FEASIBILITY STUDY REPORT

ON

ALCOGAS PROJECT

IN

MARAGONDON, CAVITE

THE REPUBLIC OF THE PHILIPPINES

VOLUME II

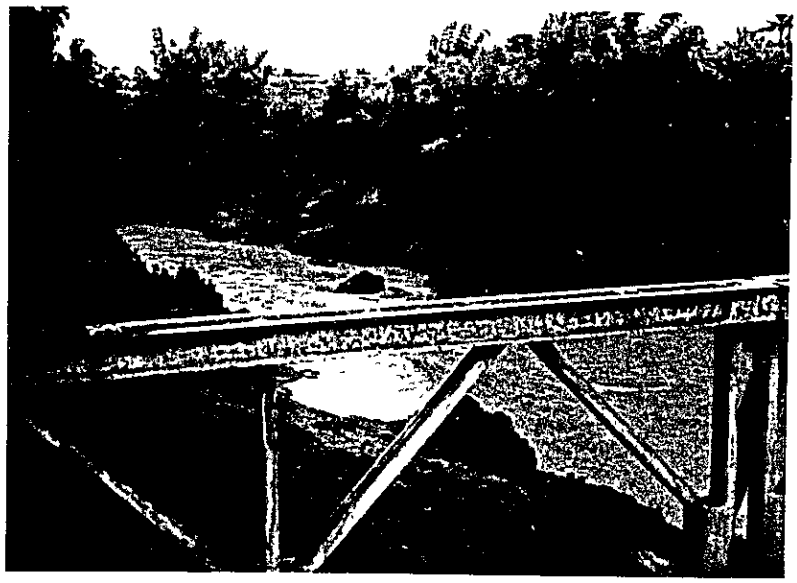
MAY 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

Proposed Plant Site "A" (Sabang)

Proposed Plant Site "B" (Halang)

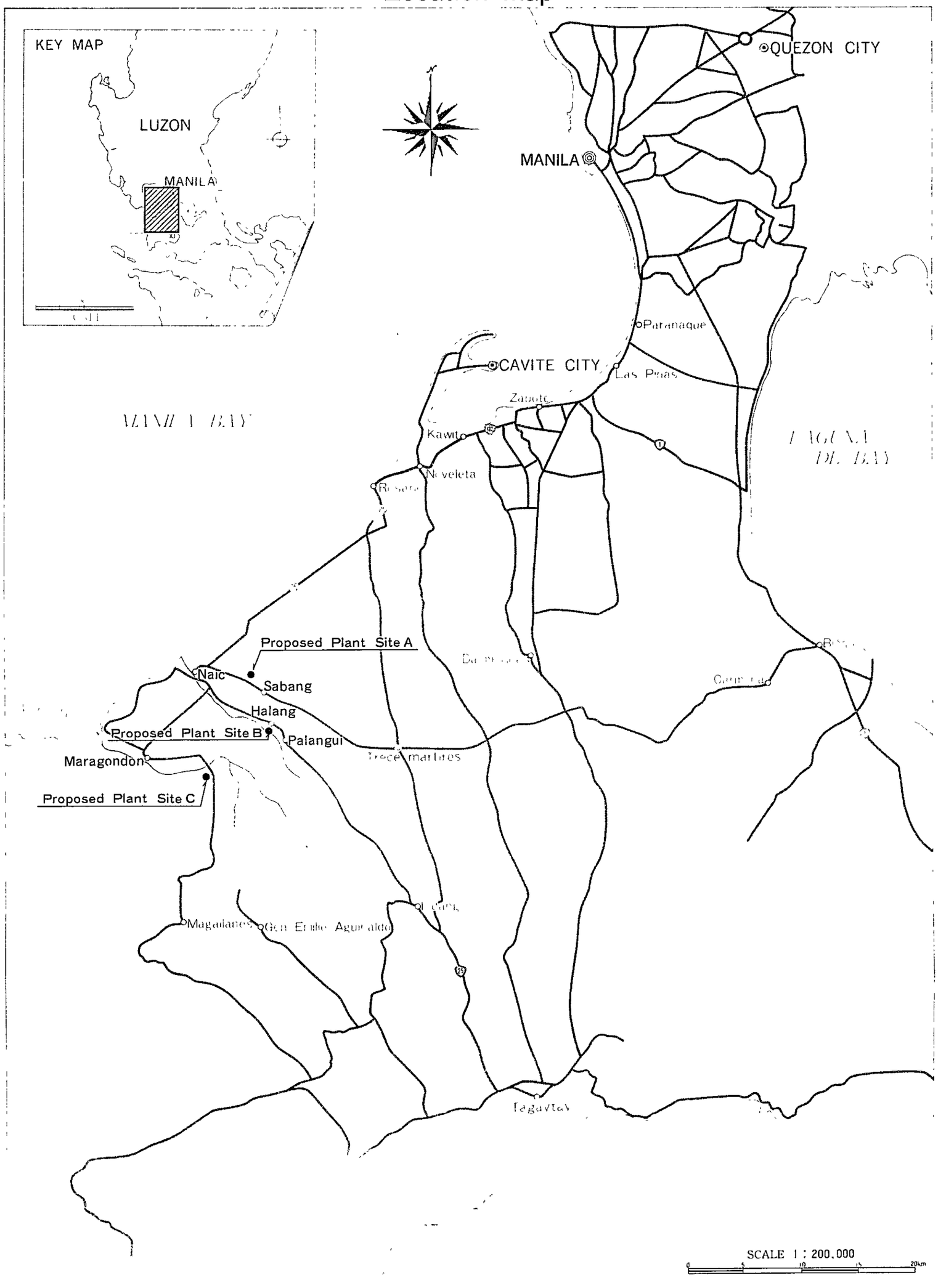
Proposed Plant Site "C" (Maragondon)



