Chapter 10 Manpower Development

Chapter 10 Manpower Development

10.1 Strategies for Manpower Development

Total manpower requirement for PV rural electrification is shown in Table 13.1-1 of Chapter 13. The strategies for the manpower development are as follows:

(1) Manpower Development for Operation and Management

It is essential to operate and manage PV rural electrification project efficiently with minimum manpower.

1) Dissemination of "Cost Conscious" Way of Doing Business

As described in Chapter 13, the costs required for Implementation Body accounts for significant portion of total costs of the PV electrification project. The saving of the costs contributes to increase profitability of the project.

It is commonly criticized that the institutional framework and management in parastatals are apt to lack for "cost conscious" way that was observed in operation of the Dissemination Project.

It is recommended that extensive education and training for all member of the Implementation Body should be made as an in-company training course.

2) Provision of Complete Managing and Accounting Tools

It is indispensable to equip complete managing and accounting tools for contract management with the users, bookkeeping of monthly fee and deposit, records of user complaints, records of maintenance, spare parts management and budget and stocktaking, etc. It is also important to periodically train personnel in charge as an in-company education course.

3) Training of Local Staffs

It is required that as much works and responsibilities as possible should be transferred to the local offices. A local officer should act as a multifaceted staff. For instance, he visits a village as a salesman, money collector and maintenance person. The transfer of power and responsibility and training should be made for the purpose.

(2) Fostering Local Technician

BPC has sufficient in-company training course for electricians and, therefore, it will no so difficult to add PV technology to such training course.
Lecturers from PV contractors should be invited for such training.

(3) Training of First-line Maintenance Personnel

As for countermeasures for lack of manpower in Implementation Body, difficulty to respond user's complaints due to remoteness and cost saving, it is proposed that unskilled persons in the villages are fostered as first-line maintenance personnel by means of on-the-job training in the course of PV installation and operation. Trainers will be local staffs of Implementation Body and PV installation contractors.
Preferably Brigades in the Districts are utilized for such purpose.

(4) User Training

Users should be trained by the local stuffs PV installation contractor and first-line maintenance personnel in the course of PV installation and operation.

(5) Fostering Contractor's Technical Personnel

It is urgent necessity to foster engineers and technicians in PV contractors. Who took professional education in the technical collages and university.
Full-scale project implementation of PV rural electrification will attract talented personnel. Campaign on PV rural electrification sponsored by EAD and Implementation Body will be important for such purpose.

Chapter 11 Financial Planning

Chapter 11 Financial Planning

11.1 Possibilities of Financing from the Financial Sector

11.1.1 Lending Conditions of Financial Institutions

In order to explore possibilities of financing from the country's financial sector, representative financial institutions were examined on their lending conditions.

(1) Commercial Banks

The lending conditions of the commercial banks are as follows:
The interest rate is a prime rate plus about 10%, subject to risks involved in business and security and repayment period is a maximum of 7 years.
The legal limit of the maximum interest rate is 35%.
It is to be noted that commercial banks are unlikely to finance businesses that is considered as a high risk.

Interest rates for bank deposits range from 5.75% to 9% in call deposit and from 9.75% to 10.75% in term deposit.

(2) Parastatal Development Banks

National Development Bank (NDB) is mandated to provide funds for individual medium-small size enterprises, not large size enterprises or large-sized businesses which have characters of project type. It should be noted that, unlike commercial banks, NDB also finances high-risk sectors such as agriculture. The interest rate for lending is prime rate plus 4%.

Botswana Development Corporation (BDC) finances large-medium size enterprises with its main lending to the manufacturing sector. The interest rate for lending is 15% and the repayment period is 10 years at maximum.

11.1.2 Possibilities of Financing PV Rural Electrification

As the financial analysis made in Chapter 13, it indicates that the PV project viability cannot be attained in case of high loan with 14% interest rate.
Therefore, it will be difficult to finance from the country's financial sector.

11.1.3 Possibilities of Direct Finance

As mentioned above, stock and bond market is very small sized and is yet to be developed. It is not realistic to raise funds from the capital market for PV rural electrification.

11.2 Financial Planning

(1) Source of Finance

As discussed above, it is difficult to obtain funds from the financial market, so that the remaining possibility is to inject funds from the fiscal budget, which may include foreign aid, grant or concessionary loan.

(2) Total Required Fund

Total required fund for 10 years from the start of operation, derived from the financial analysis of the PV rural electrification business plan, are shown in Table 11.2-1 with the breakdown of each supply source.

Table 11.2-1 Total Required Fund for PV Rural Electrification

(Electrification Rate : SHS/BCS : 40%/20%) (Unit : kP)

Year	1	2	3	4	5	6	7	8	9	10	11	12	Total for 10 years	Total for 12 Years
Subsidy	11,045	12,420	11,219	10,636	8,894	9,399	9,712	9,582	9,229	9,369	5,998	4,020	101,504	111,522
Fixed Capital Expenditures	4,180	3,452	2,805	2,659	2,223	2,350	2,428	2,395	2,307	2,342	1,749	1,317	27,142	30,208
Equity	2,761	3,105	2,805	2,659	2,223	2,350	2,428	2,395	2,307	2,342	1,749	1,317	25,376	28,442
Capital Increase for Previous Deficit	1,419	347	0	0	0	0	0	0	0	0	0	0	1,766	1,766
Long Term Loan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Required Fund	15,225	15,872	14,024	13,295	11,117	11,749	12,141	11,977	11,536	11,711	7,747	5,337	128,646	141,731

Chapter 12 PV Rural Electrification Project Planning and Implementation Procedures

Chapter 12 PV Rural Electrification Project Planning and Implementation Procedures

12.1 Project Planning and Implementation Procedures

Project planning and implementation procedures are shown in Figure 12.1-1.

1) After the formulation of the Master Plan for PV Rural Electrification, EAD and the Implementation Body will conduct a detailed socioeconomic survey of un-electrified villages and localities throughout the country in order to make adjustments for the ability to pay (average for households in a village), total electricity demand including public facilities, and the potential ability of system operation and management, and other key parameters.

2) Based on the Master Plan and the results of the socioeconomic survey, the Implementation Body will formulate the PV Rural Electrification Project Plan, which will be reviewed by the steering committee (tentatively named PV-REMC under EAD) and approved by the planning committee (tentatively named NECC). Note that local governments will be involved in the planning process.

3) Upon the approval by NECC, subsidy will be budgeted and an annual implementation plan will be developed in consultation with local governments and community organizations and approved by PV-REMC.

4) The project plan will be subject to review and approval on a periodical basis.
Yearly project plan shall be formulated based on the monitoring and evaluation of the previous year's track records of operation and management.
The above mentioned monitoring and evaluation shall be carried out by the Implementation Body. Final evaluation and approval shall be made by PV-REMC. Monitoring and evaluation shall be carried out by third party entrusted by PV-REMC at an appropriate interval (e.g. every 3 years).

