	No.
			kWh	Riel	
1	10W lighting : 1: 3 hours use per day	10	0.9	900	7
2	20 W lighting: 2 : 4 hours use per day	40	4.8	8,600	0
3	20W lighting: 2 : 4 hours use per day Black & White TV(40W) or Fan (40W) : 1:4 hours use per day	80	9.6	18,200	0
4	20W lighting: 2 : 4 hours use per day Color TV (80W) : 1:4 hours use per day	120	14.4	27,800	17
5	20W lighting: 2 : 4 hours use per day Color TV (80W) : 1:4 hours use per day Fan (40W) : 1:4 hours use per day	160	19.2	37,400	0
6	20W lighting: 3 : 4 hours use per day Color TV (150W) : 1:4 hours use per day	210	25.2	49,400	0

3.4.10 Ability to Pay for Initial Cost

All participants expressed to prepare 50$ for initial cost. They, however, need one year to prepare by saving. The people in this area have larger land which is fertile and high productivity. Their income is relatively high.

It can be observed a poverty gap from the above table of Demand Power Amount and Charge, between No. 1 and No.4. Seven (7) participants selected No.1 of 700Riel per month are in a poor situation at present because they are new migrants come in this land in one year and their house is still not yet prepared properly. These seven (7) participants are the same persons who do not have battery and use kerosene or candle. Some of them were given a land from their relatives. Some of them bought a land here. The land costs around 400$/ha here.

3.4.11 CEC Coverage Area

Stung Thmei village is several times as large as Pramaoy village, and is divided into five (5) sub-villages. Those sub-villages are far distance among them. One of the sub-village is not located along the main road connecting to Pursat. Therefore it is necessary to select a coverage area when mini grid electrification project is implemented by CEC.

3.4.12 Feasibility in Pramaoy

It seems feasible in terms of ability to pay of initial cost because all participants can prepare 50$. It is, however, necessary to conduct more detailed household survey especially for new migrants because there is a gap between people who live originally and new migrants.

In addition, the survey to confirm the ability to pay, applicants of CEC members, their number and location, and consideration of coverage area are necessary.

Operator and accountant are feasible in training are provide.

3.5 BIOMASS FUEL SUPPLY

Tree farming will be conducted by CEC members for fuel wood production. Farmed fuel wood will be purchased by CEC. Appropriate purchasing price is assumed to be around $20/t. There is 0.06 ha/household of grassland and 1.24 ha/households shrubland, which is thought to be appropriate for tree planting in Pramaoy Commune. This is much larger than required land for tree planting for supplying enough fuel wood for electricity generation. Average annual rainfall in Pursat between 1994 and 2001 was 1518 mm (JICA 2005). Most of fast growing tree species commonly planted for wood chip and fuel wood production in tropical region is likely to grow moderately under such amount of annual precipitation. Minimum 10 t/ha/year biomass production is assumed to be obtained. Following tree species are recommended for planting.

Short term coppicing wood production in and around gardens: Leucaena leucocephala, Gliricidia sepium (Leguminosae)

Longer term stem wood production: *Acacia spp.* (Leguminosae*), Eucalyptus spp.* (Myrtaceae)*, Casuarina equisetifolia* (Casuarinaceae)

Majority of land in Pramaoy Commune is covered by forest but most of forest observed from main road have been logged and degraded. Concern Worldwide (NGO) has been supporting community forestry activities in the region to rehabilitate the forests. They showed strong interest to the biomass electricity generation. They said such biomass system would be a great tool for sustainable community development and for encouraging people to participate community forestry activities.

Reference

JICA. 2005. Weather observation data.

3.6 CONSTRUCTION SCHEDULE

Proposed construction schedule is as shown in Figure 4.6.

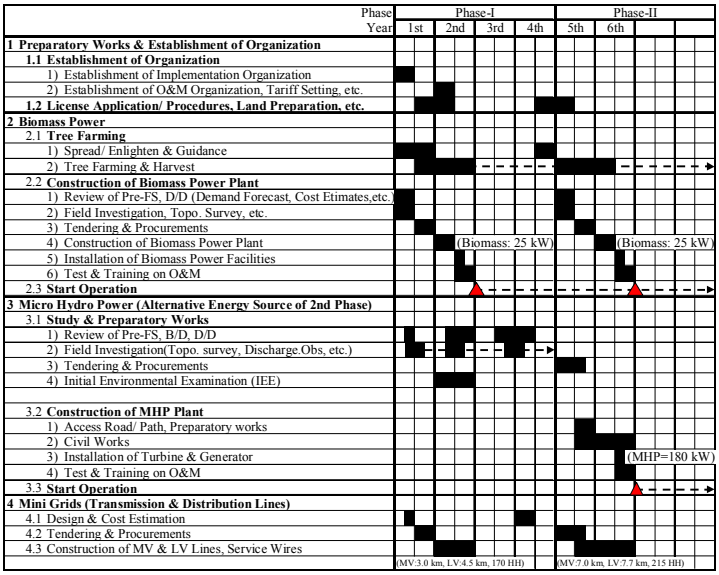


Figure 4.6 Proposed Construction Schedule

4 ECONOMIC AND FINANCIAL ANALYSIS, TARIFF SETTINGS

4.1 ECONOMIC EVALUATION

The life of proposed 1st phase electrification scheme is assumed to be 30 years after construction. Based on calculated economic cost, economic evaluation was made as shown in Table 4.15.

Table 4.13 Result of Economic Evaluation for 1st Phase Development

(unit: $)

	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	Total
(Economic costs)																				
Initital costs																				
Economic costs	66,131											29,718				29,718				125,567
Supports to CEC	5,400	1,800																		
Operation and maintenance costs	0	3,336	3,939	4,159	4,326	4,509	4,711	4,808	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	4,824	
Personenel costs		2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	2,268	68,040
O&M of biomass gasification power plant		935	1,489	1,691	1,844	2,012	2,197	2,287	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	2,301	65,377
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Biomass fuel cost		83	132	150	164	179	195	203	205	205	205	205	205	205	205	205	205	205	205	5,814
EAC license fee @ Riel 1.6/kWh		6	9	10	11	12	13	14	14	14	14	14	14	14	14	14	14	14	14	397
Monitoring of CEC by DIME		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value											-2,972				-2,972				-6,613	-12,557
Total expenditure	71,531	5,142	3,948	4,169	4,337	4,521	4,724	4,822	4,838	4,838	1,866	34,556	4,838	4,838	1,866	34,556	4,838	4,838	-1,775	261,338
(Economic benefits as costs of alternative diesel mini-grid)																				
Initital costs																				
Economic costs	48,646											15,218				15,218				79,082
Supports to CEC	5,400	1,800																		
Operation and maintenance costs	0	6,230	8,740	9,655	10,348	11,111	11,950	12,356	12,420	12,420	12,420	12,420	12,420	12,420	12,420	12,420	12,420	12,420	12,420	
Personenel costs		1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944	58,320
O&M of diesel power plant		649	1,034	1,174	1,281	1,398	1,526	1,588	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	1,598	45,408
Maintenance of distribution lines, etc.		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	1,500
Fuel cost		3,586	5,712	6,486	7,073	7,719	8,430	8,773	8,828	8,828	8,828	8,828	8,828	8,828	8,828	8,828	8,828	8,828	8,828	250,816
EAC license fee		6	9	10	11	12	13	14	14	14	14	14	14	14	14	14	14	14	14	397
Payment for technical supports		432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	12,960
Residual value											-1,522				-1,522				-4,865	-7,908
Benefits from CER sales		143	228	259	283	308	337	351	353	353	353	353	353	353	353	353	353	353	353	10,024
Total benefits	54,046	8,611	9,409	10,356	11,074	11,863	12,732	13,152	13,219	13,219	11,697	28,437	13,219	13,219	11,697	28,437	13,219	13,219	8,354	457,798
(Net benefits)	-17,485	3,469	5,461	6,187	6,737	7,342	8,008	8,330	8,381	8,381	9,831	-6,119	8,381	8,381	9,831	-6,119	8,381	8,381	10,129	196,460
EIRR	**33.3%**																			

Source: JICA Study Team

For the cost, initial costs for power generation facilities and distribution facilities, annual O & M costs for power station and distribution lines are capitalized. Economic Internal Rate of Return (EIRR) is calculated as 33.3%, which means that implementation of this project has high economic viability.

4.2 FINANCIAL EVALUATION

Taking into consideration of socio-economic survey results, and results of community workshop, trial estimate of financial viability was done by assuming tariff and subsidy level. Table 4.16 shows the result of financial analysis.

Table 4.14 Financial Analysis for 1st Phase Development of Pramaoy Electrification Scheme

Including taxes, excluding CER sales	0	1	2	3	4	5	6	7	8	9	10	11	12	19	20	21	22	29	30	(unit: $) Total
(Expenditure)																				
Initital costs																				
Construction costs	78,027											29,900				29,900				137,827
Supports to CEC	6,000	2,000																		
Operation and maintenance costs		4,597	5,484	5,807	6,052	6,322	6,618	6,762	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	6,785	197,686
Personnel costs		2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	2,520	75,600
O&M of biomass gasification power plant		971	1,546	1,756	1,915	2,090	2,282	2,375	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	2,390	67,906
Maintenance of distribution lines, etc.		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	3,000
Biomass fuel cost		520	828	940	1,025	1,118	1,221	1,271	1,279	1,279	1,279	1,279	1,279	1,279	1,279	1,279	1,279	1,279	1,279	36,340
EAC license fee @ Riel 1.6/kWh		6	10	11	12	14	15	15	16	16	16	16	16	16	16	16	16	16	16	441
Payment for technical supports		480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	14,400
Total expenditure	84,027	6,597	5,484	5,807	6,052	6,322	6,618	6,762	6,785	6,785	6,785	36,685	6,785	6,785	6,785	36,685	6,785	6,785	6,785	343,513
(Revenue)																				
Operating revenue through electricity sales		6,300	9,735	10,996	11,987	13,078	14,278	14,828	14,909	14,909	14,909	14,909	14,909	14,909	14,909	14,909	14,909	14,909	14,909	424,117
Sales of CER																				0
Residual value of equipment											2,990				2,990				7,803	
Total revenue		6,300	9,735	10,996	11,987	13,078	14,278	14,828	14,909	14,909	17,899	14,909	14,909	14,909	17,899	14,909	14,909	14,909	22,712	437,899
(Net operating income)	-84,027	-297	4,251	5,188	5,935	6,756	7,659	8,066	8,125	8,125	11,115	-21,775	8,125	8,125	11,115	-21,775	8,125	8,125	15,928	94,386
FIRR	**5.0%**																			

Source: JICA Study Team

In accordance with subsidy scheme in REF (Rural Electrification Fund), subsidy level was set at 25% of initial investment cost. By applying subsidy, tariff level is calculated as $0.400/kWh. With this tariff level, FIRR(Financial Internal Rate of Return) becomes 5.5%, which shows the implementation of 1st phase electrification is financially viable.

5 ENVIRONMENTAL CONSIDERATIONS

For the environmental considerations, JICA's Environmental Guidelines and Checklist have been used for defining project Category (A, B or C) and environmental screening. On the other hand, "Annex of Sub-Decree No.72 ANRK. BK." dated August 11, 1999, that is the "List of the Project Require an IEIA(IEE) or EIA", and other concerned environmental regulations of the MOE of Cambodia have also been referred and applied.

It is noted here that formal guidelines for preparing an Initial Environmental Impact Assessment (IEIA) Reports have not been defined by the MOE. Therefore, the IEIA report of project has been conducted and prepared based on the requirements of "Guideline for conducting Environmental Impact assessment (EIA) Report" stipulated by the "Prakas on Guidelines for preparing EIA Report", No.49 BST.SSR dated March 9, 2000.

Based on the results of the environmental screening as conducted below, it is judged that IEIA(IEE) will be required for the project. Details of the environmental screening and the IEIA are described in detail below.

5.1 ENVIRONMENTAL SCREENING

As a result of examination for electrification plan, though MHP was not considered as the priority scheme, there is still possibility to apply MHP as alternative energy source for Pramaoy electrification scheme. Prior to consideration of MHP as alternative energy source, Environmental Screening of Xtung Tun Po MHP was conducted. Table 4.17 shows the details and results of the environmental screening of Xtung Tun Po MHP project. Key results and findings of the environmental screening are summarized below.

(1) Considering the following factors, carrying out IEIA will be required.

1) The project site will be located in a Wildlife Sanctuary (Phnom Samkos) designated by the MOE.

2) Therefore, it is judged that the project belongs to Environmental Category B of "JICA Guidelines for Environmental and Social Consideration". Considering both the JICA Guidelines and also the MOE environmental regulations, carrying out an IEIA will be required for the MHP project.

Project owner/implementing organization will have to conduct the IEIA and/or EIA and prepare the reports for submittal to the MOE for review and approval.

(2) Details of results and findings of the Environmental Screening

1) Potential natural and social environmental impacts

a. Xtung Tun Po MHP project site will be located in a Wildlife Sanctuary (named Phnom Samkos, with total area of 333,750 ha) designated by the MOE. Because this is a micro-hydro power project having a small scale weir, and will use the underground waterway, there will be little impact to the protected area. On the other hand, through interview conducted on September 8, 2005 with representatives of concerned Commune and villagers, it was known that there are no any protected wildlife inhabited or found in the project area and its vicinity. The protected wildlife, such as deer, tigers and elephants are all inhabit in the mountain areas, which are far away from the project site area and its vicinity. Therefore, it can be concluded that there will be no negative impacts to be caused on the wildlife, nor to ecological system of the project site area.

b. Because this is a MHP project, there will be no negative impacts to the water quality in and around the project site area.

c. There will be no negative impacts to groundwater of the project area and its vicinity.

2) Environmental issues in connection with the plant design and construction activities

a. There will be no negative impacts to the agriculture of the project site and its vicinity.

b. Because a small scale weir and underground waterway will be used, there will be no negative impact to the wildlife and ecology system in and around the construction site area..

c. There will have the following positive impacts to the villagers in and around the project site.

a). Electrification of the rural area

b). Create employment opportunity for the villagers as labor force source

c). Create business opportunity to the villagers during project construction

d. Turbid river water and dust could be generated by construction work. Minimize river bed work to avoid high turbidity of the river water. Dust would be generated by construction work. Generating dust will be minimized by spraying water.

3) Potential environmental impacts during plant operation

a). A water reduction section could be generated during dry season in the river section between the

water intake weir and the power house. Drying out the river section would have negative impacts to flora and fauna in the section area. To protect wildlife and ecology, keep at least 10% of water flow as of the end of dry season as minimum maintaining flow to avoid drying out the water reduction section.

b). In spite of protected/rare wildlife not being found in the project site area and its vicinity, some wildlife might occasionally come into the plant facility area. Therefore, a certain protection measure, such as barrier fence/nets, will be set around outdoor electrical equipment and distribution facilities where necessary to protect the wildlife against suffering electric shock.

c). There will be no negative impacts to agriculture of the project site area and its vicinity.

5.2 INITIAL ENVIRONMENTAL IMPACT ASSESSMENTS (IEIA) OF XTUNG TUN PO MHP PROJECT

(1) Project Summary

Xtung Tun Po MHP Project will be located at Pramaoy Commune, Veal Veaeng District, Pursat Province. There are three (3) villages concerned in the Commune. There will be 361 households to be electrified among 579 households in the Commune (as of September 8, 2005). The MHP will make use of the head difference of Xtung Tun Po River, and its capacity will be 47 kW.

The MHP project site will be located in a Protected Area (Wildlife Sanctuaries) called Phnom Samkos designated by the MOE. Based on the field survey and interviews conducted with Deputy Chief, the Council Chief of the Commune, and also with the villagers, it has been known that there are no protected wildlife being inhabited or found in the project site area and its vicinity. Therefore, it can be concluded that there will be no significant negative environmental impacts to be caused by implementing the project.

Through various investigations and studied as mentioned above, it is clear that the project will be within the framework of Cambodia's national and international environmental laws and legislation standards.

(2) Purpose of the Project

The MHP project will be able to electrify 361 households (HHs) in the Commune. As of September 8, 2005, there are 579 HHs in the Commune in total. Electrification of the Commune will upgrade living conditions of the villagers.

(3) Project Description

- Project alternatives:

There are many rural areas which need electricity in Pursat Province. Through careful study by using GIS, it was found that there are about 6 MHP potential sites for rural electrification. Considering demand size, investment efficiency, potential of distribution line extension and accessibility of site area for construction machinery, etc., Xtung Tun Po MHP project has been selected.

- Details of the quantity and quality of various wastes to be disposed will be estimated at the F/S stage. There is no any data existing at this moment.

(4) Description of Environmental Resources and Background

a. Physical resources

1) Because of no any pollutant sources such as industrial facilities being existed, air quality of the project site area and its vicinity is very good. At this moment, there is no any existing data available. Because this is a MHP project, it can be anticipated that there will be no negative impact to the air quality of the project area. The climate in Cambodia is tropical and the climate condition of the project site area is similar to other places in the country in average, i.e. there are a wet season and a dry season in a year. The wet season starts from June until the end of October. Other months are in dry season.

2) Same as the case of air quality, water quality of river water quality is in good condition. At this moment, there is no any existing data available.

b. Ecological resources

1) Through field survey and interviews made with the representatives of the Commune and villagers on September 8, 2005, it was made clear that there are no any protected wildlife being inhabited or found in the project site area and its vicinity. However, it shall be noted that there are protected wildlife, such as deer, tigers and elephants, inhabit in the remote mountain areas.

2) Most of the forests existing in the site area and its vicinity are secondary forests (about 80%).

c. Socio-economical resources

1) As of September 8, 2005, total population of Pramoy Commune is 2,769. Total number of households is 579. No minority people are living in the Commune.

2) There are 4 D/Gs in the Commune, and about 50% households are using batteries for lighting and TV. Source of water supply is well and brooks.

3) Through discussions with the Chief and representatives of the Commune, it was known that most of the housing lots of the villagers are registered private lands.

4) There is one Health Center with 12 hearth care takers, including nurses.

5) There are five primary schools and one junior high school in the Commune.

6) About 3,000 Riel being spent per day per household, which is not enough to keep livelihood.

7) About 97% of income is from agriculture. Main crops are rice, soy beans and corn. Collection of nature resin is also an income source (about 3%)

(5) Public Participation

For the purpose of natural and socio-economic field survey, one MOE staff member, one MIME and one DIME engineers and JICA Study Team members visited the concerned project site and its vicinity. During the visits, they had met with the Chief, Chief of Council members, Chief of Health Center of the Commune and villagers and carried out interview with them. Through the interview, it was known that they all need more reliable electricity source for electrification of the villages. On the other hand, improvement of communication road, obtaining enough seeds and irrigation system for agriculture are also essential.

(6) Initial Environmental Impact Analysis

1) Potential natural and social environmental impacts

a. The project site is located in a Wildlife Sanctuary. Through interview made with the people mentioned above, it is known that there are deer, tigers, elephants and forest cattle inhabit in the surrounding mountain areas, which are quite far away from the

project site. Therefore, there will be no negative impacts to be caused on the wildlife by the project.

b. During dry season, operation of the MHP could reduce quite a large part of river water flow between the weir and power house. This section is called "water reduction section". To avoid impact to ecology of the section, at least 10% of river water flow will be kept remained as the minimum maintaining flow.

c. If some quarry will be collected from the river bed, turbid water will be generated in the downstream side. Possible mitigation measures shall be taken to minimize the turbidity. Also minimizing river bed work will be required.

d. There will be no negative impacts to the watershed of the river.

e. Because this is a MHP project, there will be no negative impacts to the air and water quality in and around the project site area.

f. There will be no negative impacts to groundwater of the project area and its vicinity.

2) Environmental issues in connection with the plant design and construction activities

a. As mentioned above, if some quarry will be collected from the river bed, turbid water will be generated in the downstream side. Possible mitigation measures shall be taken to minimize the turbidity. Also minimizing river bed work will be required.

b. There will be no negative impacts to the agriculture of the project site and its vicinity.

c. There will be no conflicts with existing river water rights.

d. There will have the following positive impacts to the villagers in and around the project site.

i) Electrification of the rural area

ii) Create employment opportunity for the villagers as labor force source

iii) Create business opportunity to the villagers

a. May have negative impacts to river water quality due to liquid effluents from worker' camps. Prepare sewage treatment facility to mitigate this impact.

b. Dust generation shall be minimized during construction activities. Water spray will be used for this purpose.

3) Potential environmental impacts during plant operation

a. During dry season, water flow will become very little. To avoid negative impact to the ecology of the water reduction section of the river by operating the MHP, at least 10% of water flow as the minimum maintaining flow will be kept.

b. In spite of protected/rare wildlife not being found in and around the project area, some wildlife might occasionally come into the plant facility area. To protect such wildlife against suffering electric shock, barrier fence/nets will be set around outdoor electrical equipment and distribution facilities.

c. There will be no negative impacts to the downstream water quality.

d. There will be no negative impacts to agriculture of the project site area and its vicinity.

Details of the initial environmental impact analysis results have also been summarized in the Table 4.18. For the details, refer to the table.

(7) Environmental Impact Mitigation Measures

Details of the Environmental Impact Mitigation Measures have also been shown in the Table IEIA-3. The measures have also been described in item (10) "Environmental Management Plan" below. The key issues

to be resolved together with their mitigation measures are shown again below.

1) During dry season, water flow will become very little. To avoid negative impact to the ecology of the water reduction section of the river by operating the MHP, at least 10% of water flow as the minimum maintaining flow will be kept.

2) During construction, if some quarry will be collected from the river bed, turbid water will be generated in the downstream side. Possible mitigation measure shall be taken to minimize the turbidity. The mitigation measure will be to limit the location of quarry collection site to a minimum area.

