12.3 Economic Analysis

12.3.1 Benefit of Project

The generating capacity and the annual energy production of this project at the Chiang Mai 3 Substation considering the transmission loss are as follows:

	Capacity	Energy
Nam Ngao Project	122.4 MW	300.7 GWh
Mae Lama Luang Project	207.6 MW	583.4 GWh
Total	330.0 MW	884.1 GWh

The capacity loss ratio and the energy loss ratio are estimated as 4.4% and 2.1% respectively.

The benefit of this Project shall be evaluated using the cost of the gas turbine plant as stated in section 12.2. Evaluated kW benefit and kWh benefit using "Economic Criteria and Basic Cost of Thermal Power Plants" shown on Table 12-1 are as follows:

kW benefit : 9,808 B/kW + O&M Cost

(9,100 ฿ x 0.97/0.90)

kWh benefit : For the first 25 years 1.0961 ฿/kWh

(1.0170 ฿/kWh x 0.97/0.90)

For the second 25 years 1.6406 ฿/kWh

(1.5222 ฿/kWh x 0.97/0.90)

Benefit flow of the adopted development plan (the Nam Ngao Project with 140 MW, the Mae Lama Luang Project with 240 MW) is presented in Table 12-6.

To evaluate the costs of the alternative thermal power plant as the benefits of this project, the same transmission loss ratio as this project is used.

12.3.2 Cost of Project

As indicated on Table 11-4, 11-5 and 11-6 in Chapter 11, the total initial investment for the adopted development plan is $9,131 \times 10^6$ Baht (351×10^6 US$).

Nam Ngao Project   : $4,028 \times 10^6$ Baht (155×10^6 US$)

Mae Lama Luang Project : $5,103 \times 10^6$ Baht (196×10^6 US$)

Total $9,131 \times 10^6$ Baht (351×10^6 US$)

Cost flow of the total investment cost throughout the economic life and the operation and maintenance cost are presented in Table 12-6.

12.3.3 Economic Analysis

The results of evaluation of B-C, B/C and EDR based on the benefit flow and the cost flow of the adopted development plan (Table 12-6) are as follows:

B-C   : 950×10^6 Baht (Discount rate :   12%)
B/C   : 1.13 (Discount rate :   12%)
EDR   : 14.02%

As indicated by indices of B-C and B/C, the costs of construction and operation of this project is smaller than those of an alternative thermal power plant which can provide equivalent service, and it can be concluded that the project is superior to the alternative plan. It can be also concluded that the project can continue to maintain its superiority as long as the discount rate which reflects the capital opportunity cost does not exceed 14.02%.

Table 12-6 Benefit Flow and Cost Flow of the Adopted Development Plan

(Unit: Million ฿)

Serial Number	No. after Completion	Cost Investment Cost	Cost O&M Cost	Cost Total	Cost Total (N.P.V.)	Benefit Investment Cost	Benefit O&M Cost	Benefit Fuel Cost	Benefit Total	Benefit Total (N.P.V.)	B - C
1		0.00		0.00	0.00	0.00			0.00	0.00	0.00
2		449.50		449.50	401.34	0.00			0.00	0.00	-449.50
3		1423.20		1423.20	1134.57	0.00			0.00	0.00	-1423.20
4		3327.10		3327.10	2368.16	1351.60			1351.60	962.05	-1975.50
5		3185.80		3185.80	2024.63	1689.51			1689.51	1073.71	-1496.29
6		745.60		745.60	423.07	337.90			337.90	191.73	-407.70
7	1		120.30	120.30	60.95		101.37	989.41	1090.78	552.62	970.48
8	2		120.30	120.30	54.42		101.37	989.41	1090.78	493.41	970.48
9	3		120.30	120.30	48.59		101.37	989.41	1090.78	440.55	970.48
10	4		120.30	120.30	43.38		101.37	989.41	1090.78	393.35	970.48
11	5		120.30	120.30	38.73		101.37	989.41	1090.78	351.20	970.48
12	6		120.30	120.30	34.58		101.37	989.41	1090.78	313.57	970.48
13	7		120.30	120.30	30.88		101.37	989.41	1090.78	279.98	970.48
14	8		120.30	120.30	27.57		101.37	989.41	1090.78	249.98	970.48
15	9		120.30	120.30	24.62		101.37	989.41	1090.78	223.20	970.48
16	10		120.30	120.30	21.98		101.37	989.41	1090.78	199.28	970.48
17	11		120.30	120.30	19.62		101.37	989.41	1090.78	177.93	970.48
18	12		120.30	120.30	17.52		101.37	989.41	1090.78	158.87	970.48
19	13		120.30	120.30	15.64	1351.60	101.37	989.41	2442.39	317.61	2322.09
20	14		120.30	120.30	13.97	1689.51	101.37	989.41	2780.29	322.81	2659.99
21	15		120.30	120.30	12.47	337.90	101.37	989.41	1428.68	148.11	1308.38
22	16		120.30	120.30	11.13		101.37	989.41	1090.78	100.96	970.48
23	17		120.30	120.30	9.94		101.37	989.41	1090.78	90.15	970.48
24	18		120.30	120.30	8.88		101.37	989.41	1090.78	80.49	970.48
25	19		120.30	120.30	7.93		101.37	989.41	1090.78	71.86	970.48
26	20		120.30	120.30	7.08		101.37	989.41	1090.78	64.16	970.48
27	21		120.30	120.30	6.32		101.37	989.41	1090.78	57.29	970.48
28	22	365.70	120.30	486.00	22.79		101.37	989.41	1090.78	51.15	604.78
29	23	1141.03	120.30	1261.33	52.81		101.37	989.41	1090.78	45.67	-170.55
30	24	1063.75	120.30	1184.05	44.26		101.37	989.41	1090.78	40.78	-93.27
31	25	327.75	120.30	448.05	14.95		101.37	989.41	1090.78	36.41	642.73
32	26		120.30	120.30	3.59		101.37	1480.91	1582.28	47.15	1461.98
33	27		120.30	120.30	3.20		101.37	1480.91	1582.28	42.10	1461.98
34	28		120.30	120.30	2.86	1351.60	101.37	1480.91	2933.88	69.70	2813.58
35	29		120.30	120.30	2.55	1689.51	101.37	1480.91	3271.78	69.40	3151.48
36	30		120.30	120.30	2.28	337.90	101.37	1480.91	1920.18	36.37	1799.88
37	31		120.30	120.30	2.03		101.37	1480.91	1582.28	26.76	1461.98
38	32		120.30	120.30	1.82		101.37	1480.91	1582.28	23.89	1461.98
39	33		120.30	120.30	1.62		101.37	1480.91	1582.28	21.33	1461.98
40	34		120.30	120.30	1.45		101.37	1480.91	1582.28	19.04	1461.98
41	35		120.30	120.30	1.29		101.37	1480.91	1582.28	17.00	1461.98
42	36		120.30	120.30	1.15		101.37	1480.91	1582.28	15.18	1461.98
43	37		120.30	120.30	1.03		101.37	1480.91	1582.28	13.56	1461.98
44	38	452.60	120.30	572.90	4.38		101.37	1480.91	1582.28	12.10	1009.38
45	39	411.20	120.30	531.50	3.63		101.37	1480.91	1582.28	10.81	1050.78
46	40	117.20	120.30	237.50	1.45		101.37	1480.91	1582.28	9.65	1344.78
47	41		120.30	120.30	0.55		101.37	1480.91	1582.28	8.61	1461.98
48	42		120.30	120.30	0.58		101.37	1480.91	1582.28	7.69	1461.98
49	43		120.30	120.30	0.52	1351.60	101.37	1480.91	2933.88	12.73	2813.58
50	44		120.30	120.30	0.47	1689.51	101.37	1480.91	3271.78	12.68	3151.48
51	45		120.30	120.30	0.42	337.90	101.37	1480.91	1920.18	6.64	1799.88
52	46		120.30	120.30	0.37		101.37	1480.91	1582.28	4.89	1461.98
53	47		120.30	120.30	0.33		101.37	1480.91	1582.28	4.36	1461.98
54	48		120.30	120.30	0.30		101.37	1480.91	1582.28	3.90	1461.98
55	49		120.30	120.30	0.26		101.37	1480.91	1582.28	3.48	1461.98
56	50		120.30	120.30	0.24		101.37	1480.91	1582.28	3.11	1461.98
		13010.43	6015.00	19025.43	7041.27	13516.04	5068.52	61758.01	80342.56	7991.03	61317.13

B - C	949.75718
B / C	1.1348843
E D R	0.1401851

12.4 Sensitivity Analysis

The sensitivity analysis of the project was implemented for the cases based on conditions stated below;

(1) Increase of Construction Cost

(2) Fluctuation of Fuel Prices

(3) Suspension of Implementation of the Nam Ngao Project

The results of the sensitivity analysis on the increase of the construction cost and the fluctuation of fuel prices are shown on Fig. 12-3 and Fig. 12-4 respectively. On the basis of these results, it can be concluded that the Project is feasible and superior to the alternative thermal power plant as long as the ratio of the increase of the construction cost and fall in fuel prices do not exceed 14.7% and 19.8% respectively.

The cost flow and the benefit flow for the above case (3) is presented on Table 12-7, and it can be also concluded that the project is feasible in the case that the Nam Ngao Project is suspended.

Table 12-7   Benefit Flow and Cost Flow of Sensitivity Analysis
(Nam Ngao Project suspension)

(Unit: Million ฿)

Serial Number	No. after Completion	Cost				Benefit					B - C
		Investment Cost	O&M Cost	Total	Total (N.P.V.)	Investment Cost	O&M Cost	Fuel Cost	Total	Total (N.P.V.)	
1		0.00		0.00	0.00	0.00			0.00	0.00	0.00
2		300.40		300.40	268.21	0.00			0.00	0.00	-300.40
3		632.20		632.20	503.99	0.00			0.00	0.00	-632.20
4		1919.90		1919.90	1366.55	850.28			850.28	605.21	-1069.62
5		1827.30		1827.30	1161.28	1062.84			1062.84	675.45	-764.46
6		422.70		422.70	239.85	212.57			212.57	120.62	-210.13
7	1		69.30	69.30	35.11		63.77	652.89	716.66	363.08	647.36
8	2		69.30	69.30	31.35		63.77	652.89	716.66	324.18	647.36
9	3		69.30	69.30	27.99		63.77	652.89	716.66	289.45	647.36
10	4		69.30	69.30	24.99		63.77	652.89	716.66	258.43	647.36
11	5		69.30	69.30	22.31		63.77	652.89	716.66	230.75	647.36
12	6		69.30	69.30	19.92		63.77	652.89	716.66	206.02	647.36
13	7		69.30	69.30	17.79		63.77	652.89	716.66	183.95	647.36
14	8		69.30	69.30	15.88		63.77	652.89	716.66	164.24	647.36
15	9		69.30	69.30	14.18		63.77	652.89	716.66	146.64	647.36
16	10		69.30	69.30	12.66		63.77	652.89	716.66	130.93	647.36
17	11		69.30	69.30	11.30		63.77	652.89	716.66	116.90	647.36
18	12		69.30	69.30	10.09		63.77	652.89	716.66	104.38	647.36
19	13		69.30	69.30	9.01	850.28	63.77	652.89	1566.94	203.76	1497.64
20	14		69.30	69.30	8.05	1062.84	63.77	652.89	1779.50	206.61	1710.20
21	15		69.30	69.30	7.18	212.57	63.77	652.89	929.23	96.33	859.93
22	16		69.30	69.30	6.41		63.77	652.89	716.66	66.33	647.36
23	17		69.30	69.30	5.73		63.77	652.89	716.66	59.23	647.36
24	18		69.30	69.30	5.11		63.77	652.89	716.66	52.88	647.36
25	19		69.30	69.30	4.57		63.77	652.89	716.66	47.22	647.36
26	20		69.30	69.30	4.08		63.77	652.89	716.66	42.16	647.36
27	21		69.30	69.30	3.64		63.77	652.89	716.66	37.64	647.36
28	22	195.04	69.30	264.34	12.40		63.77	652.89	716.66	33.61	452.32
29	23	721.51	69.30	790.81	33.11		63.77	652.89	716.66	30.01	-74.15
30	24	704.03	69.30	773.33	28.91		63.77	652.89	716.66	26.79	-56.67
31	25	208.15	69.30	277.45	9.26		63.77	652.89	716.66	23.92	439.21
32	26		69.30	69.30	2.07		63.77	977.22	1040.99	31.02	971.69
33	27		69.30	69.30	1.84		63.77	977.22	1040.99	27.70	971.69
34	28		69.30	69.30	1.65	850.28	63.77	977.22	1891.27	44.93	1821.97
35	29		69.30	69.30	1.47	1062.84	63.77	977.22	2103.83	44.63	2034.53
36	30		69.30	69.30	1.31	212.57	63.77	977.22	1253.56	23.74	1184.26
37	31		69.30	69.30	1.17		63.77	977.22	1040.99	17.60	971.69
38	32		69.30	69.30	1.05		63.77	977.22	1040.99	15.72	971.69
39	33		69.30	69.30	0.93		63.77	977.22	1040.99	14.03	971.69
40	34		69.30	69.30	0.83		63.77	977.22	1040.99	12.53	971.69
41	35		69.30	69.30	0.74		63.77	977.22	1040.99	11.19	971.69
42	36		69.30	69.30	0.66		63.77	977.22	1040.99	9.99	971.69
43	37		69.30	69.30	0.59		63.77	977.22	1040.99	8.92	971.69
44	38	295.90	69.30	365.20	2.79		63.77	977.22	1040.99	7.96	675.79
45	39	263.50	69.30	332.80	2.27		63.77	977.22	1040.99	7.11	708.19
46	40	74.30	69.30	143.60	0.88		63.77	977.22	1040.99	6.35	897.39
47	41		69.30	69.30	0.38		63.77	977.22	1040.99	5.67	971.69
48	42		69.30	69.30	0.34		63.77	977.22	1040.99	5.06	971.69
49	43		69.30	69.30	0.30	850.28	63.77	977.22	1891.27	8.21	1821.97
50	44		69.30	69.30	0.27	1062.84	63.77	977.22	2103.83	8.15	2034.53
51	45		69.30	69.30	0.24	212.57	63.77	977.22	1253.56	4.34	1184.26
52	46		69.30	69.30	0.21		63.77	977.22	1040.99	3.22	971.69
53	47		69.30	69.30	0.19		63.77	977.22	1040.99	2.87	971.69
54	48		69.30	69.30	0.17		63.77	977.22	1040.99	2.56	971.69
55	49		69.30	69.30	0.15		63.77	977.22	1040.99	2.29	971.69
56	50		69.30	69.30	0.14		63.77	977.22	1040.99	2.04	971.69
		7564.93	3465.00	11029.93	3943.57	8502.76	3188.50	40752.75	52444.01	5174.56	41414.08