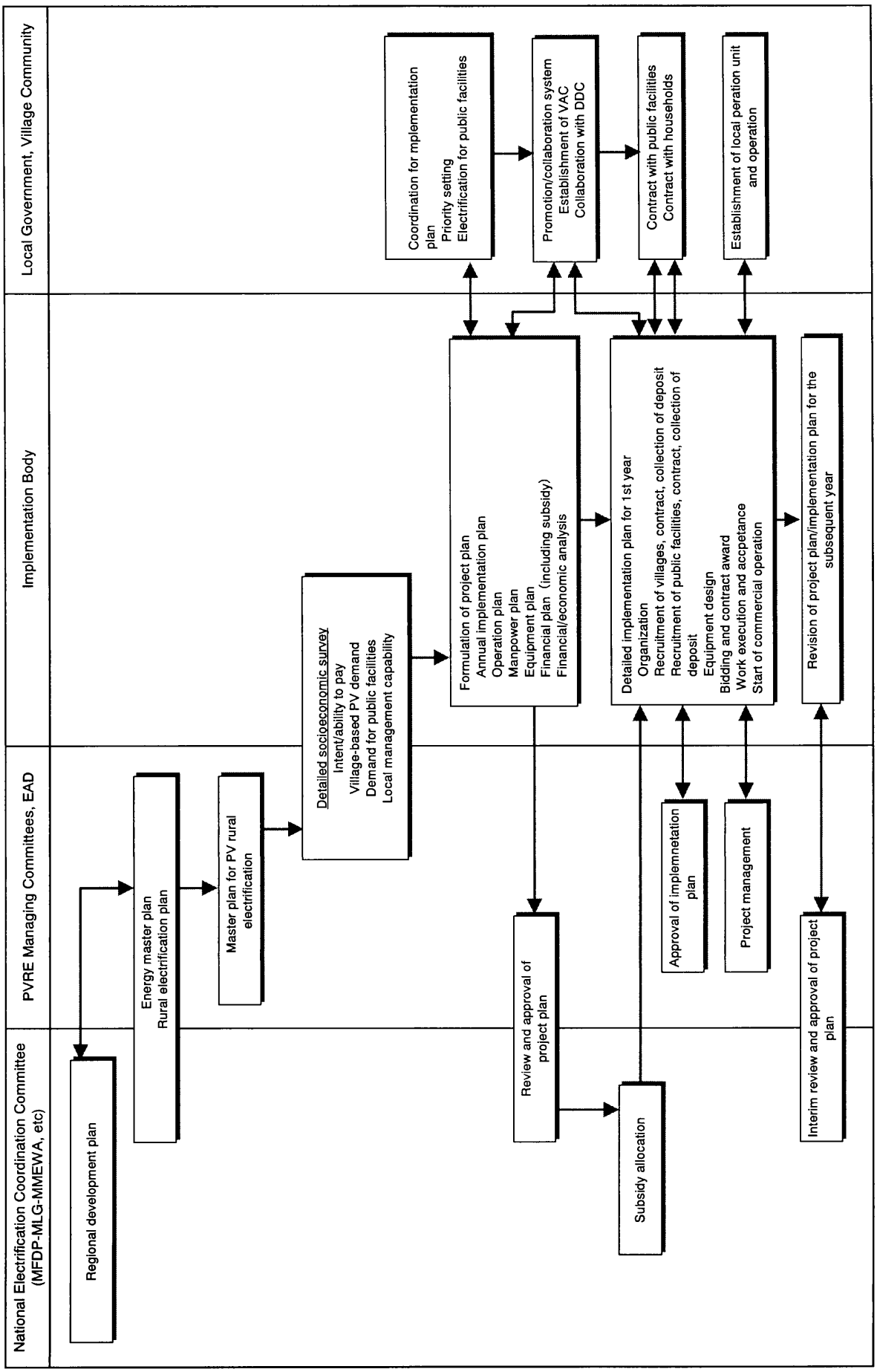

Figure 12.1-1 PV Rural Electrification Project Planning and Implementation Procedures

12.2 Implementation Schedule

The preliminary implementation schedule for the PV rural electrification project is shown in Figure 12.2-1.

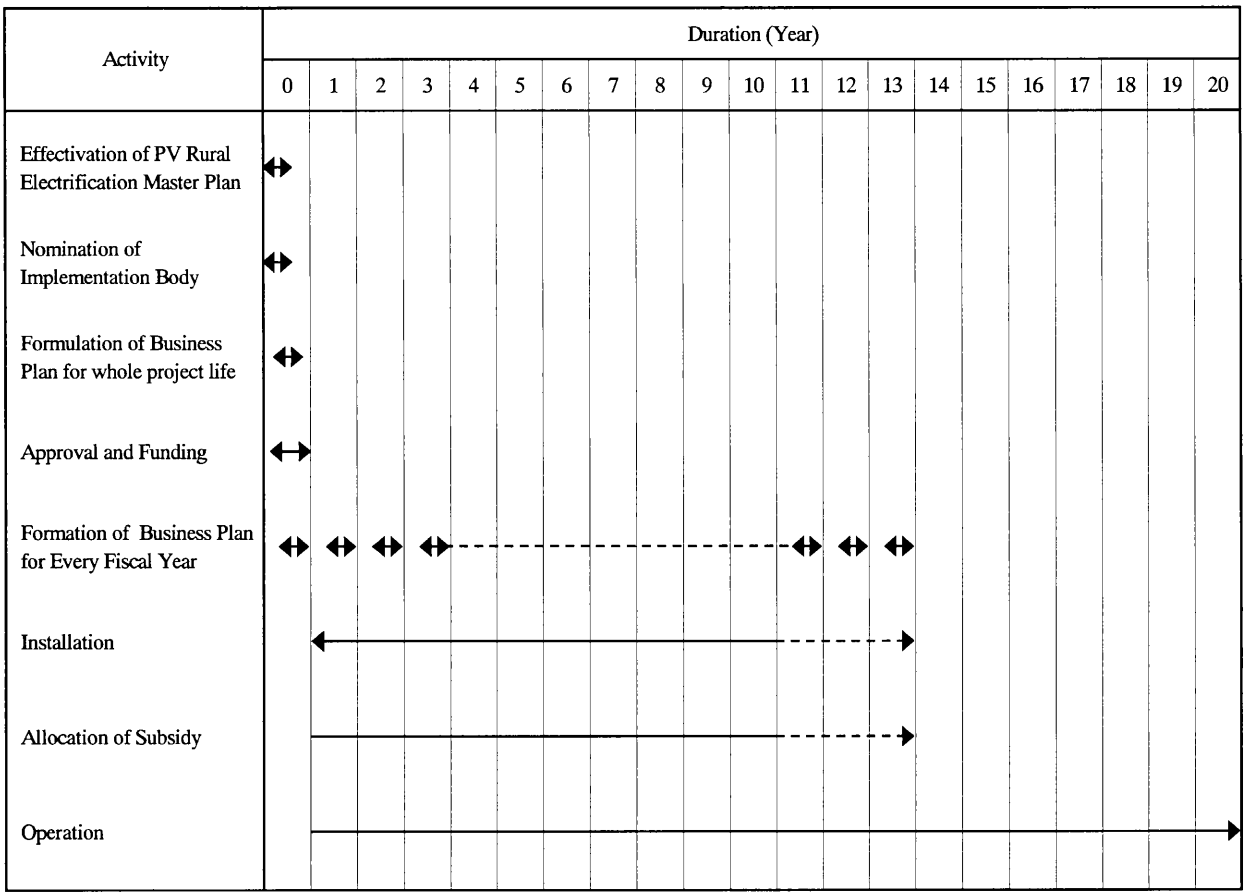

Figure 12.2-1 Implementation Schedule for the PV Rural Electrification Project

Chapter 13 PV Rural Electrification Project Planning Model and Financial/Economic Analysis

Chapter 13 PV Rural Electrification Project Planning Model and Financial/Economic Analysis

13.1 Project Model

13.1.1 Objective of the Project Model

A project model is elaborated, based on the results of the study for the purpose of pre-feasibility study. The financial and economic analyses reveal the required conditions in order for the Implementation Body to operate the business on a sustainable basis.