3) In spite of protected/rare wildlife not being found in and around the project area, some such wildlife might occasionally come into the plant facility area. To protect such wildlife against suffering electric shock, barrier fence/nets will be set around outdoor electrical equipment and distribution facilities.

(8) Economic Analysis and the Environmental Value

There will be 361 households (about 62%% of total number of households) to be electrified by the project. By the electrification, the expenditure of battery charging and replace to be needed for the villagers can be reduced or even would not be required, and the villagers can obtain high quality electricity and bright lighting instead. In addition, the project will also be able to supply power for pumping river water for domestic use and irrigation activity. On the other hand, the tree cutting for installing the facility will be very few. Reforestation of surrounding area will mitigate the impact.

(9) Environmental Management Plan

A. Environmental Protection Measures

Environmental Issue	Mitigating Measure	Implementation Responsibility
Construction		
Loss of tree resources	Trees to be cleared will be limited to the waterway, penstock and generator facility. The lost trees will be supplemented by reforestation in the surrounding area.	Project IO/operator and contractor(s) (see Remarks for IO)
Air/river water quality	Air dust will be minimized by spraying water. Proper wastewater treatment will be conducted before being discharged to the river. Water supply and waste disposal facilities will be established for workforce camps.	Project IO/operator and contractor(s)
Loss of rare and endangered species	Identify critical habitats and prepare habitat protection plan	Project IO/operator and contractor(s)
Hazardous materials	Proper storage of chemicals and fuels	Project IO/operator and contractor(s)
Worker/public health and safety	Health care and safety center will be established.	Project IO/operator and contractor(s)
Operation		
Potential impact to ecology of water reduction section	Keep at least 10% river water flow as the minimum maintaining flow.	Project IO/operator
Potential electric shock to wildlife	Set barrier nets around electrical equipment and distribution facilities.	Project IO/operator
Change in water quality (upstream and downstream)	Remove upstream pollution sources.	Project IO/operator
Sediment transport/erosion	Prepare sediment bypass system	Project IO/operator

Introduction of exotic pest species	Reduce water residence time	Project IO/operator
Public safety	Proper design to avoid villagers entering in to the facility areas.	Project IO/operator

B. Environmental Monitoring Program

Monitoring Parameter	Monitoring Technique	Monitoring Location	Monitoring Frequency	Monitoring Responsibility
Construction				
Loss of tree resources	Observation of conditions of reforestation	Site surrounding area used for reforestation	Once per month	Project IO/operator and contractor(s)
Air/river water quality	Observation, turbidity meter	Project site area	Once per week	Project IO/operator and contractor(s)
Loss of rare and endangered species	Observation	Project site area	Once per month	Contractor(s)
Hazardous materials	Observation	Construction site	Once per month	Constructor(s)
Worker/public health and safety	Observation	Whole area of the project site	Every day	Project IO/operator and contractor(s)
Operation				
Reforestation condition	Observation	Site surrounding area used for reforestation	Once per six months	Project IO/operator
Wildlife condition	Observation	Plant facility area	Once per week	Project IO/operator
Change in river water quality	Observation, pH, COD, TSS, etc.	Project site area	Once per three months	Project IO/operator
Sediment transport/erosion	Turbidity meter	Upstream and downstream	Once per month	Project IO/operator
Introduction of exotic pest species	Observation	Upstream and downstream	Quarterly	Project IO/operator
Public safety	Observation	Whole area of the project site	Once per week during tourism season	Project IO/operator

Remarks: IO stands for Implementing Organization.

(10) The situation without the Project

There are 579 households in total in Pramaoy Commune. About 97% of income is from agriculture. Expenditure amount in average is about 3,000Riel/day /HH (about US$0.75), which is very low compared with needed expenditure. The only way to supplement the insufficiency is breeding livestock and poultry and growing fruit trees for self use. But this is still not enough to solve their poverty.

There are only 3 BCS in the Commune, and about 50% of total HHs have batteries.

Urgent needs are 1) Rehabilitation of communication roads, 2) more seeds and irrigation system for improving agriculture, and 3) job opportunity.. Only wells are being used for water supply. Need pumps to get water from the river and brooks.

To resolve the difficulties of the villagers and solving their poverty issue, electrification of the villages will be one of the high priority measures to be taken. Electrical power can not only provide bright light

and power for TV, but also the power needed to pump river water for domestic and irrigation uses. Agricultural productivity will then be improved.

(11) Institutional Capacity

The project implementing organization/operator and contractor(s) shall be trained and responsible for conducting EIA. In addition, the project implementing organization/operator and contractor(s) shall be responsible for implementing the Environmental Management Plan. For this purpose, the project implementing organization/operator and contractor(s) shall establish an internal organization to be in charge of the whole environmental assessment and management activities. Training staff members of the organization will also be needed.

(12) Conclusion and Recommendations

1) Because this is a MHP project, there will be no or minor environmental impacts. The project site area will be located in a Protected Area (Wildlife Sanctuary). However, it was known from the information given by the representatives of the Commune and villagers that there are no any protected wildlife inhabit or found in this site area and its vicinity. Therefore, there will be no negative impacts to the natural environment.

2) On the other hand, the need of electrification of concerned villagers is very high. This project will also be able to supply power for pumping river water for domestic and irrigation uses. Therefore, this project will also be beneficial to resolving poverty issue of the villages. At least, employment opportunity would be given to the villagers during project construction.

3) It is recommended that the Project Implementing Organization will materialize in early stage the contents of the Environmental Protection Measures and Environmental Monitoring Program as shown in the Item (9) Environmental Management Plan (the Plan) above, so that the Plan can be surely implemented.

4) It is desirable that EIA will be conducted for the project, so that the potential impacts to the ecology of the project site area and its vicinity would be understood in more detail.

Table 4.16 shows the results of the IEIA.

Table 4.15 Environmental Screening for Xtung Tun Po MHP Project (The check list for the proposed MHP project.)

1. General Information

Name of the proposed project: **Xtung Tun Po MHP Project**
Name of Project owner/proponent: not decided yet
Project Execution Organization: not decided yet
Name of authorized person(s) responsible for the project: not decided yet

Information regarding the project site
Name of the village, commune, district and province:
Three concerned villages, Pramaoy Commune, Veal Veaeng District, Pursat Province

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about o.5 hectors for power house space and waterway construction
	No	

2.2 Description of the project

Main design specifications:
The MHP will utilize the head difference of Xtung Tun Po River. Generating capacity will be 47 kW. The power generated will be supply to 361 households.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans of MIME/DIME in Pursat Provinces
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) There are about 6 potential MHP project sites which could be utilized. Considering cost benefit, urgent need and other factors, Xtung Tun Po project has been selected.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government
		●	Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

		(mark related items listed below)	
●	Yes	●	National park, wildlife sanctuary, bio-diversity conservation, and other protected areas designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
	No		

Remarks: Based on the interviews carried out with the representatives of concerned Commune and villagers, protected animals were rarely found in the site area and its vicinity.

2.7 May the project have potential negative impacts to the environment and local communities ?

●	Yes	(brief description of the potential negative impacts) The project site is located in a Wildlife Sanctuary area being protected. Measures shall be taken to mitigate impacts to the protected animals.
	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
●	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
●	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks:

1) The waste would be generated during construction by worker's camps at site. Such wastes must be treated before being discharged to the environment.
2) As mentioned above, the project site is located in a Wildlife Sanctuary area being protected. In spite of not being found in and around the project area, mitigation measures shall be taken to avoid impacts to the wildlife which may occasionally come into the plant facilities.
3) No minority people are living in the Commune.

3. Key results and findings of the environmental screening

1) The project site will be located at a Wildlife Sanctuary area being protected.
2) Therefore, in consideration of both environmental regulations of JICA and the MOE, carrying out IEIA(IEE) will be required, and the report shall be prepared and submitted by project owner to the MOE for review and approval.

The Table attached to Part 4 Chapter 4

Table 4.16 (1/2) Results of Initial Environmental Impact Assessment of Xtung Tun Po MHP Project

Environmental Factors	Potential Negative Impact	Mitigation Measures	Potential Environmental Impacts				Remarks
			Positive impacts	Negative Impacts			
				Non, not significant or minor (C)	Moderate impacts (B)	Significant impacts (A)	
I. Natural and Social Environmental Impacts (continued)							
12. Water right conflicts	No conflicts			Non			
13. Other potential impacts	Not found			Non			
14. Held stakeholder meetings to inform and discuss on the project plan, and points of opinions and comments received	No negative impacts. Through discussions with the representatives of the Commune and villagers, found all of them need more electricity.		Yes				
II. Environmental Issues in connection with project design and construction activities							
1. Negative impacts to existing communication road/system of concerned villages	May have impacts to existing communication road condition.	Improve road conditions before starting construction activities.		Not significant			
2. Soil erosion/silt runoff	No negative impact			Non			
3. Noise during construction activities	Minor due to remote from villages			Non			

Environmental Factors	Potential Negative Impact	Mitigation Measures	Potential Environmental Impacts				Remarks
			Positive impacts	Negative Impacts			
				Non, not significant or minor (C)	Moderate impacts (B)	Significant impacts (A)	
I. Natural and Social Environmental Impacts							
1. Watershed erosion and silt runoff/sedimentation	No negative impact			Non			
2. Encroachment upon Precious ecology	The site is located in a Protected Area (a Wildlife Sanctuary) (Phnom Samkos).	Barrier nets will be set around electrical equipment and distribution facilities to protect wildlife against suffering electric shock.			●		Deer, tigers and elephants inhabit in the remote mountain areas.
3. Impact on migration fish species	No migration fish species			Non			
4. Effects on groundwater hydrology	No negative impact			Non			
5. Change of river morphology	No negative impact			Non			
6. Change of riverside vegetation	May have such impact to the water reduction section	Keep minimum maintaining water flow			●		
7. Resettlement	No need			Non			
8. Impacts on tourism (potential) area	No negative impacts due to not a tourism spot			None			
9. Encroachment upon natural/cultural heritages	No such heritages being existed			Non			
10. Impairment of navigation	No river navigation			Non			
11. Inundation of agricultural and/or pasture lands	No negative impact, due to a small scale weir.			Non			

Table 4.16 (2/2) Results of Initial Environmental Impact Assessment of Xtung Tun Po MHP Project

Environmental Factors	Potential Negative Impact	Mitigation Measures	Potential Environmental Impacts				Remarks
			Positive impacts	Negative Impacts			
				Non, not significant or minor (C)	Moderate impacts (B)	Significant impacts (A)	
II. Environmental Issues in connection with project design and construction activities (continued)							
4. Air pollution during construction activities	Minor impact to the air around the site area.	Spray water to the dust generating work.		Minor			
5. River water pollution due to Construction activities	May have impact on the turbidity of river water.	Collect high turbidity water to a pond before discharging to the river. Minimize river bed work.		Not significant			
6. River water pollution due to waste water discharged from workers' camps	May have impacts on the river water quality	Prepare sewage treatment system			●		
7. Air and/or water borne diseases	May cause such diseases .to workers.	Prepare sanitary measures			●		
8. Impacts by quarry sites	Not much quarry will be needed.			Minor			
9.Odors to be generated	No such impacts			Non			
10.Employment of local villagers	Will create employment as construction workers		Yes				

Environmental Factors	Potential Negative Impact	Mitigation Measures	Potential Environmental Impacts				Remarks
			Positive impacts	Negative Impacts			
				Non, not significant or minor (C)	Moderate impacts (B)	Significant impacts (A)	
III. Potential Environmental Impacts during Operation							
1. Potential impact to ecology of the water reduction section	May have such impact	Keep at least 10% river water flow as the minimum maintaining flow for the water reduction section.			●		
2. Potential electric shock to wildlife	May have such impact to the wildlife which come occasionally into the plant facility site	Set barrier nets around the outdoor electrical equipment and distribution facilities.			●		
3. Downstream river bed erosion or sedimentation	No such impacts			Non			
3. Eutrophication of reservoir	No such impacts due to a small weir			Minor			
4. Air/water borne diseases	May cause such impacts	Avoid long term stagnation of reservoir water		Minor			
5. Impacts on downstream fisheries	No such impacts due to no fisheries being existed			Non			
6. Increase of insect vector diseases	May have such impacts	Avoid long term stagnation of reservoir water		Minor			

6 ORGANIZATION FOR MANAGEMENT

■ Capacity of the Commune for Operation

The active NGO in Pramaoy, Disability Cambodian Organization (DCO), and Seila program are confident for collaborating in aspect of training and further action planning. The support of local knowledge is vital for institutional building at the commune level.

■ The proposed operation / management organization of the MHP

Operation and management system is still in question. Once the CEC is established by the villagers themselves, adequate support needs to be provided.

7 CONCLUSIONS AND RECOMMENDATIONS

Pramaoy Electrification Scheme was first identified as a pre-feasibility candidate for micro hydro power development. However, due to river discharge shortage during the driest period of the year, development with micro hydro as a single energy source is rather difficult. Instead, biomass power generation was selected as a result of comparative study. Therefore recommendations are so far made as follows.

1) Electrification scheme is divided into two phases.
2) 1st phase will electrify district town of Pramaoy Village with biomass power (20 kWe).
3) 2nd phase will extend electrification area to Stueng Thmei Village by installation of additional biomass power (25 kWe).
4) For an implementation of 2nd phase development, the followings should be examined.
    a) Another installation of biomass power (25 kWe) as selected energy source.
    b) Sufficient examination on daytime demand and dry season discharge should be made to re-examine economic efficiency for additional construction of micro hydro as an alternative energy source during non-dry season.

Demand

The residential demand for Pramaoy Scheme is summarized below.

Demand Estimate for Pramaoy Scheme (Phase 1)

	Number of users	Unit (kW)	Demand (kW)
Night time residential	146	0.1	14.6
Street lights	75	0.02	1.5
Reserve (30%)*	44	0.1	4.4
Total	265	-	20.5

*: Assumed at 30% of night time residential demand.

Ability to Pay

The villagers already consumed the available energy such as kerosene, car battery and mini-grid system from US$1 to 5. Once MHP will be introduced and offer more reasonable tariff, even the poorer shall be able to get electricity service. Yet, the relatively large amount of initial connection fees needs to have special financing support by leasing or special loan with low interest rate.

PRE-FEASIBILITY STUDY

Part 1	Summary
Part 2	Samlout Electrification Plan
Part 3	Bu Sra Electrification Plan
Part 4	Pramaoy Electrification Plan
Part 5	Samraong Electrification Plan
Part 6	Kampong Kor Electrification Plan
Part 7	Srae Ta Pan Electrification Plan

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PART 5 SAMRAONG COMMUNE ELECTRIFICATION PROJECT

1 SOCIO-ECONOMIC SITUATION IN THE STUDY AREA

1.1 BASIC INFORMATION OF SAMRAONG

Phnom Kravanh District, Pursat Province consists of seven communes. Samraong Commune, the target area of this electrification project, is situated in Phnom Kravanh District and consists of eleven villages. The basic information of four villages situated in the central part of Samraong Commune is given in Table 5.1. The population including migrants from other regions is 4,581.

Table 5.1 Basic Information of Samraong Commune

Villages	Household Number	Population	Number of TV -owned households	Literacy rate	Number of BCS	Number of Mini-grid
Total	948	4,581	250	86.3%	4	1
Preaek Muoy	367	1,783	169	85.2%	n.a.	n.a.
Preaek Pir	198	962	29	85.0%	n.a.	n.a.
Preaek Bei	208	1,051	31	84.4%	n.a.	n.a.
Ou Heng	175	785	21	92.6%	n.a.	n.a.

Source: Seila Commune Database 2004

1.2 CURRENT HOUSEHOLD SITUATION IN SAMRAONG FOUND BY THE SOCIOECONOMIC SURVEY

It was originally envisaged that the whole area of Phnum Kravanh District be target area of this electrification scheme. A village socioeconomic survey was executed by hearing to 26 sample households in the Phnum Kravanh. It was found that 650 households in total of six communes had been electrified by a mini-grid of REE. The REE had a plan to expand his mini-grid. It was then decided to target the Samraong Commune that was not electrified and had no plan for electrification. Household economy, energy use and willingness to pay for electricity tariff in Samraong Commune were surveyed at workshops using survey form (refer to Section 2.2). The data of household survey and key informant survey executed in Krouch Chhmar village, Leach Commune, Phnum Kravanh District will be explained below for reference since it is located in close proximity.

(1) Household Economy

The first main source of income is agriculture (rice, corn, bean and vegetable). The livestock and forestry (for collecting non-timber forest products) are the secondary source of income. Simple processing industry such as rice cake making, vegetable processing and service industry such as restaurants and shops exist in the area. According to key informant survey, they earn approximately US$10-50 per month.

1) Major income sources

Table 5.2 Main Income Sources (%)

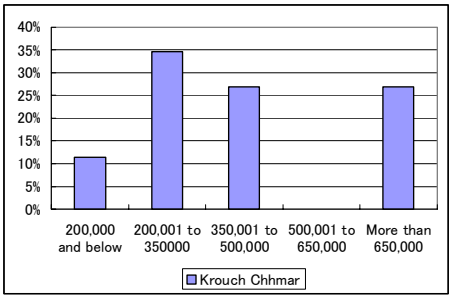
Income Source	1st	2nd	3rd
Agricultural produce (crops)	46.2	23.1	18.2
Livestock & poultry	3.8	26.9	31.8
Forestry (timber non-timber forest products)	-	7.7	13.6
Bakery/ grocery	15.4	-	-
Food/ Restaurant business	3.8	7.7	-
Salary from private business/ NGO	7.7	-	4.5
Salary from public service	-	11.5	4.5
Wage from seasonal labor	-	7.7	9.1
Home-based crafts	-	3.8	
Sell vegetable	-	3.8	4.5
Raparing moto	-	-	4.5
Construction	-	3.8	-
Moto taxi	-	3.8	-
Sewing	3.8	-	-
Make palm juice	3.8	-	-
Sell firewood/charcoal	7.7	-	-
Run taxi	3.8	-	-
Washing moto	3.8	-	-
Others	-	-	9
Total	100	100	100

Source: JICA Study Team

2) Land ownership and assets

Irrigated paddy land owner is limited to 26 %. Those depend on the rented farm land is approximately 4%.

3) Monthly expenditure



Source: JICA Study Team

Figure 5.1 Monthly Household Expenditure (Riel)

4) Monthly household expenses

Table 5.3 Monthly Household Expenses (Riel)

Expense item	n	%	Minimum	Median	Maximum
Food	26	100.0	60,000	183,000	400,000
Clothing	10	38.5	3,000	35,000	150,000
Child care	4	15.4	800	10,000	45,000
Education	21	80.8	3,000	48,000	300,000
Medical treatment/medicines	20	76.9	500	40,000	120,000
Transportation	11	42.3	10,000	60,000	870,000
Amusement/recreation	8	30.8	4,500	40,000	150,000
Fuel for lighting/cooking	24	92.3	1,200	3,400	75,000
Personal care	25	96.2	500	9,000	30,000
Water	12	46.2	2,300	17,500	90,000
Gambling	2	7.7	2,000	3,000	4,000
Payment of debt/loan	6	23.1	10,000	55,000	300,000
Saving	12	46.2	10,000	40,000	200,000
Others	11	42.3	5,000	13,800	27,600
Total expenses of each sample HH	26	100.0	84,000	362,400	1,987,000

Source: JICA Study Team

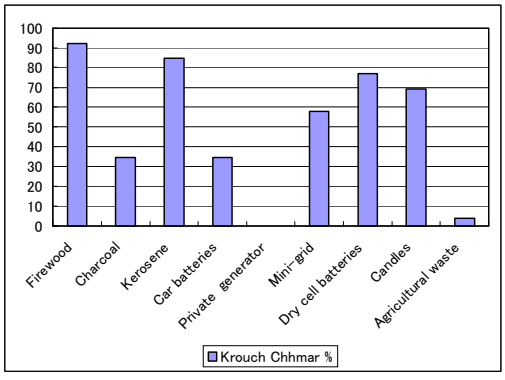
The poorest spends 84,000 Riel (U$20)while the richest spends 1,987,000 Riel(nearly US$200). Those who merely spend less than 200,000 Riel (US$50) are about 10%.

5) Credit and savings

Credits and saving activities for special purposes such as rice and livestock do exists in target four villages. In order to finance the initial costs required for consumers, consultation with these credit schemes shall be useful.

(2) Current Situation of Energy Use and Needs

1) Energy usage



Source: JICA Study Team

Figure 5.2 Current Energy Usage

Diesel oil lamps are widely used at 80%, yet battery is simultaneously used among 30% of the respondents. Those connected to mini-grid enjoy 5-8 kWh per month spending Riel 2,300 /kWh. Thus, it is assumed that those enjoying mini-grids spend average US$4.5 plus a diesel oil lamp or battery for backup. Since the mini-grid system presents 50% of households connected in Krouch Chhmar, those who use batteries are small portion while a diesel oil lamp is still widely used for backup.

2) Current usage of major lighting sources, diesel oil lamp and battery

Table 5.4 Current Usage of Diesel Oil Lamp and Battery Lighting

Kerosene (N. of users: 22 share 85%)		Car battery (N. of users:9, share 35%)	
Cost of kerosene per liter		Number of baterries owned /household	
Mean	2,550.0	Mean	1.22
Standard Error of Mean	57.6	Standard Error of Mean	0.147
Minimum	2,000	Minimum	1
Maximum	3,500	Maximum	2
Liters consumed per month		Number of times recharging batteries per month	
Mean	2.4	Mean	3
Standard Error of Mean	0.9	Standard Error of Mean	0.37
Minimum	0.5	Minimum	2
Maximum	22	Maximum	5
Monthly expenses for month		Expenses for recharging batteries per month	
Mean	3,770.5	Mean	2,388.9
Standard Error of Mean	390.8	Standard Error of Mean	532.15
Minimum	1,200	Minimum	1,000
Maximum	7,200	Maximum	6,000

Type of battery	Number	Share	Cost of battery
12 Volt - 100 Ah	0	-	-
12 Volt - 70 Ah	1	10%	150,000.0
12 Volt - 50 Ah	2	20%	74,500.0
6 Volt - 5 Ah	7	70%	15,357.1

Source: JICA Study Team

3) Present ownership and future demand of electric appliances

Those who own the electric appliances have primarily lighting, followed by TV, radio and fan. After electrification, 80% showed interests in rice cooker. Attention is needed as energy consuming appliances will require substantial cost.

