15.3 Fixed Operating Expense

The fixed operating expenses excluding depreciation and interest on loan are as follows:

15.3.1 Direct labor cost

The required number of employees for plant operation is fixed based on analysis of the manufacturing process in Chapter 12. The unit labor cost of operator is set at 10,000 k/year based on the assumption that the operators are of fairly high standard of education belonging to the group called "technician" in Zambia. The unit manpower cost of chief engineer in about 20,000 k/year; however, this project bears 50% or 10,000 k/year, assuming that the chief engineer will spend 50% of his time at the plant and the rest at NCSR laboratory. The summary of direct labor costs are as follows:

Chief engineer:	1 person (10,000 k/year)
Coal briquettes production:	3 persons (30,000 k/year)
Clay stoves production:	2 persons (20,000 k/year)
Total	6 persons (60,000 k/year)

15.3.2 Maintenance cost

The maintenance cost is divided into labor cost and cost for spare-parts. The labor cost portion of the maintenance is zero, because there will be plenty of spare time in which the plant operators conduct routine maintenance. If the nature of the work is beyond their capacity, then the highly capable maintenance group of NCSR can take care. The cost for spare-parts is estimated to be 1,000,000 k/year, which is 1.5% of the plant cost.

15.3.3 Insurance cost

The annual insurance cost is estimated at 157,000 k, which is 0.25% of the plant cost.

15.3.4 Miscellaneous cost

The term "miscellaneous cost" includes the following costs.

. Indirect personnel expenses

. Office expenses and other miscellaneous costs

The annual miscellaneous cost is set at 10,000 k through discussions with NCSR.

15.4 Summary of Operating Expenses

The annual operating expenses for producing 1,000 tons of coal briquettes and 4,000 pieces of clay stoves are summarized in Table 15-4-1.

Table 15-4-1 Summary of Operating Expenses

(Unit: Kwachas)

Variable operating expenses	111,984
. Coal Slurry	49,171
. Bagasse	18,266
. Molasses	6,143
. Slaked Lime	12,337
. Clay	1,562
. Grog	4
. Plaster	400
. Electricity	22,961
. Water	1,140
Fixed Operating Expenses	1,227,000
. Direct Labor	60,000
. Maintenance	1,000,000
. Insurance	157,000
. Miscellaneous	10,000
Total operting Expenses	1,338,984

16. FINANCIAL ANALYSIS

16.1 Methodology of Financial Analysis

Firstly, financial evaluation is conducted of this project in a manner normally applied to industrial investment projects. Namely, the following financial statements are prepared based on the sales revenue and such costs as total capital requirement and operating cost; and subsequently financial internal rate of return (FIRR) is calculated for the financial evaluation of this project (Case-1).

Production Cost Accounting Table
Profit and Loss Statement
Fund Flow Table
Balance Sheet
Cash Flow Table

In case that the result of financial analysis thus conducted is infeasible, which actually is the case of this project, financial evaluation is repeated but by excluding the plant construction cost and interest during construction from total capital requirement (Case-2). If Case 2 evaluation proves negative, again which is the case with this project, financial evaluation is done excluding spare parts cost and insurance on top of construction cost and interest during construction (Case-3). When all these attempts have failed and proven that this project is infeasible, a bench-scale plant is designed which would serve the purposes of R and D and could produce marketable coal briquettes and clay stoves.

16.2 Major Premises for Financial Analysis

This section describes the basic data and conditions for the financial analysis.

(1) Project life

Construction period: 15 months
Operation period: 10 years

(2) Price base

All prices and costs such as investment cost, production costs and sale price are calculated at the fixed pirce in March 1968, and the price escalation is not incorporated. The calculation is made on local currency, and the foreign currency portion is converted to the local currency by using the following exchange rate.

US$ 1 = 6.76 Kwachas
Kwacha 1 = 26.6 Japanese Yen

(3) Plant capacity

Coal briquettes: 1,000 tons/y

Clay stoves: 4,000 pieces/y

(4) Operation rate

First year: 50%
Second year: 70%
Third year and after: 100%

(5) Sales plan

The entire products, which will be produced based on the above operation plan, are sold at the following prices.

Coal briquettes: 200 Kwachas/ton
Clay stoves: 8 Kwachas/piece

(6) Financing plan

The total capital required for this project will be procured as mentioned in Chapter 14 TOTAL CAPITAL REQUIREMENT, and this financial plan is used in this financial analysis. The financing conditions including those for a short-term loan applied in case of shortage of funds during the period of plant operation are as follows:

(a) Financial sources

Local currency portion:

NCSR's own funds or grants from the Zambian governmental organizations such as Ministry of Higher Education

Foreign currency portion: Long-term loan

(b) Conditions for long-term loan

Interest rate: 3.0% p.a.
Repayment: 20 times/10 years, constant amount of principal

(c) Conditions for short-term loan

Interest rate: 26% p.a.
Repayment: All debt are repaid in the year following the introduction of the loan.

(7) Depreciation

The basis for depreciation are as follows:

Item	Method of Depreciation	Salvage Value (%)
Machinery & equipment	Declining balance method 30%	-
Civil works & buildings	Straight line method in 20 years	0
Pre-operation cost	Straight line method in 20 years	0
Interest during construction	Not depreciable	-

(8) Taxes

This project is a national project, and all taxes such as import duty, sales tax and corporate income tax are exempted.

(9) Working capital

Working capital is the fund required for the continuation of daily operation. In this study, working capital is defined as the balance calculated by deducting the current liabilities from the current assets as mentioned below.

(a) Current Assests

. Cash

The amount to cover the direct labor cost for one month is reserved in cash.

. Accounts receivable

Sales revenue of one month is counted to the accounts receivable assuming that sales proceeds will be collected one month after the sale.

. Raw material inventory

Raw material costs except for clay for two weeks and clay for 6 months are counted as inventory.

. Product inventory

The amount of cash to cover the operating expenses for two weeks is reserved as product inventory.

(b) Current liabilities

. Accounts payable

The equivantent of one month of raw materials cost and utility cost is counted as account receivable.

16.3 Operating Expenses

The operating expenses, mentioned in chapter 15, varies depending upon the operation rate. Table 16-3-1 shows annual operating expenses for the first year, second year, and third year on to which different operation rates are assigned as premises of financial analysis. The fixed operating expenses are allocated to coal briquettes and clay stoves based on the following premises.

The direct labor cost and miscellaneous cost are allocated in proportion to the number of operators.

The sharing of maintenance and insurance cost is fixed to 95 to 5 based on the ratio of their plant construction costs.

Table 16-3-1 Summary of Operating Expenses

(Unit: Thousand Kwachas)

Year	1	2	3-10
[Coal Briquettes]			
Variable Operating Expenses	66.87	82.46	105.87
Coal Slurry	33.09	39.52	49.17
Bagasse	14.08	15.76	18.27
Molasses	3.62	4.63	6.14
Slaked Lime	6.16	8.62	12.34
Electricity	9.54	13.36	29.09
Water	0.38	0.57	0.86
Fixed Operating Expenses	1,145.82	1,145.82	1,145.82
Direct Labor	40.00	40.00	40.00
Maintenance	950.00	950.00	950.00
Insurance	149.15	149.15	149.15
Miscellaneous	6.67	6.67	6.67
Total Operating Expenses	1,212.69	1,212.69	1,212.69
[Clay Stoves]			
Variable Operating Expenses	3.05	4.27	6.12
Clay	0.78	1.09	1.56
Grog	0.00	0.00	0.00
Plaster	0.20	0.28	0.40
Electricity	1.94	2.71	3.87
Water	0.13	0.19	0.29
Fixed Operating Expenses	81.18	81.18	81.18
Direct Labor	20.00	20.00	20.00
Maintenance	50.00	50.00	50.00
Insurance	7.85	7.85	7.85
Miscellaneous	3.33	3.33	3.33
Total Operating Expenses	84.24	85.46	87.31

16.4 Financial Analysis by the Normal Evaluation Method (Case-1)

16.4.1 Total Capital Requirement

(1) Breakdown of total capital requirement

The total capital requirement described in Chapter 14 are summarized in Table 16-4-1 as the basis of financial analysis.

Table 16-4-1 Tatal Capital Requirement

(Unit: Thousand Kwachas)

Plant Construction Cost	
. Machinery & Equipment	48,128.9
. Building & Structure	14,836.8
Pre-operation Expenses	9.4
Initial Working Capital	5.0
Interest during Construction	597.7
Total	63,577.9

(2) Expenditure schedule

The above-mentioned total capital requirement is scheduled to be paid as shown in Table 16-4-2 during the construction period.

Table 16-4-2 Expenditure Schedule of Total Capital Requirement

(Unit: Thousand Kwachas)

	1st year		2nd year		Total	
	Foreign	Local	Foreign	Local	Foreign	Local
Plant Construction Cost	11330.1	1263.1	45320.3	5052.3	56650.4	6315.4
Pre-operation Expense	0.0	0.0	0.0	9.4	0.0	9.4
Initial Working Capital	0.0	0.0	0.0	5.0	0.0	5.0
Interest during Construction	0.0	0.0	597.7	0.0	597.7	0.0
Total	11330.1	1263.1	45918.0	5066.7	57248.1	6329.8
	12593.2		50984.7		63577.9	

16.4.2 Result of financial analysis

The result of financial analysis incorporating the plant construction cost and interest during construction are summarized in the following financial statements:

. Profit and Loss Statement (Table 16-4-3)
. Fund Flow Statement (Table 16-4-4)
. Cash Flow Statement (Table 16-4-5)

Although extremely favorable conditions are applied to the long-term loan, the shortage of funds occurs throughout the operation period. In addition, the interest on the short-term loan introduced to compensate for the shortage of fund worsens the financial situations. If the shortage of funds in each year is subsidized by the Zambian government, the required funds amount to 55 million Kwachas. However, the subsidy of such an amount by the Zambian government to this project is not realistic. Adding to the shortage of fund during the operation period, the long-term loan remaining at the end of plant operation amounts to 28.6 million Kwachas. This amount of fund is simply difficult to raise. Increasing the product prices should normally be one of the effective ways to improve the profitability. However, the product prices must be raised about 40 folds in order to be able to repay the remaining debt at the end of the project, which is impracticable. As shown in Table 16-4-5, annual cash flows are all negative throughout; and calculation of IRR is impossible. As is obvious from th above discussion, Case 1 of this project is not viable. Accordingly, the financial analysis proceeds with the plant construction cost and interest during construction excluded.

Table 16-4-3 Profit and Loss Statement (Case-1)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sales Revenue													
Coal Briquettes	--	--	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	--	--	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total	--	--	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Costs & Expenses													
*Variable Operating Expenses													
Coal Slurry	--	--	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	--	--	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	--	--	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	--	--	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	--	--	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	--	--	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	--	--	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	--	--	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	--	--	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	--	--	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	--	--	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	10,000.00
Insurance	--	--	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	1,570.00
Miscellaneouse	--	--	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-total	--	--	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	12,270.00
Total	--	--	1,296.92	1,313.73	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	13,322.52
Depreciation	--	--	15,181.23	10,849.63	7,817.51	5,695.02	4,209.28	3,169.27	2,441.26	1,931.65	1,574.92	1,325.21	54,194.98
Interest on Long-term Loan	--	--	1,717.43	1,717.43	1,717.43	1,717.43	1,717.43	1,674.50	1,502.75	1,331.01	1,159.27	987.52	15,242.23
Interest on Short-term Loan	--	--	0.00	755.95	1,699.32	2,876.92	4,359.27	6,227.02	10,057.68	14,839.65	20,820.28	28,311.22	89,947.31
Profit before Tax	--	--	-18,079.59	-14,474.34	-12,341.25	-11,396.36	-11,392.97	-12,177.77	-15,108.67	-19,209.29	-24,661.45	-31,730.94	-170,572.63
Income Tax	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit after Tax	--	--	-18,079.59	-14,474.34	-12,341.25	-11,396.36	-11,392.97	-12,177.77	-15,108.67	-19,209.29	-24,661.45	-31,730.94	-170,572.63

Table 16-4-4 Fund Flow Table (Case-1)

(Unit:'000 Kyachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sources of Fund													
Profit after Tax	0.00	0.00	-18,079.59	-14,474.34	-12,341.25	-11,396.36	-11,392.97	-12,177.77	-15,108.67	-19,209.29	-24,661.45	-31,730.94	-170,572.63
Depreciation	0.00	0.00	15,181.23	10,849.63	7,817.51	5,695.02	4,209.28	3,169.27	2,441.26	1,931.65	1,574.92	1,325.21	54,194.98
Equity	1,263.10	5,066.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6,329.81
Long-term Loan	11,330.10	45,917.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57,247.80
Short-term Loan	0.00	0.00	2,907.49	6,535.86	11,065.07	16,766.41	23,950.09	38,683.38	57,075.57	80,078.00	108,889.31	145,001.55	490,952.73
Increase in Account Payable	0.00	0.00	5.83	1.40	2.10	0.00	0.00	0.00	0.00	0.00	0.00	-9.33	0.00
Sub-total	12,593.20	50,984.41	14.96	2,912.54	6,543.44	11,065.07	16,766.41	29,674.87	44,408.16	62,800.35	85,802.78	114,586.49	438,152.69
Applications of Fund													
Plant Construction	12,593.20	50,372.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62,965.80
Pre-operation Expense	0.00	9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.41
Initial Working Capital	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Interest during Construction	0.00	597.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	597.40
Increase in Account Recievable	0.00	0.00	9.67	3.87	5.80	0.00	0.00	0.00	0.00	0.00	0.00	-19.33	0.00
Increase in Inventory													
Raw Materials	0.00	0.00	2.38	0.49	0.73	0.00	0.00	0.00	0.00	0.00	0.00	-3.60	0.00
Products	0.00	0.00	2.91	0.70	1.05	0.00	0.00	0.00	0.00	0.00	0.00	-4.67	0.00
Repayment on Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,724.78	5,724.78	5,724.78	5,724.78	5,724.78	28,623.90
Repayment on Short-term Loan	0.00	0.00	0.00	2,907.49	6,535.86	11,065.07	16,766.41	23,950.09	38,683.38	57,075.57	80,078.00	108,889.31	345,951.18
Sub-total	12,593.20	50,984.41	14.96	2,912.54	6,543.44	11,065.07	16,766.41	29,674.87	44,408.16	62,800.35	85,802.78	114,586.49	438,152.69
Surplus Funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accumulated Surplus Funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 16-4-5 Cash Flow Table (case-1)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow													
*Sales Revenue													
Coal Briquettes	0.00	0.00	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	0.00	0.00	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total Cash Inflow	0.00	0.00	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Cash Outflow													
*Investment	12,593.20	50,387.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62,980.21
*Variable Opreating Expenses													
Coal Slurry	0.00	0.00	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	0.00	0.00	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	0.00	0.00	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	0.00	0.00	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	0.00	0.00	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	0.00	0.00	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	0.00	0.00	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	0.00	0.00	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	0.00	0.00	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	0.00	0.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	10,000.00
Insurance	0.00	0.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	1,570.00
Miscellaneouse	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-Total	0.00	0.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	12,270.00
*Working Capital Increase	0.00	0.00	9.13	3.65	5.48	0.00	0.00	0.00	0.00	0.00	0.00	-18.26	0.00
Total Cash Outflow	12,593.20	50,387.01	1,306.06	1,317.39	1,344.46	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,320.72	76,302.73
Net Cash Flow	-12,593.20	-50,387.01	-1,190.06	-1,154.99	-1,112.46	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,088.72	-74,168.33
Cumlative Cash Flow	-12,593.20	-62,980.21	-64,170.27	-65,325.25	-66,437.71	-67,544.69	-68,651.68	-69,758.66	-70,865.64	-71,972.62	-73,079.61	-74,168.33	--

16.5 Financial Analysis with Plant Construction Cost and Interest during Construction (IDC) Exempted (Case-2)

16.5.1 Total capital requirement

The total capital requirement is calculated to be 14,410 Kwachas as the sum of pre-operation expense (9,410K) and initial working capital (5,000K).

16.5.2 Result of Financial Analysis

The results of financial analysis in this case are summarized in the following financial statements.