13.1.2 Project Model

(1) Target villages and localities and PV electrification schedule

As a result of study, the following framework was established for project modeling.

1) The entire country is divided into six zones (Zones 1 through 6) to conduct PV electrification for more or less the same number of villages and localities in each zone over the ten-year period.
2) The BCS system will be installed in parallel with the SHS installation in villages and localities with more than 500 population in order to facilitate the use of service by low income households, thereby to increase the PV electrification rate.

(2) Electrification Rate

Based on the results of evaluation and analysis in Chapters 6 and 7, the SHS electrification rate (the percentage of households to be electrified using the SHS versus total number of households in the target villages) is assumed to be 40% of all the households in the target villages and localities. In addition, the BCS system will be installed in villages and localities with more than 500 population, covering 20% of all the households in the target villages for BCS electrification.

(3) Electrification Schedule

Village/localities: Target villages and localities will be electrified during the period from the first year to the tenth year. However, actual installation in a village will be done for 3 years:

In the first year : 35% of the target households to be PV electrified

In the second year : 40% of the target households

In the third year : 25% of the target households

The yearly change in the number of villages/localities electrified by the PV system is summarized in Figure 13.1-1. The yearly change in the number of households electrified with SHS/BCS is shown in Figure 13.1-2.

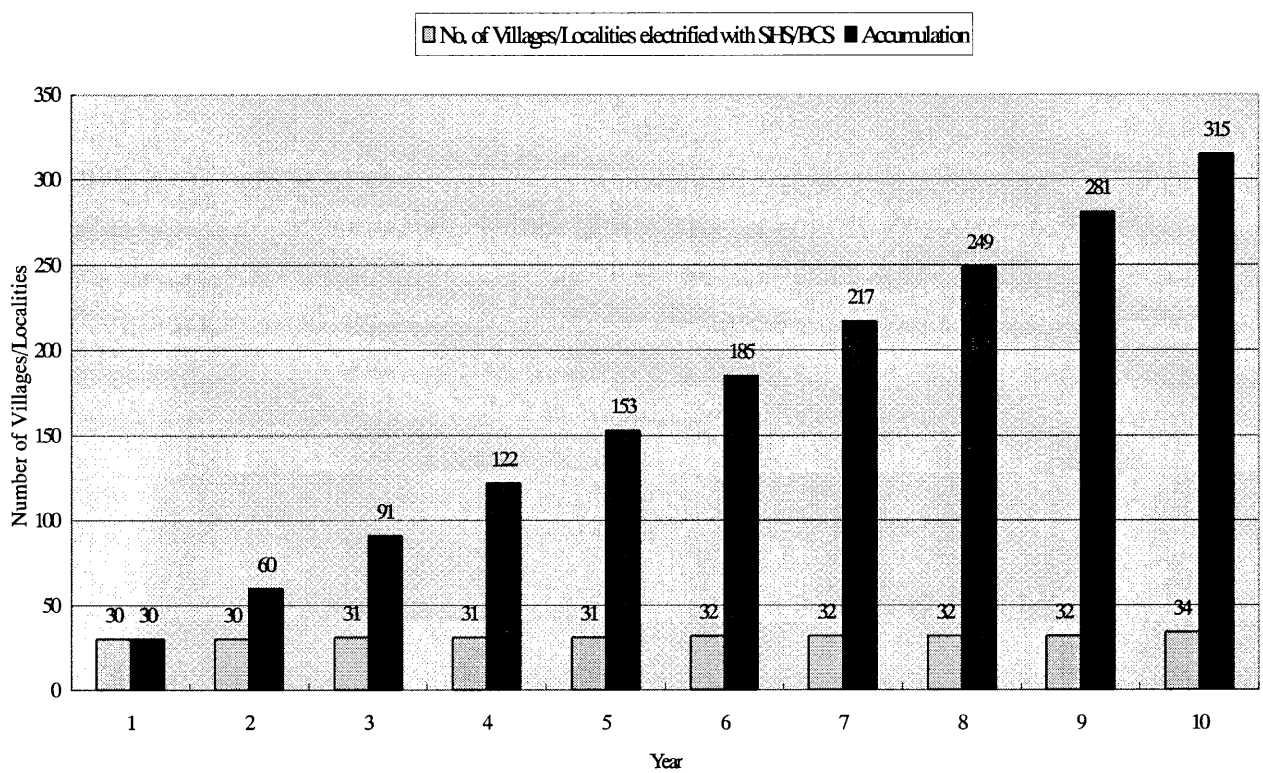

Figure 13.1-1 No. Of Villages and Localities PV Electrified (Base Case: SHS/BCS:40/20%)

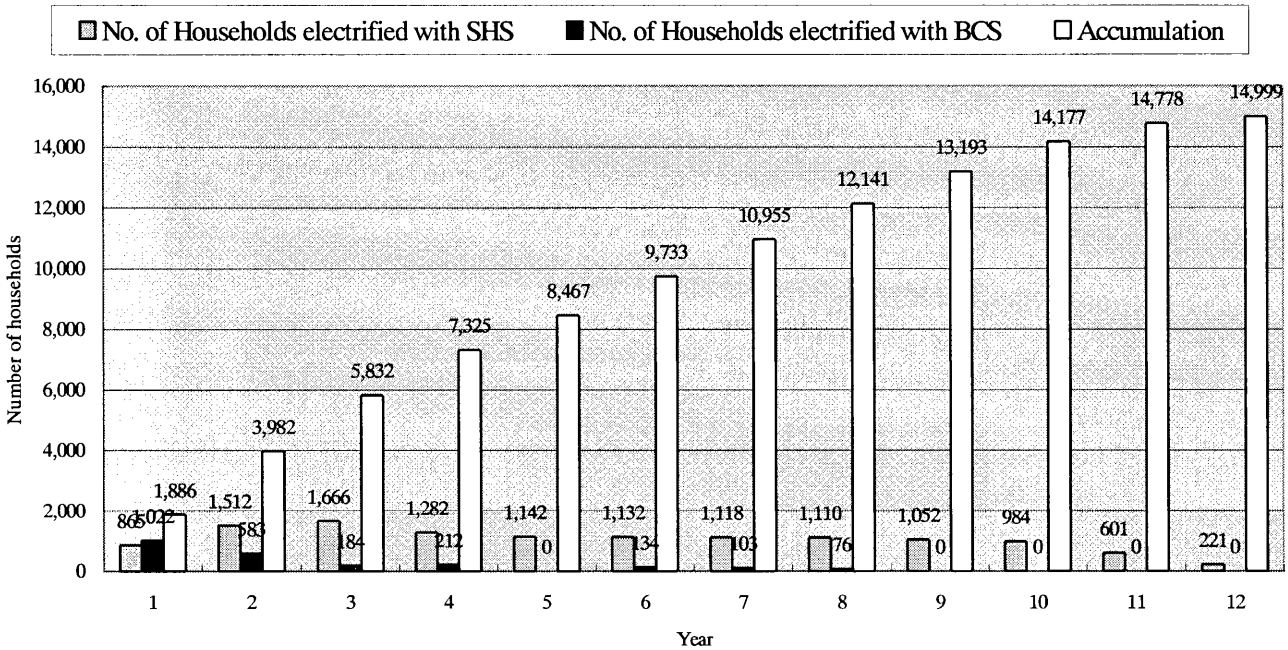

Figure 13.1-2 Number of Households Electrified with SHS/BCS (Base Case: SHS/BCS:40/20%)

(4) PV system capacity

The bases are as follows.