Table 5.5 Present Ownership and Future Demand of Electric Appliances

APPLIANCE	Currently owned		Want to buy	
	n	%	n	%
Electric lighting	20	76.9	17	65.4
Electric rice cooker	-	-	21	80.8
Television (color)	14	53.8	9	34.6
Television (black and white)	-	-	-	-
Video (VHS/VCD)	6	23.1	6	23.1
Radio/radio cassette	9	34.6	6	23.1
Electric fan	5	19.2	20	76.9
Electric water pump for drinking/household	-	-	16	61.5
Electric water pump for irrigation	-	-	6	24
Iron	3	11.5	6	24
Refrigerator	-	-	8	32
Washing machine	-	-	6	24
Video game	2	7.7	-	-
Karaoke	3	11.5	3	12
Grain/cereal/meat grinder	-	-	6	24
Others	-	-	2	8.0
Electrical pot	-	-		

Source: JICA Study Team

(3) Economic Activities

The main sources of income in Samraong target areas are agriculture, livestock and non-timber forestry products. Rice cake making and vegetable processing do exist, but very limited capacity. All these local industries are powered by the diesel generator sets.

(4) Willingness and Ability to Pay for Electricity Services

1) Willingness to pay for initial connecting fees and monthly tariff

During the WS, willingness to pay among potential customers is discussed. Considering the cost of battery is already approximately US$30 (for 12V) and its lifetime is merely 2 years, the proposed initial cost of US$50 was regarded as acceptable. Yet, it needs to be paid by instalments in 10 months.

2) Willingness to pay for monthly tariff for the electricity

Table 5.6 Willingness to Pay for Monthly Electricity Tariff

Monthly consumption of charging battery	Number of participants
4,000	8
7,500	1
12,000	21
> 12,000	4

Source: JICA Study Team

Since many households consume diesel oil and charging batteries at a range of US$ 1 to 3, willingness to pay for monthly tariff is expected to be more than US$ 2.

There was a businessman who planned to start electricity service and did demand survey in June 2005 in this commune. Yet, due to the small number of potential customers, he postponed the implementation, which disappointed potential customers.

3) Expected demand for the biomass power plant

The household demand which is targeted to 80 % of the total 948 households. In four target villages, there are considerable number of service sectors (restaurants and grocery shops 27) and small industry who will be potential large users after electrification (rice mill 33, repair shops 5, and vegetable processing 10). Besides that, it is difficult to envisage new industry after electrification. There is also demand from the public utility offices such as schools (7 primary, 4 lower secondary, and 1 health posts, 1 commune centre).

4) Appropriate tariff for the village for sustainable operation

The tariff needs to reflect sustainability as willingness to pay can be estimated to increase once villagers understand the Tariff for basic needs have to be prepared in order to expand the service areas.

1.3 DEVELOPMENT PLAN AND THE PRESENT DEVELOPMENT EFFORTS (COMMUNITY ACTIVITIES)

According to the four village chief interview, the main restriction in the commune is water management issue such as drought and flood issue. Irrigation, thus, most required service followed by electricity and road. Commune councils are willing to utilize whatever support available. They confirmed their interest in allocating commune funding for electricity. The development activities are currently executed under the some NGOs and Seila Commune Development Program. The Commune also organized a pagoda committee, parent committee, and informal labour exchange groups.

The commune has small experiences of collective works among the villagers except for the NGO led activities. There are three NGOs active in the commune; 1) community forestry supported by DANIDA; 2) credit and saving community, and rice bank supported by NGO called 'Future of Children'; 3) community of development on animal raising and agriculture supported by NGO called 'CelAgrid'.

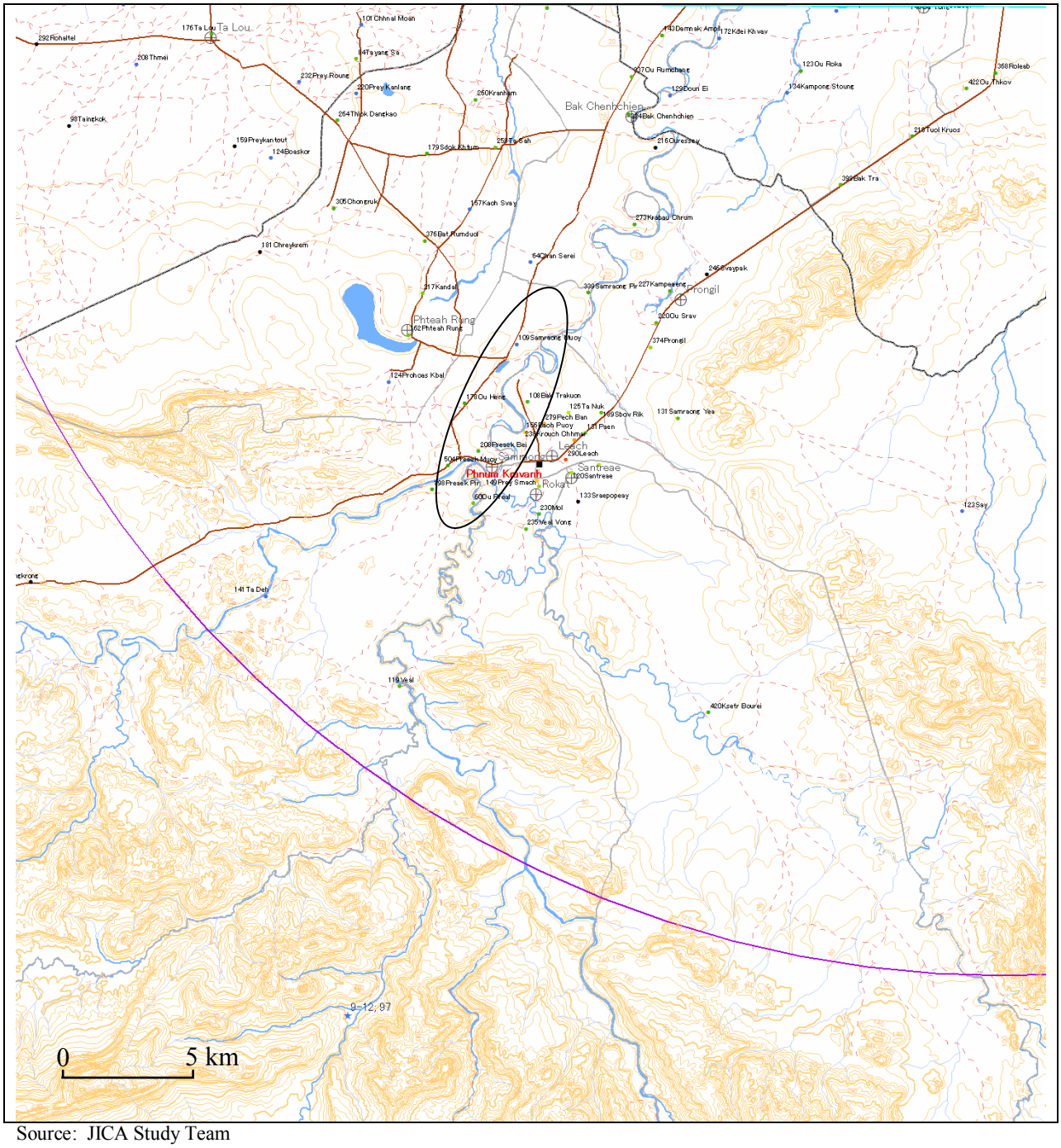
The below table is the summary of the existing activities in Samraong.

Table 5.7 Outlines of NGO Operating in Samraong Commune

Preak Muy Village	Preak Pi Village	Preak Bei Village	Oh Heng Village
Future of Children - 22 HH as members of rice bank - 27 HH as members of saving group with 2% of interest rate	Future of children – 15 HHs are members of saving groups	Future of children – 20 HH are members of self help group	
AMK (NGO name) 105 HH as members – provide credit for animal raising	AMK – 50 HHs are members of saving groups	AMK – 20 HHs are members of saving groups	
Racha(NGO name) - 105 HH as members – 3% of interest rate		Racha – provide training on health	
Seila 80 HH as members – provide credit for animal raising		Seila– 7 groups with 2-3 HH per one group are members of saving groups	Seila – 16 HH per 6 groups (borrow money for animal raising with 3-4% of interest rate)
PLUP - Community forestry (on plan)		PLUP – community forestry (on plan)	

Source: JICA Study Team

2 PLAN FORMULATION



Source: JICA Study Team

Figure 5.3 The Target Area

The target area of this scheme is shown as an ellipse.

2.1 PROSPECTIVE ELECTRIFICATION BY MAIN GRID

Centre of Samraong Commune is located about 3 km west of Phnom Kravanh District centre (Figure 5.3). The district centre is electrified by non-licensed REE by diesel generation. The REE is supplying 600 households between 5:00 am and 11:00 pm. The REE currently distributes power through low voltage

line and plans to install 22 kV line for expansion of the services. But the REE considers expansion of the service only towards to north along the road to Pursat, where more villages are situated. The REE is not considering the expansion to Samraong Commune. Pnum Kravanh District centre is located within 40 km radius from Pursat provincial capital. Once high voltage distribution line reaches to Pursat and transmission station is established, Phnom Kravanh is possibly connected by 22 kV line to the main grid. Since Samraong commune centre is located only a few kilometres away from the district centre, the area would be connected to the main grid as well. On the other hands, funding for such main grid extension plans is not confirmed yet and it will take long time to such plans to be materialized. It is therefore assumed that Samraong Commune is most likely not to be electrified by grid connection for at least 10 years. The durability of biomass gasifier electricity generation systems is thought to be about 10 years. People will have more reliable information of main grid connection at the time of system replacement. The distribution line will continue to be used after connecting to main grid. People will have a choice whether stop generating electricity and sell the systems or continue to generate and sell electricity to EdC at the time of main grid connection. This project will be the model case for the community located in grey zone of near future potential of grid connection.

2.2 RESULT OF WORKSHOP

2.2.1 Outline of Workshop

A workshop was conducted in Pramaoy. The outline is shown in the table below.

Table 5.8 Outline of Workshop

Commune Name	Date	Time	No. of Participants
Samraong	Dec. 08, 2005	9:30 – 16:00	28

Source: JICA Study Team

2.2.2 Community Based Organization

There are several community-based organizations in action. There is, however, no other community activity, which was initiated by community itself. There is, however, a traditional mutual help for poor people and starved people, and help for a family in funeral as a community activity.

The followings are the community based organizations and their activities:

- Forestry Community: organized by DANIDA. A leader monitors and supervises the forest and put a board which shows not to cut tree so as to conserve forestry in sustainable. There are 87 member households in Ang Krong village. It is planed to expand the activity to other three villages in 2006.
- Saving Community: organized and supported by Future Children (NGO). 10 to 15 households organize one group for saving and credit. One household save 500Riel per month. There are about 3-4 group in a village.
- Rice Bank: organized by Future Children.

A problem in community activity is a delay of saving and returning in micro credit activity. 18 participants bout of 27 have an experience of micro credit

2.2.3 Project by other donor

A project of CDLRA = Community Development on Livestock Rising and Agriculture is ongoing being supported by CIDA and USAID. The project is operating and making six groups consisting of about 30 members in four villages of Ouheng, Prek 2, Prek 3, Samraong 2.

2.2.4 Existing REE

There is an REE in Preck1 village and providing for 7 households. The REE is adopting a meter charging system. An initial connection charge is free and the tariff is Riel 2,200/kWh.

One REE from the outside came to this village and conducted a survey in June 2005. However, the REE did not operate because of non-profitability. There are some rich men in the community but it is not sure that they can start REE.

2.2.5 Situation of Battery Use

A situation of battery use is shown in the table below. There are 15 participants out of 28, who have only 6V battery and 3 participants do not have a battery. More than half of the participants do not have 12V battery.

Table 5.9 Households Using Battery Lighting

Types		No.
Battery	Only 6V	15
	6V and 12V	10
	Only 12V	0
Connecting REE		0
Own generator		0
Using a diesel oil lamp/candle without battery		3

Source: JICA Study Team

Table 5.10 Breakdown of Monthly Expenditure for Lighting

Types		Number of charging times per month	Amount (Riel)
Battery	6V	4times X 700R	2,800
	12V50A	3times X 2,000R	6,000
	12V70A	3times X 2,500R	7,500
	With a diesel oil lamp		6,000
A diesel oil lamp/candle			15,000

Source: JICA Study Team

Table 5.11 Monthly Total Expenditure for Lighting

Types		Amount (Riel)	total	No.
Battery	6V + diesel oil lamp	2,800+6,000	8,800	15
	12V50A + 6V + diesel oil lamp	6,000+6,000	12,000	10
	12V70A + 6V + diesel oil lamp	7,500+6,000	13,500	
A diesel oil lamp/candle			15,000	3

Source: JICA Study Team

Basically a battery owner uses a diesel oil lamp as well. They use battery from 5 p.m. to 10 p.m. and use a diesel oil lamp from 10 p.m. to 6 a.m. In fact, the monthly amount for lighting with a diesel oil lamp/candle without battery is higher than using battery. Battery cost is about $30 and its life duration is 1.5-2 years. Therefore a battery costs about $1.4 per month.

Therefore to buy a battery by preparing a certain amount of money is a barrier.

Eight participants have black and white TV and three are using 5 p.m. to 9 p.m. and five are using 5 p.m. to 10 p.m. No one has a color TV.

2.2.6 Establishment of CEC

There are several repairmen of tractor. They can be a candidate operator. Many people can be a candidate accountant. They are school teachers, business men, students, and so on.

2.2.7 Biomass Fuel Wood

All participants have an available land more than 0.02ha for planting biomass fuel wood. One household have 1-2ha of land on an average and have 0.5ha of available land for planting biomass fuel wood.

There is commune land covered with a forest. It is possible to use the forest for planting fuel wood.

2.2.8 Demand Power Amount and Charge

Six groups of power demand and its charges were shown to the participants in the workshop. Participants chose the types, which they want to use and can afford to pay the charge as shown in the table below:

Most of participants selected No. 3 and some selected No.1.

Table 5.12 Potential Demand Level Based on Ability to Pay

No.	Amount of Daily Use	Watt	monthly amount	Estimated Monthly Charge	No.
			kWh	Riel	
1	10W lighting : 1: 3 hours use per day	10	0.9	900	4
2	20 W lighting: 2 : 4 hours use per day	40	4.8	8,600	0
3	20W lighting: 2 : 4 hours use per day Black & White TV(40W) or Fan (40W) : 1:4 hours use per day	80	9.6	18,200	15
4	20W lighting: 2 : 4 hours use per day Color TV (80W) : 1:4 hours use per day	120	14.4	27,800	0
5	20W lighting: 2 : 4 hours use per day Color TV (80W) : 1:4 hours use per day Fan (40W) : 1:4 hours use per day	160	19.2	37,400	0
6	20W lighting: 3 : 4 hours use per day Color TV (150W) : 1:4 hours use per day	210	25.2	49,400	0

Source: JICA Study Team

2.2.9 Ability to Pay for Initial Cost

At first, they expressed that they cannot pay about $500 per household for the total cost and then preferred REE. But finally all participants concluded to prefer CEC. During the discussion, a participant told that it is impossible to pay before operation however it is possible after operation. It seems to show that he dose not trust whether power is generated or not.

The reason why they prefer CEC is that the money paid for biomass fuel is circulating within the area and does not go out of the community.

Twenty participant out of 27 can prepare 50$ as an initial connection cost, however they need one year for saving money.

A participant expressed his opinion that contract document with some mortgage, such as cow is necessary when they become a CEC member for the purpose to prevent non-payment.

2.2.10 Feasibility in Samraong

Readiness of electrification is a little low because lower ratio of battery possession. In terms of ability to pay, there are two category of people who have an ability to pay and not. Therefore it is necessary to conduct more detailed household survey to know the households who have an ability to pay, their house location. Then a feasible distribution cable plan and project plan should be considered.

Operator and accountant are feasible in training are provide.

2.3 PROJECT SCALE

2.3.1 Phased Development

Samraong is a very large commune in terms of the land area. Commune expands about 40 km from south to north and 30 km from east to west. There are eleven villages in the commune but electrifying all villages is not economically viable because of dispersion of villages and households. Only selected villages in the commune will be electrified. Three plans are prepared and described below.

Plan 1

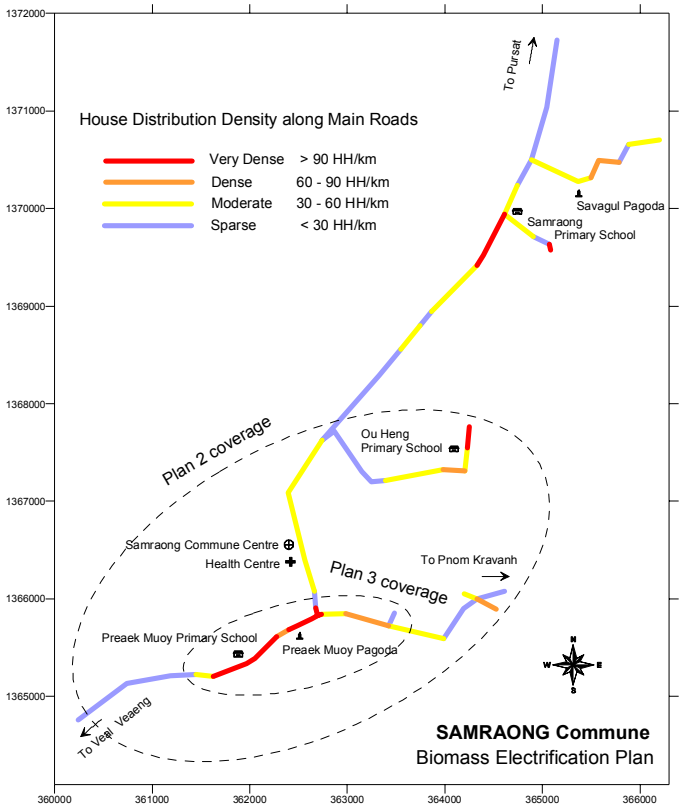
Cover all the area shown in Figure 5.4. Six villages (Preaek 1, Preaek 2, Preaek 3, Ou Heng, Samraong 1 and Samraong 2) with 1,536 households are covered in this plan. If 80% of households were connected, the necessary capacity would be about 180 kW. The required land for tree planting would be 35-57 ha.

Plan 2

Area covered is shown in Figure 5.4 and the house distribution of this plan is shown in Figure 5.5. In the both maps, small footpaths were not surveyed and many more houses are assumed to exist especially the area around Preak Muoy Pagoda and Preak Muoy School. Four villages (Preaek 1, Preaek 2, Preaek 3 and Ou Heng) with 1,088 households are covered in this plan. If 80% of households were connected, the necessary capacity would be about 120 kW. The required land for tree planting would be 15 ha.

Plan 3

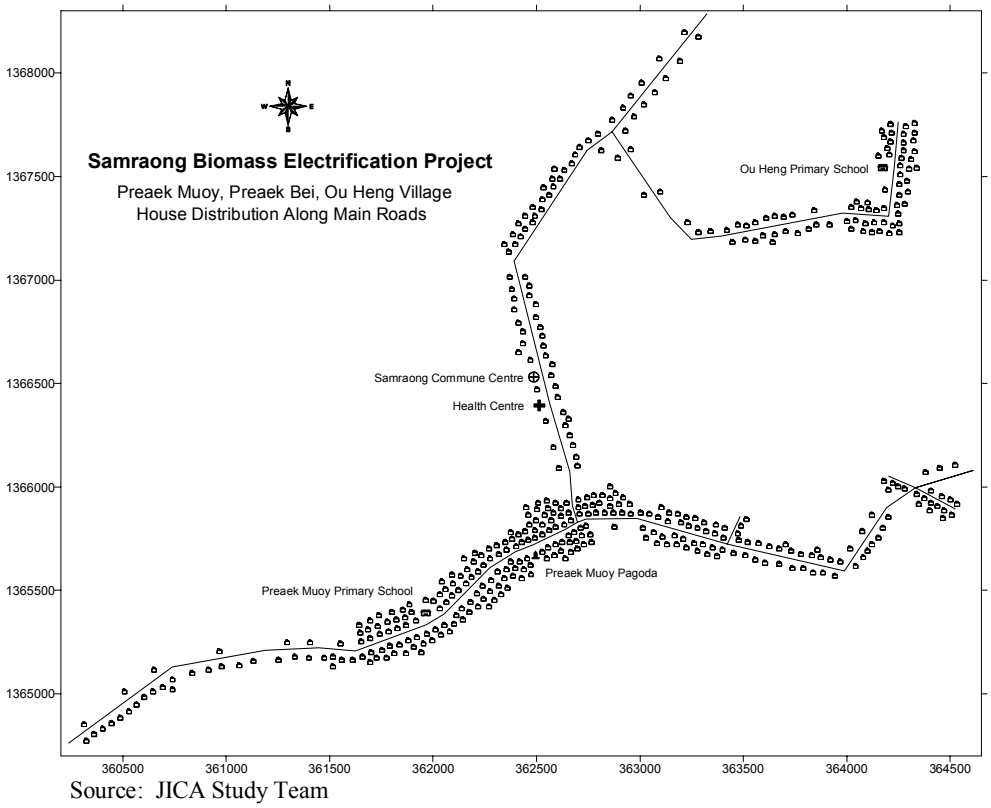
Only Preak1 village is electrified in the case of the shortage of funding. The area covered is shown in Figure 5.4. Only the most densely house distributed area around Preak Muoy Pagoda, Preak Muoy School and the junction in Figure 5.4 is electrified. 504 households are covered in this plan. The installed capacity would be about 64 kW. The required land area for tree planting would be 13 ha in the 2^{nd} year from commissioning and 22 ha in 8^{th} year.