B - C   1230.9847
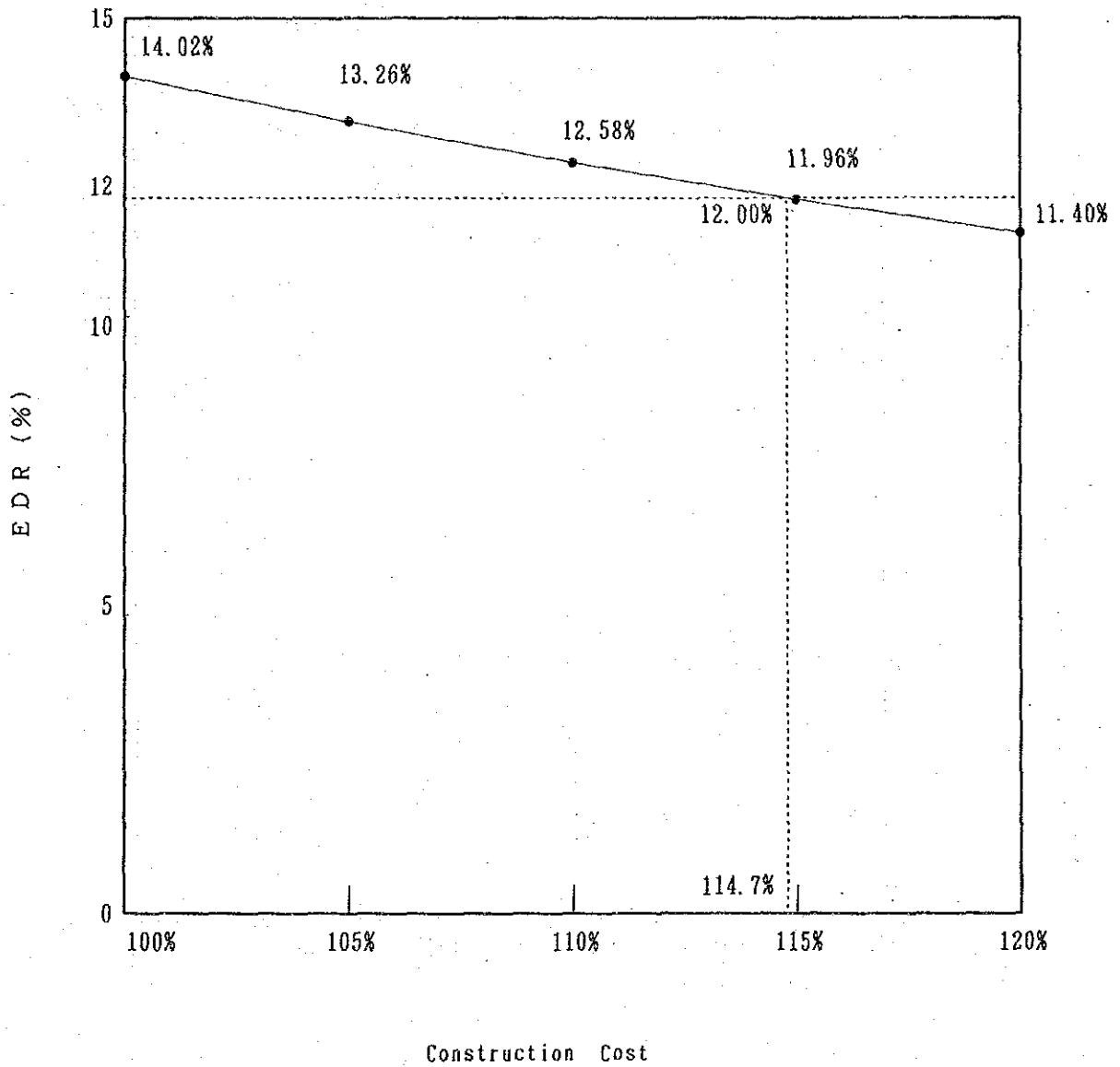B / C   1.3121495
E D R   0.1678305

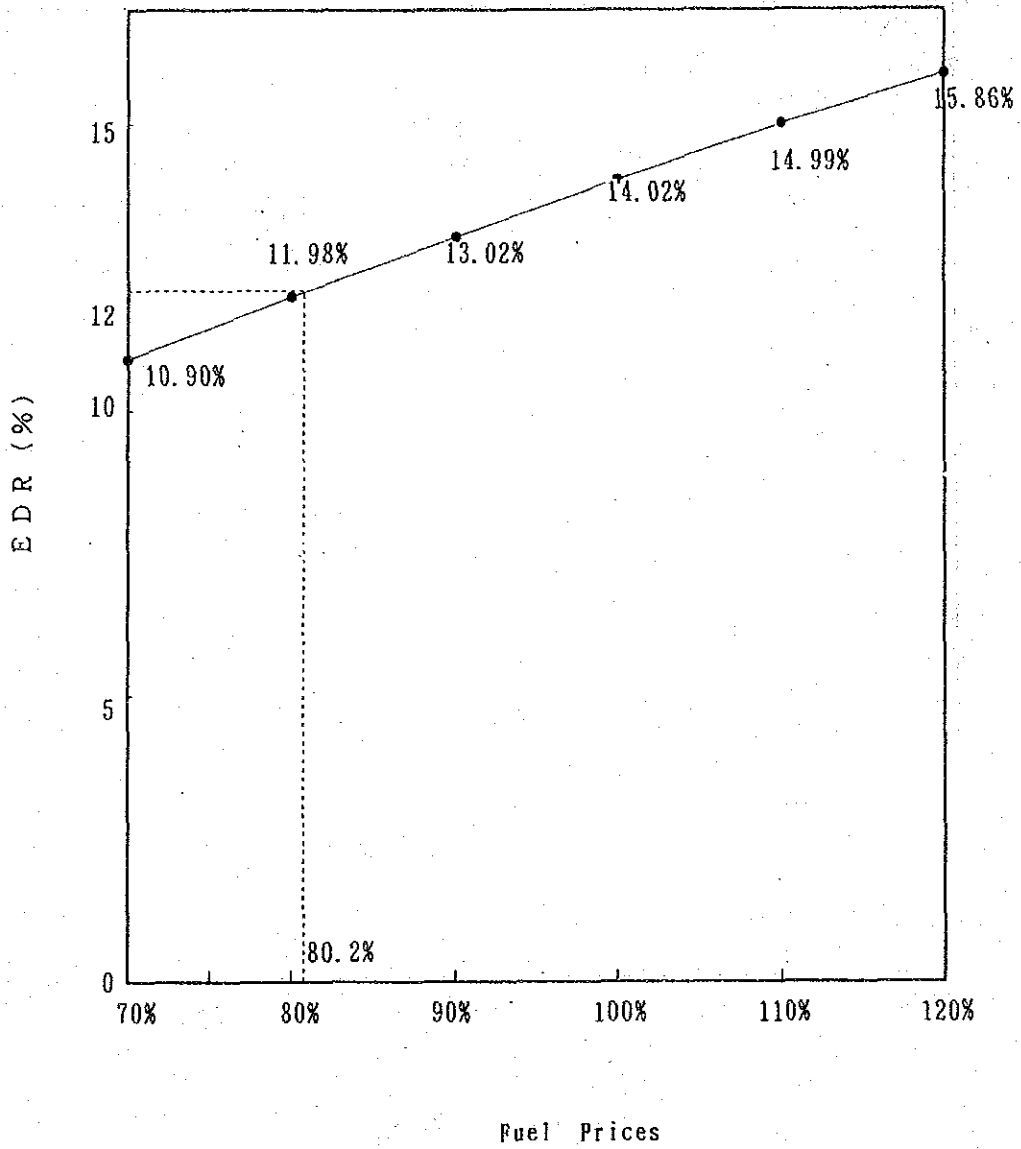Fig. 12-3   Sensitivity Analysis – Construction Cost
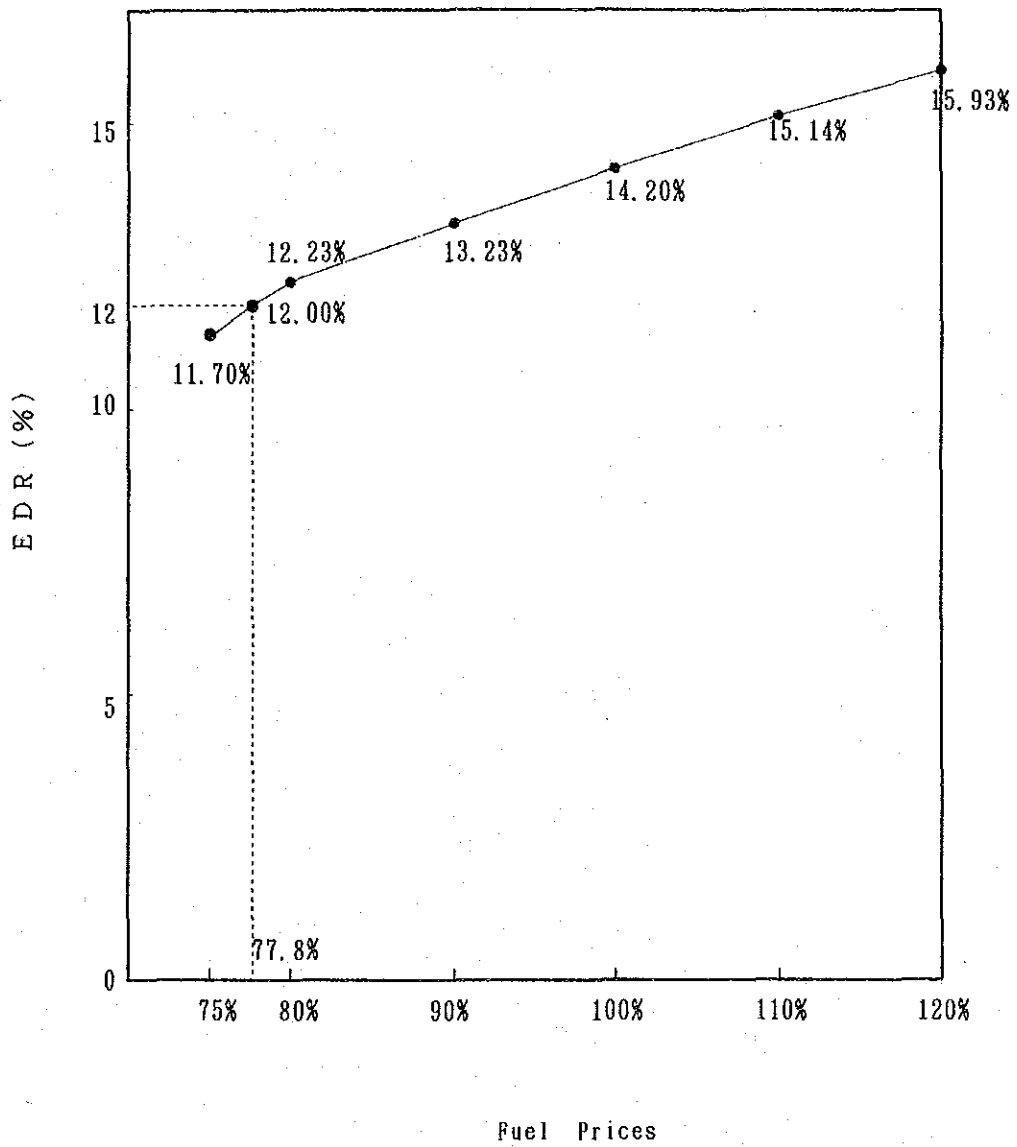
Fig. 12-4   Sensitivity Analysis - Fuel Prices