1) The average PV capacity demand per household is assumed to be 68Wp.
2) For public facilities, capacity demand is assumed to be 1,650Wp for villages and 350Wp for localities.

(5) Investment Cost

The basis of investment cost is based on the results obtained in the Dissemination Project (standard cost).

(6) Funding arrangement

Equity: 20% of equipment investment
The capital is to be applied to equipment investment during the first 10 years after commencement of the nationwide project. PV system costs and replacement costs of batteries and controllers are included in the equipment investment.

Subsidy: Subsidy for equipment investment to be considered. Analysis is conducted by varying subsidy ratios for the assumed investments.

Loan: Bank loan is to be arranged for the balance portion of equipment investment and the equity and the subsidy. Interest rate is 14%.

Capital increase for deficit:

The capital increase is to be considered and arranged when cash flow is expected to become negative.

(7) Revenue

The standard tariff system is assumed as follows:

1) Monthly user charge : SHS 50Wp – P40 /m
Centralized 500Wp – P600/m
BCS batteries – P15/m

2) Security deposit : Three months of user charge
(not including BCS users)

(8) Manpower Requirement and Salaries

The standard wage rates are assumed as follows.

1) Village operation unit (Agent-agreement in every village and locality)

Sales Agent : 1 person

Sales agent is to play a role for both a prepaid card sales agent and a contracting/deposit collecting agent.

Prepaid card agent fee : 5% of total sales

Contracting/deposit collecting agent fee: 10% of deposit collected.

System Monitoring Agent : 1 person

Agent fee : Fee will be decided, based no the number of users and capacity installed.

Note : the minimum salary is P300/m.

2) Implementation Body

Manpower requirements are estimated for the head office and local offices. Table 13.1-1 shows the manpower requirement for the Implementation Body and villages and localities. Salaries are based on BPC's standard.

Table 13.1-1 Manning Schedule

(Electrification Rate%: SHS/BCS:40/20)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Village Operation Unit																				
Coordinator	30	60	91	122	153	185	217	249	281	315	315	315	315	315	315	315	315	315	315	315
Monitoring/Service personnel	30	60	91	122	153	185	217	249	281	315	315	315	315	315	315	315	315	315	315	315
Head Office																				
Total No. of Director	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total No. of Manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total No. of Officer	6	6	6	6	7	6	6	6	6	6	8	8	7	7	7	7	7	7	7	7
Total No. of Assistant	3	4	4	3	3	4	4	4	5	5	6	6	5	5	5	5	5	5	5	5
Miscellaneous Labor	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
Total Head office	12	13	13	12	14	14	14	14	15	15	19	19	17	17	17	17	17	17	17	17
District Office																				
Total No of Technician	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6	6	6	6
Total No. of Commercial Officer	2	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
Total No of Assistance	2	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
Total No. of Miscellaneous Labor	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3
Total District Office	17	19	19	19	18	18	18	18	18	18	19	17	17	11	11	11	11	11	11	11
TOTAL	29	32	32	31	32	32	32	32	33	33	38	36	34	28	28	28	28	28	28	28

13.2 Financial Analysis

13.2.1 Basic Assumptions for Financial Analysis

① Escalation

All costs, expenses and prices in this financial analysis are fixed as of the fourth quarter of 2001, with no escalation being considered thereafter.

② Depreciation and amortization

Depreciation and amortization, where applicable in this financial analysis, are carried out under the following rules:

Depreciation of tangible fixed assets

- Depreciation method: Straight-line method
- Residual value: Zero
- Depreciation period: Building – 25 years
  PV system – 20 years
  Battery – 3 years

③ Corporate income tax

The corporate income tax rate in the country is 15%. The project is assumed to be tax exempted on strength of its objective to promote rural electrification.

④ Fixed assets

In this case study, financial evaluation is made for expenditures related to fixed assets, deducting subsidies to the initial investment (a fixed asset after a reduced value entry is counted)

⑤ Evaluation of profitability

Profitability of the project is evaluated on the basis of a financial internal rate of return (FIRR) obtained from the financial analysis. As the prime rate in Botswana is 15%, the target ROI should exceed 15%. The conditions under which the ROI of 18% - 20% can be achieved are assumed to be the Base-case.

⑥ Evaluation period

The master plan assumes the project period of ten years, while the financial evaluation period is twenty years between 2003 and 2012, with the year 2002 as the preparation period.

13.2.2 Case Study

Financial analyses for the following cases are carried out to obtain the amount of subsidy required to achieve the target ROI. Sensitive analysis is carried out as well.

(1) Base Case

The case to use both SHS and BCS (Electrification rate SHS/BCS:40%/20%) and achieve the ROI of 18% - 20% is assumed to be the Base Case.

(2) Other Cases

Various cases with the following variants are set up, PV electrification rate, Subsidy ratio for equipment investment for the first 10 years, Monthly charge, PV demand by size, Facility cost and costs of Implementation Body.

(3) Electrification rate and PV electrified households

Figure 13.2-1 shows the changes in the total electrification rate (the percentage of SHS/BCS electrified households of the total number of households in the target villages and localities) with the variation of the electrification rate of the target villages and localities assumed in the cases.

As the BCS is assumed to be installed with the SHS in villages and localities with more than 500 residents, the total electrification rate varies as follows.

Figure 13.2-2 shows the changes in the number of PV electrified households with variation of the SHS and BCS electrification rates.

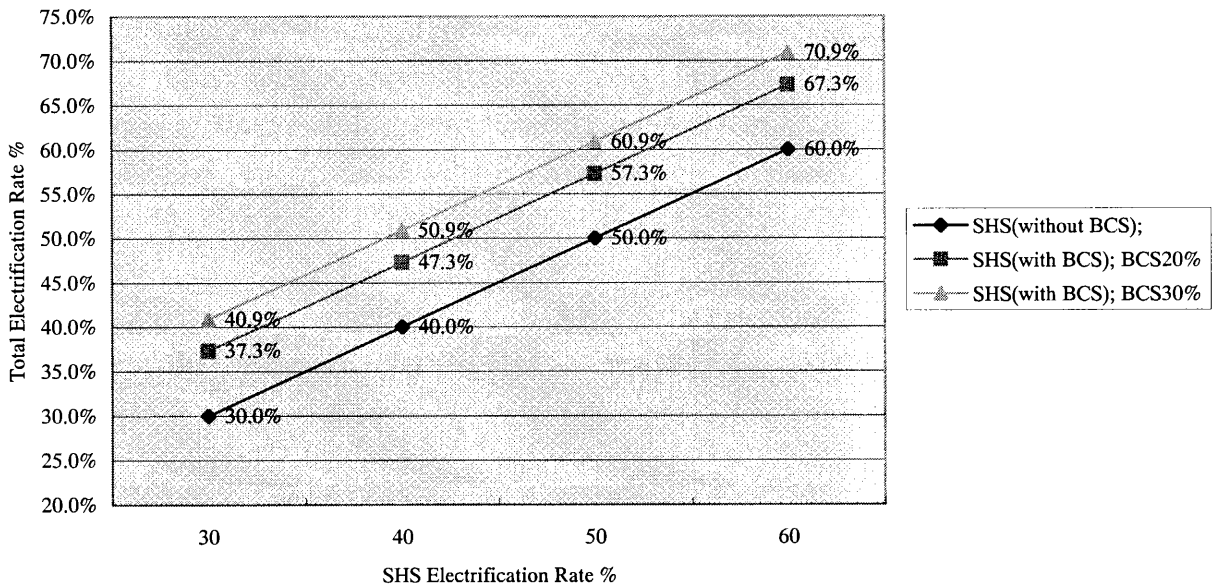

Figure 13.2-1 Total Electrification Rate per BCS Electrification

13.2.3 Financial Analysis

The results of financial analysis reveal that the Internal Rate of Return on Investment (IRROI) of 18% - 20% for Base Case can only be achieved with the following subsidy ratios.