Production Cost Accounting Table (Table 16-5-1)
Profit and Loss Statement (Table 16-5-2)
Fund Flow Statement (Table 16-5-3)
Cash Flow Statement (Table 16-5-4)

As shown in Tables 16-5-2 and 16-5-3, this project is infeasible even if plant construction cost and interest during constructions are exempted. The operation expenses exceed the sales revenue in every year, and annual cash flows are all negative. The break-down of production cost are shown in Table 16-5-1; and this table indicates that the share of the fixed operating expense is extremely high in the total production cost. Especially, maintenance cost and cost for insurance are equivalent to 4.3 times and 68% of the sales revenue, respectively. However, the production cost excluding the above two costs is lower than sales revenue. In other words, the project becomes financially viable if the project is relieved of the maintenance and insurance costs.

Table 16-5-1 Production Cost Accounting Table (Case-2)

(Unit:'000 Kvachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
<< Coal Briquettes >>													
Production Volume (tons/year)	--	--	500	700	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	9,200
Variable Operating Expenses													
Coal Slurry	--	--	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	--	--	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	--	--	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	--	--	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Electricity	--	--	9.54	13.36	19.09	19.09	19.09	19.09	19.09	19.09	19.09	19.09	175.59
Water	--	--	0.38	0.57	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	7.79
Sub-total	--	--	66.87	82.46	105.86	105.86	105.86	105.86	105.86	105.86	105.86	105.86	996.19
Fixed Operating Expenses													
Direct Labor	--	--	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	400.00
Maintenance	--	--	950.00	950.00	950.00	950.00	950.00	950.00	950.00	950.00	950.00	950.00	9,500.00
Insurance	--	--	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	149.15	1,491.50
Miscellaneouse	--	--	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	66.67
Sub-total	--	--	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	1,145.82	11,458.17
Depreciation	--	--	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	6.84
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	293.94	655.65	1,100.90	1,660.56	2,365.72	3,254.24	4,373.76	5,784.37	7,561.73	27,050.87
Total Production Cost	--	--	1,213.37	1,522.90	1,908.01	2,353.26	2,912.91	3,618.08	4,506.60	5,626.12	7,036.73	8,814.09	39,512.07
Unit Production Cost (K/ton)	--	--	2,426.75	2,175.57	1,908.01	2,353.26	2,912.91	3,618.08	4,506.60	5,626.12	7,036.73	8,814.09	--
<< Clay Stoves >>													
Production Volume (pieces/year)	--	--	2,000	2,800	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	36,800
Variable Operating Expenses													
Clay	--	--	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	--	--	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	--	--	1.94	2.71	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	35.65
Water	--	--	0.13	0.19	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	2.60
Sub-total	--	--	3.05	4.28	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	56.33
Fixed Operating Expenses													
Direct Labor	--	--	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	200.00
Maintenance	--	--	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	500.00
Insurance	--	--	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	78.50
Miscellaneouse	--	--	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	33.33
Sub-total	--	--	81.18	81.18	81.18	81.18	81.18	81.18	81.18	81.18	81.18	81.18	811.83
Depreciation	--	--	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.36
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	15.47	34.51	57.94	87.40	124.51	171.28	230.20	304.44	397.99	1,423.73
Total Production Cost	--	--	84.27	100.97	121.85	145.29	174.74	211.86	258.62	317.54	391.78	485.33	2,292.25
Unit Production Cost (K/piece)	--	--	42.13	36.06	30.46	36.32	43.69	52.96	64.66	79.39	97.95	121.33	--

Table 16-5-2 Profit and Loss Statement (Case-2)

(Unit:'000 kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sales Revenue													
Coal Briquettes	--	--	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	--	--	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total	--	--	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Costs & Expenses													
*Variable Operating Expenses													
Coal Slurry	--	--	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	--	--	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	--	--	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	--	--	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	--	--	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	--	--	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	--	--	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	--	--	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	--	--	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	--	--	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	--	--	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	10,000.00
Insurance	--	--	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	1,570.00
Miscellaneouse	--	--	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-total	--	--	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	12,270.00
Total	--	--	1,296.92	1,313.73	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	13,322.52
Depreciation	--	--	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	7.21
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	309.41	690.16	1,158.84	1,747.95	2,490.24	3,425.51	4,603.96	6,088.81	7,959.71	28,474.60
Profit before Tax	--	--	-1,181.64	-1,461.47	-1,797.86	-2,266.54	-2,855.66	-3,597.94	-4,533.22	-5,711.67	-7,196.51	-9,067.42	-39,669.92
Income Tax	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit after Tax	--	--	-1,181.64	-1,461.47	-1,797.86	-2,266.54	-2,855.66	-3,597.94	-4,533.22	-5,711.67	-7,196.51	-9,067.42	-39,669.92

Table 16-5-3 Fund Flow Table (Case-2)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sources of Fund													
Profit after Tax	0.00	0.00	-1,181.64	-1,461.47	-1,797.86	-2,266.54	-2,855.66	-3,597.94	-4,533.22	-5,711.67	-7,196.51	-9,067.42	-39,669.92
Depreciation	0.00	0.00	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	7.21
Equity	0.00	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.41
Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Short-term Loan	0.00	0.00	1,190.06	2,654.46	4,457.08	6,722.90	9,577.83	13,175.05	17,707.55	23,418.49	30,614.28	39,662.72	149,180.41
Increase in Account Payable	0.00	0.00	5.83	1.40	2.10	0.00	0.00	0.00	0.00	0.00	0.00	-9.33	0.00
Sub-total	0.00	14.41	14.96	1,195.11	2,662.04	4,457.08	6,722.90	9,577.83	13,175.05	17,707.55	23,418.49	30,586.69	109,532.11
Applications of Fund													
Plant Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pre-operation Expense	0.00	9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.41
Initial Working Capital	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Interest during Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase in Account Recievable	0.00	0.00	9.67	3.87	5.80	0.00	0.00	0.00	0.00	0.00	0.00	-19.33	0.00
Increase in Inventory													
Raw Materials	0.00	0.00	2.38	0.49	0.73	0.00	0.00	0.00	0.00	0.00	0.00	-3.60	0.00
Products	0.00	0.00	2.91	0.70	1.05	0.00	0.00	0.00	0.00	0.00	0.00	-4.67	0.00
Repayment on Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repayment on Short-term Loan	0.00	0.00	0.00	1,190.06	2,654.46	4,457.08	6,722.90	9,577.83	13,175.05	17,707.55	23,418.49	30,614.28	109,517.70
Sub-total	0.00	14.41	14.96	1,195.11	2,662.04	4,457.08	6,722.90	9,577.83	13,175.05	17,707.55	23,418.49	30,586.69	109,532.11
Surplus Funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accumlated Surplus Funds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 16-5-4 Cash Flow Table (Case-2)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow													
*Sales Revenue													
Coal Briquettes	0.00	0.00	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	0.00	0.00	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total Cash Inflow	0.00	0.00	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Cash Outflow													
*Investment	0.00	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.41
*Variable Opreating Expenses													
Coal Slurry	0.00	0.00	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	0.00	0.00	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	0.00	0.00	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	0.00	0.00	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	0.00	0.00	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	0.00	0.00	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	0.00	0.00	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	0.00	0.00	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	0.00	0.00	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	0.00	0.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	10,000.00
Insurance	0.00	0.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	157.00	1,570.00
Miscellaneouse	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-Total	0.00	0.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	1,227.00	12,270.00
*Working Capital Increase	0.00	0.00	9.13	3.65	5.48	0.00	0.00	0.00	0.00	0.00	0.00	-18.26	0.00
Total Cash Outflow	0.00	14.41	1,306.06	1,317.39	1,344.46	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,338.98	1,320.72	13,336.93
Net Cash Flow	0.00	-14.41	-1,190.06	-1,154.99	-1,112.46	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,106.98	-1,088.72	-11,202.53
Cumlative Cash Flow	0.00	-14.41	-1,204.47	-2,359.45	-3,471.91	-4,578.89	-5,685.88	-6,792.86	-7,899.84	-9,006.82	-10,113.81	-11,202.53	--

16.6 Financial Analysis without Construction, IDC, Maintenance and Insurance Costs (Case-3)

16.6.1 Introduction of Subsidy

As mentioned above, it is assumed that the project needs not bear the costs for maintenance, cost for spare parts to be strict, and for insurance.

The costs for spare parts and insurance amount to 10 million Kwachas and 1,570 thousand Kwachas throughout the operation period, respectively.

16.6.2 Financial statement

The results of financial analysis are summarized in the following tables and attached at the end of this chapter.

- Production Cost Accounting Table (Table 16-6-1)
- Profit and Loss Statement (Table 16-6-2)
- Fund Flow Statement (Table 16-6-3)
- Balance Sheet (Table 16-6-4)
- Cash Flow Statement (Table 16-6-5)

The summary of each financial statement is given in the followings.

(1) Production Cost Accounting Table

In this study, the production cost is defined as the total of operating expenses, interest and depreciation. The average production costs of coal briquettes and clay stoves are 162 K/ton and 7.9 k/piece. The sale of the products at the previously targeted selling prices, coal briquettes 200 K/ton, clay stoves 8.0 K/piece, is possible.

(2) Profit and Loss Statement/Fund Flow Statement

At the beginning of plant operation, sales revenue cannot cover the fixed operation expenses and shortage of fund occurs due to the low operation rate. However the shortage of fund is dissolved as the plant comes to full operation. The profitability of this project throughout the operation period is favorable and total profit amounts to 350,000 Kwachas. The achievement of full operation at the early stage is desirable because the interest rate of commercial bank loan in Zambia is high at 26% p.a.

(3) Balance sheet

In this study, the book value of plant in each year is evaluated to be zero, because plant construction cost is set to be zero. The remaining cash after the end of operation is about 360,000 Kwachas.

16.6.3 Financial Internal Rate of Return (FIRR)

(1) Calculation methodology of FIRR

In this case study, the financial analysis is made based on the assumption that the plant construction and interest during construction are zero, the plant is supplied by the grant aid. Accordingly, the investment cost is defined as the total capital requirement, minus the plant construction cost and interest during construction. FIRR to the above investment cost is calculated by the following formula.

$$\sum_{i=1}^{n} \frac{(CFE)i}{(1+R)i-1} + \frac{S+W}{(1+R)n-1} = 0$$

Where CFE (Cash Flow Element) represents annual cash flow which consists of.

(CFE) = (-) Investment
(+) Sales Revenue
(-) Operating Cost

Where

R: Rate of return
i: i-th year on the project including construction period
n: Years from initial cash outlay to the end of the project
W: Working capital plus non-depreciable investment
S: Salvage value

(2) Calculation result of FIRR

As shown in the cash flow table (Table 16-6-5), the calculated result for FIRR is 55.5%.

16.6.4 Other Financial Indicators

The above FIRR analysis indicates good profitability with this case. The profitability is further analyzed from other viewpoints using other financial indicators.

(1) Calculation formula of the indicators

The following financial indicators are calculated.

(a) Profit Breakeven Point

$$= \frac{f}{(ro - Vo)}$$

Where

f: Fixed Operating Costs + Depreciation
r_o: Sales Revenue at full capacity
V_o: Variable Operating Costs at full capacity

(b) Profit Ratio to Sales

= Profit/Sales Revenue

(c) Cost Benefit Ratio

= Production Cost/Sales Revenue

(d) Current Ratio

= Current Assets/Current Liability

(2) Calculation result of financial indicators

The calculated results of these financial indicators are shown in Table 16-6-6.

(a) Profit Breakeven Point (BEP)

In the break even analysis, profit breakeven point determines the on-stream factor at which sales revenue equals production cost; namely, the calculated BEP of 0.58 means that this project will yield profit even if the production rate falls down to 58% of the production capacity.

(b) Profit Ratio to Sales (P/S)

This factor indicates the profitability of the company and varies with the type of industry. In general this factor becomes high with companies producing high added value products. Accordingly, adequacy of the sales price is examined by comparing the factor of this project with that of Japanese coal briquette makers. The calculated average value of this factor, 0.14, compares favorably with the Japanese factor of 0.1 to 0.05 and hence sales price may be considered adequate as far as this factor indicates.

(c) Cost Benefit Ratio (C/B)

This factor also indicates the profitability of an enterprise. The calculated value of this factor, 0.86, seems profitable.

(d) Current Ratio (C/R)

Current Ratio indicates the capability of current assets to meet repayment liabilities. In general, the current ratio from 1.5 to 2.0 is desirable. In this study, current ratios on fourth year and after are extremely high, because the entire profits is reserved. In other words, the profit of this project can be used for research and development purposes.

Table 16-6-6 Financial Indicators

	BEP	P/S	C/B	C.R
1	0.58	-0.21	1.21	0.51
2	0.58	-0.02	1.02	0.53
3	0.58	0.17	0.83	2.21
4	0.58	0.21	0.79	8.13
5	0.58	0.21	0.79	13.49
6	0.58	0.21	0.79	18.85
7	0.58	0.21	0.79	24.21
8	0.58	0.21	0.79	29.57
9	0.58	0.21	0.79	34.93
10	0.58	0.21	0.79	39.29
Average	0.58	0.14	0.86	17.17

16.6.5 Sensitivity analysis

With the above case as base, a study is made to evaluate the influence of the variations of the presumed conditions on the profitability of the project. The evaluation of the profitability in terms of FIRR is not appropriate because plant construction cost and interest during construction are exempted. Accodingly, the total profit is used as indicator of profitability in this sensitivity analysis.

(1) Establishment of paramenter

The follwoing parameters and ranges of variation are established.

(a) Sales price of coal briquettes and clay stoves

Variation of -10 to +20% to the sales price of the base case, coal briquette: 200 K/ton, clay stove: 8 K/piece.

(b) Variable operating expenses: raw material and utility cost

Variation of ±10% of the base case.

(c) Operating expenses

±10% variations for operating expenses.

(d) Production volume

Variation of -20 to +80% to the production volume; that is, coal briquettes at 1,000 ton/year and clay stoves at 4,000 pieces/ year.

(2) Results of sensitivity analysis

The results of sensitivity analysis are shown in Table 16-6-7.

Table 16-6-7 Summary of Sensitivity Analysis

Parameter	Total Profit (1,000K)
(a) Sales Price	
. -10%	81.14
. Base Case	354.37
. +10%	579.59
. +20%	798.49
(b) Raw Material + Utility	
. -10%	467.20
. Base Case	354.37
. +10%	232.13
(c) Operating Expense	
. -10%	543.33
. Base Case	354.37
. +10%	127.35
(d) Production Volume	
. -20%	89.05
. -10%	234.30
. Base Case	354.37
. +10%	468.16
. +30%	692.93
. +50%	912.14
. +80%	1239.77

(a) Sales prices of coal briquettes and clay stoves

As shown in Table 16-6-7, the fluctuations of product prices have significant effects upon the profitability of this project. The sales prices of coal briquettes of the base case is set somewhat lower compared with charcoal. Accordingly, it may be expected that the profitability of the project will be improved considerably if the initial sales promotion is successful and the price of the coal briquettes can be raised.

(b) Variable operating expenses

If the variable operating expenses increases by 10% compared with the base case, the total profit will decrease by 120,000 Kwachas; however, the operation of the plant is feasible.

(c) Operating Expenses

If the operating expenses--variable operating expenses plus fixed operating expenses--increases by 10%, the total profit will decrease by 220,000 Kwachas. In addition, the shortage of fund will occur up to the sixth year, which adversely affects the financial situation.

(d) Production volume

This project sets the operation hours at 1,000 hours a year. If the products sell well and machines run well, it is possible to increase the production to some extent. The opposit is also possible if the products do not sell well or machines fail. If the production volume increases by 50% to the base case, the total profit increases to 910,000 Kwachas, or 2.5 times the base case. On the other hand, in case of 20% decrease of production, total profit will decrease to 89,000 Kwachas and shortage of fund will occur up to the sixth year.

16.7 Evaluation

Evaluation and conclusion for this project are given by making an overall assessment of the results of a series of financial analyses.

(1) This project is financially feasible only in the case where the project needs not bear the costs of plant construction, maintenance and insurance.