Fig.12-4   Sensitivity Analysis – Fuel Prices

CHAPTER 13

FINANCIAL ANALYSIS

CHAPTER 13 FINANCIAL ANALYSIS

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CHAPTER 13 FINANCIAL ANALYSIS

13.1 Methodology and Basic Conditions

13.1.1 Methodology

For the financial analysis of this Project, the following two cases described below will be analyzed and judgement will be made for the evaluation.

(1) Financial Evaluation from Viewpoint of Total Investment

In this financial evaluation, the financial internal rate of return (FIRR), in which the present value of the revenue from business (revenue from power sold) equals the present value of the total cost will be calculated. And the profitability of this project will be judged by comparing the EDR with the discount rate that reflects the capital opportunity cost.

The cost applicable to this evaluation will include the total investment (construction cost with import duty) without consideration of the financing conditions, such as interest, repayment of principal, repayment period, etc., and the operation and maintenance cost.

In this evaluation, the profitability of the investment for the project will be judged regardless of financing conditions.

(2) Financial Analysis from Viewpoint of Project Equity

Looking generally from the viewpoint of an enterprise, when a project is to be implemented it is necessary that the enterprise will have to finance for the project. The indices that are given serious consideration regarding the financing by the enterprise, generally include the following:

- Rate of Return

  This is the ratio of the business profit against the net
  working fixed assets, which provides for payment of interest
  on borrowing. The balance will be the net profit.

- Debt Service Ratio

  This is the ratio of the internal fund procured (business
  profit plus depreciation cost) against the debt to be repaid
  (principal plus interest).

The procedure for evaluation of these will be implemented as
follows:

Establishment of the financing conditions

Preparation of the repayment schedule of the debt

Preparation of the statement of profit and loss
and cash flow

Calculation of the rate of return and the debt
service ratio

The cost that are applicable to this evaluation consist of the
operation and maintenance cost and depreciation cost. The
depreciation cost will be calculated based on the total
construction cost including import duties and the interest
during construction.

In this evaluation only the debt service ratio will be
estimated.

13.1.2 Basic Conditions

The basic conditions for implementing the financial evaluation of this project will be as follows:

(1) Financing Conditions

   (a) Foreign Currency Portion

   Interest: 8%
   Commitment fee :   0.75%

   The repayment period shall be 20 years from the commencement of operation and repayment is in the form of regular installments.

   (b) Local Currency Portion

   Interest: 10% on 50% of the local currency portion

   The repayment period shall be 10 years from the commencement of operation and repayment is in the form of regular installments.

(2) Electric Sales Revenue

   The electric sales revenue will be estimated using the weighted average tariff of the EGAT. Sensitivity analysis using the tariff for the PEA will be implemented.

(3) Construction Cost

   The construction cost including the import duty will be used.

(4) Depreciation

   The straight line method is adopted.

(5) Operation and Maintenance Costs

Dam and Reservoir   :   1% of the construction cost
Hydro Power Station   :   2% of the construction cost
Transmission Line   :   1% of the construction cost

(6) Escalation

Project cost and the tariff for the financial analysis will be
estimated considering the escalation rate of IBRD.

13.2 Financial Analysis

13.2.1 Financial Internal Rate of Return (FIRR)

(1) Construction Cost

The construction cost adopted for calculation of FIRR including import duties and considering the escalation based on Table 11-2 and 11-3 in Chapter 11 is as follows:

Nam Ngao Project   : 5,405 x 10^6 Baht (208 x 10^6 US$)
Mae Lama Luang Project: 6,993 x 10^6 Baht (269 x 10^6 US$)

Total   12,398 x 10^6 Baht (477 x 10^6 US$)

(2) Operation and Maintenance Cost

The operation and maintenance cost based on the above construction cost is as follows:

Nam Ngao Project

Hydro Power Station (Construction Cost x 2%) 31.9 x 10^6 Baht/year
Other Facilities   (Construction Cost x 1%) 38.1 x 10^6 Baht/year

Mae Lama Luang Project

Hydro Power Station (Construction Cost x 2%) 54.7 x 10^6 Baht/year
Other Facilities   (Construction Cost x 1%) 42.6 x 10^6 Baht/year

Total   167.3 x 10^6 Baht/year

(3) Revenue

The annual energy production of this project at the Chiang Mai 3 Substation is as follows:

Nam Ngao Project   : 300.7 GWh
Mae Lama Luang Project: 583.4 GWh

Total   884.1 GWh

The revenue from this Project is calculated by multiplying "Annual Energy Production" considering the transmission loss

13 - 5

by "The weighted average tariff of the EGAT" in 1987 based on EGAT Annual Report 1987. The result of this calculation considering the escalation is as follows:

$$884.1 \text{ GWh} \times 1.2988 \text{ B/kWh} \times 1.4088 = 1,617.7 \times 10^6 \text{ Baht/year}$$

(Price level: as of 1998)

(4) Financial Internal Rate of Return (FIRR)

The cost flow and the flow of the revenue considering the escalation are presented on Table 13-1 based on the above calculation, and FIRR is evaluated as 13.39%.

Judging from this FIRR, it can be concluded that this project is sound from the financial point of view.

(5) Sensitivity Analysis

The sensitivity analysis of the project was implemented for the cases stated below.

- Increase of Construction Cost

     Case 1 :   5% up

     Case 2 : 10% up

     Case 3 : 15% up

- Suspension of the Nam Ngao Project : Case 4

- Adoption of the tariff for the PEA   : Case 5

The results of each evaluation of the FIRR are presented in the table below, and the cost flow and the flow of revenue of these cases are presented in Table 13-2 through Table 13-6.

	Case 1	Case 2	Case 3	Case 4	Case 5
FIRR (%)	12.95	12.55	12.17	15.00	11.26

It can be concluded that the Project is sound from the financial point of view in Case 1 through Case 5 judging from the

evaluation of FIRR, and that the Project is almost sound in Case 6.

(6) Energy Cost

The energy cost in 1997 considering the escalation rate of IBRD based on the project cost on Table 11-2 and 11-3 in Chapter 11 is as follows. As discount rates of capital recovery factors for calculation of the annuitized construction cost, 8% for the foreign currency portion, 10% for the 50% of the local currency portion and 12% for the another 50% of the local currency portion are adopted.

Nam Ngao Project	2.25 ฿/kWh
Mae Lama Luang Project	1.50 ฿/kWh
Nam Yuam Integrated Project	1.76 ฿/kWh

13.2.2 Debt Service Ratio

(1) Repayment Schedule of Debt

The repayment schedule of the debt based on the financing conditions stated in section 13.1.2 is shown on Table 13-7. The interest during construction shown on Tables 11-2 and 11-3 in Chapter 11 is not included in the construction cost which is the base of the debt amount. However the interest during construction will be estimated and recovered as a part of the depreciation cost.

(2) Statement of Profit and Loss and Cash Flow

The statement of profit and loss and the cash flow are shown on Tables 13-8 and 13-9 respectively.

The depreciation cost is estimated based on the construction cost including the interest during construction, and the results of calculation of the depreciation cost are as follows:

Nam Ngao Project

Dam and reservoir (Service Life: 50 years)

4,005.5 x 10^6 Baht ÷ 50 years = 80.1 x 10^6 Baht/year

Generating Facilities (Service Life: 25 years)

1,916.0 x 10^6 Baht ÷ 25 years = 76.6 x 10^6 Baht/year

Transmission Facilities (Service Life: 40 years)

547.0 x 10^6 Baht ÷ 40 years = 13.7 x 10^6 Baht/year

Mae Lama Luang Project

Dam and reservoir (Service Life: 50 years)

4,074.8 x 10^6 Baht ÷ 50 years = 81.5 x 10^6 Baht/year

Generating Facilities (Service Life: 25 years)

3,263.2 x 10^6 Baht ÷ 25 years = 130.5 x 10^6 Baht/year

Transmission Facilities (Service Life: 40 years)

1,009.9 x 10^6 Baht ÷ 40 years = 25.2 x 10^6 Baht/year

(3) Debt Service Ratio

The result of calculation of the debt service ratio is shown
on Table 13-10. Average debt service ratio for 20 years is
2.43, and it can be concluded that the Project is sound from
the viewpoint of profitability.

Table 13-1 Cost Flow and Flow of Revenue of Adopted Development Plan

(Unit: Million β)

Serial Number	Year	Cost			Revenue	B - C
		Investment Cost	O&M Cost	Total		
1	1992	0.00		0.00		0.00
2	1993	519.40		519.40		-519.40
3	1994	1810.50		1810.50		-1810.50
4	1995	4502.10		4502.10		-4502.10
5	1996	4470.60		4470.60		-4470.60
6	1997	1095.30		1095.30		-1095.30
7	1998		167.30	167.30	1617.68	1450.38
8	1999		175.00	175.00	1692.09	1517.10
9	2000		183.05	183.05	1769.93	1586.89
10	2001		191.47	191.47	1851.35	1659.88
11	2002		200.27	200.27	1936.51	1736.24
12	2003		209.49	209.49	2025.59	1816.10
13	2004		219.12	219.12	2118.77	1899.64
14	2005		229.20	229.20	2216.23	1987.03
15	2006		239.74	239.74	2318.18	2078.43
16	2007		250.77	250.77	2424.81	2174.04
17	2008		262.31	262.31	2536.35	2274.05
18	2009		274.37	274.37	2653.03	2378.65
19	2010		287.00	287.00	2775.07	2488.07
20	2011		300.20	300.20	2902.72	2602.52
21	2012		314.01	314.01	3036.24	2722.24
22	2013		328.45	328.45	3175.91	2847.46
23	2014		343.56	343.56	3322.00	2978.44
24	2015		359.36	359.36	3474.81	3115.45
25	2016		375.89	375.89	3634.66	3258.76
26	2017		393.19	393.19	3801.85	3408.66
27	2018		411.27	411.27	3976.74	3565.46
28	2019	1624.96	430.19	2055.16	4159.67	2104.51
29	2020	5179.02	449.98	5628.99	4351.01	-1277.99
30	2021	4982.01	470.68	5452.69	4551.16	-901.54
31	2022	1552.32	492.33	2044.65	4760.51	2715.86
32	2023		514.98	514.98	4979.49	4464.52
33	2024		538.67	538.67	5208.55	4669.88
34	2025		563.44	563.44	5448.14	4884.70
35	2026		589.36	589.36	5698.76	5109.39
36	2027		616.47	616.47	5960.90	5344.43
37	2028		644.83	644.83	6235.10	5590.27
38	2029		674.49	674.49	6521.92	5847.42
39	2030		705.52	705.52	6821.92	6116.40
40	2031		737.97	737.97	7135.73	6397.76
41	2032		771.92	771.92	7463.98	6692.06
42	2033		807.43	807.43	7807.32	6999.89
43	2034		844.57	844.57	8166.46	7321.88
44	2035	3616.25	883.42	4499.68	8542.11	4042.44
45	2036	3368.48	924.06	4292.54	8935.05	4642.51
46	2037	994.11	966.57	1960.67	9346.06	7385.39
47	2038		1011.03	1011.03	9775.98	8764.95
48	2039		1057.54	1057.54	10225.68	9168.14
49	2040		1106.18	1106.18	10696.06	9589.88
50	2041		1157.07	1157.07	11188.08	10031.01
51	2042		1210.29	1210.29	11702.73	10492.44
52	2043		1265.97	1265.97	12241.05	10975.09
53	2044		1324.20	1324.20	12804.14	11479.94
54	2045		1385.11	1385.11	13393.13	12008.02
55	2046		1448.83	1448.83	14009.22	12560.39
56	2047		1515.47	1515.47	14653.64	13138.17
		33715.06	30823.60	64538.66	298044.07	233505.41