Table 13.2-1 Effect of Base Case

(Unit: kP)

	Case	Base Case A-1
	Electrification rate % : SHS/BCS	40/20
1	Total investment in the project life (20 years)	185,623
2	Tariff Rate : P/m/50Wp / BCS	40/15
	Tariff Collection Rate: %	90%
3	Subsidy for operating cost in the first 10 years (% for Tariff revenue)	0%
	Subsidy for operating cost in the first 10 years	0
4	Subsidy Ratio for capital investment in the subsidy allocation period	80%
	Subsidy Allocation Period	12
	Subsidy for capital investment in the first 10 years	101,504
	Subsidy for capital investment in the subsidy allocation period	111,522
	Subsidy ratio for total investment	60.1%
5	Total subsidy in the first 10 years	101,504
6	Capital	28,442
	Capital increase to attain positive cash flow	1,766
7	Internal Rate of Return on Investment (IRROI)	18.0%
8	Cash generated in the 20 years (excluding the residual value)	62,404
9	No. of households/total PV electrification rate	14,999 (47.3%)
10	Total installed PV capacity (kWp)	1,200

(1) Government subsidy and funding requirements for the Implementation Body

1) Effect of subsidy ratio

Government subsidy is designed to cover a certain percentage of the investment cost required for the first 12 years after the start of project operation (including renewal costs of batteries) for the purpose of ensuring that the project is operated on a sustainable basis. Figures 13.2-2 show the changes in IRROI when the subsidy ratio is varied with the internal fund of 20% and the remaining fund requirement is met by loans.

Note that "E/S/L" in the figures represent "equity/subsidy/loan." As clearly seen from these figures, the subsidy ratio has significant impacts on the IRROI. To achieve the target IRROI of 18% - 20%, government subsidy should cover the entire financial requirements other than the working capital (20%) for the first 12 years.

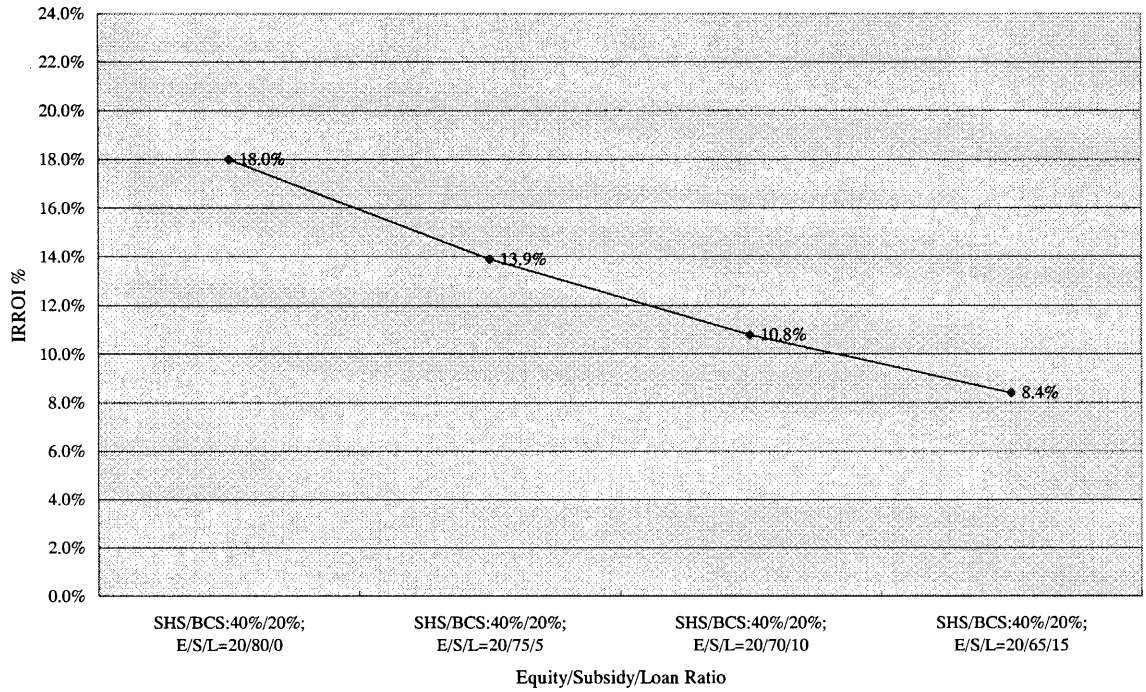

Figure 13.2-2 Sensitive Analysis on Subsidy Ratio

2) Total subsidy requirements

Figure 13.2-3 shows the changes in the amount of subsidy over 12 years for Base Case (BCS/SHS; SHS electrification rate of 40%; BCS electrification rate of 20%; equity ratio of 20%/subsidy ratio of 80%).

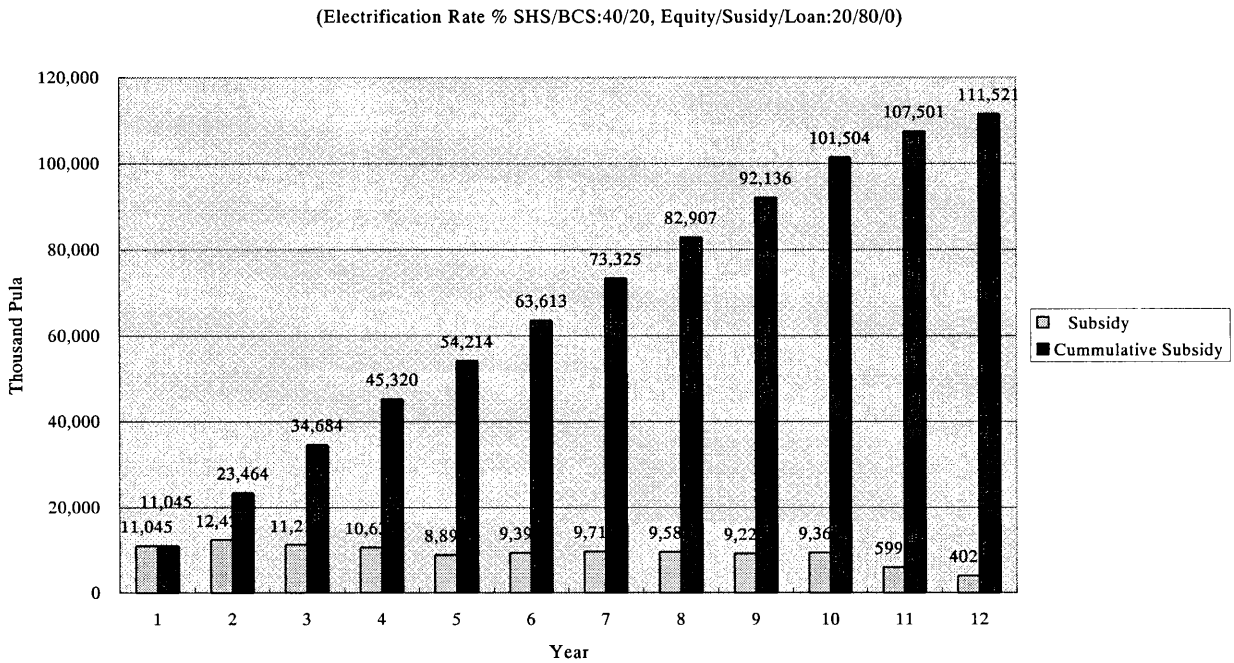

Figure 13.2-3 Change in Subsidy for 12 Years

3) Self-financed funds

The relationship between self-financed funds (equity, capital increase, loan) and net profit for Base Case (SHS/BCS electrification rate of 40%/20%; subsidy ratio of 80%) is shown in Figure 13.2-4.