Source: JICA Study Team

Figure 5.4 Household Distribution Density along the Main Roads in the Target Area

Plan 1 covers whole area of this map. The coverage of Plans 2 and 3 is indicated as dot-lined ellipses.



Source: JICA Study Team

Figure 5.5 House Distribution in the Targeted Areas of Plans 1 & 2

Houses are only surveyed along the main roads.

Summary of three plans are as shown in Table 5.13.

Table 5.13 Summary of Three Alternative Development Plans

Phase	Name of Alternative	Total Household	Installed Capacity	Necessary Tree Planting Area @10 kWh/hh/m (area planned for 2nd and 8th years)
1+2	Plan 1	1,536 (6 villages)	180 kW	25 ha (35-57 ha)
-	Plan 2	1,088 (4 villages)	120 kW	15 ha
1	Plan 3	504 (1 village)	64 kW	10 ha (13-22 ha)

Source: JICA Study Team

Restaurants and stores around the junction of three roads to Pursat, Phnom Kravanh and Veal Veng are assumed to be higher electricity consumption customers. The most densely distributed area of houses is around Preak Muoy Pagoda, Preak Muoy School and the junction in Preaek 1 village. It is therefore Plan 3 is the most economic viable option but less number of people is benefited. Plan 1 covers highest number of households but economic viability would be the lowest. Plan 2 is middle between Plan 1 and 3. Plan 1 would be preferable if enough funding is available. If funding is very limited or people have to pay all the cost, Plan 3 is recommended because it is most economically efficient plan. Pay back time of Plan 3 would be shorter than others. People can expand the capacity and supply area with the profit from the operation later.

Power station can be established anywhere free from flooding and not too far from main road (less than a few hundred meters, economic reason). More than 1000 m^2 would be required including fuel wood storage and processing area. It is preferable to obtain larger area because of the possible future system expansion.

Distribution lines will be erected along the main roads. The length of distribution lines, number of households, and unit line length per household are shown below for each Plan:

Plan 1 – 14.0 km, 1,229 households, 11.4 m

Plan 2 – 7.2 km, 870 households, 8.3 m

Plan 3 – 2.5 km. 403 households, 6.2 m (with only LV lines)

2.3.2 Construction Cost of Biomass Gasification Power (BGP) Station

Construction costs of biomass gasification power station and distribution lines are estimated as follows for Plans 1 and 3 (refer to H-4 of Vol. 5 for planning sheets):

Table 5.14 Construction Costs of Biomass Gasification Power Stations

Items	Plan 1	Plan 3
Installed capacity	180 kW	64 kW
Construction cost of generating facility	$573,700	$143,900
Construction cost of distribution facility	$519,300	$75,400
Total cost	$1,093,000	$219,300

(Source: JICA Study Team)

2.4 BIOMASS FUEL SUPPLY

Tree farming will be conducted by CEC members for fuel wood production. Farmed fuel wood will be purchased by CEC. Purchasing price is presumed to be around $20/t. People showed strong interest for selling farmed tree wood to the power station during the village workshop. Some NGO already conducted Acacia and Leucaena tree planting activities in Samraong. People have basic knowledge of nursery techniques and tree planting. Average annual rainfall in Pursat between 1994 and 2001 was 1,518 mm (JICA 2005 Weather observation data). Most of fast growing tree species commonly planted for wood chip and fuel wood production in tropical region is likely to grow moderately under such amount of annual precipitation. Leucaena and Acacia trees planted in recent years in the commune show good growth. Minimum 10 t/ha/year biomass production is assumed to be obtained. Following tree species are recommended for planting.

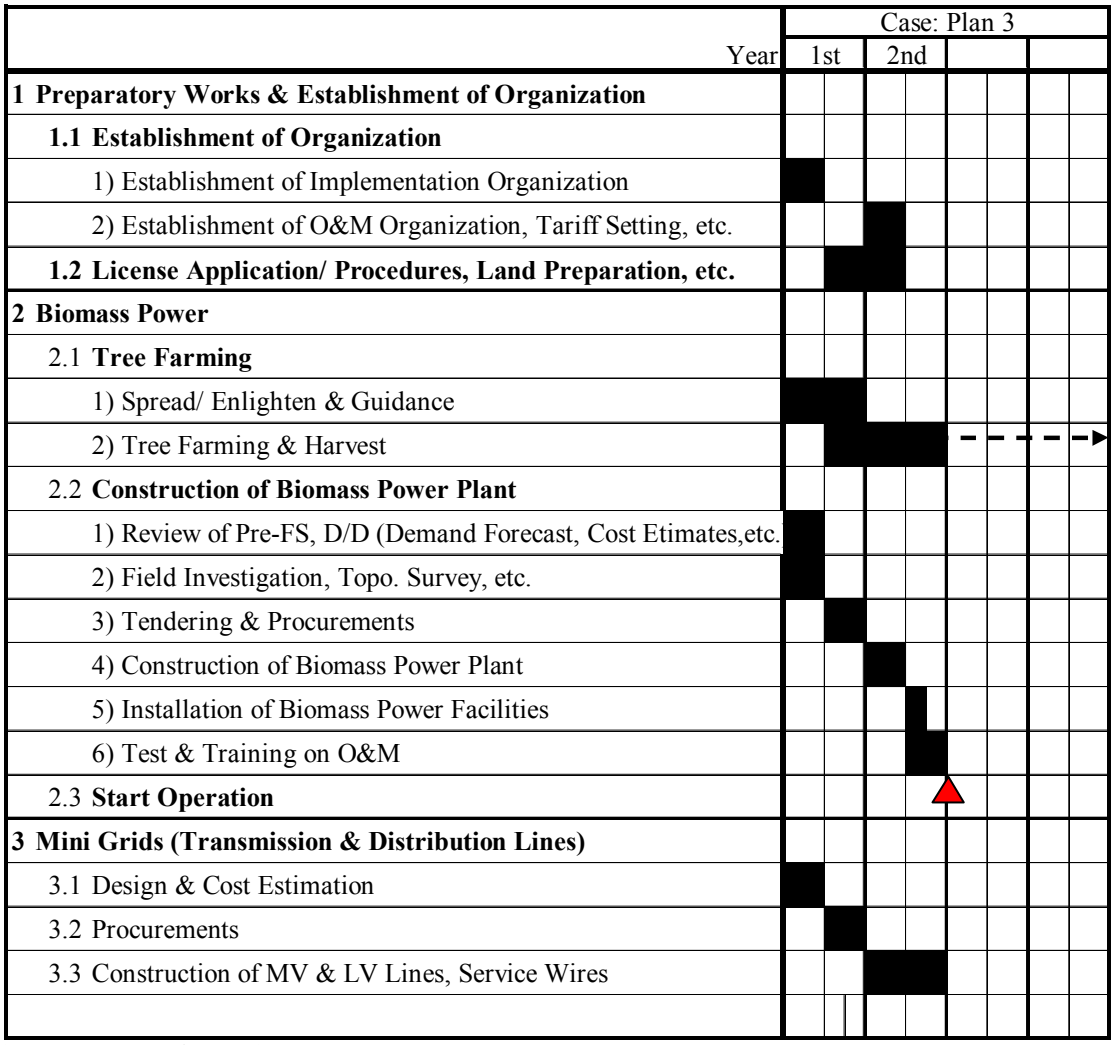
Short term coppicing wood production in and around gardens: Leucaena leucocephala, Gliricidia sepium

Longer term stem wood production: Acacia spp., Eucalyptus spp. Casuarina equisetifolia

Despite Samraong Commune has very large land area, shrubland per household is only 0.022 ha (there is no grassland). This is slightly higher than the minimum land availability for tree planting as selection criteria for biomass electrification candidate villages set in the Master Plan. Majority of land in Samraong Commune is under forest. All required biomass can be produced from tree farming but care should be taken for purchasing. Some people might attempt to sell woods obtained by cutting trees in the forest. On the other hand, most of forest observed from roads is heavily degraded. Biomass electrification would be a great opportunity for implementing forest rehabilitation activities.

2.5 CONSTRUCTION SCHEDULE

Figure 5.6 shows proposed construction schedule for Plan 3 of Samraong Electrification Plan.



(Source: JICA Study Team)

Figure 5.6 Implementation Plan of Samraong Electrification Project (Plan 3)

3 ECONOMIC/ FINANCIAL ASSESSMENT AND TARIFF SETTING INCLUDING LOAN REPAYMENT

Of the three alternative plans, Plan 3 has the smallest size and is suitable as a pilot project. Economic analysis was made for Plans 1 and 3 to prove the suitability as a pilot project.

Table 5.15 Economic and Financial Analyses

Phase/Plan	EIRR	FIRR	Night-time Tariff Rate ($/kWh)	Remarks
Phase 1/ Plan 3	37.3	4.9	0.270	Lower costs owing to omission of MV lines
Phases 1+2/ Plan 1	32.8	5.9	0.380	Higher costs due to MV lines

(Source: JICA Study Team)

Economic costs are initial costs of BGP and distribution line construction while operation costs include operators' salary, maintenance costs, and fuel costs. The economic benefits are assessed as costs of, alternative diesel power generator system. The lower O&M cost of BGP compared with diesel generator (about 1/7) will contribute to improving the operational sustainability. EIRR is as high as 37.3%.

Taking into consideration the ability to pay in the target electrification area, suitable electricity tariff was assumed and financial analysis was made. When the tariff is set at $0.270/kWh, FIRR will be 4.9%. It will be 9.3% if 25% subsidy and CDM effect (sales revenue of CER) are taken into account from the viewpoint of CEC who will implement and manage this project. This high rate of FIRR shows the project can be managed at this tariff rate with financial sustainability. The tariff rate is at a low level as of small mini-grids in the off-grid areas in Cambodia. The Samraong Electrification Project (both Plans 1 and 3) has high economic feasibility. If the proposed financial supports (25% subsidy of initial capital costs and 60% soft loan) are provided to CEC, it is judged that the Project can be managed with financial sustainability.

4 ENVIRONMENTAL CONSIDERATIONS

For the environmental consideration, JICA's Environmental Guidelines and Checklist have been used for defining project Category (A, B or C) and environmental assessment. On the other hand, "Annex of Sub-Decree No.72 ANRK. BK." dated August 11, 1999, that is the "List of the Project Require an IEIA (IEE) or EIA", and other concerned environmental regulations of the MOE of Cambodia have also been referred and applied.

Based on results of the environmental screening, IEIA (IEE) will not be required for the project because of the following conditions being all met:

(1) Based on the requirements of JICA Guideline, the project will belong to Category C.

(2) Based on the regulations of "Annex of Sub-Decree No.72 ANRK. BK." dated August 11, 1999, the project will not need an IEIA and/or EIA. That is the power output will be less than 5 MW.

(3) The Project will not be located in any Protected Area designated by the MOE.

4.1 ENVIRONMENTAL SCREENING

Table 5.16 shows the details and results of the environmental screening of Samraong (Phnum Kravanh) Project. Key results and findings of the environmental screening are summarized below.

(1) Considering the following three factors, carrying out IEIA will not be required.

1) The project will belong to Category C of JICA Environmental Guidelines.

2) The project output capacity (180 kW for Plan 1) is less than the limit which will need IEIA or EIA defined by the MOE (5MW).

3) The project site will be located outside of any Protected Area designated by the MOE.

Therefore, only the environmental screening result will be enough for the project.

(2) Based on the new Decree of the MOE regarding environmental regulatory reform, the project owner/implementing organization will have to make project license application to the concerned Province, if the project cost will be less than 2 million US dollars. For the application, it is considered that IEIA will not be required.

4.2 DETAILS OF RESULTS AND FINDINGS OF THE ENVIRONMENTAL SCREENING

1) Potential natural and social environmental impacts

a. The project site will be located outside of any Protected Area. Through interview conducted on September 7, 2005 with Deputy Chief of the Commune, Council member of the Commune and some villagers, it was known that there are no any protected wildlife inhabit in the project area. Therefore, it is concluded that there will be no negative impacts to be caused to the wildlife, nor to ecological system of the project site area.

b. The maximum power output capacity of the project will be 180 kW (Plan 1), which will need about 35-57 ha fuel wood tree farming land. Acquiring the land might cause conflicts with interests of land owners. Project owner/implementing organization will have to acquire the land which will not cause such conflicts.

c. Because this is a small scale project, there will be no negative impacts to the air and water quality in and around the project site area.

d. There will be no negative impacts to groundwater of the project area and its vicinity.

2) Environmental issues in connection with the plant design and construction activities

a. There will be no negative impacts to the agriculture of the project site and its vicinity.

b. There will have the following positive impacts to the villagers in and around the project site.

i. Electrification of the rural area

ii. Create employment opportunity for the villagers as labor force source

iii. Create business opportunity to the villagers during construction

3) Dust generation could be generated by construction work. Generating dust will be minimized by spray water.

4) Potential environmental impacts during plant operation

a. In general, illegal logging of outside forests or purchase of large amount of fuel wood from market might be happened when fuel wood would become insufficient. All of fuel wood needed for the project will be planted, and supplemental fuel wood trees in store will also be prepared. In order to assure the fuel wood supplying plan to be implemented well, preparation of the power plant operational management rules will be required. By positive implementation of the fuel wood trees planting program, and securing the supplemental fuel wood in storage by whole concerned villages, negative impacts to the forests surrounding the project area can be avoided.

b. A certain amount of air polluting fine particles could be generated from the power plant. The amount would be much less than the case of D/G plants. However, using some kind of dust filter is recommended if such fine particulates would become more than expected. To avoid any impact to be caused to the villagers by such fine particulates, the power plant site will be located far away from the residential areas of the villages.

c. A certain amount of liquid waste could be generated during plant operation. For the liquid waste, will conduct closed cycle treatment before being discharged to outside environment.

d. There will be no negative impacts to agriculture of the project site area and its vicinity.

Table 5.16 Environmental Screening of Samraong (Phnum Kravanh) Biomass Power Project (The check list for the candidate power project)

1. General Information

Name of the proposed project: Phnum Kravanh Biomass Power Project
Name of Project owner/proponent: not decided yet
Project Execution Organization: not decided yet
Name of authorized person(s) responsible for the project: not decided yet
Information regarding the project site
Name of the village, commune, district and province:
Samraong, Leach, Samtrease and Rokat Communes, Phnum Kravanh Districts, Pursat Province

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about 0.5 hectors for power house space
	No	

2.2 Description of the project

Main design specifications:
This is a bio-mass gasification power plant project. The project will utilize farmed trees as fuel wood. The trees will be cultivated continuously after each cut. Generating capacity will be about 180 kW, for which about 35-57 ha of farming land will be needed. There will be 1,536 HHs to be electrified by the project.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans of MIME in the Province
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) Svay Bakav Community Forest (CF) potential power site in Kampong Chhnang Province, and others. However, the more urgent need of electricity is in the concerned Communes.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes		(mark the corresponding stakeholders)
		●	Administrative body/local government
		●	Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, bio-diversity conservation, and other protected areas designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 May the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
●	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
●	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks:

1) A certain amount of air polluting fine particles could be generated from power plant. The amount would be much less than the case of D/G plants. However, using some kind of dust filter is recommended if such fine particulates would become more than expected.
2) The liquid waste would be generated during construction from worker's camps at site. Such wastes must be treated before being discharged to the environment.
3) In addition, a certain amount of liquid waste might also be generated during plant operation, which will be treated by closed cycle treatment method.

2.9 Key results and findings of the environmental screening:

(1) Considering the following three factors, carrying out IEIA (IEE) will not be required.

1) The project will belong to Category C of JICA Environmental Guidelines.

2) The project output capacity (180 kW) is less than the limit which will need IEIA or EIA defined by the MOE (5MW).

3) The project site is located outside of any Protected Area designated by the MOE.

Therefore, only the environmental screening result will be enough for the candidate project.

Based on the new Decree of the MOE regarding environmental regulatory reform, the project owner(s) will have to make project license application to the concerned Province, if the project cost will be less than 2 million US dollars. For the application, it is considered that IEIA will not be required.

(2) During plant operation, a certain amount of liquid wastes might be generated in plant facilities. If this will be case, such liquid waste will be treated by closed cycle treatment system before being discharged to the environment.

(3) A certain amount of air polluting fine particles could be generated during plant operation. The amount will be much less than the case of D/G facility. However, using some kind of filter is recommended, if such fine particulates would become more than expected.

5 ORGANIZATION FOR MANAGEMENT

■ Capacity of the Commune for Operation

CEC, once established, need to take care not only for technical operation, but for management issues. Collecting tariff is fairly common practice for existing REEs, thus, this can be manageable having received standard training required. Yet, managing the fuel trees is new skills required for biomass gasification plant. Having well confirmed the availability of land, land resource for fuel wood won't be a great issue such as confiscation of the land from the powerful. Yet, the CEC always pays attention to fuel trees with land issues considering the increase of new settlers or land grabbing.

■ The proposed operation / management organization of the Biomass

Motivated and disciplined operators are necessary to be trained as the labour required to operate a biomass gasification plant is quite different from that required to run a diesel engine of equivalent output. While required training and necessary backstop for certain period needs to be obtained from the government / technical consultant, the CEC is required to select the appropriate personnel with competent salary.

Headed by the CEC representative, 1 gasification plant operator (technical officer) and his /her assistants, and administrator who are responsible for finance and management, and his /her assistants will be required to run the facility on a daily basis.

6 CONCLUSIONS AND RECOMMENDATIONS

■ Appropriateness of the biomass Model

Ability to Pay

Since the villagers already consumed the available energy such as a diesel oil lamp and battery, once they understand the feature of economical and safe energy source more, electricity will be more accepted even by the poor. Yet, the relatively large amount of initial connection fees needs to have special financing support by leasing or special low interest rate.

- Demonstration Effect

This target area is far from provincial capital. The traffic is still limited for residents, thus demonstration effect will be limited.

- Challenges for the Sustainable Operation

The experience of cooperative works is limited, but the forestry project under Canadian fund is about to start. In collaboration with existing credit and saving activities and other NGOs, the capacity building for establishing CEC will be possible. Yet, operating biomass gasification plant requires substantial expertise. Technical backstop system for certain period will be necessary.

PRE-FEASIBILITY STUDY

Part 1	Summary
Part 2	Samlout Electrification Plan
Part 3	Bu Sra Electrification Plan
Part 4	Pramaoy Electrification Plan
Part 5	Samraong Electrification Plan
Part 6	Kampong Kor Electrification Plan
Part 7	Srae Ta Pan Electrification Plan

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PART 6 KAMPONG KOR COMMUNE BIOMASS ELECTRIFICATION PROJECT

1. SOCIO-ECONOMIC SITUATION IN THE STUDY AREA

Kampong Kor Commune in Preaek Prasab District, Kratie Province is proposed to be electrified by biomass gasification scheme. Kampong Kor Commune is located opposite side of Mekong River from Kratie provincial capital and is not likely to be connected to grid for many years. This commune does not have micro-hydro potential but it has far more than enough wasteland for farming trees as fuel for electricity generation. The commune also organizes community forestry activity, which is another potential source of woody biomass production. There are so many villages densely distributed in adjacent communes as well. Those villages can be electrified efficiently under one scheme or at the later stages of the project. The location of the commune and the targeted area for electrification is shown in Figure 6.2.

Source: JICA Study Team

Figure 6.1 Mainstreet of Kampong Kor Commune

Many trees are planted under the community forestry activity.

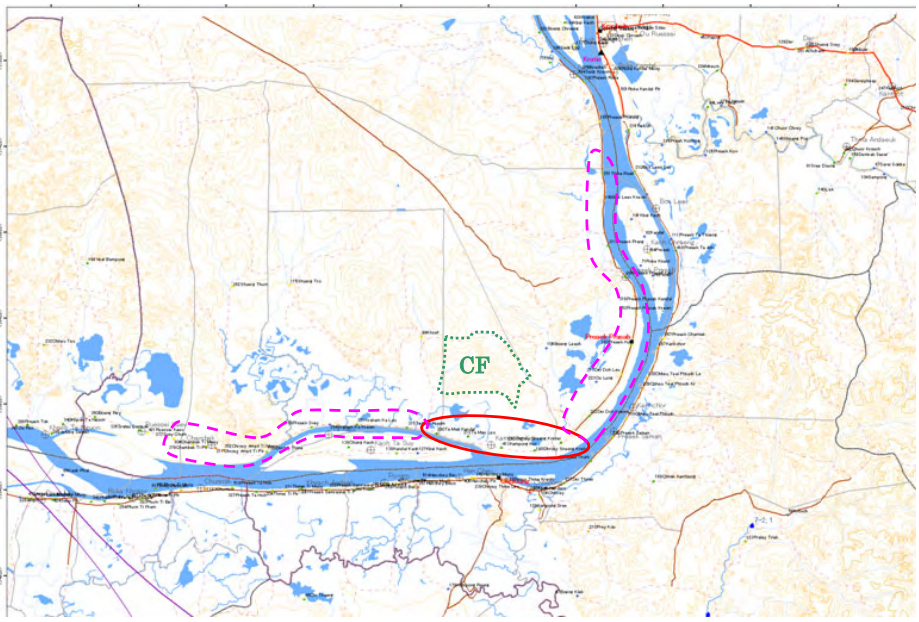
1.1 BASIC INFORMATION ON KAMPONG KOR

Table 6.1 Basic Information of Kampong Kor

Household Number	Population	Number of TV - owned households	Literacy rate
1,115	5,804	230	96.2%

Source: Seila Commune Database 2004

The study area, Kampong Kor commune is located in Preaek Prasab district in Kratie province. Kampong Kor Commune has four villages. The population consists of 96 % native Khmer and the rest are recent migrants from other provinces. The households are located along the main road.