F I R R   0.133866

Table 13-2　Cost Flow and Flow of Revenue
(Case 1:　Construction Cost 5% up)

(Unit:　Million ฿)

Serial Number	Year	Cost Investment Cost	Cost O&M Cost	Cost Total	Revenue	B - C
1	1992	0.00		0.00		0.00
2	1993	545.37		545.37		-545.37
3	1994	1901.03		1901.03		-1901.03
4	1995	4727.21		4727.21		-4727.21
5	1996	4694.13		4694.13		-4694.13
6	1997	1150.07		1150.07		-1150.07
7	1998		167.30	167.30	1617.68	1450.38
8	1999		175.00	175.00	1692.09	1517.10
9	2000		183.05	183.05	1769.93	1586.89
10	2001		191.47	191.47	1851.35	1659.88
11	2002		200.27	200.27	1936.51	1736.24
12	2003		209.49	209.49	2025.59	1816.10
13	2004		219.12	219.12	2118.77	1899.64
14	2005		229.20	229.20	2216.23	1987.03
15	2006		239.74	239.74	2318.18	2078.43
16	2007		250.77	250.77	2424.81	2174.04
17	2008		262.31	262.31	2536.35	2274.05
18	2009		274.37	274.37	2653.03	2378.65
19	2010		287.00	287.00	2775.07	2488.07
20	2011		300.20	300.20	2902.72	2602.52
21	2012		314.01	314.01	3036.24	2722.24
22	2013		328.45	328.45	3175.91	2847.46
23	2014		343.56	343.56	3322.00	2978.44
24	2015		359.36	359.36	3474.81	3115.45
25	2016		375.89	375.89	3634.66	3258.76
26	2017		393.19	393.19	3801.85	3408.66
27	2018		411.27	411.27	3976.74	3565.46
28	2019	1706.21	430.19	2136.40	4159.67	2023.26
29	2020	5437.97	449.98	5887.95	4351.01	-1536.94
30	2021	5231.11	470.68	5701.79	4551.16	-1150.64
31	2022	1629.94	492.33	2122.27	4760.51	2638.24
32	2023		514.98	514.98	4979.49	4464.52
33	2024		538.67	538.67	5208.55	4669.88
34	2025		563.44	563.44	5448.14	4884.70
35	2026		589.36	589.36	5698.76	5109.39
36	2027		616.47	616.47	5960.90	5344.43
37	2028		644.83	644.83	6235.10	5590.27
38	2029		674.49	674.49	6521.92	5847.42
39	2030		705.52	705.52	6821.92	6116.40
40	2031		737.97	737.97	7135.73	6397.76
41	2032		771.92	771.92	7463.98	6692.06
42	2033		807.43	807.43	7807.32	6999.89
43	2034		844.57	844.57	8166.46	7321.88
44	2035	3797.07	883.42	4680.49	8542.11	3861.62
45	2036	3536.91	924.06	4460.97	8935.05	4474.08
46	2037	1043.81	966.57	2010.38	9346.06	7335.68
47	2038		1011.03	1011.03	9775.98	8764.95
48	2039		1057.54	1057.54	10225.68	9168.14
49	2040		1106.18	1106.18	10696.06	9589.88
50	2041		1157.07	1157.07	11188.08	10031.01
51	2042		1210.29	1210.29	11702.73	10492.44
52	2043		1265.97	1265.97	12241.05	10975.09
53	2044		1324.20	1324.20	12804.14	11479.94
54	2045		1385.11	1385.11	13393.13	12008.02
55	2046		1448.83	1448.83	14009.22	12560.39
56	2047		1515.47	1515.47	14653.64	13138.17
		35400.81	30823.60	66224.41	298044.07	231819.66

F I R R　　0.129522

Table 13-3 Cost Flow and Flow of Revenue
(Case 2: Construction Cost 10% up)

(Unit: Million ฿)

Serial Number	Year	Investment Cost	O&M Cost	Total	Revenue	B - C
1	1992	0.00		0.00		0.00
2	1993	571.34		571.34		-571.34
3	1994	1991.55		1991.55		-1991.55
4	1995	4952.31		4952.31		-4952.31
5	1996	4917.66		4917.66		-4917.66
6	1997	1204.83		1204.83		-1204.83
7	1998		167.30	167.30	1617.68	1450.38
8	1999		175.00	175.00	1692.09	1517.10
9	2000		183.05	183.05	1769.93	1586.89
10	2001		191.47	191.47	1851.35	1659.88
11	2002		200.27	200.27	1936.51	1736.24
12	2003		209.49	209.49	2025.59	1816.10
13	2004		219.12	219.12	2118.77	1899.64
14	2005		229.20	229.20	2216.23	1987.03
15	2006		239.74	239.74	2318.18	2078.43
16	2007		250.77	250.77	2424.81	2174.04
17	2008		262.31	262.31	2536.35	2274.05
18	2009		274.37	274.37	2653.03	2378.65
19	2010		287.00	287.00	2775.07	2488.07
20	2011		300.20	300.20	2902.72	2602.52
21	2012		314.01	314.01	3036.24	2722.24
22	2013		328.45	328.45	3175.91	2847.46
23	2014		343.56	343.56	3322.00	2978.44
24	2015		359.36	359.36	3474.81	3115.45
25	2016		375.89	375.89	3634.66	3258.76
26	2017		393.19	393.19	3801.85	3408.66
27	2018		411.27	411.27	3976.74	3565.46
28	2019	1787.46	430.19	2217.65	4159.67	1942.01
29	2020	5696.92	449.98	6146.90	4351.01	-1795.89
30	2021	5480.21	470.68	5950.89	4551.16	-1399.74
31	2022	1707.55	492.33	2199.88	4760.51	2560.63
32	2023		514.98	514.98	4979.49	4464.52
33	2024		538.67	538.67	5208.55	4669.88
34	2025		563.44	563.44	5448.14	4884.70
35	2026		589.36	589.36	5698.76	5109.39
36	2027		616.47	616.47	5960.90	5344.43
37	2028		644.83	644.83	6235.10	5590.27
38	2029		674.49	674.49	6521.92	5847.42
39	2030		705.52	705.52	6821.92	6116.40
40	2031		737.97	737.97	7135.73	6397.76
41	2032		771.92	771.92	7463.98	6692.06
42	2033		807.43	807.43	7807.32	6999.89
43	2034		844.57	844.57	8166.46	7321.88
44	2035	3977.88	883.42	4861.30	8542.11	3680.81
45	2036	3705.33	924.06	4629.39	8935.05	4305.66
46	2037	1093.52	966.57	2060.08	9346.06	7285.98
47	2038		1011.03	1011.03	9775.98	8764.95
48	2039		1057.54	1057.54	10225.68	9168.14
49	2040		1106.18	1106.18	10696.06	9589.88
50	2041		1157.07	1157.07	11188.08	10031.01
51	2042		1210.29	1210.29	11702.73	10492.44
52	2043		1265.97	1265.97	12241.05	10975.09
53	2044		1324.20	1324.20	12804.14	11479.94
54	2045		1385.11	1385.11	13393.13	12008.02
55	2046		1448.83	1448.83	14009.22	12560.39
56	2047		1515.47	1515.47	14653.64	13138.17
		37086.55	30823.60	67910.17	298044.07	230133.91

F I R R   0.125487

Table 13-4 Cost Flow and Flow of Revenue
(Case 3: Construction Cost 15% up)

(Unit: Million ¥)

Serial Number	Year	Cost Investment Cost	Cost O&M Cost	Total	Revenue	B - C
1	1992	0.00		0.00		0.00
2	1993	597.31		597.31		-597.31
3	1994	2082.08		2082.08		-2082.08
4	1995	5177.42		5177.42		-5177.42
5	1996	5141.19		5141.19		-5141.19
6	1997	1259.59		1259.59		-1259.59
7	1998		167.30	167.30	1617.68	1450.38
8	1999		175.00	175.00	1692.09	1517.10
9	2000		183.05	183.05	1769.93	1586.89
10	2001		191.47	191.47	1851.35	1659.88
11	2002		200.27	200.27	1936.51	1736.24
12	2003		209.49	209.49	2025.59	1816.10
13	2004		219.12	219.12	2118.77	1899.64
14	2005		229.20	229.20	2216.23	1987.03
15	2006		239.74	239.74	2318.18	2078.43
16	2007		250.77	250.77	2424.81	2174.04
17	2008		262.31	262.31	2536.35	2274.05
18	2009		274.37	274.37	2653.03	2378.65
19	2010		287.00	287.00	2775.07	2488.07
20	2011		300.20	300.20	2902.72	2602.52
21	2012		314.01	314.01	3036.24	2722.24
22	2013		328.45	328.45	3175.91	2847.46
23	2014		343.56	343.56	3322.00	2978.44
24	2015		359.36	359.36	3474.81	3115.45
25	2016		375.89	375.89	3634.66	3258.76
26	2017		393.19	393.19	3801.85	3408.66
27	2018		411.27	411.27	3976.74	3565.46
28	2019	1868.71	430.19	2298.90	4159.67	1860.77
29	2020	5955.87	449.98	6405.85	4351.01	-2054.84
30	2021	5729.31	470.68	6199.99	4551.16	-1648.84
31	2022	1785.17	492.33	2277.50	4760.51	2483.01
32	2023		514.98	514.98	4979.49	4464.52
33	2024		538.67	538.67	5208.55	4669.88
34	2025		563.44	563.44	5448.14	4884.70
35	2026		589.36	589.36	5698.76	5109.39
36	2027		616.47	616.47	5960.90	5344.43
37	2028		644.83	644.83	6235.10	5590.27
38	2029		674.49	674.49	6521.92	5847.42
39	2030		705.52	705.52	6821.92	6116.40
40	2031		737.97	737.97	7135.73	6397.76
41	2032		771.92	771.92	7463.98	6692.06
42	2033		807.43	807.43	7807.32	6999.89
43	2034		844.57	844.57	8166.46	7321.88
44	2035	4158.69	883.42	5042.11	8542.11	3500.00
45	2036	3873.76	924.06	4797.81	8935.05	4137.24
46	2037	1143.22	966.57	2109.79	9346.06	7236.27
47	2038		1011.03	1011.03	9775.98	8764.95
48	2039		1057.54	1057.54	10225.68	9168.14
49	2040		1106.18	1106.18	10696.06	9589.88
50	2041		1157.07	1157.07	11188.08	10031.01
51	2042		1210.29	1210.29	11702.73	10492.44
52	2043		1265.97	1265.97	12241.05	10975.09
53	2044		1324.20	1324.20	12804.14	11479.94
54	2045		1385.11	1385.11	13393.13	12008.02
55	2046		1448.83	1448.83	14009.22	12560.39
56	2047		1515.47	1515.47	14653.64	13138.17
		38772.31	30823.60	69595.92	298044.07	228448.15

F I R R   0.121723

Table 13-5 Cost Flow and Flow of Revenue
(Case 4: Nam Ngao Project Suspension)

(Unit: Million ฿)