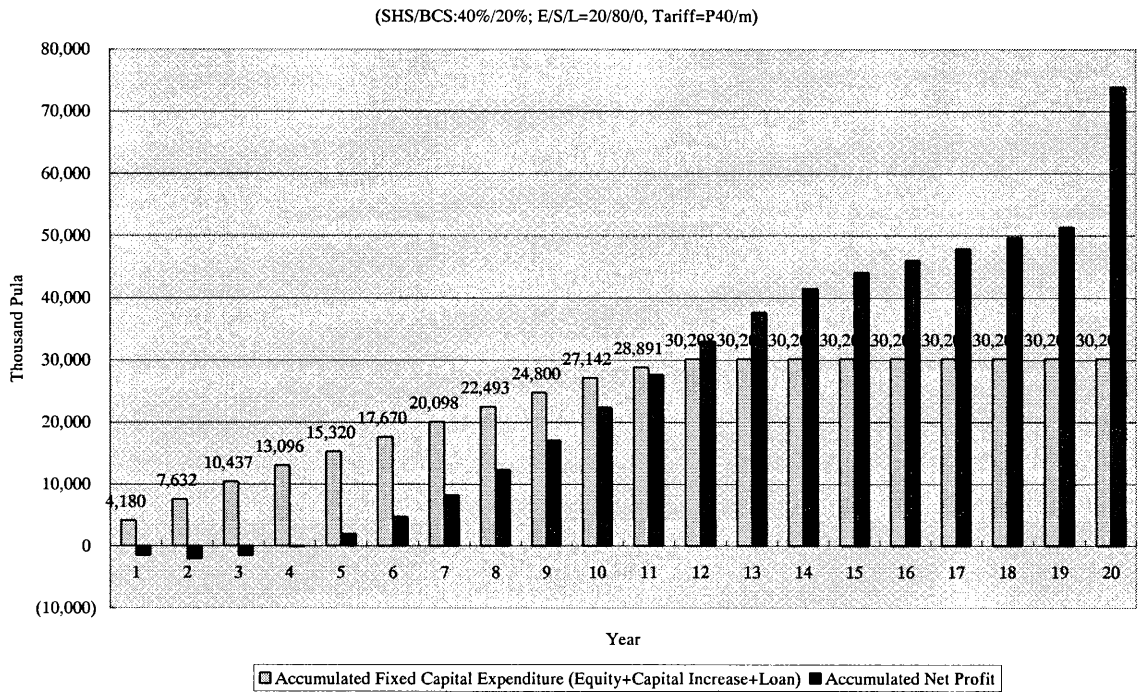

Figure 13.2-4 Accumulated (Equity + Capital Increase + Long Term Loan) and Net Profit

(2) Effect of tariff rate change

Figure 13.2-5 shows the change in the IRROI with variation of the user charge per 50Wp. Clearly, the user charge has considerable impacts on project profitability. Figure 13.2-6 shows the change in the IRROI with variation of the tariff collection rate. Baseline is supposed as 90% collection rate based on the results in Dissemination Project. Collection rate is highly sensitive on IRROI. Thus, keeping a high collection rate is critical to sound profitability.