Source: JICA Study Team

Figure 6.2 Location of Kampong Kor Electrification Scheme

Primary Plan targeted area is indicated in the red ellipse. Expanded Plan covers the area encircled by purple lines and the red ellipse. Green dotted line indicates the boundary of the community forest (1461 ha). 90 ha of grassland reforestation in the community forest can supply fuel wood for about 5000 households electrification proposed in the expanded plan. The intervals between the divisions in the figure indicate 5km.

1.2 CURRENT HOUSEHOLD SITUATION IN KAMPONG KOR FOUNDED BY THE SOCIOECONOMIC SURVEY.

29 sample households randomly selected in the four villages (Tamao Leu, Kampong Kor, Chroy Sneng Krobei Krom, Chroy Sneng Krobei Leu) are interviewed.

(1) Household Economy

1) Main income sources

The main sources of income are agriculture, livestock, and fishery. Yet, more than 20% respondents' primary income source is service sector such as grocery, seasonal labor, money lending and repair shop. Home-based crafts, grocery and vegetable processing are secondary source of approximately 20% of residents. Those service and industry owners will be potential large users of electricity.

Table 6.2 Main Income Sources (%)

Income source	1st	2nd	3rd
Agricultural produce (crops)	68.97	14.81	4.76
Livestock & poultry	6.9	25.93	38.1
Fishery	-	14.81	33.33
Forestry (timber non-timber forest products)	-	-	4.76
Home-based crafts	-	7.41	9.52
Repair shop	3.45	3.7	-
Bakery/ grocery	6.9	-	-
Food/ Restaurant business	3.45	7.41	-
Salary from public service	-	7.41	-
Wage from seasonal labor	6.9	3.7	-
Construction		3.7	-
Money lending	3.45	-	-
Vet	-	3.7	-
Traditional doctor	-	3.7	-
Vegetable processing	-	3.7	-
Rice mill	-	-	4.76
Rented land	-	-	4.76
Total	100.0	100.0	100.0

Source: JICA Study Team

2) Land ownership and assets

Beside bicycle and boats, motorbike, fishing net is widely owned. Rice-mills powered with diesel generator are also owned by 10% of respondents. While 80% respondents own irrigated paddy land, it is appeared that considerable respondents rent land for agriculture.

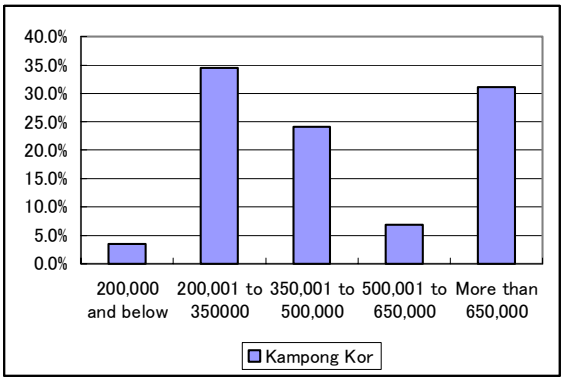
Table 6.3 Land Ownership and Assets

Asset		Land		
Type of assets	Ownership	Type of lands	Mean(ha)	Ownership
Horse/Ox cart	20.7%	Home-lot	0.122	100.0%
Bicycle	93.1%	Own paddy land irrigated	0.556	79.3%
Motobike	31.0%	Rented paddy land irrigated	0.059	48.3%
Boat with motor	3.4%	Own cultivated dry land (non-irrigated)	n.a.	41.4%
Boat without motor	41.4%	Rented cultivated land (non-irrigated)	0.036	48.3%
Generator	10.3%	Agricultural land renting to others	0.1	41.4%
Fishing net	41.4%	Own chamkar	0.163	62.1%
Diesel Water pump	20.7%	Rented chamkar	0.129	48.3%
Rice mill	10.3%			
Sewing machine	10.3%			

Source: JICA Study Team

3) Monthly expenditure

The median expense of the respondents is 418,000 (US$100). While richest household can spend more than US$400 per month, those who spend less than US$50 consist of 3.4%.



Source: JICA Study Team

Figure 6.3 Monthly Household Expenditure (Riel)

4) Household monthly expenses

Table 6.4 Monthly Household Expenditure by Item (Riel)

Expense item	N	%	Minimum	Median	Maximum
Food	29	100.0%	60,000	150,000	300,000
Clothing	18	62.1%	2,500	27,500	230,000
Child care	10	34.5%	15,000	37,500	200,000
Education	27	93.1%	1,000	30,000	200,000
Medical treatment/medicines	26	89.7%	2,000	35,000	500,000
Transportation	22	75.9%	3,000	12,500	244,000
Amusement/recreation	13	44.8%	6,000	15,000	40,000
Fuel for lighting/cooking	23	79.3%	1,500	6,000	45,000
Personal care	29	100.0%	1,000	10,000	300,000
Water	13	44.8%	2,000	7,500	150,000
Debt/loan	12	41.4%	500	46,000	800,000
Saving	12	41.4%	10,000	40,000	400,000
Others	2	6.9%	13,000	46,500	80,000
Total expenses	29	100.0%	120,500	418,000	1,809,000

Source: JICA Study Team

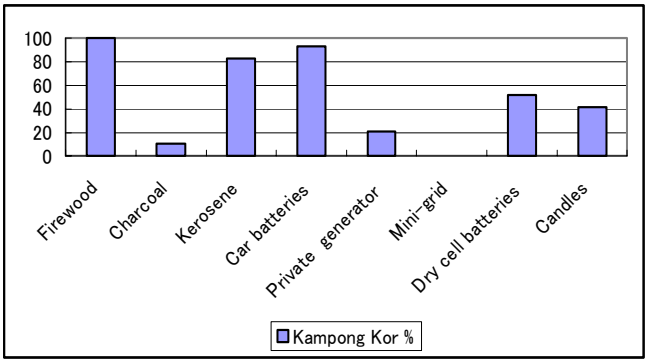
5) Credit and savings

More than 50% of respondents experienced to obtain loans and the sources of loan vary, relatives (35%), saving group (30%), money lender(25%), and bank (10%). Almost half of the respondents save money regularly.

(2) Current Situation of Energy Use and Needs

1) Energy usage

The kerosene and car batteries are both widely used more than 80% of respondents. On average, kerosene was consumed 5,500 Riel per month and used 6 hours a day. 1.4 kerosene lamp was owned per household. Car batteries are owned by 83% and recharged 6 times and spent 6,800 Riel per month.



Source: JICA Study Team

Figure 6.4 Current Energy Sources

2) Current usage of major lighting sources, kerosene and car battery

Table 6.5 Current Monthly Expenditure for Lighting

Kerosene (N. of users: 24 share 83%)		Car battery (N. of users:27, share 93%)	
Cost of kerosene per liter		Number of baterries owned /household	
Mean	2,908.33	Mean	1.52
Standard Error of Mean	20.78	Standard Error of Mean	0.12
Minimum	2,800	Minimum	1
Maximum	3,000	Maximum	3
Liters consumed per month		Number of times recharging batteries per month	
Mean	1.88	Mean	5.93
Standard Error of Mean	0.19	Standard Error of Mean	0.59
Minimum	0.5	Minimum	2
Maximum	4	Maximum	15
Monthly expenses for month		Expenses for recharging batteries per month	
Mean	5,445.83	Mean	6,870.37
Standard Error of Mean	527.02	Standard Error of Mean	1,098.56
Minimum	1,400	Minimum	2,000
Maximum	11,200	Maximum	27,000

Source: JICA Study Team

Table 6.6 Current Use of Battery Lighting

Type of battery	Number	Share	Cost of battery
12 Volt - 100 Ah	7	19.4%	184,286
12 Volt - 70 Ah	11	30.6%	126,273
12 Volt - 50 Ah	9	25.0%	83,000
6 Volt - 5 Ah	9	25.0%	16,500

Source: JICA Study Team

The type of the car batteries are varies and 1.5 batteries were owned per respondent. It is observed that both kerosene and car batteries. Considering the survey result, substantial households pay US$2-3 per month for lighting and electric appliances. The upfront cost of car batteries US$20-40 was already spent per household. Those who own generators are about 20%. The expense of diesel is about US$4, but those who own business spend more than US$20.

3) Present ownership and future demand of electric appliances

Electric lamps and TV including both black & white and colour types are widely owned more than 70%. There is substantial demand for energy consuming appliances such as rice cooker and iron after electrification, which effects directly to the demand for the whole target areas. The information on energy consumption and the cost they have to bear, and its effect for the whole system needs to be explained to

beneficiaries.

Table 6.7 Ownership and Future Demand of Electric Appliances

APPLIANCE	Currently owned		Want to buy	
	n	%	n	%
Electric lighting	23	79.31	21	72.41
Electric rice cooker	1	3.45	16	55.17
Television (color)	8	27.59	14	48.28
Television (black and white)	14	48.28	1	3.45
Video (VHS/VCD)	11	37.93	8	27.59
Radio/radio cassette	5	17.24	9	31.03
Electric fan	7	24.14	16	55.17
Electric water pump for drinking/household	4	13.79	14	48.28
Electric water pump for irrigation	8	27.59	5	17.24
Iron	2	6.9	13	44.83
Refrigerator			7	24.14
Washing machine			3	10.34
Video game				
Karaoke	3	10.34	4	13.79
Grain/cereal/meat grinder	2	6.9	5	17.24
Others	-	-	1	3.45
Electrical pot	-	-	1	3.45

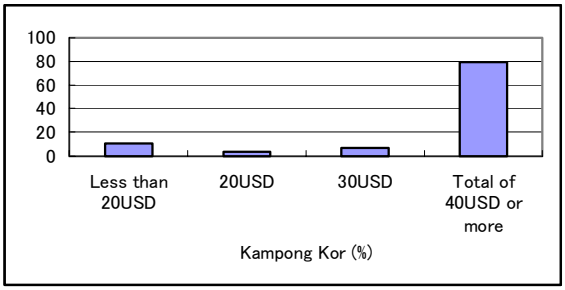
Source: JICA Study Team

(3) Economic Activities

The Kampong Kor is agro-based community with livestock and cash crops such as tobacco and sesame as income source. Located along the Mekong river, fishery is also important earning source. Nearly 30 rice milling, an ice making plant, a few vegetable processing exist other than service business such as grocery stores, repair shops and carpenters. A market exists in the pier of the commune. All these local industries are powered by the diesel generator sets.

(4) Willingness and Ability to Pay for Electricity Services

1) Willingness to pay for initial connecting fees



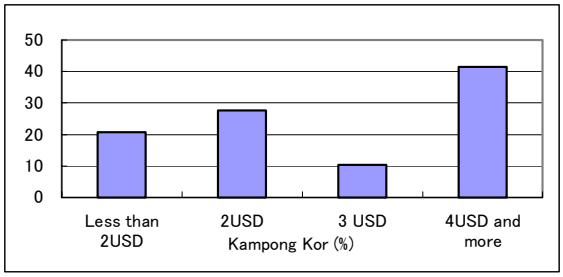
The household survey normally conducted before the workshop, was conducted after, which might affect the higher willingness to pay as they got substantial knowledge on electricity and the beneficiary-payment principle was reiterated in the workshop.

Source: JICA Study Team

Figure 6.5 WTP for Initial Costs

2) Willingness to pay for monthly tariff for the electricity

Since many households consume the kerosene and charging car batteries within the range of US$ 2 to 4. Those who responded can pay monthly tariff more than US$4 are over 40%.



Source: JICA Study Team

Figure 6.6 WTP for Monthly Tariff

3) Expected demand for the electricity

The interview regarding the possible businesses that can be started if households are electrified, 24% showed interest in starting the store and vegetable processing (making pickles), followed by not engaged any (20%), meat processing(14%), rice cake making (10 %). The daytime demand can be expected for these purposes. Besides the household demand which is targeted to 80 % of the total 1,115 households, the demand from the public utility offices such as schools (2 lower primary, 2 upper primary and 2 lower secondary), 1 commune centre, pagodas will be included. No health centre is available in the commune, yet the demand is high.

4) Appropriate tariff for the village for sustainable operation

Tariff can be set for equally per kWh basis.

1.3 DEVELOPMENT PLAN AND THE PRESENT DEVELOPMENT EFFORTS (COMMUNITY ACTIVITIES)

There is no specific commune development plans existed, yet development activities are currently executed under the some NGOs and Seila Commune Development Program. The organizations organized by the provincial departments are the water users group, parents' association and health management committee. NGO supported to organize community forestry, rice seed bank, credit and saving groups. Water management is top priority in the commune as lack of irrigation and flooding is chronic problem in the area.

Table 6.8 Community Activities and Participants

TYPE OF ORGANIZATION	N=28	%	Organized by
Not a member',	11	39.29	
Rice seed bank	15	53.57	NGO
Credit and savings	4	14.29	NGO
Pagoda Committee	2	7.14	Commune
Water user group	2	7.14	Government
Forestry/fishery group	16	57.14	NGO
Parents Association	2	7.14	Government
Self-help / labor exchange group	6	21.43	Commune
Health Management committee	2	7.14	Government
Vegetable Group	4	14.29	NGO

Source: JICA Study Team

2 PLAN FORMULATION

2.1 PROSPECT OF GRID CONNECTION AND ELECTRICITY DEMAND

Kampong Kor Commune is located opposite side (the right bank) of Mekong River from Kratie provincial centre. Grid connection across the river will not be happened for many years. Kampon Cham provincial capital is located same side of the river but it is about 60 km away and 22 kV line connection is not possible. Consequently Kampong Kor Commune will not be connected to grid for so many years. On the other hand, houses are very densely distributed not only in Kampong Kor Commune but also in adjacent communes. Distribution lines would be efficiently established. Electricity demand is very high. Almost all houses use batteries for lighting. TV diffusion is 41% (Seila 2003). There are many small diesel generators installed for various purposes such as lighting, rice milling, ice making, battery charging and water pumping (Photo 6.2). The commune is at the level for shifting from battery electricity to mini-grid electricity. Mini-grid electrification would improve living standard and generate income significantly.

Many people in Kampong Kor frequently visit Chhloung town at opposite side of Mekong River for work and school. In Chhloung, REE is supplying electricity 24 hours. It is therefore people in Kampong Kor are familiar with grid electricity and understand the merit and systems of grid electricity. People are likely to adapt the grid power system smoothly.

Source: JICA Study Team

Figure 6.7 Rice-mill for Village Consumption

Source: JICA Study Team

Figure 6.8 Examples of Use of Small Generators in Kampong Kor Commune

These are the potential of day time electricity consumption. Right: Small rice miller. Below right: Ice maker. Below: Children came to purchase drinking water for their home. Water was pumped up from Mekong River. Combined establishment of power station and water supply system reduce the unit electricity generation cost and contribute a lot to improve hygiene and reduce the workload of village life.

2.2 RESULT OF WORKSHOP

2.2.1 Outline of Workshop

A workshop was conducted in Kampong Kor Commune. The outline of W/S is shown in the table below.

Table 6.9 Outline of Workshop

Commune Name	Date	Time	No. of Participants
Kampong Kor	Nov. 23, 2005	10:00 – 17:00	46

Source: JICA Study Team

2.2.2 Literacy of Electricity

All participants have 6V or 12V battery. 37 participants out of 43 possess 12V battery while 6 participants possess only 6V battery. Fourteen participants possess 6V battery therefore eight 8 participants possess both 6V and 12V battery. 22 participants possess TV.

There are 5 BCSs in this commune. There are 4 villages. One village does not have BCS but it is not inconvenient because there is a battery delivery system.

A battery charging fee is about 2,000 Riel and people charge 3 to 5 times per month. Therefore they spend about 5,000 to 9,000 Riel per month. While it cost about 35 $ for 12V battery and its life duration is about 1.5 year. Therefore it cost about 8,000 Riel per month for battery. Consequently they

Spend about 13,000-17,000Riel par month in total for lighting charge. Some people use a candle or kerosene light together with a battery. They spend more than that for the total lighting charge.

2.2.3 Location of Biomass Generator Installation

There are three candidate locations for biomass generator installation. One of the locations is 16m width and depth is no limitation. Another location is 8m width and 50m depth. The last one is 20m width and 40m depth.

There are commune lands. They locate behind a river where flood area is. Therefore they are not suitable for the location for installation and only the way is to use a private land. Only one candidate site is vacant. There is an owner of the one location and they agreed 50$ per year as a rental charge.

It seems that there are more candidate locations because there are agricultural lands northern behind the river. It is preferable that the location is a little far from houses because of noise of the generator.

It will cost about 7,000$ if a power house of 20m x 25m =500 m^3 is constructed.

2.2.4 Ability to Pay for Initial Cost

All participants answered that it was impossible for them to prepare $50 per household as an initial connection charge. Then they discussed how to manage the cost. They concluded that they will save $10 par month for 5 months and they prefer that the saving, collection and management should be done under

a responsibility of commune chief and village chief.

2.2.5 Operator

There are some people who have diesel generators and other machines such as rice mill in this commune but they cannot repair machines though they can operate them. Therefore in case of trouble, it is necessary to ask a repairman from out side. There are candidate operators who own generators, etc. if training will be provided.

2.2.6 Accountant

There are some candidate accountants in the commune. They discussed how to collect monthly charge. A monk proposed to establish sub-committee in each village and collect by each village. They also discussed both case of collector visit every house to collect and every household come to pay.

Finally they concluded that every household come to the office to pay. Because if collector visits every house, it will be about 1,000 households. So the salary for collector will be large and it is costly, and there is a fear that the collector might spend collected money.

2.2.7 How to Select Staff

When they try to discuss who are the relevant persons as a staff, they prefer to select by election.

2.2.8 Planting Fuel Wood

It was confirmed that a land for community forestry can be used for planting fuel wood. They discussed how to plant the fuel wood, such as plant in the land for community forestry intensively, planting in each household, and planting in the selected contract farmers. As a result, they concluded that planting in each household is preferable.

It was explained that if planting in each household, 0.02ha is necessary for each household. It was confirmed that about 80% of households can prepare the land for planting, however about 20% of them cannot have enough land and cannot have opportunities to have additional income by planting. Then they discussed and concluded that the community can provide some part of community forestry land for planting to those households so that they can have equal opportunities.

2.2.9 Feasibility in Kampong Kor

It seems feasible in terms of ability to pay. They can prepare an initial connection fee and monthly charge. The ratio of battery possession and TV possession is relatively high. The people in this community understand what is mini-grid because they often go to Churong where locates at the opposite side of the river for going to work and school. Then needs to mini-grid electrification are high in the commune.

The allocation of houses in Kampong Kor is that all houses are located along the road in parallel with the river. Therefore an efficiency of cable distribution is high in terms of geographically allocation, and all households can be connected to the mini grid if mini grid is installed by CEC.

Human resources, such as operator and accountant, are available if they can have training. Therefore a readiness of electrification is high and mini-grid electrification by CEC is feasible if there is financial, technical and management support.

2.3 PROJECT SCALE

Primary plan (Phase 1)

This plan electrifies only Kampong Kor Commune. There are four villages, 1,107 households and 2,865 people in Kampong Kor Commune. If 80% of households were connected, the necessary capacity of the station would be about 120 kW. If we presume that average monthly electricity consumption per household is 10 kWh and annual biomass production is 10 t/ha, the required land for tree farming is about 15 ha. Along with the increase in the energy demand, the land area will increase to be about 39 ha in 8th year from the commissioning. The targeted area for this plan is shown as red ellipse in Figure 6.2.

Expanded plan (Phase 2)

This plan electrifies four communes including Kampong Kor, Preaek Prasab, Ta Mau and Chamback Commune. Preaek Prasab Commune is located north of Kampong Kor Commune. There are nine villages, 2,382 households (5,946 people) along the 17.9 km of main roads. Houses are continuously and densely distributed from commune border between Kampong Kor and Preaek Prasb to north border of Preaek Prasab Commune. There are many stores and workshops at the Preaek Prasab district centre. There are two mobile phone repeaters for 011 and 012 services (Photo 6.3). One of them uses diesel generator and the other use solar and diesel generator for their electricity. They are the potential consumers for daytime electricity. Ta Mau and Chambak are western adjacent communes to Kampong Kor. There are total 10 villages, 2,613 households (6,381 people) along the 15.4 km of main road. Again, houses are continuously and densely distributed. If we combined them as one project, total households covered become 6,102 (15,192 people). If 80% of households were connected, the necessary generation capacity would be about 635 kW. If average monthly electricity consumption per household is 10 kWh and annual biomass production is 10 t/ha, the required land for tree farming is about 90 ha. Required land for tree farming would be 90-180 ha. Targeted area of Expanded Plan in Preaek Prasab, Ta Mau and Chambak commune is shown in Figure 6.2 as surrounded by a red ellipse and purple broken lines.

Villages and houses are continuously distributed even further west of Chambak Commune but study team has not surveyed yet and therefore exclude it from the plan.