Serial Number	Year	Cost Investment Cost	Cost O&M Cost	Total	Revenue	B - C
1	1992	0.00		0.00		0.00
2	1993	347.60		347.60		-347.60
3	1994	811.80		811.80		-811.80
4	1995	2607.90		2607.90		-2607.90
5	1996	2597.80		2597.80		-2597.80
6	1997	627.80		627.80		-627.80
7	1998		97.30	97.30	1067.48	970.18
8	1999		101.78	101.78	1116.58	1014.80
9	2000		106.46	106.46	1167.94	1061.48
10	2001		111.35	111.35	1221.67	1110.31
11	2002		116.48	116.48	1277.86	1161.39
12	2003		121.83	121.83	1336.65	1214.81
13	2004		127.44	127.44	1398.13	1270.69
14	2005		133.30	133.30	1462.45	1329.14
15	2006		139.43	139.43	1529.72	1390.29
16	2007		145.85	145.85	1600.09	1454.24
17	2008		152.56	152.56	1673.69	1521.13
18	2009		159.57	159.57	1750.68	1591.11
19	2010		166.91	166.91	1831.21	1664.30
20	2011		174.59	174.59	1915.45	1740.85
21	2012		182.62	182.62	2003.56	1820.93
22	2013		191.02	191.02	2095.72	1904.70
23	2014		199.81	199.81	2192.12	1992.31
24	2015		209.00	209.00	2292.96	2083.96
25	2016		218.62	218.62	2398.44	2179.82
26	2017		228.67	228.67	2508.77	2280.09
27	2018		239.19	239.19	2624.17	2384.98
28	2019	866.50	250.19	1116.70	2744.88	1628.18
29	2020	3273.32	261.70	3535.03	2871.14	-663.88
30	2021	3298.26	273.74	3572.00	3003.22	-568.78
31	2022	984.71	286.33	1271.04	3141.37	1870.33
32	2023		299.51	299.51	3285.87	2986.36
33	2024		313.28	313.28	3437.02	3123.74
34	2025		327.69	327.69	3595.12	3267.43
35	2026		342.77	342.77	3760.50	3417.73
36	2027		358.54	358.54	3933.48	3574.94
37	2028		375.03	375.03	4114.42	3739.39
38	2029		392.28	392.28	4303.68	3911.40
39	2030		410.32	410.32	4501.65	4091.33
40	2031		429.20	429.20	4708.73	4279.53
41	2032		448.94	448.94	4925.33	4476.39
42	2033		469.59	469.59	5151.90	4682.30
43	2034		491.19	491.19	5388.88	4897.69
44	2035	2368.33	513.79	2882.12	5636.77	2754.65
45	2036	2164.68	537.42	2702.10	5896.06	3193.96
46	2037	632.72	562.15	1194.87	6167.28	4972.41
47	2038		588.00	588.00	6450.98	5862.97
48	2039		615.05	615.05	6747.72	6132.67
49	2040		643.34	643.34	7058.12	6414.77
50	2041		672.94	672.94	7382.79	6709.85
51	2042		703.89	703.89	7722.40	7018.50
52	2043		736.27	736.27	8077.63	7341.36
53	2044		770.14	770.14	8449.20	7679.06
54	2045		805.57	805.57	8837.86	8032.29
55	2046		842.62	842.62	9244.40	8401.78
56	2047		881.38	881.38	9669.65	8788.26
		20581.42	17926.70	38508.12	196673.35	158165.24

F I R R   0.150002

TAble 13-6 Cost Flow and Flow of Revenue
(Case 5: Using the Tariff for PEA)

(Unit: Million ฿)

Serial Number	Year	Cost Investment Cost	Cost O&M Cost	Total	Revenue	B - C
1	1992	0.00		0.00		0.00
2	1993	519.40		519.40		-519.40
3	1994	1810.50		1810.50		-1810.50
4	1995	4502.10		4502.10		-4502.10
5	1996	4470.60		4470.60		-4470.60
6	1997	1095.30		1095.30		-1095.30
7	1998		167.30	167.30	1295.22	1127.92
8	1999		175.00	175.00	1354.80	1179.80
9	2000		183.05	183.05	1417.12	1234.07
10	2001		191.47	191.47	1482.30	1290.84
11	2002		200.27	200.27	1550.49	1350.22
12	2003		209.49	209.49	1621.81	1412.33
13	2004		219.12	219.12	1696.42	1477.29
14	2005		229.20	229.20	1774.45	1545.25
15	2006		239.74	239.74	1856.08	1616.33
16	2007		250.77	250.77	1941.46	1690.68
17	2008		262.31	262.31	2030.76	1768.45
18	2009		274.37	274.37	2124.18	1849.80
19	2010		287.00	287.00	2221.89	1934.89
20	2011		300.20	300.20	2324.10	2023.90
21	2012		314.01	314.01	2431.01	2117.00
22	2013		328.45	328.45	2542.83	2214.38
23	2014		343.56	343.56	2659.80	2316.24
24	2015		359.36	359.36	2782.15	2422.79
25	2016		375.89	375.89	2910.13	2534.24
26	2017		393.19	393.19	3044.00	2650.81
27	2018		411.27	411.27	3184.02	2772.75
28	2019	1624.96	430.19	2055.16	3330.49	1275.33
29	2020	5179.02	449.98	5628.99	3483.69	-2145.31
30	2021	4982.01	470.68	5452.69	3643.94	-1808.75
31	2022	1552.32	492.33	2044.65	3811.56	1766.91
32	2023		514.98	514.98	3986.89	3471.91
33	2024		538.67	538.67	4170.29	3631.62
34	2025		563.44	563.44	4362.12	3798.68
35	2026		589.36	589.36	4562.78	3973.42
36	2027		616.47	616.47	4772.67	4156.19
37	2028		644.83	644.83	4992.21	4347.38
38	2029		674.49	674.49	5221.85	4547.36
39	2030		705.52	705.52	5462.06	4756.54
40	2031		737.97	737.97	5713.31	4975.34
41	2032		771.92	771.92	5976.12	5204.20
42	2033		807.43	807.43	6251.03	5443.60
43	2034		844.57	844.57	6538.57	5694.00
44	2035	3616.25	883.42	4499.68	6839.35	2339.67
45	2036	3368.48	924.06	4292.54	7153.96	2861.41
46	2037	994.11	966.57	1960.67	7483.04	5522.37
47	2038		1011.03	1011.03	7827.26	6816.23
48	2039		1057.54	1057.54	8187.31	7129.78
49	2040		1106.18	1106.18	8563.93	7457.75
50	2041		1157.07	1157.07	8957.87	7800.80
51	2042		1210.29	1210.29	9369.93	8159.64
52	2043		1265.97	1265.97	9800.95	8534.98
53	2044		1324.20	1324.20	10251.79	8927.59
54	2045		1385.11	1385.11	10723.37	9338.26
55	2046		1448.83	1448.83	11216.65	9767.82
56	2047		1515.47	1515.47	11732.62	10217.14
		33715.06	30823.60	64538.66	238632.61	174093.95

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Table 13-7   Repayment Schedule of Debt

(Unit: Million ฿)

No.	Year	Const. F.C.	Cost L.C.	Total	Repayment of F.C. Interest	Principal	Total	Balance	Repayment of L.C. Interest	Principal	Total	Balance
	1993	128.7	390.7	519.4				7204.9				2596.50
	1994	964.1	846.4	1810.5								
	1995	2793.5	1708.6	4502.1								
	1996	2720.5	1750.1	4470.6								
	1997	598.1	497.2	1095.3								
1	1998				576.39	157.44	733.83	7047.46	259.65	152.92	422.57	2433.58
2	1999				563.80	170.04	733.83	6877.42	243.36	179.21	422.57	2254.37
3	2000				550.19	183.64	733.83	6693.78	225.44	197.13	422.57	2057.24
4	2001				535.50	198.33	733.83	6495.44	205.72	216.84	422.57	1840.40
5	2002				519.64	214.20	733.83	6281.24	184.04	238.53	422.57	1601.87
6	2003				502.50	231.34	733.83	6049.91	160.19	262.38	422.57	1339.49
7	2004				483.99	249.84	733.83	5800.07	133.95	288.62	422.57	1050.87
8	2005				464.01	269.83	733.83	5530.24	105.09	317.48	422.57	733.38
9	2006				442.42	291.42	733.83	5238.82	73.34	349.23	422.57	384.15
10	2007				419.11	314.73	733.83	4924.09	38.42	384.15	422.57	0.00
11	2008				393.93	339.91	733.83	4584.18				
12	2009				366.73	367.10	733.83	4217.08				
13	2010				337.37	396.47	733.83	3820.62				
14	2011				305.65	428.19	733.83	3392.43				
15	2012				271.39	462.44	733.83	2929.99				
16	2013				234.40	499.44	733.83	2430.55				
17	2014				194.44	539.39	733.83	1891.16				
18	2015				151.29	582.54	733.83	1308.62				
19	2016				104.69	629.15	733.83	679.48				
20	2017				54.36	679.48	733.83	0.00				
Total		7204.9	5193.0	12397.9	7471.80	7204.90	14676.70		1629.18	2596.50	4225.68	

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Table 13-8 Statement of Profit and Loss

(Unit: Million ฿)

No.	Year	Revenue	Business Expenses			Business Profit	Financial Cost		Net Profit
			O&M Cost	Depreciation	Total		I.D.C.	Interest	
1	1993						83.80		-83.80
2	1994						202.30		-202.30
3	1995						503.90		-503.90
4	1996						788.10		-788.10
5	1997						840.40		-840.40
6	1998	1617.68	167.30	407.60	574.90	1042.78		836.04	206.74
7	1999	1692.09	175.00	407.60	582.60	1109.50		807.15	302.34
8	2000	1769.93	183.05	407.60	590.65	1179.29		775.63	403.65
9	2001	1851.35	191.47	407.60	599.07	1252.28		741.23	511.06
10	2002	1936.51	200.27	407.60	607.87	1328.64		703.68	624.96
11	2003	2025.59	209.49	407.60	617.09	1408.50		662.69	745.82
12	2004	2118.77	219.12	407.60	626.72	1492.04		617.94	874.10
13	2005	2216.23	229.20	407.60	636.80	1579.43		569.09	1010.34
14	2006	2318.18	239.74	407.60	647.34	1670.83		515.76	1155.07
15	2007	2424.81	250.77	407.60	658.37	1766.44		457.52	1308.92
16	2008	2536.35	262.31	407.60	669.91	1866.45		393.93	1472.52
17	2009	2653.03	274.37	407.60	681.97	1971.05		366.73	1604.32
18	2010	2775.07	287.00	407.60	694.60	2080.47		337.37	1743.10
19	2011	2902.72	300.20	407.60	707.80	2194.92		305.65	1889.27
20	2012	3036.24	314.01	407.60	721.61	2314.64		271.39	2043.24
	2013	3175.91	328.45	407.60	736.05	2439.86		234.40	2205.46
	2014	3322.00	343.56	407.60	751.16	2570.84		194.44	2376.40
	2015	3474.81	359.36	407.60	766.96	2707.85		151.29	2556.56
	2016	3634.66	375.89	407.60	783.49	2851.16		104.69	2746.47
	2017	3801.85	393.19	407.60	800.79	3001.06		54.36	2946.71
	Total	51283.78	5303.75	8152.00	13455.75	37828.03	2418.50	9100.98	26308.55

Table 13-9 Cash Flow

(Unit: Million B)

No.	Year	Financing	Cash Inflow			Cash Outflow			Balance	
			Net Profit	Depreci- ation	Total	Investment	Repayment of Princi.	Total	Year	Accumlated
	1993	519.40	-83.80		435.60	519.40		519.40	-83.80	-83.80
	1994	1810.50	-202.30		1608.20	1810.50		1810.50	-202.30	-286.10
	1995	4502.10	-503.90		3998.20	4502.10		4502.10	-503.90	-790.00
	1996	4470.60	-788.10		3682.50	4470.60		4470.60	-788.10	-1578.10
	1997	1095.30	-840.40		254.90	1095.30		1095.30	-840.40	-2418.50
1	1998		206.74	407.60	614.34		320.36	320.36	293.98	-2124.52
2	1999		302.34	407.60	709.94		349.25	349.25	360.70	-1763.83
3	2000		403.65	407.60	811.25		380.77	380.77	430.48	-1333.34
4	2001		511.06	407.60	918.66		415.18	415.18	503.48	-829.87
5	2002		624.96	407.60	1032.56		452.73	452.73	579.83	-250.03
6	2003		745.82	407.60	1153.42		493.72	493.72	659.70	409.67
7	2004		874.10	407.60	1281.70		538.46	538.46	743.24	1152.91
8	2005		1010.34	407.60	1417.94		587.31	587.31	830.62	1983.53
9	2006		1155.07	407.60	1562.67		640.65	640.65	922.03	2905.56
10	2007		1308.92	407.60	1716.52		698.88	698.88	1017.64	3923.20
11	2008		1472.52	407.60	1880.12		339.91	339.91	1540.21	5463.41
12	2009		1604.32	407.60	2011.92		367.10	367.10	1644.82	7108.23
13	2010		1743.10	407.60	2150.70		396.47	396.47	1754.23	8862.46
14	2011		1889.27	407.60	2296.87		428.19	428.19	1868.69	10731.15
15	2012		2043.24	407.60	2450.84		462.44	462.44	1988.40	12719.55
16	2013		2205.46	407.60	2613.06		499.44	499.44	2113.62	14833.17
17	2014		2376.40	407.60	2784.00		539.39	539.39	2244.61	17077.78
18	2015		2556.56	407.60	2964.16		582.54	582.54	2381.62	19459.39
19	2016		2746.47	407.60	3154.07		629.15	629.15	2524.93	21984.32
20	2017		2946.71	407.60	3354.31		679.48	679.48	2674.83	24659.15
	Total	12397.90	26308.55	8152.00	46858.45	12397.90	9801.40	22199.30		24659.15