(2) Though the plants are pilot plants and their production capacities are small, profitable operation of this project can be expected if the above conditions are fulfilled. The premises of financial analysis such as production volume and product price are set somewhat conservative. Accordingly, as mentioned in "sensitivity analysis," an improvement in profitability and financial situation can be expected in case where the products sell well enough to allow increase in price and sales volume.

Table 16-6-1 Production Cost Accountig Table (Case-3)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
<< Coal Briquettes >>													
Production Volume (tons/year)	--	--	500	700	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	9,200
Variable Operating Expenses													
Coal Slurry	--	--	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	--	--	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	--	--	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	--	--	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Electricity	--	--	9.54	13.36	19.09	19.09	19.09	19.09	19.09	19.09	19.09	19.09	175.59
Water	--	--	0.38	0.57	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	7.79
Sub-total	--	--	66.87	82.46	105.86	105.86	105.86	105.86	105.86	105.86	105.86	105.86	996.19
Fixed Operating Expenses													
Direct Labor	--	--	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	400.00
Maintenance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insurance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneouse	--	--	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	66.67
Sub-total	--	--	46.67	46.67	46.67	46.67	46.67	46.67	46.67	46.67	46.67	46.67	466.67
Depreciation	--	--	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	6.84
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	8.16	9.79	1.33	0.00	0.00	0.00	0.00	0.00	0.00	19.29
Total Production Cost	--	--	114.22	137.97	163.00	154.54	153.21	153.21	153.21	153.21	153.21	153.21	1,488.99
Unit Production Cost (K/ton)	--	--	228.45	197.10	163.00	154.54	153.21	153.21	153.21	153.21	153.21	153.21	--
<< Clay Stoves >>													
Production Volume (pieces/year)	--	--	2,000	2,800	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	36,800
Variable Operating Expenses													
Clay	--	--	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	--	--	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	--	--	1.94	2.71	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	35.65
Water	--	--	0.13	0.19	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	2.60
Sub-total	--	--	3.05	4.28	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	56.33
Fixed Operating Expenses													
Direct Labor	--	--	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	200.00
Maintenance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insurance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneouse	--	--	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	33.33
Sub-total	--	--	23.33	23.33	23.33	23.33	23.33	23.33	23.33	23.33	23.33	23.33	233.33
Depreciation	--	--	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.36
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	0.43	0.52	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1.02
Total Production Cost	--	--	26.42	28.08	30.01	29.56	29.49	29.49	29.49	29.49	29.49	29.49	291.03
Unit Production Cost (K/piece)	--	--	13.21	10.03	7.50	7.39	7.37	7.37	7.37	7.37	7.37	7.37	--

Table 16-6-2 Profit and Loss Statement (Case-3)

(Unit:'000 Kvachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sales Revenue													
Coal Briquettes	--	--	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	--	--	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total	--	--	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Costs & Expenses													
*Variable Operating Expenses													
Coal Slurry	--	--	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	--	--	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	--	--	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	--	--	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	--	--	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	--	--	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	--	--	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	--	--	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	--	--	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	--	--	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insurance	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneouse	--	--	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-total	--	--	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	700.00
Total	--	--	139.92	156.73	181.98	181.98	181.98	181.98	181.98	181.98	181.98	181.98	1,752.52
Depreciation	--	--	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	7.21
Interest on Long-term Loan	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on Short-term Loan	--	--	0.00	8.59	10.31	1.40	0.00	0.00	0.00	0.00	0.00	0.00	20.30
Profit before Tax	--	--	-24.64	-3.65	38.99	47.89	49.30	49.30	49.30	49.30	49.30	49.30	354.37
Income Tax	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit after Tax	--	--	-24.64	-3.65	38.99	47.89	49.30	49.30	49.30	49.30	49.30	49.30	354.37

Table 16-6-3 Fund Flow Table (Case-3)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Sources of Fund													
Profit after Tax	0.00	0.00	-24.64	-3.65	38.99	47.89	49.30	49.30	49.30	49.30	49.30	49.30	354.37
Depreciation	0.00	0.00	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	7.21
Equity	0.00	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.41
Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Short-term Loan	0.00	0.00	33.06	39.64	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.09
Increase in Account Payable	0.00	0.00	5.83	1.40	2.10	0.00	0.00	0.00	0.00	0.00	0.00	-9.33	0.00
Sub-total	0.00	14.41	14.96	38.11	47.22	48.61	50.02	50.02	50.02	50.02	50.02	40.69	454.08
Applications of Fund													
Plant Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pre-operation Expense	0.00	9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.41
Initial Working Capital	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Interest during Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase in Account Recievable	0.00	0.00	9.67	3.87	5.80	0.00	0.00	0.00	0.00	0.00	0.00	-19.33	0.00
Increase in Inventory													
Raw Materials	0.00	0.00	2.38	0.49	0.73	0.00	0.00	0.00	0.00	0.00	0.00	-3.60	0.00
Products	0.00	0.00	2.91	0.70	1.05	0.00	0.00	0.00	0.00	0.00	0.00	-4.67	0.00
Repayment on Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repayment on Short-term Loan	0.00	0.00	0.00	33.06	39.64	5.40	0.00	0.00	0.00	0.00	0.00	0.00	78.09
Sub-total	0.00	14.41	14.96	38.11	47.22	5.40	0.00	0.00	0.00	0.00	0.00	-27.60	92.50
Surplus Funds	0.00	0.00	0.00	0.00	0.00	43.21	50.02	50.02	50.02	50.02	50.02	68.28	361.58
Accumlated Surplus Funds	0.00	0.00	0.00	0.00	0.00	43.21	93.23	143.25	193.26	243.28	293.30	361.58	361.58

Table 16-6-4 Balance Sheet (Case-3)

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10
Current Assets												
Cash on Hand & Bank	0.00	5.00	5.00	5.00	5.00	48.21	98.23	148.25	198.26	248.28	298.30	366.58
Account Recievable	0.00	0.00	9.67	13.53	19.33	19.33	19.33	19.33	19.33	19.33	19.33	0.00
Inventory												
Rav Materials	0.00	0.00	2.38	2.87	3.60	3.60	3.60	3.60	3.60	3.60	3.60	0.00
Products	0.00	0.00	2.91	3.61	4.67	4.67	4.67	4.67	4.67	4.67	4.67	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Current Assets	0.00	5.00	19.96	25.01	32.60	75.81	125.82	175.84	225.86	275.88	325.89	366.58
Fixed Assets												
Plant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Intangible Assets	0.00	9.41	9.41	9.41	9.41	9.41	9.41	9.41	9.41	9.41	9.41	9.41
Accumlated Depreciation	0.00	0.00	0.72	1.44	2.16	2.88	3.60	4.32	5.04	5.76	6.48	7.21
Book Value	0.00	9.41	8.69	7.97	7.25	6.53	5.81	5.09	4.37	3.65	2.93	2.21
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toatl Fixed Assets	0.00	9.41	8.69	7.97	7.25	6.53	5.81	5.09	4.37	3.65	2.93	2.21
Total Assets	0.00	14.41	28.65	32.98	39.84	82.33	131.63	180.93	230.23	279.52	328.82	368.78
Current Liabilities												
Account Payable	0.00	0.00	5.83	7.23	9.33	9.33	9.33	9.33	9.33	9.33	9.33	0.00
Short-term Loan	0.00	0.00	33.06	39.64	5.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Current Liabilities	0.00	0.00	38.88	46.86	14.73	9.33	9.33	9.33	9.33	9.33	9.33	0.00
Long-term Liabilities												
Long-term Loan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stockholders Equity												
Capital	0.00	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41	14.41
Retained Earning	0.00	0.00	-24.64	-28.29	10.70	58.59	107.89	157.19	206.48	255.78	305.08	354.37
Total Equity	0.00	14.41	-10.23	-13.88	25.11	73.00	122.30	171.60	220.89	270.19	319.49	368.78
Total Equity & Liabilities	0.00	14.41	28.65	32.98	39.84	82.33	131.63	180.93	230.23	279.52	328.82	368.78

Table 16-6-5 Cash Flow Table (Case-3)

FIRR (%) = 55.62

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow													
*Sales Revenue													
Coal Briquettes	0.00	0.00	100.00	140.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	1,840.00
Clay Stoves	0.00	0.00	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total Cash Inflow	0.00	0.00	116.00	162.40	232.00	232.00	232.00	232.00	232.00	232.00	232.00	232.00	2,134.40
Cash Outflow													
*Investment	0.00	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.41
*Variable Opreating Expenses													
Coal Slurry	0.00	0.00	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	0.00	0.00	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	0.00	0.00	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	0.00	0.00	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	0.00	0.00	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	0.00	0.00	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	0.00	0.00	11.48	16.07	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	211.23
Water	0.00	0.00	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-total	0.00	0.00	69.92	86.73	111.98	111.98	111.98	111.98	111.98	111.98	111.98	111.98	1,052.52
*Fixed Operating Expenses													
Direct Labor	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneouse	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-Total	0.00	0.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	700.00
*Working Capital Increase	0.00	0.00	9.13	3.65	5.48	0.00	0.00	0.00	0.00	0.00	0.00	-18.26	0.00
Total Cash Outflow	0.00	14.41	149.06	160.39	187.46	181.98	181.98	181.98	181.98	181.98	181.98	163.72	1,766.93
Net Cash Flow	0.00	-14.41	-33.06	2.01	44.54	50.02	50.02	50.02	50.02	50.02	50.02	68.28	367.47
Cumlative Cash Flow	0.00	-14.41	-47.47	-45.45	-0.91	49.11	99.12	149.14	199.16	249.18	299.19	367.47	--
Discounted Cash Flow	0.00	-9.26	-13.65	0.53	7.59	5.48	3.52	2.26	1.45	0.93	0.60	0.53	0.00

17. ECONOMIC ANALYSIS

17.1 General

This chapter discribes how this project contributes to Zambian national economy by producting coal briquettes and clay stoves from the domestic resources. The primary social benefit of this project is the saving of charcoal consumption. However, the saving of charcoal consumption directly attributable to this pilot plant project is very small in comparison with the market scale of charcoal and iron stove. In addition, the products are not exportable goods nor import substitutes; therefore, direct benefits such as foreign currency saving will not be realized by the execution of this project.

Nevertheless, this economic analysis quantifies all the quantitative benefits and costs and develops an economic cash flow and presents an assessment. In addition, intangible benefits are also mentioned.

17.2 Economic Cash Flow Table

The Economic costs are calculated from the financial costs used for the financial analysis. The economic costs and benefits are combined into a cash flow table of which an evaluation is made. In the calculation of economic costs and benefits, the official exchange rate is adoped because the Zambian government has introduced the auction system of foreign currency thereby Kwacha is made to reflect the real value against foreign currencies.

17.2.1 Economic costs

(1) Investment cost

As mentioned in chapter 16, this project will become financially feasible, provided that the project is relieved of the plant investment costs and spare-parts throughout the operation period. Economic analysis is done for this case only; therefore, the plant construction cost is not a cost from national economical view-point, because all required costs for imported goods, inland transportation

and plant installation are assumed to be covered by the aid from a foreign country. Accordingly, the plant construction cost is zero from national economic viewpoint. The cost of land may also be regarded as zero, because there is no alternative plan to compete for the planned land with this project. The economic total investment cost, therefore, is the sum of pre-operation expense and initial working capital used for the financial analysis.

(2) Labor cost

This project will use manpower of fairly high standard of education belonging to a group called "technician" in Zambia. Therefore, the labor cost for the economic analysis is considered equal to the financial cost of labor.

(3) Raw material cost

Again, the economic costs of the raw materials are considered equal to their financial costs which are the sum of their source prices plus transportation cost. The reasons are:

(a) Transportation cost

The financial transportation costs are calculated on the basis of transportation by trucks, consisting mainly of labor cost and fuel cost. The financial labor costs are properly graduated according to the skill. The fuel price used in the financial analysis includes the excise tax on petroleum (2 Ngwees/l). The tax is a transfer item and should theoretically be deducted from the fuel cost to obtain the economic cost. This is not done, however, because the effect of this tax to total transportation cost is negligibly small (less than 1%).

(b) Raw material price at a source of supply

. Coal slurry:

The coal slurry at Maamba is a waste resource for which there is no immediate alternative plan for utilization; the economic price may be regarded as zero.

. Bagasse:

The bagasse to be used by this project is the excess bagasse left after the Sugar Estate has used it for fuel. Since there is no alternative plan to compete for the excess bagasse, the economic price may be regarded as zero.

. Molasses:

Molasses is sold at a price of 40 kwachas/ton as the raw material of alcohol or feed. This project will use only a small portion of the product and will not disrupt the balance of supply and demand of molasses. Therefore, the economic price of molasses is equal to the market price.

(c) Raw material price at plant site

As discussed above, the economic costs of the major raw materials are set equal to their financial costs. Other raw materials, clay, gypsum and slaked lime are manufactured and sold under free competition; their market size are much larger than the raw material requirements by this project. In addition, these materials are not utilized to manufacture higher added value products compared with the products of this project. Accordingly, the economic prices of these raw materials are considered equal to market prices.

(4) Electricity

In general, the economic prices of tradable goods are evaluated by the border price. At present, Zambia exports to Zimbabwe 30% of the total electric power at a price of 0.0137 Kwachas/Kwh. Therefore, this study sets the economic price of electricity to be 0.0137 Kwachas/Kwh.

(5) Maintenance cost

The spare-parts are assumed to be supplied without cost to the project and therefore, their economic costs are zero. As for the labor cost for maintenance, additional economic cost is not necessary because the maintenance works are done by the plant operators and professional workers of NCSR. Therefore, this cost is evaluated to be zero.

(6) Cost for insuarance

It is assumed that the insurance is underwritten by the government and the government does not reinsure the risk overseas, say at Lloyd's. In such a case, the cost for insurance is only internal transfer of cash in Zambia and the economic cost is zero.

(7) Other economic costs

In addition to those mentioned above, there are costs for water and miscellaneous items.

The interest on short-term loan is not counted as economic cost, because it is a transfer item within the country.

17.2.2 Economic benefit

Obviously, the direct benefit of this project is the values of the coal briquettes and clay stoves. In general, the economic benefits of consumer goods are measured by their market prices under the following conditions:

(1) Any customer can buy the product of his or her own free will without rationing or restriction.

(2) No consumer is big enough to exercise monopolistic power to influence the market price through his own purchase.

(3) The additional supply of products brought by the project is not large enough to change the market price.

The coal briguettes and clay stoves will be introduced to the market in free competition in quality and price with charcoal and mbaulas but not in quantities large enough to affect the market; therefore, their economic prices are valued equal to the wholesale values of charcoal and mbaulas, the former corrected to coal briguettes on equal heat value base using 7,000 kcal/kg for charcoal and 5,200 kcal/kg for coal briguettes namely:

. Coal Briquettes: 230K/ton
. Clay stoves: 8K/price

17.2.3 Results of Economic Cash Flow Analysis

The economic costs and benefits are summarized in Table 17-2-1. The total economic costs and benefits are 1.77 million and 2.41 million kwachas, respectively. Their balance, 640 thousand kwachas, is the net economic benefit of this project. The net economic benefit discounted at 15% is 230 thousand kwachas.

17.3. Evaluation

This is a pilot plant project and would not bring a great benefit to the Zambian economy. The purposes of this project are to transfer the coal briquette and clay stove technology to Zambia, establish an appropriate technology in Zambia and develop market.

1) Savings of imported iron
2) Effective utilization of unused domestic resources, and
3) Transfer of coal briquettes and ceramic technology.

Under such circumstances, the social significance of this project is great. The clay stoves on their part will contribute greatly to the saving of charcoal by virtue of their supreme heat efficiency. They have advantages in that, in contrast to mbaulas, the raw material is domestically available. In addition, the transfer of ceramic technology has a great significance in view of the state of the art of the Zambian ceramic industry.