Table 6.10 Summary of Three Alternative Sizes of Development Plans

Name of Alternative	Total Household	Installed Capacity	Necessary Tree Planting Area @10 kWh/hh/m (area planned for 2nd and 8th years)
Primary Plan (Phase 1)	1,107 (1 commune, 4 villages)	120 kW	15 ha (24-39)
Expanded Plan (Phase 2)	6,102 (3 communes, 19 villages)	520 kW	75 ha (108-175)
Total	504 (4 communes, 23 villages)	640 kW	90 ha (132-214)

Source: JICA Study Team

Source: JICA Study Team

Figure 6.9 The Street in Preaek Prasab (left) and A Repeater of Mobile Phone in Preaek Prasab (right)

2.4 POWER STATION AND DISTRIBUTION LINES

Villages in Kampong Kor are located between Mekong River and seasonal (<3 months per year) waterlogged area. Consequently the land in villages is limited. For Primary Plan, power station can be established in a village. It would be better to establish the power station north of seasonal waterlogged area in the case of Expanded Plan because larger land is required. More than 1000 m^2 for Primary Plan and 3000 m^2 for Expanded Plan would be required including fuel wood storage and processing area.

22 kV line will be distributed along the main road which runs parallel to Mekong River. Owing to the village distributions between the river and seasonal water logged land of the targeted area, almost all houses are distributed along the main road. The length of 22 kV line required for both plans, expected number of households to be connected and 22 kV line length per household are shown in H-1 of Vol 5.

Table 6.11 Construction Costs of Biomass Gasification Power Station

Items	Phase 1	Phase 2
Installed capacity (kW)	120	640
Construction cost of generating facility ($)	385,200	1,794,500
Construction cost of distribution facility ($)	303,900	1,481,100
Total cost ($)	689,100	3,275,600

(Source: JICA Study Team)

Source: JICA Study Team

Figure 6.10 Densely Distributed Houses in Kampong Kor

2.5 BIOMASS FUEL SUPPLY

Tree farming will be conducted by CEC members for fuel wood production. Kampong Kor Commune has 0.75 ha/HH of shrubland which is nearly forty times larger than required 0.02 ha/HH for tree farming for sustainable fuel supply. Farmed fuel wood will be purchased by CEC. Purchasing price is presumed to be around $20/t. Kampong Kor Commune has been conducting community forest activities since 2001 (Photo 6.5). Many trees have been planted and people know how to plant and take care of trees. Average annual rainfall in Kratie between 1997 and 2001 was 1992 mm (JICA 2005). Most of fast growing tree species commonly planted for wood chip and fuel wood production in tropical region is likely to grow moderately under such amount of annual precipitation. Acacia trees planted in recent years in the commune show good growth. Minimum 10 t/ha/year biomass production is assumed to be obtained.

There is considerable amount of seasonally waterlogged area in Kampong Kor. Only small portion of such land is used for agriculture. There are certain tree species growing on such land (species list is shown in Table 6.12). Most of them have coppicing characteristic and some of them grow very fast according to villagers. Planting these local species in seasonal waterlogged area is a unique and potential method for biomass production. Seasonal waterlogged area is extensively spread many regions in Cambodia. If biomass production in seasonal waterlogged area works well in Kampong Kor, it would be a good model for other area in similar condition.

Nearly five thousand households are electrified in the Expanded Plan. Tree farming in a land of 75 ha

wide is required to supply enough biomass with sustainability. Along with the increase in the energy demand, the land area would increase to be about 175 ha in 8th year from the commissioning. There are 1,461 ha of community forest in Kampong Kor (shown as a green dotted line in Figure 6.2). But only very small fractured portion is closed forest. Most area is covered by heavily degraded shrub or grassland (Photo 6.6). Certain amount of area is used for garden as well. Grassland in the community forest needs tree planting and grassland reforestation of less than 10% of the community forest would meet the wood requirement of 5,000 households electrification. Community forest will not be managed properly without certain financial incentives. Biomass electrification can be a strong tool for community forest management.

Recommended tree species for planting is shown below:

Short term coppicing wood production in and around gardens: *Leucaena leucocephala, Gliricidia sepium*

Longer term stem wood production: *Acacia spp., Eucalyptus spp. Casuarina equisetifolia*

Seasonal waterlogged land: *Barringtonia acutangula and Combretum guadrangulare are assumed to be high potential species according to interviewed survey to villagers. Other potential species are listed in Table 6.12.*

Table 6.12 Typical trees species growing seasonal waterlogged land

Scientific name	Family	Khmer Name
Barringtonia acutangula	Barringtoniaceae	Reang
Peltophorum dasyrrhachis	Caesalpiniaceae	Trase:k
Combretum quadrangulare	Combretaceae	Sangkae
Combretum trifoliatum	Combretaceae	Trahs
Hymenocardia wallichii	Euphorbiaceae	Phnom Phnaeng
Pithecellobium dulce	Mimosaceae	Ampil tuk
Zizyphus mauritiana	Rhamnaceae	Putrie
Gmelina asiatica	Verbenaceae	Anncha:nh

Source: JICA Study Team

Source: JICA Study Team

Figure 6.11 Community Forest Activities

Top left: A nursery established in a pagoda. The front right seedlings are Teak and behind left seedlings are Acacia. *Top right*: A monk of Ta Mau pagoda, a leader of community forest activity with Teak trees planted less than a year ago. *Bottom*: The landscape in the community forest. Rehabilitation is required. Sustainable fuel wood production is expected to contribute to the restoration of forest ecosystem. *Bottom left*: Vast grassland of Imperata sp. *Bottom right*: Heavily degraded vegetation.

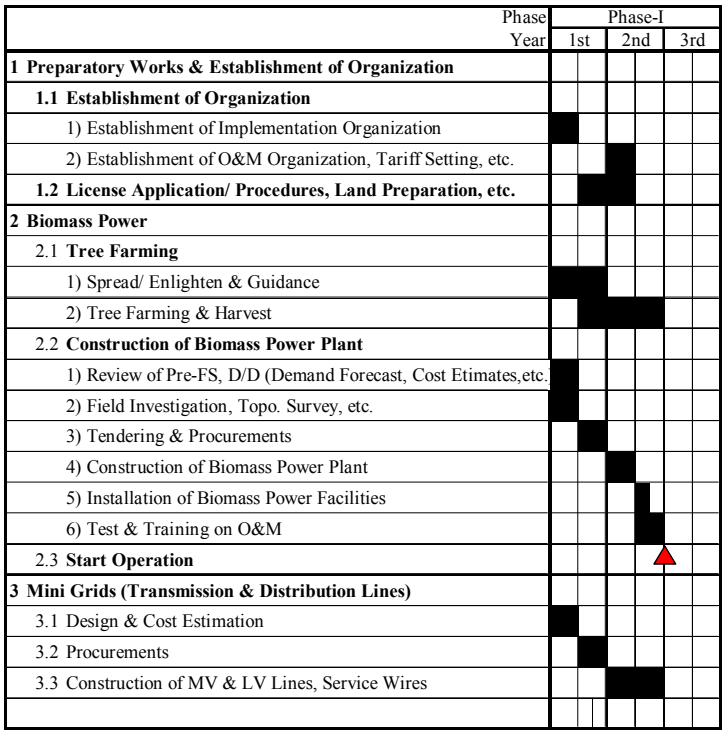
Reference

SEILA. Seila commune database 2003. (www.seila.gov.kh)

JICA. 2005. Weather observation data.

2.6 CONSTRUCTION SCHEDULE

Figure 6.2 shows proposed implementation plan for Kampong Kor Electrification Plan for Phase 1.



Source: JICA Study Team

Figure 6.12 Proposed Implementation Schedule for Kampong Kor (Phase 1)

3 ECONOMIC / FINANCIAL ASSESSMENT AND TARIFF SETTING INCLUDING LOAN PAYMENT

Of the two schemes of Primary Plan (Phase 1) and Expanded Plan (Phase 2), Phase 1 will be implemented first as a pilot. Construction costs estimated in Section 2 is converted to economic cost by deducting customs and value added taxes etc. After setting the power tariff at a level sufficient to recover costs, financial analysis was performed. Table 6.13 presents economic and financial indicators and tariff for both Phases 1 and 2.

Table 6.13 Economic and Financial Analyses

Phase	EIRR	FIRR	Night-time Tariff Rate ($/kWh)	Remarks
Phase 1	30.9	5.2	0.350	Tariff is rather high due to high burden of fixed costs for access road and distribution line from village to power station site
Phases 1+2	35.6	5.2	0.310	

(Source: JICA Study Team)

Economic costs are initial costs of BGP and distribution line construction while operation costs include operators' salary, maintenance costs, and fuel costs. The economic benefits are assessed as costs of, alternative diesel power generator system. The lower O&M cost of BGP compared with diesel generator (about 1/7) will contribute to improving the operational sustainability. EIRR is as high as 30.9%., proving the high economic efficiency

Taking into consideration the ability to pay in the target electrification area, suitable electricity tariff was assumed and financial analysis was made. When the tariff is set at $0.350/kWh, FIRR will be 5.2%. It will be 9.3% if 25% subsidy and CDM effect (sales revenue of CER) are taken into account from the viewpoint of CEC who will implement and manage this project. This high rate of FIRR shows the project can be managed at this tariff rate with financial sustainability. The tariff rate is relatively at a low level as of small mini-grids in the off-grid areas in Cambodia. The Kampong Kor Electrification Project (both Phases 1 and 2) has high economic feasibility. If the proposed financial supports (25% subsidy of initial capital costs and 60% soft loan) are provided to CEC, it is judged that the Project can be managed with financial sustainability.

4 ENVIRONMENTAL CONSIDERATIONS

For the environmental considerations, JICA's Environmental Guidelines and Checklist have been used for defining project Category (A,B or C) and environmental assessment. On the other hand, "Annex of Sub-Decree No.72 ANRK. BK." dated August 11, 1999, that is the "List of the Project Require an IEIA(IEE) or EIA", and other concerned environmental regulations of the MOE of Cambodia have also been referred and applied.

Based on results of the environmental screening, IEIA will not be required for the project because of the following conditions being all met:

1) Based on the requirements of JICA Guideline, the project will belong to Category C.
2) Based on the regulations of "Annex of Sub-Decree No.72 ANRK. BK." dated August 11, 1999, the project will not need an IEIA and/or EIA.
3) The Project will be located outside of any Protected Area designated by the MOE.

4.1 ENVIRONMENTAL SCREENING

Table 6.14 shows the details of the results of the environmental screening of the Kampong Kor Project. Key results and findings of the environmental screening are summarized below.

(1) Considering the following three factors, carrying out IEIA will not be required.

1) The project will belong to Category C of JICA Environmental Guidelines.
2) The project output capacity of Phase 1 (120kW) is less than the limit which will need IEIA or EIA defined by the MOE (5MW).
3) The project site area is located outside of any Protected Area designated by the MOE.

Therefore, only the environmental screening result will be enough for the project.

(2) Based on the new Decree of the MOE regarding environmental regulatory reform, the project owner/implementing organization will have to make project license application also to the concerned Province, if the project cost will be less than 2 million US dollars. For the application, it is considered that IEIA will not be required.

4.2 DETAILS OF THE RESULTS AND FINDINGS OF THE ENVIRONMENTAL SCREENING

1) Potential natural and social environmental impacts

   a. The project site area is located outside of any Protected Area. Through interview conducted on September 15, 2005 with Chief of the Commune, Director of a primary school and some villagers, it was known that there are no any protected wildlife inhabit in the project area. Therefore, it is concluded that there will be no negative impacts to be caused on the wildlife, nor to ecological system of the project site area.

   b. The power output capacity of phase 2 of the project will be 640 kW which will need about 90 ha fuel tree farming land (it will need to expand to about 214 ha by 8th year after the commissioning). Acquiring the land might cause conflicts with interests of land owners. Project owner/implementing organization will have to avoid such conflicts when acquiring the land. Under the same interview, the Commune Chief expressed that there will be about 50 ha available to the project, because this is a public land which is under control by the Commune. Only obtaining approval by the Commune will be necessary.

   c. Because this is a small scale project, there will be no negative impacts to the air and water quality in and around the project site area.

   d. There will be no negative impacts to groundwater of the project area and its vicinity.

2) Environmental issues in connection with the plant design and construction activities

   a. There will be no negative impacts to the agriculture of the project site and its vicinity.

   b. There will have the following positive impacts to the villagers in and around the project site.

      i. Electrification of the rural area

      ii. Create employment opportunity as labor force source

      iii. Create business opportunity to the villagers

   c. May have negative impacts to river water quality due to liquid effluents from worker's camps. Prepare sewage treatment facility to mitigate this impact.

3) Potential environmental impacts during plant operation

   a. In general, illegal logging of outside forests or purchase of large amount of fuel wood from market might be happened when fuel wood would become insufficient. All of fuel wood needed for the project will be planted, and supplemental fuel wood trees in store will also be prepared. In order to assure the fuel wood supplying plan to be implemented well, preparation of the power plant operational management rules will be required. By positive implementation

of the fuel wood trees planting program, and securing the supplemental fuel wood in storage by whole concerned villages, negative impacts to the forests surrounding the project area can be avoided.

b. A certain amount of air polluting fine particles could be generated from the power plant. The amount would be much less than the case of D/G plants. However, using some kind of dust filter is recommended if such fine particulates would become more than expected. To avoid any impact to be caused to the villagers by such fine particulates, the power plant site will be located far away from the residential areas of the villages.

c. A certain amount of liquid waste could be generated during plant operation. For the liquid waste, will conduct closed cycle treatment before being discharged to outside environment.

d. There will be no negative impacts to agriculture of the project site area and its vicinity.

Table 6.14 Environmental Screening for Kampong Kor Biomass Power Project (The check list for the project)

1. General Information

Name of the proposed project: Kampong Kor Biomass Power Project
Name of Project owner/proponent: not decided yet
Project Execution Organization: not decided yet
Name of authorized person(s) responsible for the project: not decided yet
Information regarding the project site
Name of the village, commune, district and province:
Four villages, Kampong Kor Commune, Preaek Prasab Districts, Kratie Province

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about 0.5 hectors for power house space
	No	

2.2 Description of the project

Main design specifications:

(1) The bio-mass power project will utilize 132 ha to 214 ha of land for fuel tree farming. Generating capacity will be about 640 kW, which will be able to supply electricity to more than 6,000 households.

(2) Through interview carried out with the Commune Chief on September 15, 2005, it was known that at least about 50 ha of land would be available in the Commune for the bio-mass project. When needed, the project can install up to about 250kW output capacity. Tree species to be farmed will be *Leucaena leucocephala, Gliricidia sepium, Acacia or Eucalyptus*.

2.3 Is the project consistent with the higher program/policy?

●	Yes	(outline of the higher program/policy) Rural electrification plans of DIME in the Province
	No	

2.4 Any alternatives considered before the project?

●	Yes	(outline of the alternatives) Svay Bakav CF project in Kampong Chhnang Province, and Takeo Celagrid project in Kampong Thom Province. However, both of them are not cost effective as the case of Kampong Kor project.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government (MIME/DIME, Commune and villages)
		●	Local residents/villagers
		●	NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, bio-diversity conservation, and other protected areas designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 May the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
●	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
●	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks:

1) A certain amount of air polluting fine particles could be generated by the power plant. The amount of such dust would be much less than the case of D/G plants. However, use of some kind of filter is recommended if such fine particulates would become more than expected.

2) The liquid waste would be generated during construction by worker's camp at site. Such wastes must be treated before discharge to the environment. In addition, a certain amount of liquid waste could be generated within plant facilities during operation. If this will be case, closed cycle treatment method should be used.

2.9 Key results and findings of the environmental screening :

Considering the following three factors, carrying out IEIA (IEE) will not be required.

(1) The project will belong to Category C of JICA Environmental Guidelines.

(2) The project total output capacity (640 kW) is less than the limit which will need IEIA or EIA defined by the MOE (5MW).

(3) The project site is located outside of any Protected Area designated by the MOE.

Therefore, only the environmental screening result will be enough for the project.

Based on the new Decree of the MOE regarding environmental regulatory reform, the project owner(s) will have to make project license application also to the concerned Province, if the project cost will be less than 2 million US dollars. For the application, it is considered that IEIA will not be required.

5 ORGANIZATION FOR MANAGEMENT

Capacity of the Commune for Operation

The Kampong Kor already received various funding supports from international donors through local NGOs. The community forestry project, led by KAFDOC and monks, one of the most active and widely participated activities, have empowered commune how to manage and operate the projects. Villagers are already trained and educated for forest ecological management and tree planting, which is great advantage for biomass project since local sourcing of appropriate fuel trees and its management, are key points in sustainability.

Ability to Pay

Since the villagers already consumed the available energy such as kerosene and car battery, there will be few problem for monthly payment. Yet, the large amount of initial connection fees needs to have special financing support by leasing or special low interest rate.

Table 6.15 Benefit Anticipated

	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	n	%	n	%	n	%	n	%	n	%
Our life will be better if our village is electrified							4	13.79	25	86.21
It is important for information (TV, radio)							10	34.48	19	65.52
Children can study at night							5	17.24	24	82.76
Working at night make cash income					2	6.9	10	34.48	17	58.62
Some electric appliances reduce work loads					2	6.9	13	44.83	14	48.28
Food can be better preserved					6	20.69	11	37.93	12	41.38
Reduction in door air pollution caused by lamps					4	13.79	10	34.48	15	51.72
Fan prevent malaria and make good sleep					2	6.9	10	34.48	17	58.62
Electricity is important for better water supply							11	37.93	18	62.07
Electricity is important for our health center							1	3.45	28	96.55
It will improve security at night							11	37.93	18	62.07
It will improve social relations between neighbors							12	41.38	17	58.62
It will create work-time for productive endeavor					1	3.45	10	34.48	18	62.07
It will provide more time for family gatherings							14	48.28	15	51.72
I want to start business after electrified	1	3.45			7	24.14	7	24.14	14	48.28

Source: JICA Study Team

The socioeconomic study also revealed the benefit they anticipated after electrification as above. They appreciated primary about health center, improvement of the village in general and education.

Demonstration Effect

The current accessibility of Kampong Kor is only by boat. Once electricity is available by biomass power, DIME shows great interest in applying the scheme in other parts of Kratie province as many mini-grid systems have serious problem of high fuel costs. Having experienced the grid-extension program in border district Snoul, the DIME Kratie province already showed competence in working with district / commune representatives for demand survey and relocation. Active DIME and commune representatives have no difficulties to demonstrate the schemes for other areas.

Challenges for the Sustainable Operation

The commune in the target area already have experienced **community forestry project**.

6 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that electrification of Kampong Kor Commune be implemented as Phase 1:

1) The electrification will be implemented in two phases.
2) 1st phase will electrify Kampong Kor Commune that consists of 4 villages.
3) 2nd phase will extend electrification area to another 3 communes with 19 villages, totalling 4 communes with 23 villages.
4) 1st phase is taken as a pilot project for enlightenment and public awareness, and preparation for 2nd phase.

PRE-FEASIBILITY STUDY

Part 1	Summary
Part 2	Samlout Electrification Plan
Part 3	Bu Sra Electrification Plan
Part 4	Pramaoy Electrification Plan
Part 5	Samraong Electrification Plan
Part 6	Kampong Kor Electrification Plan
Part 7	Srae Ta Pan Electrification Plan

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PART 7 SRAE TA PAN SOLAR BCS PROJECT

1. SOCIO-ECONOMIC SITUATION IN THE STUDY AREA

1.1 BASIC INFORMATION ON SREA TA PAN

Household Number	Population Number	Literacy rate	Distance to nearest year-round road*	Time from village to nearest year-road by motor or motorboat
95	480	49.8%	2 km	45 minutes

Source: Seila Commune Database 2004 *For 4 wheel motor vehicles. No household is reported to own TV.

The study area, Srea Ta Pan village is located in Samkhuoy Commune, Sesan district in Stung Treng province. The Sesan district is consists of seven communes and has the population of 13,704 as a whole. Samkhouy Commune has four villages, and its population is 404. Srae Ta Pan is located along the Sesan river and is approached only by boat during the rainy season. The population consists of 88% Lao speaking minority and 12 % Khmer. Besides primary school, no public facilities exists.

1.2 CURRENT HOUSEHOLD SITUATION IN SRAE TA PAN FOUNDED BY THE SOCIOECONOMIC SURVEY

The economic situation with details of the energy usage of the households and willingness to pay for electricity service in the Srae Ta Pan was shown by the socio-economic survey conducted under this study, where 26 sample households in the village are interviewed.

(1) Household Economy

The first main sources of income are agriculture consisting more than 80% and fishery follows. The livestock and forestry (for collecting non-timber forest products) are the secondary source of income. A few families earn by seasonal labour, midwife, and from private business and salary from NGO.

1) Major income sources (%)

Income Source	Primary	Secondary	Tertiary
Agricultural produce (crops)	84.6	7.7	5.9
Livestock & poultry		73.1	29.4
Fishery	7.7	19.2	41.2
Wage from seasonal labor	3.8	-	-
Midwife	3.8	-	-
Forestry (timber non-timber forest products	-	-	17.6
Salary from private business/ NGO	-	-	5.9
Total	100	100	100

2) Land ownership and Assets

Irrigated paddy land owner is 60%, but not well quality. All households own their home lot. More than 80% respondents own fishing net. Nearly half of respondents own boat with motor. Less than 30% respondents own bicycle or horse cart. A few own generator, rice mill, and motor bicycle.

3) Monthly expenditure (Riel)

More than 65% respondents spend below 5 US$. Those who responded more than 100 US$ is a few.

There seems to be not many distinct richer households in the community.

Monthly expenditure (Riel)	n	%
200,000 and below	17	65.38
200,001 to 350000	7	26.92
350,001 to 500,000	2	7.69
Median	100,850.00	
SE Mean	23,376.11	
Minimum	22,000.00	
Maximum	433,100.00	

4) Household monthly expenses by items (Riel)

The detail items of expense were shown in the Table below.