Table 13-10 Calculation of Debt Service Ratio

(Unit: Million B)

No.	Year	Internal Fund Business Profit	Internal Fund Depreciation	Procured Total	Procured Accumulated (A)	Repayment Interest	Repayment of Principal	Debt Total	Debt Accumulated (B)	Debt Service Ratio (A)/(B)
	1993									
	1994									
	1995									
	1996									
	1997									
1	1998	1042.78	407.60	1450.38	1450.38	836.04	320.36	1156.40	1156.40	
2	1999	1109.50	407.60	1517.10	2967.48	807.15	349.25	1156.40	2312.81	
3	2000	1179.29	407.60	1586.89	4554.37	775.63	380.77	1156.40	3469.21	
4	2001	1252.28	407.60	1659.88	6214.25	741.23	415.18	1156.40	4625.61	
5	2002	1328.64	407.60	1736.24	7950.49	703.68	452.73	1156.40	5782.02	1.38
6	2003	1408.50	407.60	1816.10	9766.59	662.69	493.72	1156.40	6938.42	
7	2004	1492.04	407.60	1899.64	11666.23	617.94	538.46	1156.40	8094.82	
8	2005	1579.43	407.60	1987.03	13653.26	569.09	587.31	1156.40	9251.23	
9	2006	1670.83	407.60	2078.43	15731.69	515.76	640.65	1156.40	10407.63	
10	2007	1766.44	407.60	2174.04	17905.73	457.52	698.88	1156.40	11564.03	1.55
11	2008	1866.45	407.60	2274.05	20179.78	393.93	339.91	733.83	12297.87	
12	2009	1971.05	407.60	2378.65	22558.43	366.73	367.10	733.83	13031.70	
13	2010	2080.47	407.60	2488.07	25046.50	337.37	396.47	733.83	13765.54	
14	2011	2194.92	407.60	2602.52	27649.02	305.65	428.19	733.83	14499.37	
15	2012	2314.64	407.60	2722.24	30371.26	271.39	462.44	733.83	15233.21	1.99
16	2013	2439.86	407.60	2847.46	33218.71	234.40	499.44	733.83	15967.04	
17	2014	2570.84	407.60	2978.44	36197.16	194.44	539.39	733.83	16700.88	
18	2015	2707.85	407.60	3115.45	39312.61	151.29	582.54	733.83	17434.71	
19	2016	2851.16	407.60	3258.76	42571.37	104.69	629.15	733.83	18168.55	
20	2017	3001.06	407.60	3408.66	45980.03	54.36	679.48	733.83	18902.38	2.43
	Total	37828.03	8152.00	45980.03	—	9100.98	9801.40	18902.38		

CHAPTER 14

ENVIRONMENTAL IMPACT

CHAPTER 14   ENVIRONMENTAL IMPACT

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CHAPTER 14 ENVIRONMENTAL IMPACT

14.1 General

The impact on the environment due to the development of the dam and
power station ranges from that on the natural environment to that on
the social environment. Analysis and evaluation of those impacts are
considered important subjects.

EGAT, since 1984, has continued to execute the preliminary environ-
mental investigation in relation to the hydroelectric development
project in the Yuam river basin, and EGAT has prepared in August 1989
a report incorporating up-to-date information or data on the environ-
ment.

The investigations have aimed:

(i)   to research the existing conditions of environmental resources
      from view points of socio-economic and ecological aspects in
      the project area

(ii) to identify the probable environmental impacts due to the pro-
      ject implementation, and

(iii) to study the possible mitigative measures, as well as iden-
      tification of potential resettlement areas and compensation
      issue.

Those study results can provide to the project feasibility study with
useful information and various input regarding the environment.

This Chapter describes the existing conditions of the natural and
social environments of the project basin, a study of environment
impacts due to the development of the project, and preservation of
the environment based on the said investigation results performed by
EGAT and the field surveys performed in 1988 and 1989 by the JICA
team.

EGAT subsequently will proceed to the detailed environmental investi-
gation or study, that is Environmental Impact Assessment (EIA in

short), to be undertaken by the licenced institute(s) or consulting firm(s) in pursuance of the guideline set forth by National Environmental Board.

14.2 Present Conditions of the Environment

14.2.1 Natural Conditions

The project area is located in the north of Thailand where it is adjacent to the border with Myanmar, and is one of the sub-basins of an international river, the Salawin river.

The basin can be roughly divided into two areas topographically. One is the area from the junction of the Moel river downstream via the junction with the Ngao river and on to Ban Mae Suat Village upstream. Most of the area is covered by the forest and the Yuam river flows in a gorge through a mountainous area.

The other is the Mae Sariang plain with a rice producing area as a center in the upstream and forest mountainous area which surrounds it.

The climate in the project area is tropical monsoonal and the rainfall in Mae Sariang town is about 1,300 mm per year on average. As most of the rainfall is concentrated in the season from May to October, there are typical dry season and rainy seasons.

The mean monthly temperature is stable in the range between 20°C and 30°C throughout the year.

The principal characteristics of the river water are as follows;

DO values : in the range of 5.5 to 8.8 mg/lit.
PH values : in the range of 7.0 to 8.2, a weak alkalinity
Electric conductivity : in the range of 210 ~ 320 umho/cm

Based on the above analyses, physico-chemical characteristics of all water samples are suitable for aquatic life. However, being high in turbidity and sediment, conventional water treatment is required for domestic use.

14.2.2 Ecological System

(1) Vegetation

The distribution of tropical forest type varies diversely depending upon meteorological, water and soil conditions. (See Fig. 14-1)

The tropical forest type in the project basin of the Yuam river can be classified in the range of evergreen seasonal forest, semi-deciduous seasonal forest, deciduous seasonal forest and savanna forest depending upon the amount of rain-fall. The savanna forest can be seen extensively in the low elevation areas of Mae Sariang basin in the upstream of the project basin.

The seasonal forest is distributed in the high elevation areas in the Mae Sariang basin and in the valley downstream of the basin, which can be classified into evergreen seasonal forest, semi-deciduous seasonal forest and deciduous seasonal forest depending upon the amount of rainfall and soil conditions.

According to the EGAT report, the forest within the reservoir area is classified into 3 types as follows:

(i) Mix-deciduous forest which is found mainly in the lowland close to the river courses and streams. These forests are generally in good condition with Teak (Tectona gran-dis Linn.f.) and Pra duu (Pterocarpus macrocarpus Kurz.) as major species.

(ii) Tropical rainforests that are distributed mainly on the highland and mountainous areas along the major water courses.

(iii) Dipterocarp forest can be observed upon the mountain ridges of medium altitude. Species composition are Teng, Rang and Dipterocarpus tuberculatus Roxb.

It is understood that semi-deciduous and deciduous seasonal forests correspond to Mix-deciduous forest, evergreen seasonal

forest to Tropical Rainforest and savanna forest to Dipterocarp forest respectively.

(2) Animals

In Thailand, although the natural environment for wild animals has been affected year by year due to lumbering, shifting cultivation, etc., forests and swamps still form a suitable habitat for wild animals.

Wildlife in the project area are those Muntiacus muntjak, deers, wild boars, bears, Capricornis sumatraensis, tigers, elephants, monkeys, Pygathrix spp., gibons, Hystrix brachyura, squirrels, peacocks, wild chicken and reptiles. Hunting for food among the hill tribes is common in the area. Deers, wild boars and birds are among their favorites. Birds of various species are also caught and sold for domestic pets.

With regard to fish in Thailand, as many as 557 species of fish were counted according to the comprehensive survey of H. M. Smith in 1945, and fish which live at the bottom of water, such as cat-fish, etc. are abundant in number.

Fish found in the project area are, striped snake-head fish, climbing fish, walking catfish, common silver barb, etc.

As for shellfish, conches similar to a large snail, various species of corbiculae, etc., live on the river bed, whose production is noted to be high in this area.

14.2.3 Occupation

The occupation in the project area can be divided into two types, occupation in flatlands and the other in the mountains. The main occupation in the flatland is agriculture. Major crops are paddy rice in the rainy season followed by cultivation of soybean, peanuts, garlic, tobacco, etc.

It is worthy of mention that irrigation facilities of large and small sizes installed by RID (Royal Irrigation Department) and RAD

(Rural Accelerated Development) are scattered along the main stream and tributaries of the Yuam river basin supplying irrigation water to farmlands. Of these, the diversion weir of the main stream of the Yuam river is a medium scale project completed by RID in July 1976 to irrigate the farmland on the right bank of Mae Sariang plain of 12,500 Rai. The design irrigation discharge is about 3 m^3/sec and is used for agricultural production throughout the year.

The farmland making use of the river water is limited to the above irrigation area and near the river bank of the Yuam river. In the other areas, rainfed agriculture has been into the practice due to the restrictions of topography and water resource.

Hill tribes, mainly the Karen tribe, inhabit the mountainous areas bringing shifting cultivation into practice.

In Amphoe Mae Sariang, major minerals are found in two areas: Tungsten (Wolfram), and tin mine are operated in the southern part of Sub-district Sop Moei, adjacent to District Tha Song Yang of Tak Province. Mae La Ma mining group, having 10 mines are located on the right bank of the Yuam river while Huai Luang Mining Group are located on the left bank of the Yuam river.

Fluorite, barite and lead are found largely in the eastern part of Sub-district Sop Moei, District Mae Sariang where these are a few mines in operation such as Yong Pipat Mining Company, a fluorite mine on the Nam Mae Rit.

There are small scale freshwater fish production in the area, the quantity of which is decreasing year by year.

14.2.4 Social Environment

(1) Social Structures

Population of the project area consists of lowland Thais, upland Thais and hill tribes. Hill tribes account for approximately 65 percent of the total population. Labourers from Myanmar are commonly found working in logging business in the area. Average household size is 5.5 persons per household

with an average density of about 16.24 persons per square kilometer. Northern dialect is spoken widely and tribal languages are spoken among the hill tribes.

(2) Education

Most of the population in the project area have only primary education. Those who reside in the towns or cities are offered a higher education. The hill tribes who are scattered over remote highlands and mountainous areas are deprived of the public educational system and the school aged children are normally needed to assist families in the traditional agricultural practices.

(3) Economic Conditions

Agriculture is major occupation in the area. Major crops are paddy rice with supplementary crops such as soy bean, peanut, garlic and tobacco. Wage earnings in construction, forest plantation, minings and agriculture are generally supplementary occupations. Only a few people are involved in working as government employees and commerces. Skill workers are very small in number and are only in the towns or cities.

(4) Land Holding

Due to the limitation of cultivable and flat land in the area, legal land rights are still small in number. Average land holding is 6.5 Rai per household in Amphoe Mae Sariang, while 7.7 Rai in King Amphoe Sop Moei. Increase in deforestation due to shifting cultivation is remarkable in these areas.

(5) Transportation

The main routes of traffic in the project areas include the national road No. 1085 which connects Mae Sariang and Mae Sod, which is an important means of transportation for both people and materials. There is a town, Mae Sariang where the population is concentrated forming the center of the economies of various peripheral villages along the Yuam river.

Navigation is possible mainly in the lower Yuam river from Ban Sop Ngao onto the Moei river then to the Salawin river. This navigation route has facilitated the transportation of goods among the Thais and the trade with the people from Myanmar by the Salawin river as well. However, although navigation in the Salawin river is possible all year round, some portions of the Moei river and the Yuam river can be traversed only during the rainy season.

(6) Public Health

Each district is provided with a community hospital and all Tambons are served by health offices.