Table 17-2-1 Economic Cash Flow Table

(Unit:'000 Kwachas)

Project Year	-2	-1	1	2	3	4	5	6	7	8	9	10	Total
Economic Benefit													
Coal Briquettes	0.00	0.00	115.00	161.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	2,116.00
Clay Stoves	0.00	0.00	16.00	22.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	294.40
Total Economic Benefit	0.00	0.00	131.00	183.40	262.00	262.00	262.00	262.00	262.00	262.00	262.00	262.00	2,410.40
Economic Costs													
*Investment	0.00	14.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.41
*Variable Opreating Expenses													
Coal Slurry	0.00	0.00	33.09	39.52	49.17	49.17	49.17	49.17	49.17	49.17	49.17	49.17	465.97
Bagasse	0.00	0.00	14.08	15.76	18.27	18.27	18.27	18.27	18.27	18.27	18.27	18.27	175.97
Molasses	0.00	0.00	3.62	4.63	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14	57.39
Slaked Lime	0.00	0.00	6.16	8.62	12.34	12.34	12.34	12.34	12.34	12.34	12.34	12.34	113.48
Clay	0.00	0.00	0.78	1.09	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	14.37
Grog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Gypsum	0.00	0.00	0.20	0.28	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.68
Electricity	0.00	0.00	5.48	7.67	10.96	10.96	10.96	10.96	10.96	10.96	10.96	10.96	100.83
Water	0.00	0.00	0.51	0.76	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	10.39
Sub-Total	0.00	0.00	70.08	86.96	112.32	112.32	112.32	112.32	112.32	112.32	112.32	112.32	1,055.60
*Fixed Operating Expenses													
Direct Labor	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	600.00
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Insurance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneouse	0.00	0.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	100.00
Sub-Total	0.00	0.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	700.00
Total Economic Cost	0.00	14.41	140.08	156.96	182.32	182.32	182.32	182.32	182.32	182.32	182.32	182.32	1,770.01
Economic Cash Flow	0.00	-14.41	-9.08	26.44	79.68	79.68	79.68	79.68	79.68	79.68	79.68	79.68	640.39
Discounted Cash Flow at 15%	0.00	-12.53	-6.87	17.39	45.56	39.62	34.45	29.95	26.05	22.65	19.70	17.13	233.08

18. ORGANIZATION

This pilot plant project will be run by NCSR. The Secretary General will assume the overall responsibility of the project. The daily routines of the plants will be taken care of by six technicians: four for coal briquettes and two for clay stoves. One of the four technicians for coal briquettes manufacturing will be the local manager of the pilot plants. Provided that the right technology is transferred to NCSR, NCSR is capable of meeting the administration and management requirements for operating the pilot plant project. However, this project should have a government-wide support for which the organization shown in Figure 8 is recommended. And two or more expatriate engineers, one for coal briquettes and one for clay stoves, should be invited to transfer the technology and skill of operation and management to the local staff.

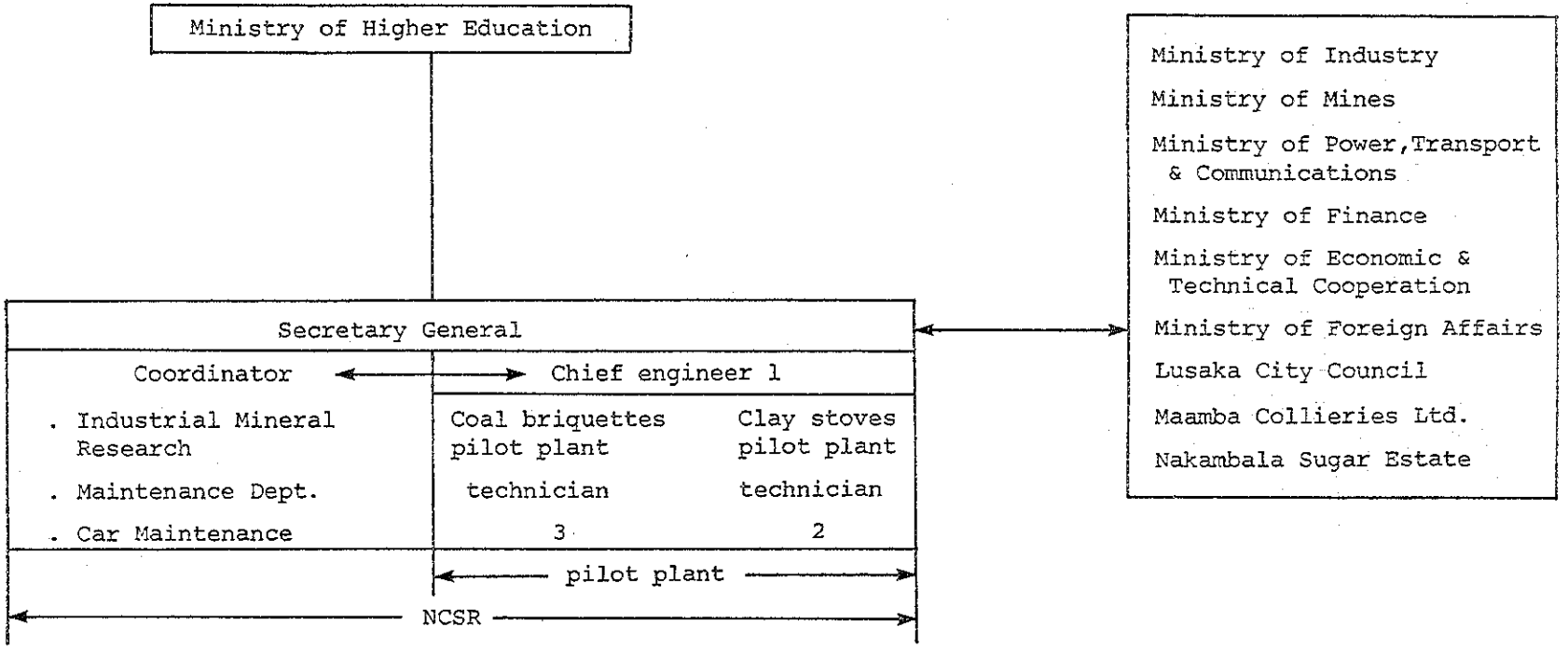

Figure 18-1-1 Organization

19. THEME OF FURTHER STUDY

In case this project is materialized, the pilot plant should be operated, at least during some initial years, to realize the design conditions of operation and quality of the products. After the plant has been thoroughly broken in the following studies should be done by effectively utilizing the pilot plant:

(1) Technical and economic subjects

1) Study possible ways to reduce or eliminate use of expensive components.
2) Study the possiblity of simplifying the manufacturing process.
3) Find a practical and reasonable compromise between the desired quality and manufacturing economy that could make production economically viable.
4) Make further studies on clay stoves and develop new versions of clay stoves that could effectively and safely burn coal briquettes of inferior quality, or economically manufactured briquettes.

(2) Social subjects

1) What kinds of organization are effective to promote and operate a project of this nature.
2) What kinds of incentives should be prepared to stimulate use of coal briquettes in place of traditional woodfuel.
3) What distribution channels would be effective for coal briquettes to reach general consumers.
4) What typical behavioral reactions of general consumers would be to an entirely new commodity and what actions should be taken to the reactions.
5) What kinds of PR, or promotion activities would be effective and under what conditions.

This feasibility study has already investigated these themes and made the results of the study reflected in the report. Once the project is realized the organization in charge of running the project should be able to rightly respond to any challenges no matter how unexpected they may be.

20. OVERALL EVALUATION

As explained in Chapter 16, FINANCIAL EVALUATION, this project could not make both ends meet without introduction of a subsidy to relieve the project of the burden of spare parts and insurance fee on top of the construction cost. Technically it was confirmed that coal briquettes and clay stoves of the desired quality may be produced from the intended domestic raw materials; also the market analysis indicates good possibility of marketing the products.

The overall evaluation of this project consists in the tradeoff between the financial burden to be incurred in the project and such benefits as utilization of unused resources and a practical step towards making a substitute fuel for woodfuel available. If there is an outside subsidy to cover the cost of spare parts and insurance fee, the research and development activities into the technical economic and social subjects mentioned in Chapter 19, THEME OF FURTHER STORY, would be made possible.

APPENDIX I

Scope of Work

on

The Study

on

Briquettes Development Project

in

The Republic of Zambia

Agreed upon

Between

The Japan International Cooperation Agency

and

National Council for Scientific Research

December 20, 1985

Prof. Siamwiza
for Secretary-General
National Council for
Scientific Research

Mr. Keiichi TAKEDA
Leader of the Preliminary
Study Team
Japan International
Cooperation Agency

I. Introduction

In response to the request of the Government of the Republic of Zambia (hereinafter referred to as "the Government of Zambia"), the Government of Japan has decided to conduct the study on Briquettes Development Project in the Republic of Zambia (hereinafter referred to as "the Study") in accordance with the laws and regulations in force in Japan.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study, in close cooperation with authorities concerned of the Government of Zambia.

The present document sets forth the scope of work with regard to the Study.

II. The Objectives of the Study

The objectives of the Study are to investigate the technical and economic feasibility of manufacturing briquettes using the waste slurries which are produced by coal processing in the Maamba Collieries Ltd., and of developing a new type of stove for briquettes, and to formulate the master plan for the implementation of the briquettes development project in the Republic of Zambia.

MNS

III. Scope of the Study

In order to achieve the above objectives, the Study will cover the following items:

1. Present situation and future prospects of the supply and demand of household fuels in the Republic of Zambia.

   (a) Classification of household fuels, fuel usage, supply-demand, and price structures

(b) Fuel imports

(c) Household expenditure and consumers' response to different types of household fuels.

(d) Acts and regulations governing usage of fuels

2. Policy of the Government of Zambia with respect to the development of briquettes and stoves

3. Demand forecasting of briquettes and stoves in the households in the urban and rural area

4. Resources and materials for manufacturing briquettes and stoves:

(a) Volume and qualities of slurry resources at the Maamba Collieries Ltd.

(b) Qualities and supply of briquettes binder

(c) Qualities and supply of resources and materials for manufacturing stoves

(d) Other relevant resources

5. Production technology of briquettes:

(a) Review of production technology developed by National Council for Scientific Research (hereinafter referred to as "NCSR")

(b) Testing and analysis of slurry, briquettes binder and other raw materials (physicochemical analysis, combustion analysis, etc.)

(c) Briquette manufacturing methods and production process

6. Production technology of stoves

(a) Purpose of stove users - for cooking or room heating

(b) Adaptability of stoves to different fuels such as firewoods, charcoal and briquettes

(c) Physicochemical analysis of materials for stoves

(d) Stove manufacturing methods and production process

7. Marketing and distribution of briquettes and stoves

8. Construction study of pilot plants for briquettes and stoves

(a) Site selection of pilot plants

(b) Conceptional design and cost estimation of the pilot plants for briquettes and stoves

(c) Supply methods of resources and materials

(d) Utilities (water, sewerage, electricity, etc.)

(e) Construction schedule

(f) Operational planning

(g) Operational costs

9. Operation and management organization of the Briquettes Development Project in the Republic of Zambia

10. Project evaluation

(a) Financial analysis

(b) Economic comparison between briquettes and charcoal as household fuels

(c) Economic evaluation

11. Conclusion and recommendations

IV. Steps and Schedule of the Study

1. Steps

Step 1: Preparatory office work in Japan
Step 2: Field work in the Republic of Zambia
Step 3: Home office work in Japan
Step 4: Presentation of and discussion on the Draft Final Report

2. Schedule

As shown in Annex

V. Reports

JICA shall prepare and submit the following reports written in English to the Government of Zambia:

1.	Progress Reports at the end of Step 2:	10 copies
2.	Draft Final Report and its summary within 6.5 (six and a half) months after the end of Step 2:	15 copies
3.	Final Report and its summary within 2.5 (two and a half) months after the receipt of comments on the Draft Final Report by the Government of Zambia:	30 copies

VI. Undertaking of the Government of Zambia

1. To facilitate the smooth implementation of the Study, the Government of Zambia shall take necessary measures;

(a) To secure the safety of the Team

(b) To permit the members of the Team to enter, leave and sojourn in the Republic of Zambia for the duration of their assignment therein, and exempt them from alien registration requirements

(c) To exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into the Republic of Zambia for the implementation of the Study

(d) To exempt the members of the Team from income taxes and other charges of any kinds imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study

(e) To provide the necessary facilities to the Team for the remittance as well as utilities of fund introduced in the Republic of Zambia from Japan in connection with the implementation of the Study

(f) To provide medical services as needed and its expenses will be chargeable on the members of the Team

(g) To secure permission for entry into private properties or restricted areas for the conduct of the Study

(h) To secure permission to take all data and documents related to the Study (including photographs) out of the Republic of Zambia to Japan by the Team

2. The Government of Zambia shall bear claims, if any arises against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the Japanese members of the Team.

3. NCSR shall act as counterpart agency to the Japanese study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. NCSR shall, at its own expense, provide the Japanese study team with the following, in cooperation with other relevant organizations:

   (a) Available data and information related to the Study

   (b) Counterpart personnel

   (c) Suitable office space with necessary equipment

   (d) Identification cards

VII. Undertaking of JICA

For the implementation of the Study, JICA shall take the following measures:

1. To dispatch, at its own expense, the Team to the Republic of Zambia

2. To pursue technology transfer to ~~the Republic of~~ Zambian counterpart personnel in the course of the Study

VIII. Consultation

JICA and NCSR shall consult with each other in respect of any matter that may arise in the interpretation of implementation of the present arrangement.

Annex

Tentative Schedule of the Study

Item \ Year & Month	1986											
	January	February	March	April	May	June	July	August	September	October	November	December
Preparatory Office Work (Step 1)												
Field Work (Step 2)												
Home Office Work (Step 3)												
Presentation of Draft Final Report (Step 4)												
Submission of Final Report												▲

In Japan

In the Republic of Zambia

Communications should be addressed to the Permanent Secretary

Telephone LUSAKA 213824

Telegrams: FINANCE, RIDGEWAY

In reply please quote
MF/NCDP/101/7/69

REPUBLIC OF ZAMBIA

MINISTRY OF FINANCE

P.O BOX 50062
LUSAKA

16th December, 1985

The Secretary General,
National Council for
Scientific Research,
LUSAKA

ATT: PROF. SIAMWIZA

Dear Sir,

STUDY ON BRIQUETTES DEVELOPMENT
PROJECT IN ZAMBIA

Reference is made to the draft regarding the above project proposal agreed upon between the Japanese Internationa Cooperation Agency and the National Council for Scientific Research.

I am pleased to inform you that the Government of the Republic of Zambia has approved the project. You may therefore arrange and sign the agreed performance of work with the Japanese officials.

Yours faithfully,

D. Kasunga
for/PERMANENT SECRETARY
MINISTRY OF FINANCE

APPENDIX II

PROGRESS REPORT

FOR

FEASIBILITY STUDY

ON

BRIQUETTES DEVELOPMENT PROJECT

IN

THE REPUBLIC OF ZAMBIA

MARCH 20, 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

1. INTRODUCTION

We, the study team of Japan International Cooperation Agency (JICA) for a feasibility study on BRIQUETTES DEVELOPMENT PROJECT in the Republic of Zambia, submit this PROGRESS REPORT to National Council for Scientific Research (NCSR) of the Republic of Zambia with our heart-felt appreciation to the devoted cooperation and assistance NCSR and the concerned government authorities as well as private organizations have extended to the team during the course of the field survey which started on February 26th. During this period we have been able to accomplish the objectives of the field survey which are broadly to: (1) collect samples of raw materials for coal briquettes and clay stoves and send them by air to Japan, (2) collect information and data which are necessary for this feasibility study, and (3) establish a tentative project scheme on which the rest of the study is to be conducted.

The purposes of this PROGRESS REPORT are to:

(1) Summarize the results of the field survey

(2) Present the tentative project scheme on which the rest of the feasibility study is to be conducted giving rationale for arriving at such a tentative project scheme

(3) Explain important findings of the field survey, and

(4) Establish a thorough understanding between NCSR and JICA study team upon the course of the study.

PROGRESS REPORT does not enter into details which, of course, will be developed in Japan and presented in the final report.