Expense items	n	Min	Median	Max
Food	26	8000	30001	210,000
Clothing	11	2000	10000	70,000
Child care	3	2000	3000	3,500
Education	6	3000	14400	120,000
Medical treatment/medicines	15	3000	12000	80000
Transportation	23	2000	10000	180000
Amusement/ recreation	14	1500	6750	35000
Personal care	26	700	4500	30000
Saving	8	5000	20000	30000
Others	3	11200	36000	360000
Total	26	22000	100850	433100

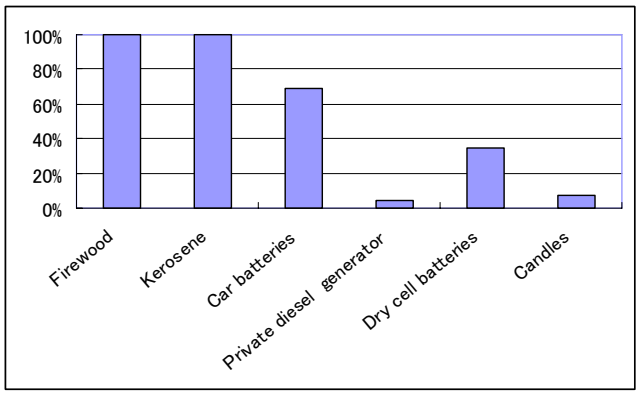
5) Credit and Savings

100 % of respondents did not experienced to obtain loans. Credit organization is reported to exist, but those responded to save money, 20% of respondents keep them at home.

(2) Current Situation of Energy Use and Needs

1) Energy usage

For lighting source, it is regarded that kerosene is still widely used as 100% of respondents own.



2) Current usage of major lighting sources, kerosene and car battery

On average, they spend 4,500 Riel per month and normally uses 3.4 hours a day and owned 2 lamps. Car battery are owned by 70 % and recharged 3.47 times and spend 3,600 Riel per month. Yet, the majority (18 out of 19 respondents) owns 6V type for hunting purpose

Kerosene (N. of users: 26 share 100%)		Car battery (N. of users:18, share 70%)	
Cost of kerosene per liter		Number of baterries owned /household	
Mean	2,862	Mean	1.3
Standard Error of Mean	44	Standard Error of Mean	0.1
Minimum	2,400	Minimum	1.0
Maximum	3,200	Maximum	2.0
Monthly consumption		Recharging timesper month	
Mean	2	Mean	6.9
Standard Error of Mean	0	Standard Error of Mean	1.0
Minimum	1	Minimum	3.0
Maximum	4	Maximum	20.0
Monthly expenses		Monthly expenses for recharging	
Mean	4,527	Mean	3,611.1
Standard Error of Mean	489	Standard Error of Mean	520.1
Minimum	1,500	Minimum	1,500
Maximum	12,000	Maximum	10,000

Type of battery	Number	Share	Cost of battery
12 Volt - 100 Ah	–	0%	–
12 Volt - 70 Ah	1	6%	130,300
12 Volt - 50 Ah	0	0%	83,000
6 Volt - 5 Ah	18	100%	25,000

3) Present ownership and future demand of electric appliances

Those who own the electric appliances are still small as 24%. VCD, Karaoke are popular appliances for genset owner. After electrification, therefore, 95% respondents will buy lighting followed by fan and rice cookers. Electric water pump, TV and VCD are also in demand.

APPLIANCE	Currently owned		Want to buy	
	n	%	n	%
Electric lighting	6	24	24	96
Electric rice cooker	-	-	12	48
Television (color)	1	4	19	76
Television (black and white)	-	-	3	12
Video (VHS/VCD)	1	4	6	24
Radio/radio cassette	-	-	11	44
Electric fan	-	-	10	40
Electric water pump for drinking/household	-	-	7	28
Electric water pump for irrigation	-	-	10	40
Iron	-	-	2	8
Refrigerator	-	-	1	4
Karaoke	1	4	2	8

(3) Economic activities

The Srea Ta Pan village rely on rice, livestock and fishery for their own consumption. Rice / corn milling is the only industry existed.

(4) Willingness and ability to pay for the electricity services

1) Willingness to pay for initial costs and monthly tariff

There are great hesitance on paying more than 20 US$ for the initial cost. Since many households consume the kerosene and charging car batteries within the range of US$ 1 to 2. In order to obtain the required initial cost for establishing a BCS, few responded to borrow money, rather 80% respondents would manage to sell produces, and 30% would manage by their own savings.

Willingness to pay for initial cost for getting the electricity	N=25
Mean	84,400
Standard Error of Mean	7,960
Minimum	10,000
Maximum	150,000
Willingness to pay for monthly electric consumption?	
Mean	5,360
Standard Error of Mean	486
Minimum	2,000
Maximum	10,000

2) Expected demand for the BCS

64% respondents see no possibility to start new businesses. Those who have ideas are to start shops, rice-cake making, rice and corn milling, food restaurants, repairing motorcycle and making fishing net at night. The large demand cannot be expected in the short run.

3) Appropriate tariff for the village for sustainable operation

Tariff has to be reflected the surrounding market level considering the poorer household for basic needs.

(5) Development Plan and the Present Development Efforts

There is no specific village development plans existed, yet some development activities such as education and health, water sanitation are currently executed under the international NGOs and consultants for implementation and monitoring. The most needed services are primarily irrigation, followed by road and electricity.

2. SOLAR BCS

In remote area, people who can afford are using car batteries to light their house or to see TV. But in remote area due to small numbers of users or low ability to pay, even diesel BCS are few in numbers. To charge their battery people need to walk long distance and pay high cost comparing to high population or near to the national highways or provincial towns. Solar BCS consisting mainly PV module and charge controller can be easily installed even at remote areas from few watts to required demand size. By installing this kind of system it will help villagers to axis easily and also reduce the cost for transportation. Beside reduction of transportation cost, Solar BCS will provide clean energy to the people with effective charging system.

2.1 LOCATION OF PROJECT SITE

To install the Solar BCS, the possible sites were selected. Among those possible sites, Srae Ta Pan Village of Stung Treng province is selected as a potential site. Srae Ta Pan village of Samkhuoy Commune, Sesan District, Stung Treng Province lies at bank of Sesan river around 12 km from Stung Treng city port. It takes around 30 minutes to reach the village by boat. The village is approximately around 5 km long, along the river and households are scattered along the walk way around 40 to 50 meter far from the river bank. Below Figure 7.1 shows the location of village

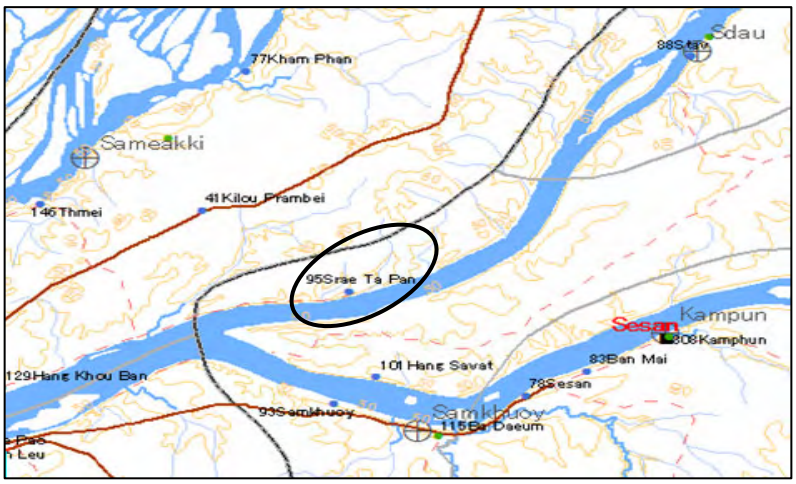


Figure 7.1 Location Map of Srae Ta Pan village

2.2 RESULT OF WORKSHOP

(1) Outline of Workshop

A workshop was conducted in Srae Tapan village. The outline of the W/S is shown below.

Outline of Workshop

Village Name	Date	Time	No. of Participants
Srae Ta Pan	Nov. 21, 2005	9:00 – 16:30	29

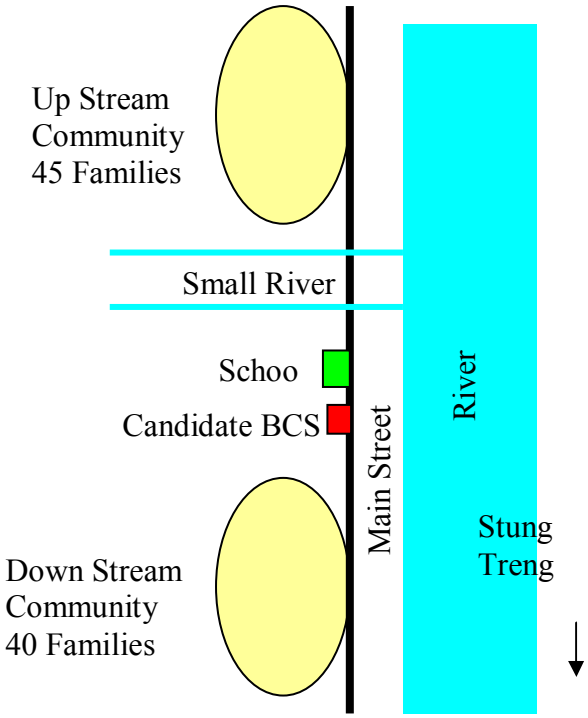
(2) Community Formation in the Village

There are two (2) communities in the village; they are up stream community and down stream community. The village chief lives in down stream community and the venue of the W/S is next to the house of the commune chief.

There are 45 households in the up stream community and 40 households in the down stream community. There is a primary school at the center of the both communities. It takes about 30 minutes on foot from the each community.

There is no car, three (3) motorbikes. About 25% of households possess bicycles. While all households possess hand boats and about 15% of them possess motor boats. Therefore a boat is a major transportation in the village.

People in the down stream community often go to the



up stream community because they have agricultural land near the up stream community. While people in the up stream community seldom come to the down stream community. Therefore they in the both communities have a stronger connection to Stung Treng.

(3) Literacy of Electricity

All households possess 6V battery and use it for fishing and a portable light. About 5 households possess 12V battery. There is a new battery charging station, which just starred in last few month. They charge a battery at this new station or one in Stung Treng. Even they prefer to charge in the village, they have to go to Stung Treng some times because the charging capacity of new station is small and it does not operate every day.

People in the village go to Stung Treng two (2) to four (4) times per month for shopping and at the same time they charge a battery. They do not go to Stung Treng only for charging purpose.

About 10 households possess TV but here is out of the coverage area of TV broadcast. They use TV for video and VCD.

When owners of 6V battery are asked whether they want to buy 12V battery if BCS is installed in this village, then they answered to want a 12V battery, however they cannot but at this moment. It seems that it is difficult for them to prepare 30$ for 12V battery.

(4) Location of BCS Installation

A location of BCS installation was discussed. In the morning discussion, participants, who are from the down stream community, concluded to install in the down stream community instead of near the school, where was concluded in the previous W/S though the participant who lives near the school. Because of their convenience. In addition they thought that the people in the up stream community would not cooperate with this project.

On the other hand, the participant, who lives near the school and the owner of new BCS, insisted that the location of BCS installation should be in his yard, where is near the school, because his house is at the middle of the both communities so that the people in the up stream community can utilize the BCS.

In the afternoon discussion, two (2) participants from the up stream joined in the W/S. Then the participants revised the conclusion to install the BCS in the yard of the house of the new BCS owner. The reason why they revised the morning conclusion suddenly is to be more impartial for the people in the up stream community as well.

(5) BCS Building

The BCS building requires the size of 3 m x 8 m = 24 m^2 and it will cost about 450$ as a material cost. This means that each household have to shoulder about 5$. Only two (2) participants out of 25 participants can prepare this cost. One (1) out of these two (2) is the owner of new BCS, and the other is a richer parson from the up stream community. They discussed how they can prepare the cost for the building, then these richer persons expressed that they can pay for the entire amount in the worst case. In this case, they expect that poorer peoples contribute their labor force and return money little by little.

(6) Ability to Pay

For the building construction cost, 23 participants out of 25 cannot pay 5$. All of the participants who have only 6V battery cannot buy 12V battery of 30$. Therefore an ability to pay is seemed low.

(7) Operator

They concluded that the owner of new BCS is suitable for an operator. Because the candidate location is his yard and has an experience of diesel BCS operation.

There are several candidate accountants. They discussed how to prevent that the accountants do wrong and find an idea that they establish a small committee as a check mechanism and a committee member confirm the daily sales amount by turn.

There is no bank in this village, however, there is a bank in Stung Treng. There is no one who has a bank account in this village.

(8) Feasibility of Srae Ta Pan BCS

The ability to pay is low in terms of preparation of electrify. Because it is difficult for them to buy 12V battery and prepare 5$ for the building cost. But if setting the target is about 40 households as a half of the total households, it is assumed a number of capacity of daily charging is about eight (8). Therefore it is considered that the new building for BCS installation is not necessary. The cost of the building would not be a problem because a part of an existing house is enough to protect from the rain.

The feasibility of proposed BCS location at first seems to be low in terms of accessibility. The coverage area is divided into two (2) communities though it is one village. It takes 30 minutes to access to the center of the village from the both of the communities. In addition, the BCS will not bring a large merit in terms of accessibility because their major transportation is walk and there is not much exchange between the communities; and it is assumed that many of the people will go to Stung Treng to charge. Therefore it is necessary that BCS is to be divided into two (2) in the both community or establish a delivery system so as to ensure the accessibility.

There is a fear of friendly and cooperative operation in terms of operation by CEC because they have little collective sense between the communities and there is a distance geographically. In this connection, divided two (2) BCS in each community is suitable.

It is necessary for the people to consider whether BCS is to be divided or establish the delivery system in the implementation stage.

There is candidate operators and accountants, however, they need a training. They can prepare the land and building but it is fear that they cannot shoulder the cost of land, fence and building equally. It is, however, possible to prepare it because some richer persons can shoulder a higher amount of the cost.

It is difficult for them to pay 5$ as a building cost. This is a the case to construct a new building. But it can be possible to utilize an existing building such as the house of candidate operator.

2.3 SOLAR IRRADIATION LEVEL AND DESIGN PARAMETERS

To estimate the system capacity some standard parameter is required to be considered. By the data and study carried out within the country the parameters are standardized for system sizing. In the case of solar irradiation the annual average of Cambodia 5.1 kW/m2/day is taken for the system sizing. Figure 7.2 shows the distribution of solar irradiation in Cambodia and Table 7.1 shows the standard parameters for system sizing of Solar BCS.

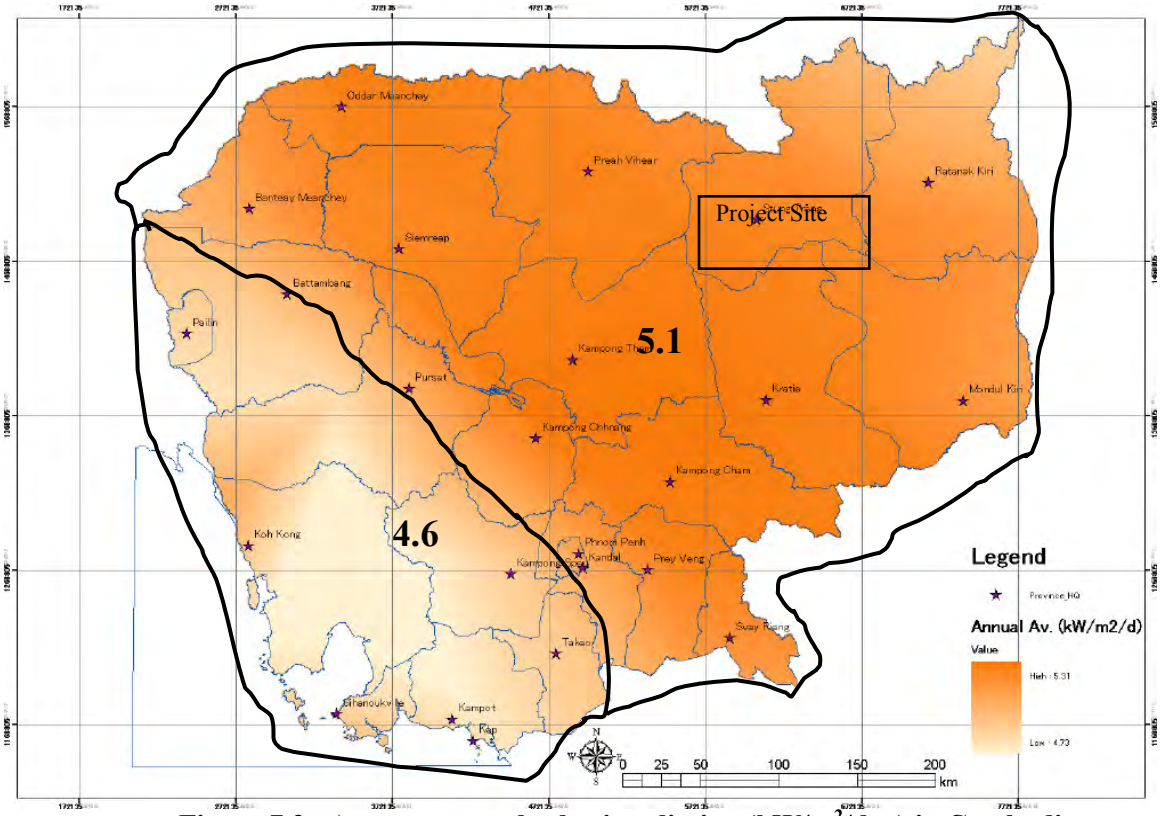


Figure 7.2 Average annual solar irradiation (kW/m^2/day) in Cambodia

Source : NASA home page

Table 7.1 Design Parameters of Solar BCS

Item	Parameter	Value	Unit	Remark
1	Horizontal irradiation	5.1	kWh/day	Country average (satellite data)
2	Module derating factor	10	%	Decrease of output due to dirt, years of uses and so on.
3	Columbic efficiency	90	%	To charge battery effectively.
4	Consumption by Charge controller (C/C)	20	mA/day	Depends on manufacturer
5	Depth of discharge (DOD) of battery	50	%	Manufacturers recommendation for shallow cycle lead acid batteries
6	Charging interval	5	days	To control deep discharge manually
7	Voltage from C/C	13.5 & Up	V	To charge battery effectively
8	C/C capacity (Minimum)	12	Amp	To charge battery effectively in a day

Source: JICA Study Team

2.4 PV SYSTEM SIZING

Beside the standard deign parameters, number of household to be covered and capacity of batteries to be charged in a day is also a very important factor for deigning system. The number of households to be covered, battery capacity to be charged and estimated system capacity is summarized in Table 7.2. Detailed system sizing is given in Appendix-B, Table AP-B.1.9.

Table 7.2 Number of household to be covered and capacity of solar BCS

Numbers of HH to be covered	Percentage (%) of battery to be charged			Nos. of batteries to be charged each day	System Capacity (kWp)
	50 Ah	70 Ah	100 Ah	18	3.3
89	30	50	20		

Source: JICA Study Team

If small 6 Volt, 5 to 7Ah batteries are also counted as a load to be charged then the required capacity of PV system to be charge those batteries is given in Table 7.3. Detailed system sizing is given in Appendix-B, Table AP-B.1.10.

Table 7.3 Required PV Capacity to charge small 6 Volt batteries at Solar BCS

Total number of batteries to be covered (nos.)	Charging interval (Day)	Number of battery to be charged in a day (Round figure)	System Capacity (kWp)
89	3	30	0.1

Source: JICA Study Team

From above if required capacity to charge the small battery is added to the system then total PV system capacity will be 3.4 kWp.

It is known fact there is a seasonal variation in weather year by year. To generate enough power for battery charging need to consider average seasonal variation. Table7.4 shows the solar irradiation value of Srae Ta Pan area and differences at minimum and maximum side measured by satellite within the 10 years period.

Table 7.4 Satellite data of Srae Ta Pan area within the period of 10 years (1983 to 1993)

Boundary (In degree)		Average Elevation (m)	Month	Monthly Average Solar Irradiation ($kW/m^2/day$)	Maximum diffrence within the data recording period (10 Years)	
Latitude	Longitude				at Minimum side (%)	at Maximum side (%)
13 S - 14 N	106 W - 107E	107	Jan	5.51	-5	3
			Feb	5.99	-4	5
			Mar	6.16	-5	3
			Apr	6.01	-3	4
			May	5.51	-4	5
			Jun	4.91	-8	13
			Jul	4.95	-8	9
			Aug	4.50	-14	15
			Sep	4.69	-11	11
			Oct	4.72	-14	11
			Nov	4.98	-14	8
			Dec	5.17	-3	5
			Average	**5.26**	**-7.8**	**7.7**

Source: NASA home page

From the satellite data around Srae Ta Pan area there is around 7.8% difference in an average at minimum side. This may occur frequently in the life time period of system operation. Therefore if it is added to the estimated capacity then total required capacity will be around 3.7 kWp. If this required capacity is rounded up to a digit then it will be 4.0 kWp same as BCS Model for 76 to 100. Therefore, the PV capacity for Solar BCS will be as shown below and can cover the small batteries too.

- Capacity of Solar BCS : 4.0 kWp
- Number of households to be covered : 89 HH

2.5 SYSTEM COST

The system cost is calculated on the base of local purchase. The detail of PV module, equipments and material, installation cost for 4kWp Solar BCS is given in Table 7.5.