The physician population ratio is approximately 1:17,000, in this region.

Based on the hospital records of District Mae Sariang, diseases of digestive system, eye infections, influenza and malaria are commonly found among the people who received hospital services. Statistic of people with parasitic diseases indicates that Ascaris lumbicoides, Hookworm and Trichuris trichiura are very common parasites.

It was found that the area of the Yuam river basin has an environment suitable for endemic disease such malaria as indicated by the high number of people with malaria.

Especially in mountainous area, they were high in number. It was believed that these areas are suitable habitat of mosquito vectors of malaria such as Anopheles minimus and A.balabacensis. Beside being habitat for vectors, malaria control has not been effective in this area due to the lacking of co-operation from the local people and inaccessiblity of the remote areas. Little education among the hill tribes has deprived them of better malaria control and prevention. The limitation of man-power in Malaria Control Offices itselves also contributed to the high rate of malaria in the area.

(7) Archaeology and Tourism

There are no significant tourist resources or archeological remains, excepting a monastery, Wat Ban Mai of Tambon Mae Kha Tuan in the project area.
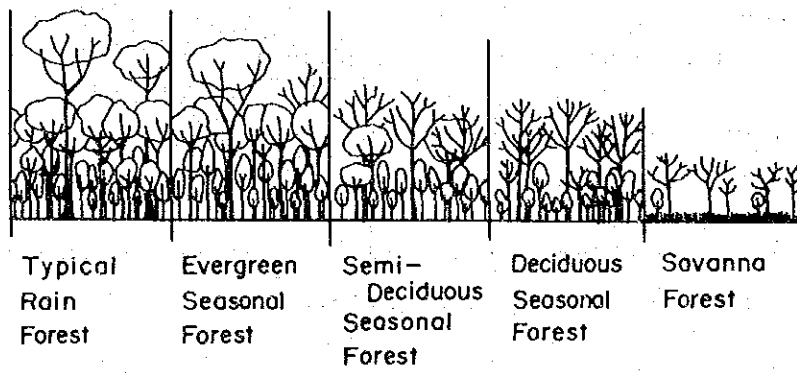
Fig.14-1   Variety of Tropical Forest Type   (in Dry Season)

14.3 Aspects of the Environment

14.3.1 Main Impacts on Environment

Table 14-1 shows the environmental impacts of the development of dam and reservoir.

The following important issues are included in the case of this project.

(1) Problems relating to immigration of the considerable number of people who will be engaged in project construction.

(2) Problems associated with the changes in ecological system due to appearance of the submerged area.

(3) Problem relating to residents to be emmigrated/shifted out of the inundated area.

The most typical impacts and the mitigation measures to preserve the environment are described as follows.

14.3.2 Natural Conditions

It is necessary to give due consideration to preserve the scenery and not to make great changes in the scenery in constructing the project.

In the case of this project, one of the main changes in scenery is the appearance of the reservoir. It is unlikely that the reservoir presents much of a problem, because the site is in the mountainous area and the reservoir forms a long and narrow channel in the valley. It might rather be considered that this kind of change would provide a favorable change in scenery with a reservoir. The important point is that the project area is located within the national reserve forest as shown in Fig. 14-2. It is possible, however, to construct a dam and power station in the national reserve forest area upon completion of environmental impact assessment and approval of the government.

14.3.3 Ecological System

(1) Vegetation

There exists a humus soil in the soil of tropical forests. It has special characteristics that suddenly disappear. Due to the tropical climate as soon as the forest is damaged and/or destroyed and there would be nothing left but a worthless alkali soil. The once lost vegetation cannot easily be recovered.

In the case of Thailand, the main causes for forest destruction are the devastation due to reclamation of farmland in forest areas, shifting cultivation, and lumbering of teak, lauan, etc.

During the project construction period, there is worry about an emergence of bare ground due to felling of forest for construction of job site and access roads, etc.

To cope with such a situation, it is desirable that changes to be made for the said purposes should be minimized, the maintenance thereof replete, and planting of trees should be performed after the completion of the project.

(2) Animals

The impact on land animals includes noise and vibration caused by the construction work, activities of men and the extinction of forests where animals can live. In the case of this project, measures should be taken to minimize the area of forest to be destroyed through means to raise the consciousness of people involved in the construction for protection of animals.

The impacts shall be considered on the aquatic animals and includes changes in biota due to the change from a running water ecological system to a still water ecological system. It is predicted that the relationship of the food chain (weeds - aquatic insects - fish) in the running-water ecological system would change to that of a still-water system (plant

plankton - animal plankton - fish), which will create an advantageous condition for fish that have the eating habit of plankton.

14.3.4 Occupation

The present utilization of water resources consists merely of irrigation water and living water for the hill tribes. Therefore, the impact on the present form of water utilization due to the emergence of a dam and reservoir would not be too serious. Farmlands or plantations to be immersed in the reservoir varies depending upon the reservoir level which seriously affects the mitigation measures thereof. In Thailand, the mitigation measure in these cases has been made by resettlement for migration rather than by monetary compensation. In the case of this project, investigation was performed to look into the affected villages and the potential resettlement areas as described in Section 14.4.

14.3.5 Social Environment

The migration of and the compensation for those local residents to be affected by the reservoir are serious impacts for this project. In the case where the social environmental conditions of the resettlement areas differ greatly from their existing homes, it is likely for the people that they will have some diffficulty to adapt themselves to the new circumstance or to maintain mutual communication and relationships.

Taking into consideration the above, potential resettlement areas were selected in the vicinity of the affected area as stated in Section 14.4.

With regard to the contracting of diseases, it is possible that diseases will frequently occur due to moving in of laborers and people who are engaged in the construction.

In order to cope with this problem, it is necessary to maintain good sanitary conditions in their camp and to provide them with an adequate medical care and service system.

Table 14-1 Main Environmental Effects of Dam Development

Stage of Development	Main Factors of Occurrence and Their Effects	
Under Construction	1. Immigration of persons related to construction	— Increase in demand of water and food — Increase of discharged things related to life — Increase of diseases
	2. Appearance of storage reservoir Diversion of agricultural lands to dwelling places	— Emigration of local people — Decrease of self-support in foods
After Construction	3. Inflow of pollutants from forests, agricultural lands and human habitations Dissolution from under-water farm land	— Over-nourishment of reservoir
	— Deterioration of water quality	— Impacts on function of intake structure, equip material, etc — Occurrence of infection — Deterioration of inhabitable condition of fish
	4. Change of mode of life	— Inhabitance of still water fishes — Possibility of fish rearing (Over-nourishment of reservoir) — Decrease of existing fishes

Stage of Development	Main Factors of Occurrence and Their Effects
	5. Fluctuation of — Appearance — growth of water level of stagnant water mosquitoes and water holes
	6. Decrease of water for living — Appearance of droughty areas
	7. Outflow of sediment from — Sedimentation river basin in reservoir ┐ └ Deterioration of dam function
	8. Change of scenery — Sightseeing potential of dam reservoir
	9. Increase of population ┐ ┌ Expansion of urbanization Increase of traffic ┘ └ Increase of diseases
	10. Water released from — Increase of water reservoir volume in dry seasons

Remarks

Nam Yuam (Left Bank)
National Reserve Forest

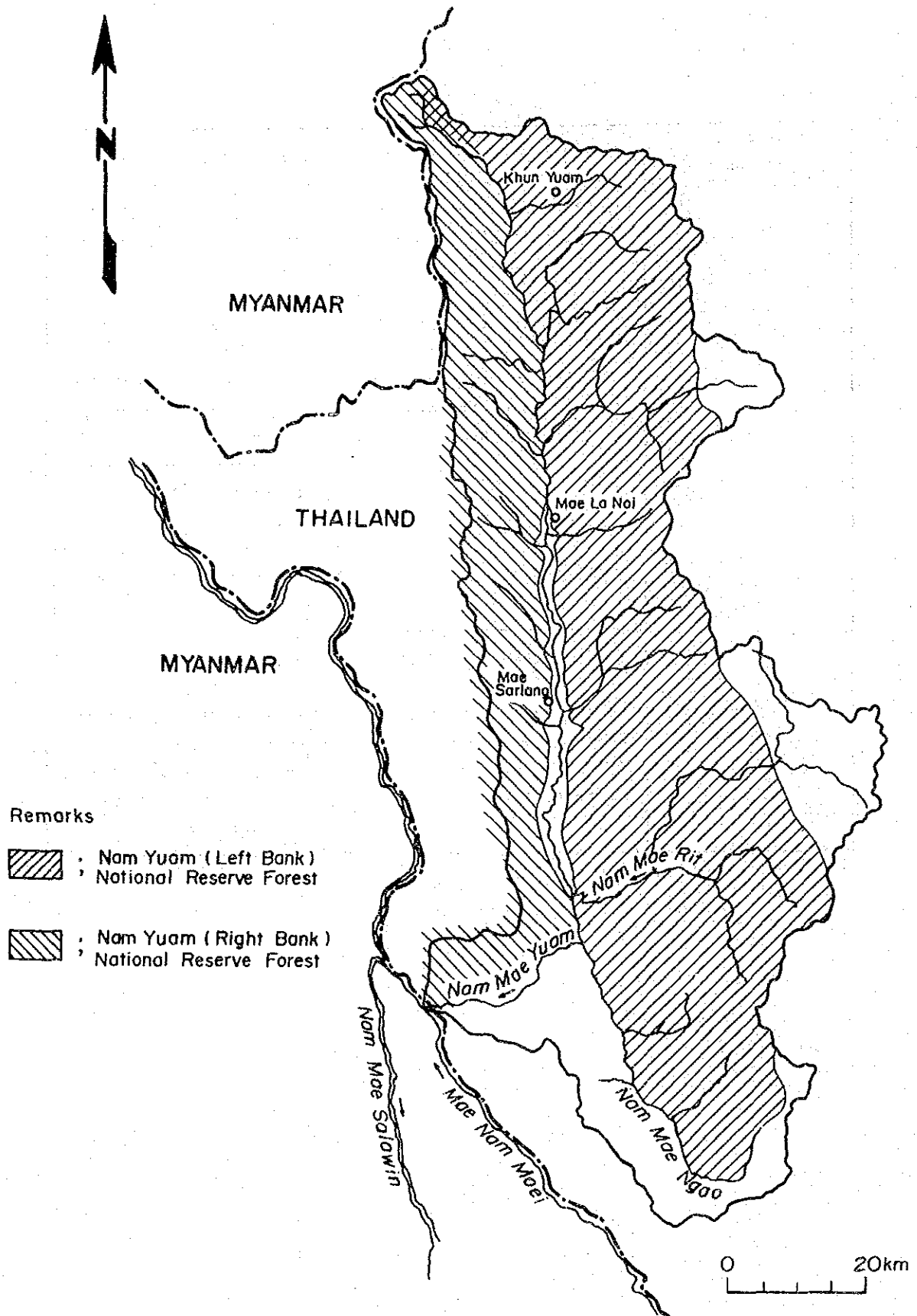Nam Yuam (Right Bank)
National Reserve Forest

Fig.14 -2   Location of National Reserve Forest

14.4 Compensation and Potential Area for Resettlement

14.4.1 General

The Project contemplates constructing a 119 m high rockfill dam, namely, the Mae Lama Luang dam, with the high water surface at EL. 165 m, approximately 5 km upstream from the confluence of the Yuam river and the Moei river.

The surface area of the reservoir impounded by the Mae Lama Luang dam is 18 km^2 and the tail of reservoir reaches approximately 50 km upstream from the dam site, Ban Mae Ko in the southern part of the Mae Sariang plain. The flat and low land along the Yuam river in the following three Tambons*/, which belong to King Amphoe Sop Moei, Mae Hong Son Province, will be affected by the impoundment of the Mae Lama Luang Reservoir.

Tambon	Affected Village
T. Mae Kha Tuan	Ban Mae Ko
T. Sop Moei	Ban Mae Kha Tuan
T. Mae Suat	Ban Mae Suat

In order to cope with the said effects, there are two alternatives conceivable. The first alternative is to construct dikes and drainage facilities along the Yuam river for the purpose of mitigation of inundation or flooding. The other is to provide resettlement areas in the vicinity for the farmlands and houses of the affected villages.

The JICA team made a preliminary study on the first alternative. As a result of discussion with EGAT, it was finally decided to select potential resettlement areas based on the second concept.

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*/ Tambon: An administrative unit with composition of villages equivalent to township.