Overall, the field survey may be considered as a success. The study team was able to collect and send to Japan the kinds and quantities of the samples as have previously been planned except for waste coal fines at Nitrogen Chemicals of Zambia at Kafue which was found to be inadequate. The absence of this material, however, will not constitute any problem to the execution of the feasibility study nor to the execution of the project. The information and data we have been able to collect with intensive and attentive supports by our counterparts provided a sound basis on which, along with the rapport generated between NCSR and the team, a realistic tentative project scheme has been established. The information and data would be sufficient to enable the home-office works to be properly executed. In addition to obtaining written information and data, each member of the team has been educated through the survey, though superficially and very limited, about the characteristics and functions of the society of Zambia, which would no doubt prove to be very valuable and would lead us to make a sound judgement when making an important decision in the development of home-office work.

The study team concludes the field survey by presenting this PROGRESS REPORT.

On behalf of JICA we sincerely thank all those who have supported us during the field survey.

2. SUMMARY

The study team summarizes the results of the field survey as follows:

(1) With cooperation of our counterparts, the study team has been able to accomplish the objectives of the field survey, which are to:

1. Collect samples of raw materials for coal briquettes and clay stoves and send them to Japan,
2. Collect information and data necessary for the execution of this feasibility study, and
3. Establish a tentative project scheme on which the rest of the study is to be based.

(2) The study team has confirmed that sufficient amounts of raw materials are domestically available for the operation of the briquettes and clay stove pilot plants.

(3) The study team has established the following tentative project scheme:

1. Coal briquettes pilot plant

Site:	Namununga in Lusaka
Annual production:	nominal 1,000 tons per year with some allowance for extra capacity
Raw materials:	Maamba coal slurry, bagasse, molasses, lime

2. Clay stove pilot plant

Site:	Namununga in Lusaka
Annual production:	nominal 4,000 pieces per year but mechanical capacity will have a

considerable allowance

Raw materials: clay produced in Lusaka area

Types of stoves: Three

(4) The study team has had a hard look at the existing distribution channels of household fuels, particularly charcoal, and mbaulas, and also potentially effective marketing channels of coal briquettes and clay stoves. Our conclusion is that the existing distribution channels and official channels like NIEC Stores can be depended upon.

The study team also considers that the annual productions set for the tentative project scheme, 1,000 tons per year of briquettes and 4,000 pieces of clay stoves, are appropriate and by no means adventurous if the prices and the marketing strategy are right.

The target prices ex-factory should be at the current March 1986 price:

Coal briquettes: 200 Kwachas per ton

Clay stoves: 8 Kwachas per piece

The study team conducted demonstrations on briquettes burning to potential marketers and consumers of briquettes and clay stoves. They exhibited keen interest and positive responses. The comments they gave us should be regarded as important suggestions on the design of the quality of briquettes and types of clay stoves.

The houses in Lusaka area are mostly made of bricks or concrete blocks. Consequently, the houses are walled on

all sides, or of closed type. Therefore, smokes and sulfur dioxide emission should be ruled out. This is particularly true if we consider that coal briquettes are to replace charcoal which is essentially smokeless and sulfur-free.

(5) In cooperation with Industrial Mineral Research of NCSR, the study team conducted burning tests of coal briquettes and charcoal using Japanese clay stoves and mbaulas, and also test baking of clay samples.

The study team has found that Industrial Mineral Research is well equipped with capabilities of becoming nuclei of the briquettes and clay stove pilot plants.

The results of the tests indicate that the clay stoves are significantly more thermally efficient than mbaulas presumably because too many air holes and high conductivity of the metal do not properly contain heat.

The study team also found that it is rather difficult, although by no means impossible, to start fire on coal briquettes in mbaulas as compared with the result of the similar test in clay stoves.

The coal briquettes produced by NCSR are well-made. They noticeably produce smoke when burning, particularly during the initial period of burning. This gives us an important clue as to the necessity of carbonization process to eliminate smokes in view of the fact that NCSR's briquettes are made of the same coal slurries that will be used for this project.

(6) The transportation of coal slurry from Maamba to the plant site is considered to be most reasonable if the slurry is first brought to Masuku Station by the ropeway operated by MCL and then transported by rail to Lusaka Station followed by a short-distance transportation by truck to the site.

It has been confirmed that Zambian Railways Limited (ZRL) has enough facilities and routine services capable of accommodating the slurry transportation.

This does not necessarily mean, however, that the feasibility study abandons the possibility of transporting coal slurry by road, either by contract or by own trucks. This alternative should be studied in view of the fact that operation of the public utilities is sometimes disrupted for various reasons and, therefore, complete dependence upon others for the operation of an essential element of the project should be considered risky. The home-office work will study these two alternatives.

The transportation of bagasse and molasses to the site may be considered to be best done by shuttle services of trucks. Other raw materials like lime, clay or perhaps charcoal dust may be transported by truck or pick-up as needed since their consumptions are little and distances of transportation are short.

(7) The infrastructure of this country may not be regarded as well developed. However, the present status of infrastructure would not pose any serious difficulty to the construction or operation of the pilot plants. The infrastructure surrounding the selected plant site is adequate enough. There is no need to make additions or improvements to the existing infrastructure.

The study team sees no need for provisions for a standby power generator. There are occasional power failures but not frequent enough to warrant installation of a power generator. Sudden suspension of power supply may be coped with without giving irrecoverable damages to the operation of briquettes or clay stove pilot plants.

Given that the pilot plants are to be located in Lusaka, the study team recommend Namununga to be the most desirable. The portion of land in heavy industrial area which NCSR has taken position of is not necessarily recommendable for technical reasons. The study team plans to build the clay stove plant beside the briquettes plant.

(8) The study team has obtained information and data required for the design and cost estimation of the plants. We are unable to give any indication of the estimate at this moment; we will develop a fairly accurate estimate, good enough for the purpose of feasibility study, based on a design best suited to the Zambian conditions. Locally available materials will be used to the extend possible and practical.

(a) The study team has been able to collect information, statistics and data required for the financial and economic evaluation of the project. Government projects are exempted from income tax and import duties. The conditions for financial and economic analysis are summarized in Chapter 5, BASIS FOR FINANCIAL AND ECONOMIC ANALYSIS.

(10) Five kinds of clay were sampled and sent to Japan. Four of them occur in Lusaka area. One was taken at Nega Nega near Nakambala. Three kinds of clay produced at Lusaka are actually used for manufacture of bricks by baking at around 500°C or lower. Test pieces made from pure samples of these clay or their blends were subjected to experimental baking at Industrial Mineral Research of NCSR with the result that Chamba clay proved very promising on baking at 800°C for 7 hours.

Availability of plaster of Paris used for making molds has been confirmed. SANPOO INDUSTRIES LIMITED in Lusaka manufactures plaster of Paris from domestic natural gypsum. The quality of their plaster of Paris is not exactly ideal, but good enough for our purpose.

The reserves of clay and natural gypsum are large enough.

(11) The study team has found that almost all government offices the team has visited recognize this project as a first concrete step toward prevention of deforestation. The team has also realized how seriously the government of Zambia looks at the speed of deforestation.

3. PROJECT SCHEME FOR FEASIBILITY STUDY

The study team has established the following tentative project scheme:

Coal briquettes pilot plant

Site:	Namununga in Lusaka
Annual production:	nominal 1,000 tons per year with some allowance for extra capacity
Raw materials:	Maamba coal slurry, bagasse, molasses, lime

Clay stove pilot plant

Site:	Namununga in Lusaka
Annual production:	nominal 4,000 pieces per year but mechanical capacity will have a considerable allowance
Raw materials:	clay produced in Lusaka area
Types of stoves:	Three

(1) Selection of Plant Location

Selection of Namununga among three candidate sites in Lusaka is based purely on technical reasons. The question here is why the location is Lusaka instead of Maamba or Nakambala where either of the most important raw materials is available.

First and foremost, if the plants are located in Maamba, NCSR says it is almost impossible for NCSR to closely manage the operation of the plants. Having made a trip to

Maamba, the study team agrees with NCSR in this respect. Without being able to closely manage the operation, NCSR would be no longer in a position to perform research and development activities on the pilot plants. Consideration on effectiveness of research and development activities definitely favors Lusaka.

When we look at transportation cost, Maamba is preferable. As a preliminary transportation cost from Maamba to Lusaka by ropeway/rail/road we have 70 Kwachas per ton.

Let it be assumed that:

Coal content of slurry,% (wet base):	60 to 85
Yield of carbonization process,% :	75
Carbonized coal content in briquette,% :	90 to 100
Content of carbon from bagasse in briquette,% :	0 to 10

It follows that every one tone of briquette, if bagasse is used, 1 ton/0.6 to 0.85/0.75 x 0.9, or 1.4 to 2.2 tons of slurry is required.

If the plant is located in Lusaka 1.4 to 2.2 tons of slurry must be transported. In contrast, if the plant is located in Maamba the product is transported to Lusaka area, the major consuming area. The overall balance is that to be located in Lusaka is penalized by transportation cost 0.4 to 1.2 ton excess, or 28 to 84 Kwachas for every ton of product briquette. An excess cost of 84 Kwachas constitute a significant portion of the target ex-factory price of 200 Kwachas per ton briquettes.

Although unable to quantify at this moment, the study team is pretty sure that the overall construction cost is higher at Maamba than in Lusaka and the annual expenses accruing from this incremental cost would offset the 84 Kwacha excess transportation cost.

Having weighed such advantages and disadvantages associated with the two candidate locations, the study team considers that Lusaka has advantages over Maamba, although these are not necessarily quantitative. The rationale for supporting Lusaka will be elaborated more in the final report.

Nakambala should be ruled out. Nakambala is an agricultural area. Mere existence of bagasse can hardly justify consideration as site. Nakambala would have all the problems of slurry transportation, briquettes transportation, operational problems, and incremental construction costs, the magnitude of these problems being just between Maamba and Lusaka, which means that Lusaka remains advantageous vis-a-vis Nakambala.

Location of the clay stove pilot plant should never be remote from NCSR, in view of the size and nature of this pilot plant. The study team considers it best to place the clay stove pilot plant just beside the coal briquettes pilot plant.

(2) Annual Production of Coal Briquettes

Being a pilot plant, the hourly production should not far exceed one ton product. To be practical two operation patterns are assumed; namely, (1) 6 hours/day, 10 days/month and 12 months/year, or 720 hours/year. (2) 6 hours/day, 20 days/month and 12 months/year, or 1,440 hours/year. Annual productions are calculated for assumed hourly production of 0.5, 0.75, and 1.0 tons per hour.

Hourly Production, tons	Annual Production, tons	
	720 Hours	1,440 Hours
0.5	360	720
0.75	540	1,080
1.0	720	1,440

From the above table, the study team would like to exercise a little bit of restraint and set the standard annual production at 1,000 tons per year when the operation has reached maturity, even though the pilot plant has a mechanical capacity of 1.0 ton per hour or more. Operation at reduced rates must be accepted during the test operation period and initial few years before coal briquettes are firmly established in the market.

From the marketing point of view, the study team endeavors not to be optimistic but still considers it possible to sell 1,000 tons per year of coal briquettes in Lusaka area alone at the target ex-factory price of 200 Kwachas per ton.

The study team sees no critical problem of technical nature

in the design, construction or operation over this range of capacity.

(3) Annual Production of Clay Stoves

The study team considers 4,000 pieces per year would be appropriate. Before actually starting the field survey, the study team gave clay stoves a subordinate position to the briquettes in that clay stoves would sell only in association with coal briquettes. Through the field survey the study team has become convinced that a great potential exists for clay stoves to replace mbaulas to burn charcoal. If the clay stoves become popular, they may pave the way for extensive acceptance of coal briquettes by general populace.

The study team estimates that annual sale of mbaulas in open markets of Lusaka alone could amount to 20,000 pieces. If clay stoves could occupy 20 percent of the mbaula market, sale of 4,000 pieces could be achieved.

Viewed from a different angle, we consider that four clay stoves per one ton of coal briquette would be right as is proposed in Inception Report. An average household consuming 0.5 tons of birquettes would need two clay stoves, or four clay stoves per ton of coal briquettes.

Regarding the types of clay stoves, the study team is convinced that three types - - large, medium and small - - of clay stoves would be needed to satisfy the requirements of the majority of medium and low income brackets.

4. RESULTS OF THE FIELD SURVEY

(1) General

The field survey has been very fruitful. The study team was impressed by the enthusiasm the Government of Zambia has in this BRIQUETTE DEVELOPMENT PROJECT. The study team did not have an opportunity to go deep into the charcoal burning areas but the team has been still able to have a glimpse at the serious degree of deforestation having taking place around a coal burning area of Lukolongo, Nakooma Village near Lusaka.

The study team has realized the importance charcoal has in the daily life of general populace, particularly in urban area as represented by Lusaka. The study team has well understood the roles played by mbaulas in their life style and also the drawbacks to the mbaulas.

The circumstances surrounding this BRIQUETTES DEVELOPMENT PROJECT in all the aspects of urgency for stopping deforestation, government policy, demands for coal briquettes and clay stoves, level of quality of coal briquettes and clay stoves considered achievable, availability of raw materials, conditions of infrastructure, conditions of the site, technical capability of NCSR have been found favorable for the development of this project.

(2) Sampling

A. Coal slurry of Maamba Collieries Limited

Of the two slurry ponds, the new pond is wet and is not suitable for sampling. Even the older pond, as relatively dry it may seem on the surface, the slurry is soft and heavy equipment cannot be placed on. Therefore, test digging and sampling were done manually entirely by hand shovels. Six holes were dug at points A, B, C, D, F, G of the old pond as indicated on a chart contained in Attachment to an approximate depth of two meters and the states of layers were observed. At C point, clay accumulation was noticed and it was judged that the slurry there needs treatment before it can be used and hence sample was not taken.

At B point near the overflow exit, particle size is so fine that kneading behavior is almost similar to that of clay. Amount of accumulation at B point was considered limited and therefore only a small representative sample was collected.

The states of accumulation are similar at points A,D,F and G and were considered suitable. The upper two meter of slurry layer surrounding these points alone is calculated to contain about 12,000 tons of coal. About 0.8 tons of samples were collected from these holes.

The new pond is swampy. For the sake of safety only about 0.1 tons of slurry was taken at a relatively dry point near the bank for the purpose of comparison. Concurrently, a large number of small samples were collected for the purpose of estimating average grade of accumulated coal fines. These samples were taken at relatively shallow points the depth ranging from 30 to 50 cm. Those samples were taken from near the surface but the team is pretty sure that the quality does not vary very much along the depth as observed from other deep holes.

B. Bagasse of Nakambala Sugar Estate

Bagasse are piled up in the estate since the end of dry season, that is last November. Although there are slight differences in quality from one place of the pile to another because sugar content differs with harvest time, and bio-degradation is taking place. There was no way of distinguishing quality by mere observation and, therefore, the relatively new bagasse were sampled. The sample taken is about one ton. Along with it an aged humic sample of one drum was taken. The moisture content of bagasse on leaving the sugar plant is about 50 percent.

(3) Raw Materials

A. Coal slurries of MCL

The team estimates that the older pond alone contains about 12 thousand tons of coal fines that could be fed to the pilot plant with only a simple pretreatment. This calculation excludes about one half of the pond that was found to contain too much clay

and sand and also to be suspected of being not uniform in quality.

Assuming coal production of MCL to be one million tons per year and the slurry production to be four percent on coal, annual supply of coal fines is 40,000 tons. Even on stringent assumption that half of this is suitable as feed, there will be 20,000 tons of supply every year.

B. Bagasse

About 400,000 tons of bagasses are produced every year at Nakambala Sugar Estate of which the estate burns 350,000 tons as fuel. The balance, 50,000 tons, remains as excess which this project could count on as feed. The bagasse contains about 50 percent moisture; therefore, on dry basis 25,000 tons are available.

C. Lime

The City of Lusaka sits on a huge limestone deposit. Therefore, there will be an infinite supply of lime. There is a supplier of slaked lime called Crushed Stone Sales from which the project can purchase slaked lime.

D. Molasses

There is a plenty of excess at Nakambala Sugar Estate which the project can depend on.

(4) Market

A. Purpose of the market study

The purpose of the market study is basically two-fold, namely,

(a) To assess the potential market sizes of the coal briquettes and clay stoves pilot plants, thereby assist in the establishment of the project scheme.

(b) To investigate several alternative ways for promotion of the coal briquettes and clay stoves and recommend the most promising promotional measures.