Table 7.5 4 kWp Solar BCS installation cost

Item	Description	Qty.	Unit (US$)	Total (US$)
Equipment & PV cost				
1	PV module (Crystaline Module)	4 kWp	5,400	21,600
2	Charge Controller PL20 (LCD with memory)	20 pcs	250	5,000
3	Multi-meter	1 pcs	20	20
	Sub-Total			26,620
Installation of PV & material cost				
4	Structure for PV 4 kWp (Galvanized, C100 & C75 x 2.1mm)	1 set	570	570
5	M12 nut bolts & M6 nut bolts (Stainless), 200 sets each	400 pcs	1	400
6	Cable 6mm^2 (Single) made in Singapore	160 m	0.5	80
7	Flexible conduit #16	200 m	0.35	70
8	Joint box {0.3m(H) x 0.3m(W) x 0.15(D)} plastic	4 pcs	5	20
9	Cable Ties 300mm	8 packet	4	32
10	Termial connector	48 pcs	1	48
11	Installation cost (including foundation for PV*)	1 set	1160	1,160
	(*) 1.5m(H) x 0.2m(B) x 0.2m (W) with anchor bolt 24 pole			
	Sub-Total			2,380
Installation of Charge controller & material cost				
12	Circuit Breaker 2P 30 Amps with box	20 pcs	20	400
13	Flexible wire 10mm^2 (for battery)	40 m	1	40
14	Crocodile clip	40 pcs	1	40
15	Trucking 100mm x 50mm (For wiring)	8 pcs	5	40
16	Terminal connector bar	20 pcs	4	80
17	Installation cost	1 set	400	400
	Sub-Total			1,000
Under ground work (PV array to Charge house) Cost				
18	Wire 25mm^2 (20 pair x 25m)	500 m	1.5	750
19	Conduit PVC 13. type #42mm (with connector)	60 m	4	240
20	Joint box {0.3m(H) x 0.3m(W) x 0.15(D)} plastic	4 pcs	5	20
21	Terminal connector	40 pcs	1	40
22	Installation cost	1 set	60	60
	Sub-Total			1,110
Grounding work cost				
23	Steel Rod 1.6m	20 pcs	3.5	70
24	Rod Connector	20 pcs	1	20
25	Ground wire 6m^2 (Singapore made)	120 m	0.5	60
26	Installation cost	1 set	200	200
	Sub-Total			350
Battery Charging station Construction cost				
28	Wooden fencing	1set	100	100
30	Construction of Charge house (1 door & 2 windows)	Lump sum		200
	Sub-Total			300
	Grand Total			31,760

(Source: MIME/JICA Study Team)

From above table it is understood that to install 4kWp Solar BCS, total cost will be US$31,760. By adopting simple building for BCS, relevant cost is only $300. Most of the costs are for BCS equipment.

2.6 CHARGING PLAN

To prevent the deep discharge it is assumed that the local people will bring their batteries to charge when it is discharge around 50% (of total capacity). The 6 Volt batteries also charged at same time together with 12 Volt batteries. Below are the points for charging batteries at Solar BCS.

- Number of charge controller to be installed is 20 nos.
- Possible number of 12 Volt batteries to be charged in a day is 18 nos.
- Charging interval of 12 Volt batteries is in every 5 days (average).
- Possible number of 6 Volt batteries to be charged in a day is 30 nos. in an average.
- Charging interval of 6 volt batteries is in every 3 days (average).
- The charging cost is depends upon the amount of current charged to the each battery which can be conformed on LCD of PL20 charge controller. Therefore, the charging cost will vary upon depth of discharge of each battery.
- LCD of PL20 can display input and output current separately. The 6 Volt batteries can be charged at same time only by adjusting voltage either by dropping 12 Volt to 6 Volt after charge controller or by connecting two 6 Volt batteries in series to make 12 volt.
- As 6 Volt battery is not so big in capacity, the same charge controller charging 40 to 50Ah batteries can charge at same time if required.
- It is not recommended to charge 6 Volt batteries with 100Ah battery by same charge controller at same time due to amount of current need to be charge will be higher.
- Solar BCS can charge batteries from early morning (after sunrise) to sunset. For effective charging batteries need to charge at least from 8 AM to 4 PM.

2.7 MANAGEMENT OF SOLAR BCS AND BOOK KEEPING

The village/commune base organization need to manage the system for smooth daily operation as suggested below;

- Solar BCS may not generate enough power in bad weather days or in rainy season to charge batteries fully in a day. Therefore, it needs to adjust the charge interval of batteries.
- Need to select the system operator for daily operation.
- Need to report periodically to District level management organization.
- Need to hire professionals for maintenance if required.
- Need to take care of safety measures to protect from accidents and so on.

Beside daily operation management, system operator and management organization also need to keep records of daily collection of revenue by charging facility and storage of electrolytes, spare parts such as circuit breaker, crocodile clip and so on. These spare parts are recommended to purchase from collected revenue. The individual and monthly record keeping sample table for Solar BCS is given in Table 7.6 and Table 7.7 respectively.

Table 7.6 Sample for Individual Record keeping

Batt. Owner: **Commune:**

Village: **District:** **Province:**

Date (yy:mm:dd)	Weather of the day (AM / PM)	Slandered Battery Capacity (Ah/Volt)	Before Charging		Electrolyte Refilling (Liter)	After Charging		Amount of Charged current (Amp)	Rate of Charging (R/Amp)	Total (R)	Remarks (If any)
			Battery Voltage (V)	Time (hh:mm)		Battery Voltage (V)	Time (hh:mm)				
2006/01/01											
2006/01/06											
2006/01/11											
2006/01/20											
2006/01/22											
2006/01/26											
2006/01/31											
2006/02/10											
2006/02/15											
2006/02/20											
2006/02/25											
2006/03/02											

Table 7.7 Sample for Monthly Record keeping

Village: **District:** **Date:**

Commune: **Province:** **Site Name:**

Serial No.	Name of Battery Owner	Slandered Battery Capacity (Ah / V)	Total Electrolyte refilled (L)	Total Charged current (Amp)	Rate (R / Amp)	Total Amount (R)	Remarks (If any)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
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29							
30							
31							

2.8 CONSTRUCTION SCHEDULE

Construction schedule is formulated as shown in Figure 7.3. Installation of Solar Panel and BCS charge controller does not take time. But establishment of CEC and preparation of operation system will need much more time.

Year	1st		2nd	
1 Establishment of Organization				
1) Establishment of Implementation Organization	■			
2) Establishment of O&M Organization, Tariff Setting, etc.		■		
2 Construction of Solar Battery Charging (BCS) Station				
1) Field Investigation, Cost Estimation, Land lending etc.)	■			
2) Preparatory Works, Tendering & Procurements		■		
3) Construction of Solar BCS (4 kWp, Concrete Basement)			■	
4) Installation of Solar Panels and Battery Charging Facilities, etc.				■
5) Test & Training on O&M				■
6) Start Operation				▲

(Source: JICA Study Team)

Figure 7.3 Proposed Construction Schedule for Srae Ta Pan Solar BCS Scheme

2.9 RECOMMENDATIONS

There are some recommendations mentioned below for daily operation and maintenance purpose.

- It is recommended to keep extra charge controller and store electrolyte to refill battery if required this should be done as charging service.
- To maintain the charging interval of batteries mentioned above, if battery owner brings their battery to charge at least 6 times a month then some discount should provided in charging cost to initiate local people for regular or frequent charging. It is because to prevent from deep discharging of battery and for full utilization of generated power.

3. ECONOMIC AND FINANCIAL ASSESSMENT

Solar BCS is positioned as a social electrification tool to level up village electrification ratio. Further, with diffusion of battery, if villagers' living standard levels up, people may become possible candidates for mini-grid introduction, and thus electrification level of off-grid area goes up.

Social electrification program is normally supported by government as grant project. However, in reality, costs for periodical maintenance of solar panel and charge controllers, becomes necessary. To compensate for such cost, villagers should pay some amount of money as equity as well as lease cost for BCS. By assuming such equity and lease costs as 10% of initial investment cost, which means 90% of subsidy from government, financial analysis was made to get appropriate tariff level. As a result of calculation,

assumed tariff level is $0.447/kWh and FIRR (financial internal rate of return) is 12.2% as shown in Table 7.8.

Table 7.8 Result of Financial Analysis

Assumed Tariff Level	FIRR
$0.447/kWh	12.2%

4. ENVIRONMENTAL CONSIDERATIONS

4.1 ENVIRONMENTAL ASSESSMENT

For the environmental considerations, JICA's Environmental Guidelines and Checklist have been used for defining project Category (A,B or C) and environmental assessment. On the other hand, "Annex of Sub-Decre No.72 ANRK. BK." dated August 11, 1999, that is the "List of the Project Require an IEIA(IEE) or EIA", and other concerned environmental regulations of the MOE of Cambodia have also been referred and applied.

Based on results of the environmental screening, IEIA will not be necessary for the project because of the following conditions being all met:

(1) Based on the requirements of JICA Guideline, the project will belong to Category C.
(2) Based on the regulations of "Annex of Sub-Decre No.72 ANRK. BK." dated August 11, 1999, the project will not need an IEIA and/or IEIA.
(3) The Project will be located outside of any Protected Area designated by the MOE.

4.2 ENVIRONMENTAL SCREENING

Table7.9 shows the details and results of the environmental screening of the Project. Key results and findings of the environmental screening are summarized below.

(1) Considering the following three factors, carrying out IEIA will not be required.
   1) The project will belong to Category C of JICA Environmental Guidelines.
   2) The project output capacity (4kW) is less than the limit which will need IEIA or EIA defined by the MOE (5MW).
   3) The project site is located outside of any Protected Area designated by the MOE.

   Therefore, only the environmental screening result will be enough for the candidate project.

(2) Based on the new Decree of the MOE regarding environmental regulatory reform, the project owner/implementing organization will have to make project license application also to the concerned Province, if the project cost will be less than 2 million US dollars. For the application, it is considered that IEIA will not be required.

4.3 DETAILS OF THE RESULTS AND FINDINGS OF THE ENVIRONMENTAL SCREENING:

1) Potential natural and social environmental impacts

   i). The project site area is outside of any Protected Area. Through interview conducted on September 12, 2005 with Deputy Chief of the Commune, Chief of Srae Ta Pan Village and some villagers, it was known that there are no any protected wildlife inhabit in the project area. Therefore, it is concluded that there will be no negative impacts to be caused on the wildlife, nor to ecological system of the project site area,

   ii). There will be no negative impacts to groundwater of the project area and its vicinity.

   iii). 95% of total households of the Village are all minority people, all of them are Laos. All of them expressed the need of more electricity for upgrading their livelihood.

2) Environmental issues in connection with the plant design and construction activities

   a). There will be no negative impacts to the agriculture of the project site and its vicinity.

   b). There will have the following positive impacts to the villagers in and around the project site.

   i). Electrification of the rural area

   ii). Create employment opportunity for the villagers as labor force source

   iii). Create business opportunity to the villagers

   c). May have negative impacts to river water quality due to liquid effluents from worker' camps. Prepare sewage treatment facility to mitigate this impact.

3) Potential environmental impacts during plant operation

   a). There will be no any negative impacts to the surrounding environment of the project area..

   b). There will be no negative impacts to agriculture of the project site area and its vicinity.

4.4 DISPOSAL OF USED BATTERIES

This is a common issue being existed in anywhere when utilizing batteries for lighting and others in both urban and rural areas. After about 3 years of usage, a battery could become not useful. The used batteries should be collected and transported to a treatment factory which can disassembling, proper treatment of various parts, recycle of the lead and proper disposal of solid and liquid wastes.

To avoid illegal disposal of a used battery to damping sites or anywhere without proper treatment and recycle, the collection, transportation and recycle treatment system should be established in all villages concerned.

The following show the process of treatment and recycle of used batteries:

1) Establish rules by local authorities to prevent illegal disposal of used batteries
2) Certify qualified collectors for collecting used batteries
3) Certify qualified disassembling factories for collected used batteries
4) Certify qualified incineration factories for burnable wastes
5) Certify qualified recycling treatment factories

6) Implement the recycling activities

The following is the flow chart showing the whole process of recycling used batteries to be disposed.

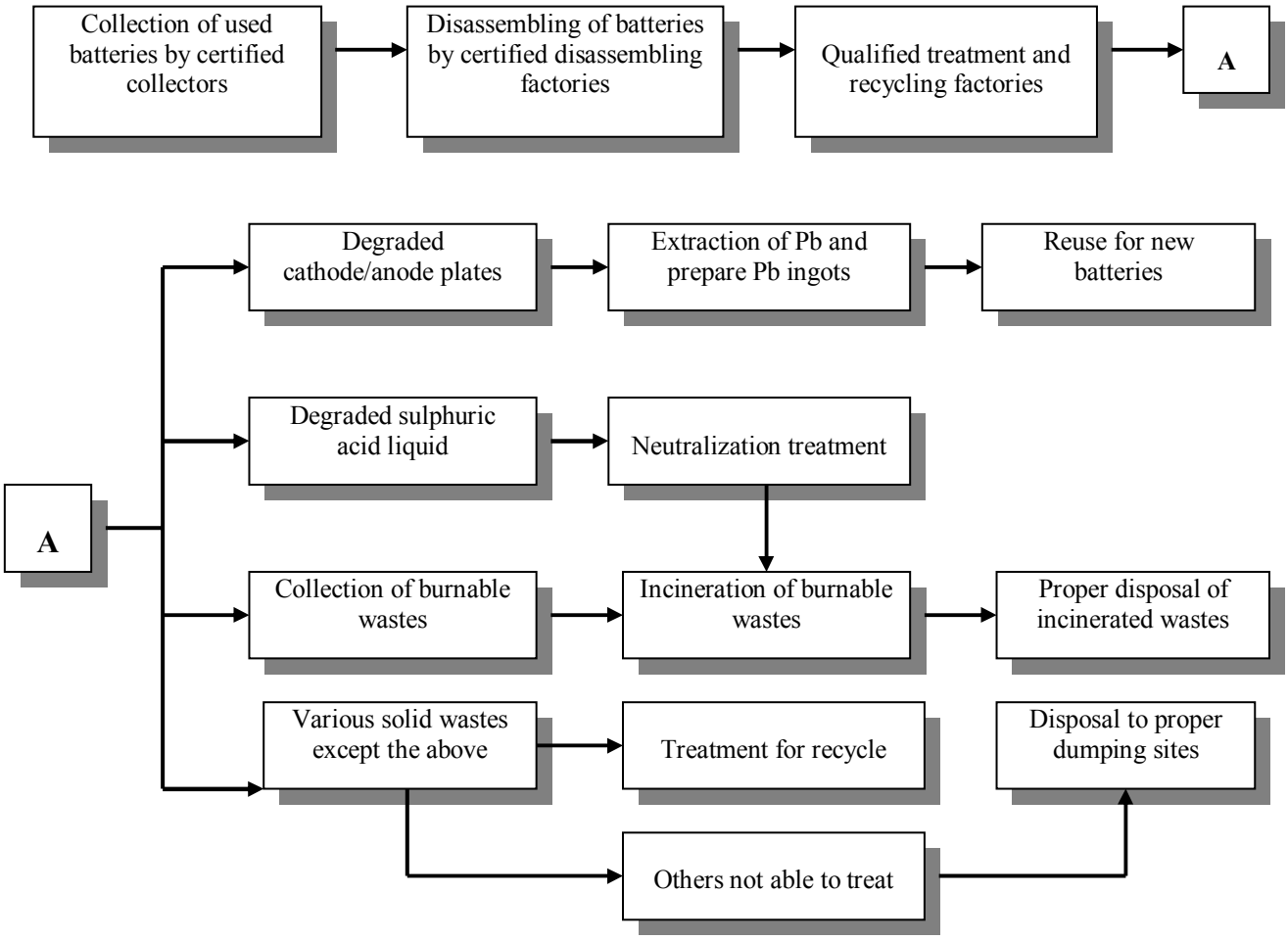

Table 7.9 Environmental Screening for Srae Ta Pan Solar Power Project (The check list for the proposed project)

1. General Information

Name of the proposed project: Srae Ta Pan Solar Power Project

Name of Project owner/proponent: not decided yet

Project Execution Organization : not decided yet

Name of authorized person(s) responsible for the project : not decided yet

Information regarding the project site
Name of the village, commune, district and province :
Srae Ta Pan Village, Samkbuoy Commune, Sesan District, Stung Treng Province

2. Outline of the Proposed Project

2.1 Information on project characteristics

(1) Needs involuntary resettlement		
	Yes	Scale: households, persons
●	No	
(2) Groundwater pumping		
	Yes	Scale: m^3/year
●	No	
(3) Land reclamation, land development and land cleaning		
	Yes	Scale: hectors
●	No	
(4) Logging		
●	Yes	Scale: about 0.06 hectors for photo-cell boards and power house/BCS space.
	No	

2.2 Description of the project

Main design specifications:

The project will utilize photo-cell system to generate elctricity. Generating capacity will be 4kW for providing electricity to 76 households. The system will be used for BCS for the villagers. The village does not have BCS now, so the villagers have to get their batteries charged in nearby villages.

At the time of interview conducted with the Village Chief on September 12, 2005, it was known that a private land with about 20m x 35m (0.07ha) space would be offered by a villager.

2.3 Is the project consistent with the higher program/policy ?

●	Yes	(outline of the higher program/policy) Rural electrification plans of MIME/DIME in both of Provinces
	No	

2.4 Any alternatives considered before the project ?

●	Yes	(outline of the alternatives) La Meuy Solar project in Rattnak Kiri Province. This will be to supply 82 households by 4kW. However, the project will be less cost benefit.
	No	

2.5 Did the project proponent have meetings with related stakeholders during the project planning ?

●	Yes	(mark the corresponding stakeholders)	
		●	Administrative body/local government
		●	Local residents/villagers
			NGOs
			Others (to specify)
	No		

2.6 Are any of the following areas located inside or around the project site ?

	Yes	(mark related items listed below)	
			National park, wildlife sanctuary, bio-diversity conservation, and other protected areas designated by the government
			Virgin forests, tropical forests
			Ecological important habitat areas
			Habitat of valuable species protected by domestic laws or international treaties
			Likely salt cumulus or soil erosion areas on a massive scale
			Remarkable desertification trend areas
			Archaeological, historical or cultural valuable areas
			Living areas of ethnic, indigenous people or nomads who have a traditional lifestyle or specifically valuable areas
●	No		

2.7 May the project have potential negative impacts to the environment and local communities ?

	Yes	(brief description of the potential negative impacts)
●	No	
	Not identified	

2.8 Mark the related potential environmental and social impacts and describe briefly the contents of the impacts, if any.

Items of potential impacts		Items of potential impacts	
	Air pollution		Local economy, employment, livelihood, etc.
	Water pollution		Land use and utilization of local resources
	Soil pollution		Existing social infrastructures and services
	Waste (liquid and/or solid)		Poverty issue
	Causing noise and vibration		Ethnic and /or indigenous people
	Ground subsidence		Misdistribution of benefits
	Offensive odors		Local conflict of interests among villagers
	Geographical features		Gender issue
	Bottom sediment		Children's rights
	Biota and ecosystem		Natural and/or cultural heritages
	Potential conflict on water use rights		Infectious diseases such as HIV/AIDS, etc.
	Public health and hygiene		Others if any
	Global warming		
	Involuntary resettlement		

Remarks:

1) No any negative environmental impacts will be foreseen by the project.

2.9 Key results and findings of the environmental screening :

(1) It is noted that 95% of households are Lao people. Only 4 households are Khmer people. Through interview conducted on September 12, 2005, it was also known that all of the villagers are in urgent condition to have their own BCS for charging batteries. Therefore, they are all positive to the project.

(2) The project location is outside of any Protected Area.

Considering both the environmental regulations of JICA and the MOE, carrying out IEIA(IEE) will not be required.

For more details, refer to Section 4.2 above.

5. ORGANIZATION FOR MANAGEMENT

■ Capacity of the Commune for Operation

Small bridges and deep wells were provided by NGO in the past, but these activities not accompany the capacity building activities. Considering the language barriers among the Lao speaking minorities, proper preparation should be designed at the beginning both from government and NGOs.

■ The proposed operation / management organization of the BCS

6. CONCLUSIONS AND RECOMMENDATIONS

■ Appropriateness of the BCS Model

Demand

The demand of Srea Ta Pan village is still small, yet 6V-5Ah type-batteries for hunting and lighting are used by 70% respondents. Those who own the 70Ah type are few. In order to increase the benefits of BCS, it is significant for villagers to make avail the 70Ah type-battery so that they can enjoy not only lighting, but also enjoy radio or black and white TV for obtaining the information.

Ability to Pay

As they have a few income sources besides selling produces and livelihoods, the support financing scheme for their purchasing car batteries at the beginning of the project is necessary. Applicability of the hire purchase, leasing system so on shall be assessed.

Benefit anticipated

	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	n	%	n	%	n	%	n	%	n	%
Our life will be better if our village will be electrified							10	40	15	60
It is important for Information (TV, Radio)							8	32	17	68
Children can study at night							8	32	17	68
Working at night makes cash income					5	20	5	20	15	60
Some electric appliances reduce work loads					1	4	10	40	14	56
Food can better be preserved					1	4	9	36	15	60
Reduction in indoor air pollution caused by lamp							7	28	18	72
Fan prevents malaria and make good sleep					1	4	9	36	15	60
Electricity is important for better water supply					3	12	11	44	11	44
Electricity is important for our Health Center							5	20	20	80
It will improve security at night					1	4	7	28	17	68
It improves social relations between neighbors							11	44	14	56
It will create work-time for productive endeavor					2	8	12	48	11	44
It will provide more time for family gatherings					1	4	8	32	16	64
I want to start business after electrified	6	24	3	12	8	32	3	12	5	20

They appreciated primary about benefit on the health reduction, followed by air pollution as they currently rely on kerosene or firewood. Education and security, communication were also appreciated.

■ Demonstration Effect

This site is approached only by boat during the rainy season, though it is not far away from the provincial town. Despite the disadvantage of the approach, the pilot system of BCS would provide lessons for remote villages existing in the country.

■ Challenges for the Sustainable Operation

Srea Ta Pan is village level with few experiences to implement the project on their own. Once the CEC is established by the villagers themselves, adequate support from DIME together with the provincial authority needs to be provided.