14.4.2 Natural and Socio-economic Conditions

The total area of Sub-district Sop Moei is 1,177 km^2, 90% of which is in mountainous and/or hilly area. Only 10% is flat land, most of which located along the Yuam river and has been made available for agriculture.

The project area is under the influence of tropical monsoon. A period from early June to October is the rainy season which is affected by the southwest monsoon and there is drought period from November to April or May.

According to the records for a period from 1951 to 1980 at the Mae Sariang meteorological station, annual average temperature is 26.2°C and mean annual precipitation is 1,245 mm.

Most of the mountainous and hilly areas in Sub-district Sop Moei are within "National Reserve Forest of the Nam Yuam Left Bank and Right Bank" which is mainly covered by deciduous tropical forests.

Agriculture depending on rain-fed irrigation has been practiced in King Amphoe Sop Moei. Low and/or depressed areas along the Yuam river are used for rain-fed paddy field in the rainy season. Some parts are used for field crops in the dry season, as well as in the rainy season. Major field crops are soy bean, garlic, peanut, etc. Average land holding is 7.76 Rai per household and annual income is reportedly in a range from 8,000 to 13,000 Baht in King Amphoe Sop Moei.

14.4.3 Agricultural Land and Households to be affected due to Reservoir

The area in the said three villages affected by the Mae Lama Luang reservoir is about 5.3 km^2 at the normal high water of EL. 165 m according to the preliminary study of EGAT. Households and public facilities, which will be affected and/or inundated by the respective reservoir water levels of the Mae Lama Luang dam, are as shown in Tables 14-2 and 14-3 according to the survey undertaken by EGAT.

14.4.4   Potential Resettlement Areas

The JICA team made reconnaissance in November and December 1988 and August 1989 to search potential resettlement areas taking into account the following conditions.

Resettlement area(s), as well as its development plan, for the affected villages will be selected among the said potential areas based on the results of further investigations, EIA and environmental mitigation program.

(1)   Approximately 5 km^2 to be required for farmlands, residential areas and public facilities assuming a possibility that all the households in the three affected villages would move into resettlement areas.

(2)   Within King Amphoe Sop Moei in order to maintain the present administrative and mutual community units.

(3)   Flat or gently undulated areas in their topography and suitable for farmland, living quarters and public facilities with potential for reclamation.

(4)   Areas easily accessible, and with convenient water.

(5)   Areas possible to be acquired.

Potential resettlement areas (A/0, A/1, A/2 and A/3) in Fig. 14-3 were identified by the reconnaissance and orthophoto maps among areas which are judged to be relatively less rolled/undulated on the left bank of the Yuam river. Appropriate reclamation design or work will be necessary to meet the topographical conditions in the respective areas, as well as selection of promising crops in the resettlement areas to maintain attractive income.

(For information, there are some spaces which seem to be favorable as resettlement areas on the right side of the RID main canal of the Mae Sariang irrigation project. However, it is located not in King Amphoe Sop Moei, but in Amphoe Mae Sariang.)

14.4.5 Characteristics of Potential Resettlement Areas

Potential resettlement areas were identified along the Route 1085 as indi-
cated in Fig. 14-3 and important characteristics such as location,
topography, vegetation, ownership, etc. are summarized as follows.

(1) Potential Resettlement Area: A/0

    (i)   Location   : Approximately 10 km south of Mae Sariang,
          and approximately several hundred meters
          south of the boundary between Mae Sariang
          and King Amphoe Sop Moei. Located to the
          east of Mae Sop Bridge. Flanked by H.Kong 0
          in the north and by Ban Phae in the south.

    (ii)   Acreage   : Approx. 1 km^2

    (iii) Elevation   : Approx. 180 - 240 m including un-used
          swamp areas below the highway.

    (iv) Accessibility : Easy along Route 1085

    (v)   Topography   : Gently inclined toward the Yuam river

    (vi) Vegetation   : Open forest with mix-deciduous trees

    (vii) Water Resource : The Yuam river, Huai Kong 0, Huai Luk, Huai
          Hin Lap, Huai Tom Pim, etc.

    (viii) Drainage   : Easy

    (ix) Ownership   : Nam Yuam National Reserve Forest

(2) Potential Resettlement Area : A/1

    (i)   Location   : Located at the southern end of Ban Mai, and
          hugging to a "hair-pin" curved parts of the
          Yuam river.

    (ii)   Acreage   : Approx. 1.5 km^2

    (iii) Elevation   : Approx. 180 - 240 m

    (iv) Accessibility : Easy along Route 1085

    (v)   Topography   : "Ups and downs", and/or wrinkly

    (vi) Vegetation   : Open forest with mix-deciduous trees

    (vii) Water Resource : The Yuam river, Huai Mae Pan, Huai Kong
          Chang, etc.

    (viii) Drainage   : Easy

(ix) Ownership   : Nam Yuam National Reserve Forest

(3) Potential Resettlement Area : A/2

              (i) Location   : Located to the south of Potential
                                      Area-A/1 and flanked by Huai Mae Mut in the
                                      southern end of this area

             (ii) Acreage   : Approx. 3 km^2

            (iii) Elevation   : Approx. 180 - 240 m

             (iv) Accessibility   : Easy along Route 1085

              (v) Topography   : Less hilly or undulated than Area A/1, but
                                      "ups and downs" and/or wrinkly in some parts

             (vi) Vegetation   : Open forest with mix-deciduous trees

            (vii) Water Resource : The Yuam river, Huai Mae Ko, Huai Mae Mut
                                      etc.

           (viii) Drainage   : Easy

             (ix) Ownership   : Nam Yuam National Reserve Forest

(4) Potential Resettlement Area : A/3

              (i) Location   : Flanked by Huai I Nai to the north, and a
                                      little past Huai Pha Kan to the south.
                                      Located to the east of Mae Kha Tuan Bridge.

             (ii) Acreage   : Approx. 1 km^2

            (iii) Elevation   : Approx. 170 - 240 m

             (iv) Accessibility   : Easy along Route 1085

              (v) Topography   : Inclined toward the Yuam river

             (vi) Vegetation   : Open forest with mix-deciduous trees

            (vii) Water Resource : The Yuam river, Huai Pha Kan

           (viii) Drainage   : Easy

             (ix) Ownership   : Nam Yuam National Reserve Forest

14.4.6 Expenses required for Environmental Mitigation

Total expenses required for compensation for loss of agricultural land, affected buildings, etc. reclamation cost of resettlement area(s) plus cost for mitigation programs is preliminarily estimated to be 299.4 million Baht for the Mae Lama Luang project as described in Chapter 11.

Environmental mitigation cost amounting to 190.5 million Baht is also included in the Nam Ngao project cost in Chapter 11.

Table 14-2   Estimated Number of Households in Villages to be
              Inundated at Different Reservoir Levels

(Unit: Household)

Village	Tambon	Amphoe	Total Households	High Water Surface (MSL)			
				160 m	163 m	165 m	170 m
Ban Huai Khia	Mae Yuam	Mae Sariang	45	-	-	-	-
Ban Mae Ko	Mae Kha Tuan	Sop Moei	32*/	-	-	-	24
Ban Mae Mut	Mae Kha Tuan	Sop Moei	53	-	-	-	13
Ban Mai	Mae Kha Tuan	Sop Moei	111	-	-	-	-
Ban Mae Thalu	Sop Moei	Sop Moei	60	-	-	-	21
Ban Mae Kha Tuan	Sop Moei	Sop Moei	317*/	70	94	102	119
Ban Mae Suat	Mae Suat	Sop Moei	129*/	42	52	54	60
Total			747	112	146	156	237
			(478)				

*/ The figure in the parenthesis is the sum of household in the affected villages
    as asterisked in the table.

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Table 14-3   Public Facilities and Offices to be
              Inundated at Different Reservoir Levels

High Water Surface (MSL)

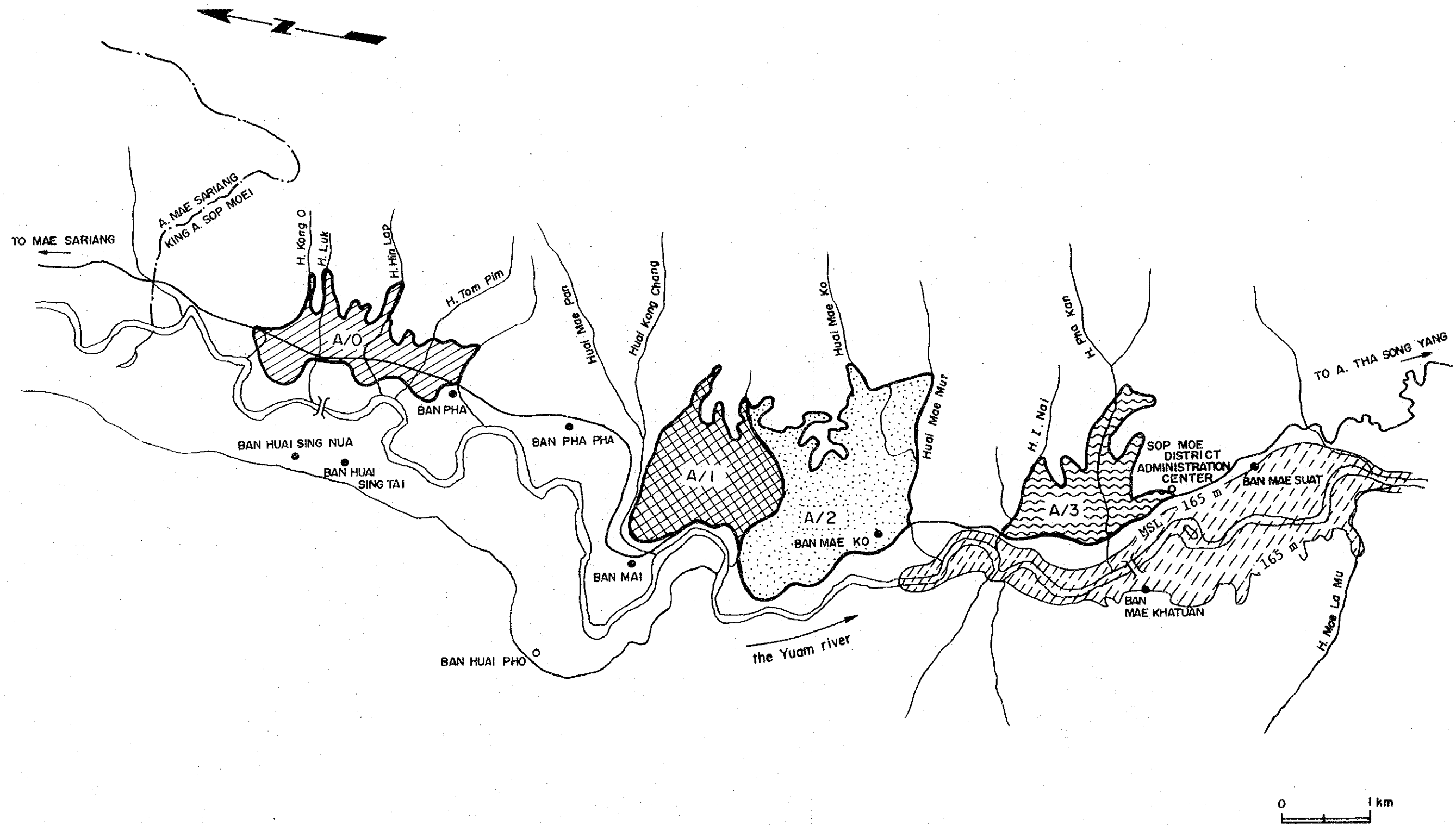| Village	160 m	163 m	165 m
Ban Huai Khia	-	-	-
Ban Mae Ko	-	-	-
Ban Mae Mut	-	-	-
Ban Mai	-	-	-
Ban Mae Thalu	-	-	-
Ban Mae Kha Tuan	- Teacher's Residence - Meeting Center - Health Office - Mae Kha Tuan Temple	- School - Teacher's Residence - Agricultural Officer's Residence - Meeting Center - Health Office - Mae Kha Tuan Temple	- School - Teacher's Residence - Agricultural Officer's Residence - Meeting Center - Health Office - Mae Kha Tuan Temple
Ban Mae Suat	- School	- School - Teacher's Residence - Monk's Residence	- School - Teacher's Residence - Monk's Residence

Source of Tables 14-2 and Table 14-3

Fig. 14-3

Potential Resettlement Areas