For assessing the market sizes of coal briquettes and clay stoves, the markets sizes of charcoal, firewood and mbaulas are very important, because coal briquettes and clay stoves are to partly replace these products. In the execution of these studies, the study team attached particular importance to the market size in Lusaka urban area for the reasons presented in Inception Report.

Concerned authorities were interviewed to evaluate the various promotion strategies the study team had in mind.

B. Sales at open markets

To begin with, about 55,000 tons of charcoal is consumed in Lusaka which may be regarded as indicating a great potential for coal briquettes. As a result of investigation on the charcoal market in Lusaka area, the study team has been convinced that what are most important for the sale of coal briquettes at this pilot plant stage are,

ex-factory price, methods of sales promotion, quality and display of coal briquettes and clay stoves in the market place. There are several quarters for selling charcoal in each market place. If one of these quarters handles coal briquettes, it could sell about five bags a day. Based on this estimate the annual sale of coal briquettes in Lusaka area would be 1,800 tons per year, or (5 bags/day/shop/market) x (40 kg/bag) x (30 markets) x (300 days/year) = 1,800 tons/year.

Similarly for clay stoves,
(10 pieces/month/shop/market) x (30 markets) x (12 months) = 3,600 pieces/year.

Actually there are more than 30 market places in Lusaka alone. These figures are therefore, not optimistic.

C. Sales price of coal briquettes and clay stoves

The prices of coal briquettes and clay stoves must be competitive enough with those of charcoal and mbaulas, respectively. The prices of firewood may be disregarded because majority of middle and low income brackets in the urban areas use mostly charcoal rather than firewood, while in the rural areas the opposite may apply. The retail price of charcoal in open markets in Lusaka is 10 to 12 Kwachas per 40 Kg bag, or 200 to 240 Kwachas per ton. Retail price of mbaulas ranges from 2.5 to 25 Kwachas per piece.

D. Marketers and consumers responses

The study team conducted public demonstration of briquettes and charcoal burning by clay stoves and mbaulas at several strategic locations. The responses may be considered very positive, sometimes enthusiastic. The suggestions the potential marketers and consumers showed gave the team very constructive suggestions as to the quality designs of briquettes and mbaulas.

(5) Coal Briquettes Manufacturing

Burning tests were conducted on NCSR's coal briquettes, Japanese coal briquettes using a mbaula and Japanese clay stoves. NCSR's briquettes use untreated coal slurries of MCL as raw material and are well-made. It was demonstrated that NCSR's briquettes burn well on the clay stoves but still leave room for improvement. First of all they give off smoke and odor on burning, particularly during the first one hour. Secondly it is rather difficult to start fire, particularly on mbaula. Improvement on these should be made during this study.

(6) Transportation

A. Transportation of raw materials

Since coal fines of Nitrogen Chemicals of Zambia (NCZ) has been found inadequate, the transportation study concerns waste coal slurry of MCL and Nakambala Sugar Estate's bagasse and molasses. The study on coal slurry transportation compares the following three cases:

			Km
Case 1	MCL to Masuku	Ropeway	12
	Masuku to Lusaka	Rail	320
	Lusaka to Plant Site	Road	10
Case 2	MCL to Batoka	Road	88
	Batoka to Lusaka	Rail	226
	Lusaka to Plant Site	Road	10
Case 3	MCL to Plant Site	Road	352

The transportation of bagasse and molasses was studied for the following cases:

Molasses

Case 4	Nakambala to Lusaka	Rail	96
	Lusaka to Plant Site	Road	10
Case 5	Nakambala to Plant Site	Road	132

Bagasse

Case 6	Nakambala to Lusaka	Rail	96
	Lusaka to Plant Site	Road	10
	Nakambala to Plant Site	Road	132

Molasses is actually transported by rail and road by tank car or tank truck. Nakambala Sugar Estate has three molasses tanks from which molasses can be loaded to tank cars or tank trucks. Bagasse is very light and can be manually loaded to railway open wagons or trucks.

Regarding limestone, the team planned to obtain it from Chilanga Cement Limited but later the team has found Crush

Stone Sales Limited supplies slaked lime instead of limestone, the former being a better material. Their slaked lime is sold in paper bags and, therefore, is easily loaded to and unloaded from trucks manually.

Clay stoves would use one or more of the four types of clay mined in Lusaka area. The distance of transportation is around 10 Km.

B. Transportation cost

(a) Conditions for cost estimate (1985/1986)

Methods		Charge or Tariff	Source
1. Ropeway	Maamba to Masuku	K6.^{08}/Ton	M.C.L.
2. Railway			Z.R.
.Wagon Capacity		40^{Ton}/Wagon	
.Basic Charge	Documentation	K5.^{00}/one distination	
	Siding	K 10.^{00}/Wagon	
.Tariff	Masuku to Lusaka	K52.^{50}/Ton	
	Batoka to Lusaka	K39.^{90}/Ton	
	Nakambala to Lusaka	K24.^{30}/Ton	
3. Road		K0.^{5}/Ton/Km	CH

(b) Cost (See case numbers for A)

- Coal Briquettes; 1,000 t/y -

. 1,400 to 2,200/y of the coal slurries: Case* 1 K90 to 140/t

2 K130 to 200/t

3 K250 to 390/t

. 50 to 100/y of Molasses	Case 4	K2 to 3/t
(Price is equal to K6/Ton)	5	K3 to 6/t
. 0 to 1,000t/y of Bagasse	Case 6	K0 to 30/t
	7	K0 to 70/t
- Clay stove; 4,000 pieces/y -		
. 25t/y of clay	Case 8	K0.23/piece
(Price is equal to K0.18/piece)		

*If we can unload the coal slurries from the railway directly, transport cost will become cheap by about K6.

(7) Infrastructure

The overall results of the infrastructure study is summarized in two tables in Attachment; "Field survey for infrastructure related to the transportation" and "Field survey for infrastructure and utilities related to the pilot plant location".

The former table analyzes the conditions of the existing infrastructure along the routes of transportation of raw materials; that is, coal slurry and clay. Seven sub-sections of transportation route are established for coal slurry and three for clay according to their characteristics to facilitate analysis.

The latter table shows important features of candidate sites, two in Maamba, two in Nakambala and three in Lusaka.

The study team trust that these two tables are self-explanatory. The study team itself conducted surveys of the places mentioned in the tables as well as collected information through interviews with concerned government authorities and councils.

(8) Design, Cost Estimation

Collection of information, data and recommendations required for preliminary design and cost estimation has been completed almost to our satisfaction during our surveying period.

We will carefully study and analyze these information, and data through our home-office work in Japan in order to minimize the project cost which is one of major factors for the successful execution of this project.

The following are the minimum design criteria that will be reflected in the design and cost estimation.

(a) Codes and Standards for the design, workmanship and Materials.

Although Zambian codes and standards shall, in principle, be applied to the design, workmanship and materials to be used for this project. Unless otherwise specified in these codes and standards, we will satisfy the requirements of British standard.

(b) Design Conditions (Recommended by NHA and Urban District Council)

1. Soil bearing capacity shall be 100KN/m^2 (safety side)
2. Wind pressure shall be 30^m/sec. (direction mainly from East)
3. Concrete compressive strength shall be as follows:
   - 3-1 For Structure and Foundantion: Grade 20.
   - 3-2 For Blinding Concrete: Grade 15 or 10.
4. Reinforcing bar yield strength shall be of 250N/mm^2 (Round bar) and 410N/mm^2 (DEFORMED bar)
5. No earthquake shall be considered

6. Imposed load on floor shall be of more than 0.25KN/m^2
7. Top height of chimney shall be of 10ft above the plant Building top
8. The plant Building shall have an adequate ventilation system.

(c) Approval of Design Drawings

6 (six) copies of following drawings shall be submitted, through NCSR, to Public Health, Lusaka Urban District Council inorder to obtain their approvals (0.25% of expected construction cost shall be borne by NCSR as drawing inspection fee)

1. Layout drawing
2. Location drawing
3. Plan, Section, Elevation (including machine layout)
4. Typical framing detail (beam and column)
5. Typical detail of machine foundation
6. Drainage plan

Note: No design calculations are submitted.

(d) Scope of Works

1. Incoming cables (11KV 3 phase 3w), Transforming system including WHM shall be installed and be maintained by ZESCO. (Cost shall be borne by NCSR)
2. Incase 11KV/6KV/3KV Transformer(s) is required for this project, NCSR shall provide such a transformer(s) with one stand-by. (Specifications of transformer shall be provided by ZESCO)
3. Medium and Low voltage distribution board shall be provided and be maintained by NCSR

4. Drainage system shall be extended to the plant boundary (one point) from the public drainage by Urban District Council. (Cost shall be borne by NCSR)
5. Water supply system shall be extended to the plant boundary (one point) from the public supply system by Urban District Council. (Cost shall be borne by NCSR)

(e) Cost Estimation

After plant mechanical and electrical preliminary design are finalized in Japan, we will estimate the project cost based on the following conditions:

1. Cement, Gravel, Sand, Asbestos cement sheet, Brick, Concrete block and similar materials are available in Lusaka
2. Steel materials such as structural steel or reinforcing bar are not available in Lusaka
3. We wstimate that it is very difficult to purchase finishing materials such as windows, doors, glass and their accessaries, lighting equipment, and plumbing equipment and materials according to the pre-determined procurement schedule of this project though some of them are deemed available in Lusaka
4. All mechanical and electrical machine, equipment and materials for the process shall be provided from abroad
5. Common labors are available in Lusaka, and their salaries are as follows (Informed by NHA)

1.	Semi-skilled	1.5K/Hour
2.	Unskilled	1.0K/Hour

6. Construction Supervisors and Technicians for the process, and structural steel works shall be despatched from abroad if necessary.

7. Maximum working hour shall be 192 hours per 4 weeks. (Informed by NHA).

8. In general, total contract price consist of the following ratio: (Informed by NHA)

8.1 Temporary works, site mobilization: 15 to 25% of 8.2 (Direct Cost)

8.2 Direct Cost

Materials	65%	Total 100%
Labor	30%	
Plant	5%	

8.3 Overhead: 10 to 12%of 8.1 plus 8.2

Note: 8.1 plus 8.2 = 32 to 35% of 8.2 (Direct Cost)

9. Price escalation (Informed by NHA)

Price of local materials and labors is escalating at 1.5 (month) or 18 to 25% (year)

(f) Meteorological data for the design

Please refer to clause (7)

(g) List of Data collected

The following is a list of Data collected by the team during surveying period.

LIST OF DATA COLLECTED

	Description	Collected from	Note
1.	Topographic survey map of proposed site	NCSR (City Council)	
2.	CAP 475 Town & Country Planning	Government Printing Centre	
3.	CAP 480 Local Government	- do -	
4.	CAP 514 Factories	- do -	
5.	CAP 535 Public Health	- do -	
6.	Sewage regulation	Lusaka Urban District Council	
7.	Application for permission to develop	Public Health, Lusaka Urban District Council	2 copies
8.	Application to erect a building	- do -	4 copies
9.	Structural steel and R. concrete certificate	- do -	2 copies
10.	Building Permit (Form 75001)	- do -	
11.	Price List of Construction Materials	NHA	
12.	Price List of Glass	Zambia Steel & BLDG Supply Ltd	
13.	Price List of Steel Materials	- do -	
14.	Catalogue of steel windows and doors	- do -	
15.	Price List of Crushed Stone Sales Ltd	Crushed Stone Sales Ltd	

16.	Price List of Construction materials	Shimizu Construction
17.	Labour's cost list	Zambia Gazette
18.	- do -	Minestone
19.	Local Contractor's list	Shimizu Construction
20.	Price List of pressure pipes	Top BLDG PRODUCT LTD (NHA)
21.	Price List of sewer pipes	- do -

(9) Financial and Economic Aspect

The study team had had a number of discussions with NCSR to obtain accurate information regarding financial and economic aspects of this project.

The study team visited Ministry of Finance, Committee of Taxes, Price and Income Commission and Ministry of Energy to obtain information on financial and economic matters.

The study team discussed raw material costs with the suppliers of these raw materials.

The major items having been discussed and discovered are as follows:

A. Taxes

(a) Import duty

Almost all commodities imported to Zambia are subject to import duty. However, the payment of import duty is normally exempt in the case of national projects. The final decision, whether the import duty will be imposed or not, will depend on the negotiations between Zambian Government and NCSR.

(b) Income Tax

Corporate income tax (35% of the profit) is exempt as incentives to pioneering industries.

(c) Other taxes

Sales tax (15% of selling price) is also exempt.

Property tax is not levied in Zambia.

B. Financing

Equity required for this project is assumed to be supplied by the own fund of NCSR and/or grants from the governmental organizations such as Ministry of Higher Education, for the purpose of evaluation.

Long term loan with appropriate conditions will be used in financial calculation.

C. Input cost

The following cost elements are assumed for financial evaluation:

(a) Coal slurry

The coal slurry at Maamba Collieries is waste resources, and can be supplied at zero price. The price of coal slurry at plant site is decided by the transportation cost.

(b) Bagasse

Excess bagasse which is piled at Nakambala Sugar Estate will be utilized at zero price.

(c) Molasses

Molasses will be supplied by Nakambala Sugar Estate. The present price of molasses at Nakambala is 40 Kwachas/ton.

(d) Clay

A sufficient amount of clay is available from brick bakers at Lusaka. The price of clay at the deposit is 30 Kwachas/ton.

(e) Electricity

Electricity will be supplied by Zambia Electric Supply Corporation at the price of 0.0287 Kwachas/kWh.

(f) Industrial water

The price of industrial water charges in proportion to consumption volume.

. less than 35,999 l/month	11 Kwachas/month
. 36,000 -135,999 l/month	0.34 Kwachas/l
. 136,000 -235,999 l/month	0.36 Kwachas/l
. 236,000 -335,999 l/month	0.38 Kwachas/l
. 336,000 -435,999 l/month	0.40 Kwachas/l
. more than 460,000 l/month	0.42 Kwachas/l

(10) Clay Stoves

Five kinds of clay were sampled and sent to Japan. Four of them occur in Lusaka area. One was taken at Nega Nega near Nakambala. Three kinds of clay produced at Lusaka are actually used for manufacture of bricks by baking at around 500°C or lower. Test pieces made from pure samples of these clay or their blends were subjected to experimental baking at Industrial Mineral Research of NCSR with the result that Chamba clay proved very promising on baking at 800°C for 7 hours.

Availability of plaster of Paris used for making molds has been confirmed. SANPOO INDUSTRIES LIMITED in Lusaka manufactures plaster of Paris from domestic natural gypsum. The quality of their plaster of Paris is not exactly ideal, but good enough for our purpose.

The reserves of clay and natural gypsum are large enough.

The team plans to use electricity for baking clay stoves in the oven.

5. BASIS FOR FINANCIAL AND ECONOMIC ANALYSIS

The following basis will be applied to the financial and economic analysis of this project:

(1) The financial analysis will prepare the following financial statements:

1. Production Cost Accounting Table
2. Profit and Loss Statement
3. Cash Flow Table
4. Balance Sheet

And then, the profitability of this project is evaluated by calculating Internal Rate of Return (IRR), Net Present Value and Benefit Cost Ratio.

(2) The financial and economic evaluations will be done on the constant price base as of March 1986 without escalations. The currency for the financial and economic analysis will be the local currency (Kwacha), and the foreign currencies will be converted to Kwacha.

(3) The major assumptions to be applied for the evaluations are as follows:

(A) Exchange Rate

US $ 1 = 6.76 Kwachas

1 Kwacha = 26.6 Japanese Yen

(B) Project Schedule

The project schedule will be developed by the study team.

(C) Selling Price

Coal briquettes, Kwachas/ton ex-factory	200
Clay stoves, Kwachas/piece	8

(D) Input Cost

- Coal Slurry : Transportation Cost
- Bagasse : - ditto -
- Molasses : Transportation Cost + 40 (Kwachas/ton)
- Slaked Lime : Transportation Cost + 440 (Kwachas/ton)
- Clay : Transportation Cost + 30 (Kwachas/ton)
- Gypsum : Transportation Cost + 2,500 (Kwachas/ton)
- Electricity : 0.0287 (Kwachas/Kwh)

(E) Financial Conditions

(a) Debt/Equity Ratio

Debt : Foreign Currency Portion

Equity : Local Currency Portion

(b) Conditions of Long-term Loan

The following two conditions will be applied to the financial evaluations.