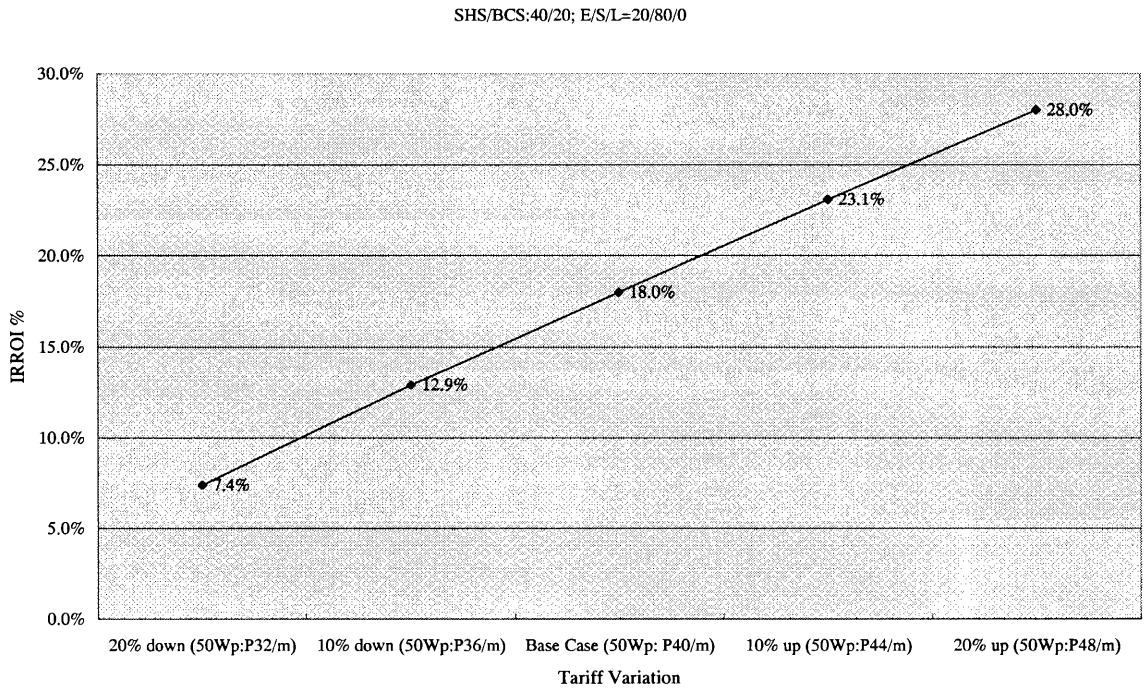

Figure 13.2-5 Sensitivity Analysis on Tariff Level

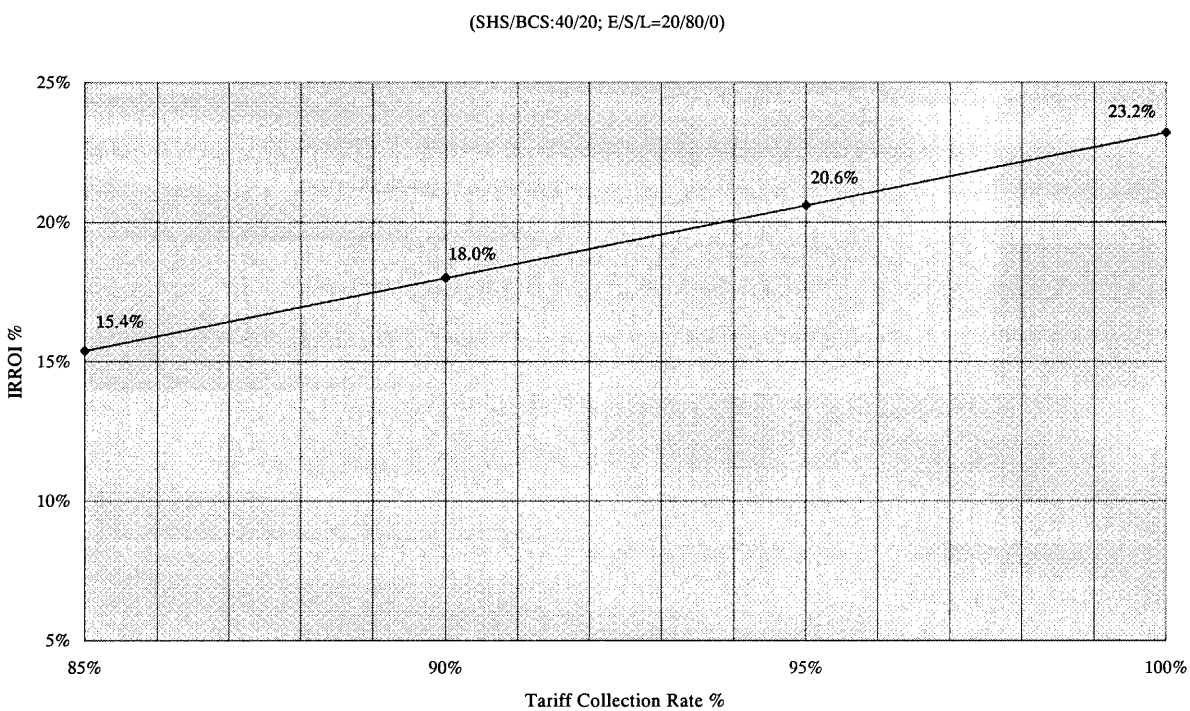

Figure 13.2-6 Sensitivity Analysis on Tariff Collection Rate

(3) Electricity demand for public facilities

The project plan assumes electricity demand for public facilities at 1,650Wp per village (350Wp per locality) on the basis of the results of the socioeconomic surveys. Then the user charge is assumed to be 50% higher than that for general households, P60 per month.

Figure 13.2-7 shows the changes in the IRROI when demand for public facilities accounts for 60% of the above mentioned assumption, 1,650 Wp and 350Wp, (assuming the SHS/BCS electrification rate of 40/20%), for which the IRROI is 13.2%, down 4.8 percentage points from 18.0% for the Base Case.

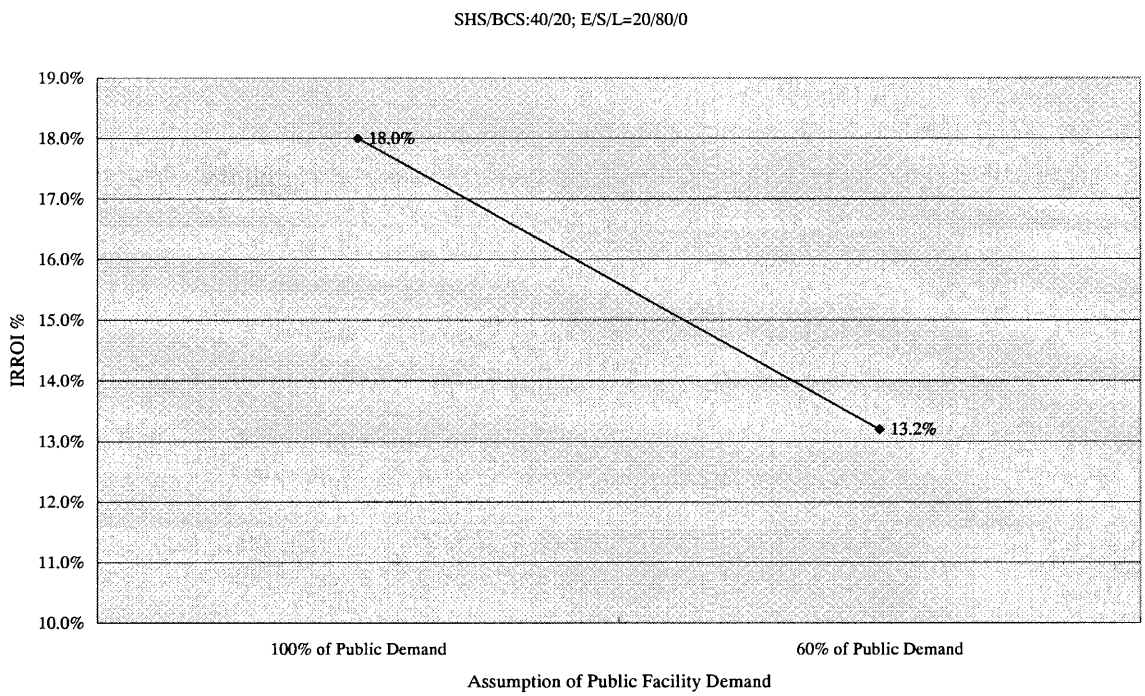

Figure 13.2-7 Effect of Public Demand on IRROI

Clearly, inclusion of public facilities in the project is very important. At present, each district installs and operates the PV system, which seems to require a much higher cost – a few times more than the cost estimated in the plan. Thus, integration of public facilities into the project is beneficial for both the Implementation Body and Districts.

(4) Sensitivity analysis on equipment investment

Figure 13.2-8 shows the effect of variation of the total investment cost, i.e., 10% decrease, 20% decrease or 10% increase, on the IRROI for the SHS electrification rate of 40%.

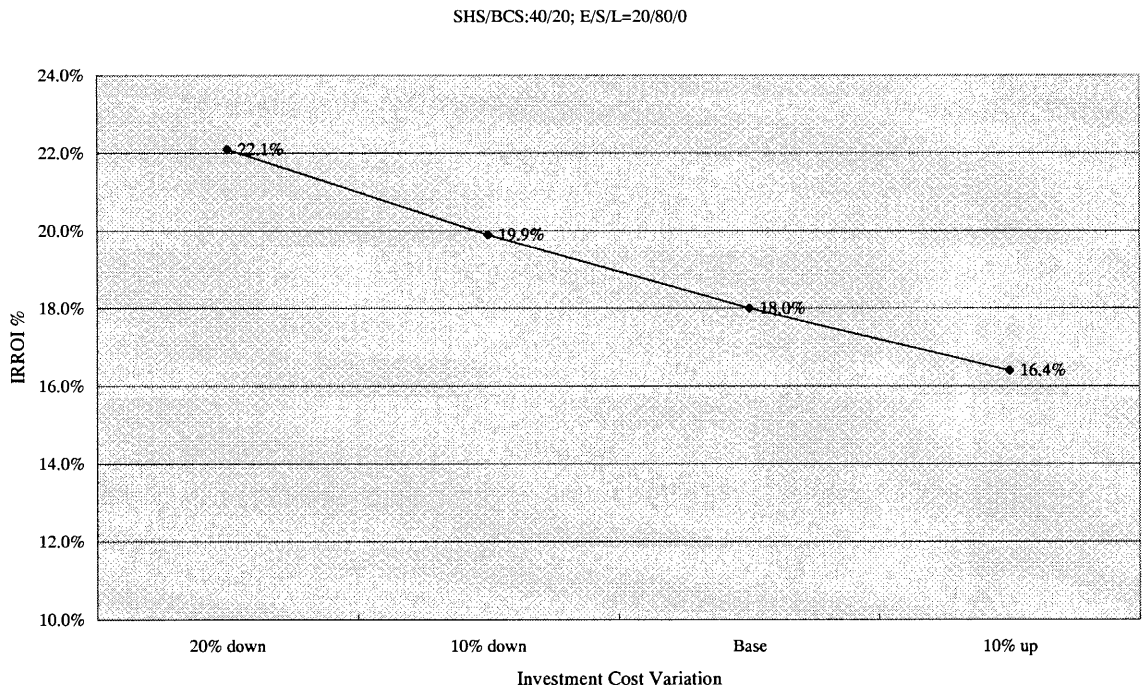

Figure 13.2-8 Sensitive Analysis for Investment Cost: IRROI

The 10% decrease in the investment cost causes the IRROI to improve approximately 1.9% for the Base Case.