	Case 1	Case 2
Interest Rate, %	12	As JICA sees appropriate.
Installments, times	20	
Repayment, year	10	
Grace period, year	0	

(c) Interest on short-term loan,% p.a. 26

(d) Interest during construction

The interest during construction for 18 months before start of production will be capitalized. The others are treated as cost.

(F) Depreciation and Amortization

(a) Machinery and Equipment

Method:	declining balance
Rate,% p.a.	30

(b) Building and Structure

Method:	straight line
Rate,% p.a.	5

(c) Amortization

Method:	straight line
Rate,% p.a.	5

(G) Tax

This project will be exempted from all taxes such as import duty, sales tax and corporate income tax.

(H) Unit Labor Cost (Kwacha/year)

- Engineer : 24,000
- Technician : 10,000

(I) Miscellaneous Cost (Kwacha/year)

10,000

(J) Administration Cost

This project is not charged with administration cost.

(K) Insurance Cost

0.25% of plant cost

(4) Sensitivity Analysis will be conducted for the following items:

- Investment cost
- Raw material cost
- Selling prices of the products
- Operation cost
- Annual production

(5) Taking into account economic costs and benefits of the project, the economic evaluation will be conducted from the national/social benefit view-points.

6. TEAM ACTIVITIES

Brief records of activities by the study team is given as follows:

Date	Place	Activity, Visit to
Feb. 25, Tue	Arrive in Lusaka	Meeting at Embassy of Japan
26, Wed	Lusaka	Meeting with NCSR, Presentation of Inception Report.
27, Thu	Lusaka-Maamba	Trip to Maamba. Meeting with MCL.
28, Fri	Maamba	Coal Slurry sampling Infrastructure survey (IN.MS) Clay survey (MU) Information gathering.
Mar. 1, Sat	Maamba-Lusaka	Return trip to Lusaka
2, Sun	Lusaka	Review of Information and data Market Survey
3, Mon	Nakambala	Trip to Nakambala Sugar Estate Sampling of Bagasse and Molasses Information gathering
	Lusaka	Clay survey and sampling (MU.IN)
4, Tue	Kafue	Trip to Kafue Fertilizer plant Sampling of coal slurry from flyash Information gathering
	Lusaka	Clay survey and sampling (MU.IN)
5, Wed	Lusaka	Visit to NDPC AND MHE (KT,MN,YI)

Date	Place	Activity, Visit to
		SITE SURVEY (ALTERNATIVE I)
		CLAY SURVEY AND SAMPLING (MU. IN)
Mar. 6, Thu	Lusaka	MEASURING AND PACKING OF SAMPLES
		Preparation of Test piece of clay (MU. IN)
		Preparation of shipping documents (KT, MN)
		Visit to UZ and Information gathering of clay (MU)
		Market survey (KC).
7, Fri	Lusaka	Arrangement and confirmation of shipping of samples
		Report to NCSR and Embassy of Japan about shipping (KT.MN)
		Market survey (KC).
8, Sat	Lusaka	Survey of Life style
		Market survey (KC. YI)
		Review of Information and data.
9, Sun	Lusaka	Market survey (KC, YI, MH, JS. MU)
		Construction site and Infrastructure survey (MN. IN.MS)
		Inner meeting.
10, Mon	Lusaka	Meeting with NCSR (KT. MN)
		Inner Meeting about Coal and Bagasse (KT. MH.JS.MN)
		Market survey (KC)
		Survey of Economic situation (YI)

Date	Place	Activity, Visit to
Mar 10, Mon	Lusaka	Discussion with Industrial Minerals Unit, NCSR (MH.MU.JS)
11, Tue	Lusaka	Meeting with NCSR (KT.MN) Preparation of Progress Report(KT) Visit to Construction Sites (MN. IN) Survey of Transportation (MS) Market survey (KC) Survey of Economic situation (YI)
12, Wed	Lusaka	Discussion with Industrial Minerals Unit, NCSR (MU.MH.JS) Inner Meeting about clay stove (KT. MN.MU) Survey of Design standard and Construction Cost (MN) Survey of Infrastructure and Transportation (IN.MS) Survey of Economic situation (YI) Preparation of Progress Report(KT)
13, Thu	Lusaka	Demonstration of briquette and clay stove (KT.MU.MH.JS) Survey Design standard and Construction Cost (MN.IN)
	Lusaka/Kabwe	Visit to National Railway of Zambia (MS)
	Lusaka	Survey of Economic situation(YI) Preparation of Progress Report

Date	Place	Activity, Visit to
Mar 14, Fri	Lusaka	Meeting with NCSR (KT) Survey of Design standard and Construction Cost (MN.IN) Market and Economic Survey (KC.YI.MH.JS) Review and Arrangement of Information and data (MU.MS) Preparation of Progress Reports (KT) Visit to NIEC (KT.YI.KC)
15, Sat	Lusaka	Demonstration of Briquette and clay stove at Market (MH.MU. JS.KC. YI) Preparation of Progress Reports (KT.MN.IN.MS.) Inner meeting for Progress Reports
16, Sun	Lusaka	Market survey at provincial area (KC.YI) Construction site and Infrastructure survey (MN.IN.MS) Preparation of Progress Report Review of Information and data
17, Mon	Lusaka	Meeting with Embassy of Japan (KT. MH.MN.YI) Visit to new proposed sites (MN.IN.MS)

Date	Place	Activity, Visit to
Mar 17, Mon	Lusaka	Market survey (KC) Survey of Economic situation (YI) Preparation of Progress Report
18, Tue	Lusaka	Preparation of Progress Report Survey of car maintenance shop, NCSR (MN) Visit to Provincial Forest Office (MU.MH) Survey of Transportation System Survey of Plaster of Paris (MU)
19, Wed	Lusaka	Preparation of Progress Report Preparation of Minutes of Meeting Survey of Transportation System (MS)
20, Thu	Lusaka	Submission and presentation of Progress Report Signing of Minutes of Meeting.

Note: Abbreviations of the study team names:

KT: Koji TANAKA (Team Leader)

MH: Mitsuyoshi HAYASHI (Briquetting process)

MU: Motoo UENO (Clay stove)

JS: Jiro SASAOKA (Briquetting manufacturing facilities)

MN: Mitsuhisa NISHIKAWA (Design and Cost estimation)

IN: Iwao NAKAJIMA (Infrastructure and building)

MS: Mamoru SHIBATA (Transportation)

KC: Kenju CHIMURA (Market)

YI: Yoshitaka IMAEDA (Economic analysis, policies)

7. CONCLUSION

Here we present major concludion of the field survey as follows:

(1) The study team of JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) arrived in Lusaka on 25th of February and held on the 26th the first meeting with their counterparts on NCSR. The study team presented Inception Report. The study team collected necessary samples and sent them to Japan. The team also collected information and data necessary for the home-office work.

(2) The study team established a tentative project scheme to define the project on a preliminary basis.

(3) Thus, the study team has completed the objectives of the field survey.

8. ACKNOWLEDGEMENT

We, study team for feasibility study on BRIQUETTES DEVELOPMENT PROJECT, consider this field survey a success and we owe it greatly to NCSR for giving us the fullest cooperation and support. First of all, we thank Dr Silangwa for making the best of NCSR available to us. Dr Silangwa himself also has spared a large portion of his time for discussion with us. We also express our deepest appreciation to Professor Siamwiza for acting as our chief counterpart and facilitating our field activities. Mr Mwamfuli accompanied the team for trips to Maamba, Nakambala and Kafue for sampling of raw materials. He also accompanied us to many interviews. Mr Chimwara allowed us to use facilities and equipment for experiments. Professor Yamba gave us valuable pieces of advise on clay stoves. Mr Nyenga assisted us in coal slurry samples collection. He also explained processing schemes of the colliery. Dr Kaoma, Mr Phiri, Mr Mwonu and Mr Mukumbwa conducted with us briquettes and charcoal burning tests. These gentlemen also provided us with valuable information. Miss Mwanza assisted our market study. Without her assistance our lifestyle survey would have been very superficial. Mr Kambani helped us with Mr Kondowe a great deal in our market study. Mr Kambani helped us particularly in obtaining a permission for market survey. Mr Dimingo helped us identify clay deposits and take clay samples. Mr Chanda assisted us in our site survey.
Mr Ngulube is instrumental in obtaining

design standard and information for cost estimation and also for our infrastructure study. Mr Bima assisted our transportation study. Miss Maambo and Miss Malwa helped making appointments. The last but by no means the least Mrs Nyemba typed this report.

The contributions by these ladies and gentlemen of NCSR and other organization are not limited to those described above. We thank all those who have helped us to accomplish this field survey.

INTERVIEW LIST

Maamba Collieries Ltd

Mr J.M. Sangambo	Personnel and Admin. Manager
Mr M S Simataa	Technical Service Manager
Mr T J Nyenga	Chief Chemist

Nakambala Sugar Estate Ltd

Mr J Spook	General Manager
Mr J M Ragnauth	Assistant General Manager

Nitrogen Chemicals of Zambia Ltd

Mr Polizzi Saliatore	General Manager
Mr Mwewa F Kambobe	Assistant General Manager

National Commission for Development Planning

Mr F M Siame	Senior Under Secretary
Mr L E Banda	Senior Economist
Mr D D Kasunga	Economist

Ministry of Higher Education

Mr C M Sikazwe	Permanent Secretary
Mr A K Mukela	Under Secretary

Ministry of Power, Transport and Communication

Mr D J Mbewe	Director, Department of Energy

Ministry of Finance

Mr D D Kasunga	Economist

Price and Incomes Commission	
Mr Thorbjorn Gudjonsson	Chief Accountant
Commission of Taxes	
Mr K L Pulu	Assistant Commissioner of Taxes
Zambia Industrial and Mining Corporation Ltd	
Mr Phillip O. Simfukwe	Executive Assistant
Industrial Development Corporation Ltd	
Mr Kimber Grant	Acting Director of Projects
Mr Kufika Tom N.	Industrial Engineer
Mr Hojan	Manager of Public Relations Control
Small Industries Development Organization	
Mr Derrick Chitala	Manager, Training and Co-operatives
Mr Henry S S Phiri	Project Engineer
Zambia Bureau of Standard	
Mr Matta Mukelabai	Standards Officer
Mr M C S Ratu	Engineer
National Housing Authority	
Mr Y K Gulati	Senior Surveyor
Mr A Rahim	Senior Engineer
Mr P J Mukuka	Chief Architect

Meteorological Office

Mr V Simango	Director of Meteorology
Mr A Siwiti	Meteorological Assistant

Lusaka Urban District Council

Mr Same Mbewe	Health Inspector
Mr Y R Wijesuriya	Chief Building Inspector
Mr R H Hankombo	Water Engineer

Behrens Ltd

Mr Tony J Rawnsley	Contracts Manager

Lusaka Station and Goods Office of Zambia Railways

Mr B T Chinyonga	Lusaka Station Master
Mr C Chimbotu	Goods Office Manager

Contract Haulage Ltd

Mr Anderson S Kapaya	Regional Manager

Zambia Railways in Kabwe

Mr R M Yikona	Marketing Manager
Mr M T Hiwuzila	Assistant Traffic Manager
Mr A Mbahkhe	Operations Planning Officer

City Council (City Engineering Department)

Mr Chieta	Senior Road Engineer

Ministry of Works and Supply (Road Department)

Mr T Ngoma	Director

Brick and Tile Manufacturing Co. Ltd

Mr Patel	Production Manager

Sanpoo Industries Ltd	
Mr Srinivasan Selvaraj	Production Manager
Moore Pottery Ltd	
Mr A M Chambeshi Jr	Managing Director
Geological Survey Department	
Dr Pether	
Lusaka Urban District Council	
Mr Hubert Bweupe	Commercial and Industrial Secretary
Mr Padwell Lubaya	Chief Administration Officer
Mr Shadreck Mtonga	Assistant Accountant
Mr S M Changaya	Building Inspector
Mr W M Kabimba	Advocate/Solicitor
Mr Mwila Mumbi	Market Supervisor
Mr T L Mwanamoonze	Chief Housing Officer
Mr Mwendapole	Peri-Urban Housing Dept.
Miss Irene N Mulundika	Peri-Urban Section
Mr F M Mulele	Site and Service Housing Officer
University of Zambia	
Lecton Owada	School of Mines
Mr Francis P Kasoma	Lecturer in Journalism and Head
Mrs Robie Siamwiza	Lecturer, Social Development Studies
Prof F D Yamba	Dean, School of Engineering

Dr Michael Leslie	Lecturer in Journalism
Prof Lunga	Dean, Department of Humanities
Dr Fundanga	Head, Business and Economic Study Department
Mr C N Mwikisa	Lecturer, Transport/Energy
Mr Abraham Mwenda	Lecturer, Finance/Marketing
Mr Msafili K Bigambo	Lecturer, Marketing/Finance

Department of Natural Resources

Mr E N Chidumayo	Conservator of Natural Resources

Department of Forest (Ndola)

Mr A S Banda	Chief Extension and Training Officer

Provincial Forest Office

Mrs Winnie Musonda	Provincial Forest Officer

Lusaka North Plantation

Mr S Namakando	Forestor

Central Statistical Office

Mrs Mulenge	Statistical Officer

Zambia Electric Supply Corporation

Mr E A Moyo	

Kalingalinga Compound

Mr S Simalabe	Ward Chairman
Mrs Mwemba	Chairlady

Chelston Market

Mr Mwape Masuku	Branch Chairman

Chaisa Compound

Mr F Njovu	Ward Chairman
Mrs Avet Tembo	Chairlady

National Import and Export Corporation Ltd

Mr C C F Mambwe	Managing Director
Mr B Dhlamini	Merchandisor Manager

Midland Farmers Cooperatives Society Ltd

Mr B E Masters	Trading Manager

Lusaka Province Co-operative Union Ltd

Mr S L Muyakwa	General Manager
Mr Winney Kaumba	Marketing Manager

National Council for Scientific Research Counterpart Team

Dr S M Silangwa	Secretary General/NCSR
Professor M N Siamwiza	Deputy Secretary General/NCSR
Mr S Kambani	Mineral Economist/NCSR
Dr J Kaoma	Metallurgical Engineer/NCSR
Mr G Phiri	Chemical Technology/NCSR
Mr S Mwonu	Technical Officer/NCSR
Professor F D Yamba	Mechanical Engineer/UNZA
Mr A Ng'andu	Mechanical Engineer/UNZA
Mr C Konayuma	Electrical Engineer/Department of Energy
Mr W Serenje	Energy Planner/Department of Energy
Miss D Mwanza	Economist/National Energy Council

Mr G Ngulube	BLDG Research Unit/NCSR
Mr C C Munthali	Clerical Officer - Insurance
Ms Mwambwa Imenda	Senior Accountant
Mr C P Chanda	Senior Administrative Officer (Real Estates)
Mr M T Dimingo	Ceramic Laboratory
Mr J Mujaye	- ditto -
Mr G V Chimwala	Industrial Mineral Unit
Dr Chisanga	Geological Unit
Mr P M Mwamfuli	Chief Research and Development Coordination and User Liaison Officer
Mr M M Kondowe	Research and Development Coordination and User Liaison Officer
Mr B L H Bima	- ditto -
Mr G Phiri	Head of Project, Briquette Development Unit
Mr A Mukumbwa	Assistant

APPENDIX III - 1

MINUTES OF MEETING

THEME : FEASIBILITY STUDY ON BRIQUETTES DEVELOPMENT PROJECT IN THE REPUBLIC OF ZAMBIA

DATE : MARCH 20, 1986

PLACE : National Council for Scientific Research (NCSR), Lusaka, the Republic of Zambia

1. The study team of JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) arrived in Lusaka on 25th of February and held on the 26th the first meeting with their counterparts of NCSR. The study team presented 20 copies of Inception Report. NCSR and the study team basically agreed on the objectives, schedule and the method for the execution of this feasibility study as explained in Inception Report, although there have been some modifications in the field survey schedule.

2. The study team presented to NCSR 10 copies of Progress Report on March 20, 1986 upon conclusion of the field survey. NCSR and the study team agree on the content of Progress Report.

3. NCSR and the study team agree that, with intensive and attentive support by NCSR, the study team has accomplished the objectives of the field survey as explained in Inception Report.

4. NCSR and the study team agree on the tentative project scheme as formulated in Chapter 3 PROJECT SCHEME FOR FEASIBILITY STUDY of Progress Report and also both parties agree that the financial and economic evaluations will be developed according to Chapter 5 BASIS FOR FINANCIAL AND ECONOMIC ANALYSIS of the same report.

Date : March 20, 1986

Place : Lusaka, Zambia

DR S M SILANGWA
Secretary-General
National Council for
Scientific Research.

KOJI TANAKA
Leader of Study Team, JICA,
on BRIQUETTES DEVELOPMENT
PROJECT IN THE REPUBLIC OF
ZAMBIA.

APPENDIX III - 2

NATIONAL COUNCIL FOR SCIENTIFIC RESEARCH

MINUTES OF MEETING ON THE PRESENTATION OF DRAFT FEASIBILITY STUDY REPORT ON BRIQUETTE DEVELOPMENT PROJECT IN THE REPUBLIC OF ZAMBIA

1. The Japan International Cooperation Agency (JICA) Feasibility Study Team formally presented the Draft Feasibility Study Report on Briquettes Development Project in the Republic of Zambia to the Right Honourable K S K Musokotwane, MCC, MP, Prime Minister of the Republic of Zambia in his capacity as Chairman of the National Council for Scientific Research (NCSR) on 05 November 1986.

2. In his welcoming remarks to the JICA Team, the Right Honourable Prime Minister, enthusiastically received the Report. He highlighted and underscored the importance and priority the Zambian Government has, over the past six years, attached and continue to attach to the project.

3. In presenting the Report, Mr Koji Tanaka, the JICA Team Leader outlined and explained the Report which was based on the Terms of Reference agreed to between the NCSR and JICA. At the Presentation Ceremony also, the coal briquettes and the stove made from Zambian raw materials and the stove from the Japanese raw materials were shown.

4. Prior to the formal presentation, the NCSR, the Zambian Counterpart agency to JICA on this feasibility study, and other relevant Government authorities had studied the Draft Feasibility Study Report and accepted it without any reservation. It is well developed, well documented and satisfies the Scope of Work agreed upon between JICA and NCSR. It also conforms to the understanding between the study team and NCSR that was established and recorded in the Progress Report presented to NCSR and to the Minutes signed at the end of the field study.

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KT

5. The JICA Study Team conducted burning tests of the coal briquettes in the clay stove at the NCSR. The briquettes and the clay stove were both experimentally produced, as part of the feasibility study, from the Zambian raw materials as explained in Chapter 11 of the Draft Feasibility Study Report. The burning tests were demonstrated at the Department of Energy in the Ministry of Power, Transport and Communications (MPTC). The Honourable F Chuula, Minister and Honourable E Haimbe, Minister of State in the Ministry attended the demonstration. The burning tests were also demonstrated at the Ministry of Mines where Honourable L S Subulwa, Minister and his Senior Officials attended the demonstration. The NCSR found that the performance of the coal briquettes and clay stove were quite satisfactory under the Zambian conditions.

6. NCSR explained on behalf of the Government of Zambia the importance that the Government attaches to this project in that this project would lay a groundwork onto which could be formulated future coal briquette projects for providing an alternative domestic fuel for charcoal and firewood, whose production encroaches upon the nation's forests.

7. The NCSR said that with the available technical knowledge in coal briquetting and ceramics together with the plentiful supplies of the requisite raw materials especially coal slurries at Maamba and clay at Chaamba Valley, it (the NCSR) has the technical base to provide both administrative and management requirements of operating the pilot plants once a right technology has been properly transferred.

8. The NCSR further said that they and the relevant authorities of the Zambian Government had studied the financial evaluation of the draft report. NCSR considers that the possibility of the insurance and maintenance costs of Case 3 being borne by the Zambian Government is very high. NCSR will also continue to study on their own the possibility of reducing the maintenance cost by effectively utilizing Zambian machine shops, which NCSR considers quite realistic in the light of the results of the

observation of Japanese coal briquettes factories and their operation by the counterparts during their training in Japan.

9. NCSR takes this opportunity to express its sincere appreciation to JICA for the cooperation extended to NCSR in the form of this feasibility study and also congratulates the Study Team for the excellent job embodied in the draft feasibility study report.

November 7, 1986

K. Tanaka

Koji Tanaka
Leader of Study Team
on Briquette Development
Project, Japan International
Cooperation Agency, Japan

S M Silangwa
Secretary General
National Council for
Scientific Research,
Zambia.

APPENDIX IV

Months	Pressure (0800)	Thermograph Mean Temperature °C	Mean Max Temperature °C	ABS Max Temperature °C	Mean of ABS Max Temperature °C	Mean Min Temperature °C	ABS Min Temperature °C	Mean of ABS Min Temperature °C	Dew Point °C	Rel Hum %	Sunshine Hours Per Day	Wind Speed Knots	Evaporation mm	Rainfall Total mm	0.01" Rain Days	0.04" Rain Days (1 mm)	0.40" Rain Days (10 mm)	Frost Days	Radiation (Langleys)
No. of Years Available	3	4	4	4	4	4	4	4	3	3	3	4		4	4	4	4	3	30
July	892.6	15.6	24.2	28.9	26.7	7.7	0.6	3.3	6	53	9.1	7.0		0	0	0	0	ø	468
August	890.9	18.1	26.2	32.8	30.9	10.6	0.6	6.0	6	47	9.2	7.9		0	0	0	0	0.	536
Sept	889.0	21.6	29.8	33.9	33.3	12.9	7.2	9.3	7	39	10.1	8.2		ø	ø	0	0	0	593
Oct	887.5	24.3	32.0	37.2	36.1	17.0	11.1	13.3	10	41	8.9	7.9		25	3	3	1	0	619
Nov	887.4	23.1	29.3	35.0	34.4	17.8	13.9	15.3	14	58	7.0	6.3		96	11	10	4	0	562
Dec	886.3	21.5	26.9	32.8	31.1	17.6	12.8	15.6	17	76	5.6	4.5		245	18	15	9	0	511
Jan	885.7	21.7	27.3	32.2	30.9	17.7	13.9	15.0	18	77	6.0	3.9		216	20	77	8	0	495
Feb	886.1	21.4	27.3	31.1	30.0	17.2	12.8	14.6	16	72	6.7	4.6		119	14	11	3	0	493
March	887.6	21.3	27.6	32.8	30.5	16.1	10.0	11.7	15	68	7.6	5.2		60	12	11	2	0	525
April	888.8	20.2	27.3	31.1	30.3	14.1	8.9	10.7	14	68	8.8	6.0		34	4	3	1	0	534
May	890.3	18.3	26.2	30.0	29.1	11.5	7.2	7.3	11	61	9.2	6.5		11	2	1	ø	0	488
June	891.6	15.8	24.2	30.0	28.2	8.3	0.0	2.6	8	57	8.9	5.5		0	0	0	0	1	453
Year	888.6	20.2	27.3	37.2	30.9	14.1	0.0	10.4	11	58	8.1	6.1		806	84	70	28	1	

LUSAKA INTERNATIONAL AIRPORT

LAT. 15° 19'S LONG. 28° 27'E ALT. 1154 m

Station	Lat. Long. Alt.	Months	Pressure (0800)	Derived Mean Temp. $\frac{Max + Min}{2}$	% Rel. Hum.	Mean Max °C	Mean Min °C	ABS Max °C	Mean of Highest Max °C	ABS Min °C	Mean of Lowest Min °C
1923-1937											
No. of Years Available				15		15	15	15	15	15	15
		July		18.4		26.6	10.3	32.2	30.2	-2.2	6.1
		August		20.6		29.2	12.1	36.7	34.3	4.4	7.0
		September		24.2		33.4	15.1	38.9	37.2	5.6	10.0
		October		27.5		36.1	18.9	41.7	39.0	13.3	15.2
		November		26.9		34.5	19.3	41.1	38.2	13.3	15.8
BOMA		December		24.5		30.5	18.6	36.7	34.2	10.6	14.0
		January		24.1		29.9	18.2	33.9	32.6	12.2	14.3
		February		24.0		29.9	18.1	32.8	31.3	14.4	16.0
MAZABUKA	1039 Mts.	March		23.8		30.1	17.6	32.2	31.4	10.0	13.3
		April		22.8		29.9	15.7	33.3	31.6	8.9	11.7
		May		21.1		29.1	12.9	32.8	31.1	3.3	6.9
	15°49'S 27°45'E	June		18.6		26.6	10.6	32.2	30.0	-1.1	5.4
		Year		23.0		30.5	15.6	41.7	33.4	-2.2	11.3

Months	Pressure (0800)	Thermograph Mean Temperature °C	Mean Max Temperature °C	ABS Max Temperature °C	Mean of ABS Max Temperature °C	Mean Min Temperature °C	ABS Min Temperature °C	Mean of ABS Min Temperature °C	Dew Point °C	Rel Hum %	Sunshine Hours Per Day	Wind Speed Knots	Evaporation mm	Rainfall Total mm	0.01" Rain Days	0.04" Rain Days (1 mm)	0.40" Rain Days (10 mm)	Frost Days	Radiation (Langleys)
No. of Years Available	14	14	15	22	22	15	14	14	18	18	14	8	7	22	22	10	10	3	14
July	879.9	12.6	22.8	28.9	26.8	3.3	-3.3	0.0	5	58	9.2	2.5	127	0	0	0	0	0	464
August	879.2	15.1	25.3	32.8	30.0	5.1	-2.7	0.8	5	50	9.9	2.3	152	0	0	0	0	0	529
September	877.5	19.2	29.0	35.0	33.5	9.2	1.7	4.7	7	45	9.8	2.5	202	1	Ø	0	0	0	598
October	876.2	22.1	31.2	37.2	35.6	12.8	6.7	8.2	9	45	9.2	2.5	217	22	2	4	0	0	621
November	875.5	21.8	29.1	37.2	34.1	15.8	8.9	12.1	15	63	6.3	2.3	181	93	11	12	4	0	528
December	874.6	21.0	27.5	34.4	32.1	16.5	10.0	13.5	16	75	5.5	2.2	134	209	17	16	8	0	508
January	874.2	20.7	26.6	35.0	30.7	16.3	10.0	12.5	17	79	5.9	1.9	133	200	20	17	7	0	521
February	874.1	20.5	26.6	31.7	29.9	16.3	12.2	13.3	17	81	5.8	1.9	125	185	16	12	6	0	507
March	875.5	19.9	26.7	33.9	29.8	14.3	7.2	10.5	16	77	7.6	1.9	151	86	10	7	2	0	556
April	876.9	18.6	26.8	31.7	30.3	11.7	3.9	7.3	14	73	8.8	1.6	153	23	3	2	1	0	531
May	878.2	15.3	24.9	32.2	28.9	6.7	-0.5	2.0	8	63	9.3	1.8	146	6	1	Ø	0	0	482
June	879.8	12.9	22.7	28.9	26.5	3.8	-6.1	0.0	6	61	9.1	1.8	121	6	1	Ø	0	4	448
Year	876.8	18.3	26.6	37.2	30.7	10.9	-6.1	7.0	11	64	8.0	2.1	1342	831	81	71	28	4	

CHOMA

LAT. 16° 51'S LONG. 27° 04'E ALT. 1267 m

Months	Pressure (0800)	Thermograph Mean Temperature °C	Mean Max Temperature °C	ABS Max Temperature °C	Mean of ABS Max Temperature °C	Mean Min Temperature °C	ABS Min Temperature °C	Mean of ABS Min Temperature °C	Dew Point °C	Rel Hum %	Sunshine Hours Per Day	Wind Speed Knots	Evaporation mm	Rainfall Total mm	0.01" Rain Days	0.04" Rain Days (1 mm)	0.40" Rain Days (10mm)	Frost Days	Radiation (Langleys)
No. of Years Available 13	13	13	13	13	13	13	13	13	13	13	8	8	13	13	10	10	3	13	
July	15.9	24.7	30.0	28.2	7.4	1.1	3.3	8	54	9.3	5.3	164	0	0	0	0	0	482	
August	18.3	27.4	32.8	31.9	9.7	0.6	4.7	7	47	10.0	5.5	187	0	0	0	0	0	545	
September	21.9	29.9	36.1	34.9	13.4	0.6	8.8	9	43	10.1	6.3	225	2	Ø	0	0	0	611	
October	24.8	33.6	37.8	37.2	16.6	11.1	12.1	11	41	9.8	6.1	169	15	4	3	0	0	644	
November	23.8	31.3	38.3	36.1	18.2	12.8	13.8	15	59	6.9	4.0	190	85	11	7	4	0	556	
December	22.7	28.9	37.2	34.1	18.2	12.2	15.6	18	75	5.7	3.2	147	250	19	10	7	0	521	
January	22.3	28.3	35.6	31.9	18.2	13.3	15.3	19	81	6.2	2.7	150	197	19	13	7	0	526	
February	22.2	28.1	32.8	31.0	18.2	12.8	15.7	19	81	6.4	2.5	128	149	17	14	5	0	532	
March	21.7	28.7	33.9	31.5	16.3	10.0	12.0	17	76	8.2	3.1	164	55	8	6	2	0	575	
April	20.7	28.9	33.3	31.9	13.9	6.1	9.5	15	67	9.3	3.8	179	18	3	1	0	0	557	
May	18.3	27.2	33.3	30.1	10.1	0.6	4.5	11	62	9.6	4.8	166	6	3	Ø	Ø	0	509	
June	16.1	24.9	30.0	29.1	8.5	-3.8	3.5	8	60	9.1	4.9	139	Ø	Ø	0	0	3	466	
Year	20.8	28.5	38.3	32.3	12.4	-3.8	9.9	13	62	8.5	4.3	2108	777	84	54	25	3		

KAFUE POLDER

LAT. 15° 46'S LONG. 27° 55'E ALT. 987 m

APPENDIX V

FIRST SCHEDULE
(Regulation 2)

PART I (EXTRACT)

FEES AND PRICE FOR FOREST PRODUCE

ITEM NO.	TYPE OF PRODUCE	FEES PER CUBIC METRE	
	A--TIMBER	K	K
001	Afzelia quanzensis (Mupapa, Mwende)	4.30	8.50
002	Albizia species (Musase, Mutanga)	3.00	5.75
003	Baikiaea plurijuga (Mukusi)	4.50	4.90
004	Entandrophragma species (Mofu, Mofwe, Mupumena)	4.90	8.20
005	Erythropleum africanum (Kayimbi, Mukoso, Mubako)	3.00	6.00
006	Guibourtia coleosperma (Muzauli, Mushibi)	3.00	4.90
007	Faurea saligna (Saninga, Mushokoto)	3.00	4.90
008	Khaya nyasica (Mululu, Mbawa)	4.30	8.10
009	Mitragyna stipulosa (Mupa)	3.00	4.90
010	Pericopsis angolensis (Mubanga)	2.30	6.90
011	Pterocarpus angolansis (Mukwa, Mulombwa, Mulombe, Mukula)	4.30	10.35
012	Other species	1.15	2.50
	B-POLES		
021	Poles not exceeding 14 centimetres butt diameter	06n each	
022	Poles between 15 centimetres and 19 centimetres butt diameter	17n each	
023	Poles between 20 centimetres and 24 centimetres butt diameter	23n each	
024	Poles between 25 centimetres and 30 centimetres butt diameter	46n each	
025	Bamboos	05n for 10 canes	
	C--FUELWOOD FROM INDIGENOUS TREES		
031	Stacked in cubic metre or just stacked	12n per cubic metre	
032	In cords 1 metre x 1 metre x 3 metres	35n per cord	
033	In headloads	12n for 5 headloads	
034	Charcoal	09n per standard grain bag measure	
041	For temporary huts	K1.00 per hut	
042	For semi permanent huts built with poles not exceeding 14 centimetres butt diameter	K2.30 per hut	
043	For maintenance of huts	17n per month	

附录