(5) Sensitivity analysis on operating cost

The present study recommends that, to ensure sustainable management of the project, activities related to system operation be conducted by local community organizations, as far as possible. Now, the operating cost incurred by the Implementation Body accounts for large portions and its reduction is expected to have significant impacts on project profitability. As shown in Figure 13.2-9, the IRROI improves more than 4.3 percentage points when the 20% cost reduction is achieved.

In case System Monitor's cost is reduced by 50%, the IRROI improve 3.8 percent that is less than that attained by BPC cost 20% cut.

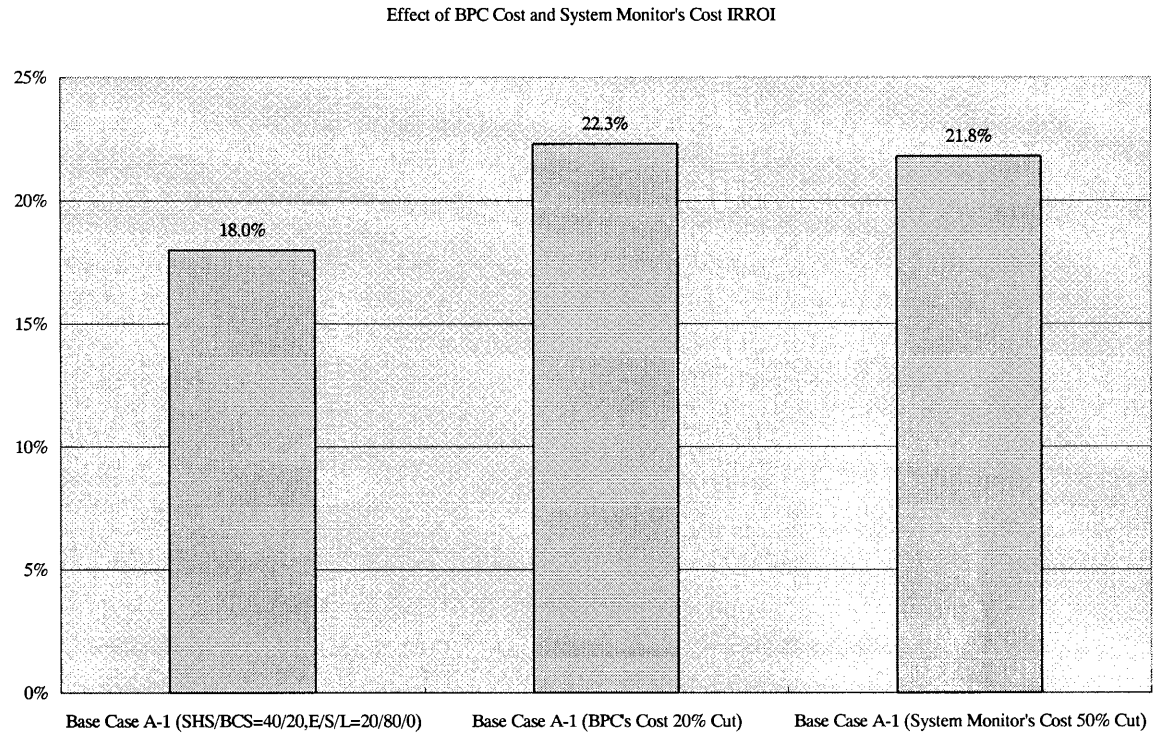

Figure 13.2-9 Effect of BPC and System Monitor's Costs on IRROI

13.3 Economic Analysis

Financial analysis examines and estimates how much profit the Implementation Body will be able to make from the implementation of the project. On the other hand, economic analyze concerns with benefits and costs incurred by the project to the national economy or the society as a whole. For the purpose of the present study, economic analysis is carried out to estimate costs and benefits on the basis of the above assumptions and to determine an economic internal rate of return (EIRR) as a principal indicator to allow evaluation.

(1) External benefits

i) At present, un-electrified households in rural villages use paraffin oil, candles and batteries (dry and automotive) for lighting and radio-cassette

recorder. The project is expected to substitute for these imported products. Households with below-average income in villages are assumed to spend 19P/m for paraffin, 12P/m for candles, and 12P/m for batteries. Assuming that these expenses are replaced with the 50Wp SHS, the benefit is assumed to be 5.09P/kWh.

ii) CO_2 reduction

As paraffin oil and candles, used for lighting, are replaced with the PV system, reduction of CO_2 gas is expected, at a rate of around 380kg/kWh. Assuming that CO_2 reduction is worth US$20/ton-$CO_2$, the external benefit amounts to 0.46P/kWh.

Thus, the product is expected to generate above external benefits, which total 5.55P/kWh and is counted as the saving in foreign currency under the economic analysis.

(2) Other indirect economic benefits

Although not reflected in the economic analysis due to the difficulty in quantification or valuation, the following indirect economic benefits are expected to be generated from the project.

- Economic vitalization and enhancement of well-being of rural villages through creation of employment opportunities.

  As shown in Table 13.1-2 of Chapter 13, 630 persons can get job as the workers for operation units in the village. Also it is expected that many peoples will be engaged in the PV-system installation work Additionally, jobs to sell and maintain electrical appliances will be created in those villages.

  Clearly, the PV rural electrification project, if implemented in full scale, will generate enormous benefits for rural villages, not only economic vitalization but social and cultural enhancement.

(3) Results and evaluation

For the Base Case, the EIRR exceeded 15%. In addition, the project is expected to generate significant indirect economic benefits, particularly job creation in rural villages. Thus, the economic analysis justifies implementation of the project.

13.4 Recommendations

Based on the results of evaluation and analysis, the following recommendations are made for the formulation and implementation of the PV rural electrification project plan.

1) Base Case A-1 "SHS/BCS (SHS electrification rate of 40%/BCS 20%)" should form the basis of the project. This is expected to achieve the electrification rate of 47.3% for all households in the target villages and localities.

2) To ensure sustainable operation of the project (Base Case), the government should provide the subsidy outlined in Figure 13.2-3 for the first 12 years, while the Implementation Body will be able to meet the rest of financial requirements by itself. Under this financial plan, the IRROI is estimated at 18.0%.

3) Appropriate pricing holds the key to the achievement of a desired electrification rate and project profitability. In particular, it is important to:
   a) Maintain a sufficiently high rate of user charge collection; and
   b) Have the user charge exempted from the VAT, which would otherwise discourage low income households from use of the PV system. If VAT cannot be exempted, the same amount of operation subsidy as VAT should be allocated during the entire business period.

4) As the operating cost of the Implementation Body (salary, etc.) accounts for significant portions of the project cost, its reduction will contribute greatly to the improvement of project profitability. Efforts should be made to use local workforce as far as possible.

5) The PV system for public facilities in villages should be incorporated into the scope of the project.

6) Efforts should be made to minimize the equipment cost, especially the BCS.

7) There are significant differences between the results obtained in the socio-economic survey and Dissemination Project. The differences affect the project feasibility.

It is, therefore, recommended to conduct detailed socioeconomic survey for the formulation of the business plan of PV rural electrification.