Maragondon River

Balsahan River

Location Map



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ABSTRACT

1. Outline of Project

(1) General

1) Total capital investment

Approx. 186 (10^6 pesos). In addition to this, governmental investment of about 24 (10^6 pesos) would be required.

2) Schedule

Start-up of Distillery is assumed January 1987. (Construction period of 4 years will be required.)

(2) Agricultural

1) Farm area

Estate area	400 ha
Individual farmers' land area	2,640 ha

2) Expected sugarcane yield

123,670 t/y as total sugarcane yield from both estate and individual farmers' land.

(3) Industrial

Distillery

Plant capacity	48 kl/d
Annual operating days	200 d/y

2. Project Evaluation

(1) Economic analysis

Results of economic analysis give EIRR value of 9.7% which implies that the project can create certain economic benefit to the country and therefore that it should be promoted for realization.

(2) Financial analysis

Financial analysis gives FIRR on Investment and FIRR on Equity of 9.2% and 16.8% respectively which imply that the project can have fair profitability if not very high.

SUMMARY
AND
CONCLUSION

SUMMARY AND CONCLUSIONS

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SUMMARY AND CONCLUSIONS

I. INTRODUCTION

(1) This study was carried out on the Model-III of the Alcogas Project based on the Minutes of the Meetings dated December 16, 1980 and June 4, 1981 as agreed upon between the Japan International Cooperation Agency (JICA) and the Philippine National Alcohol Commission (PNAC).

(2) This is the final report as the result of a technical and economical study of the Alcohol Distillery on the premise that sugarcane is the most suitable raw material as derived from the findings of the Phase-I study.

(3) The tables and illustrations being used in this summary and conclusions are numbered in the same way as those referred to in the detailed report.

II. TECHNICAL REVIEW OF ALCOHOL DISTILLERY FACILITIES

1. Basis of Facility Planning

Based on the agreement with PNAC, major factors which were taken into consideration as a basis of the facility designing are as follows:

(1) Capacity of the Alcohol Distillery

In making a technical review, a capacity of the Alcohol Distillery was set at 60 kl/d, a standard capacity of the Model-III.

(2) Annual plant operating days

It was estimated at 200 days/year.

(3) Sugar content of the raw material

Based on the findings of the Agricultural Sector Team, it was determined as follows:

1)	Sucrose	13.5%
2)	Invert sugar	0.6%
	Total	14.1%

In the Interim Report the total sugar content was stated as 12.0%, but the actual sugar content of sucrose in the sugarcane being produced in the Southern Luzon was taken into consideration and the figures were changed as stated.

2. Location of Alcohol Distillery

Three locations were selected as the proposed sites of the Alcohol Distillery and a comparative study was made. The three locations are shown in Figure VII-1.

Fig. Ⅶ - 1 Proposed Plant Sites

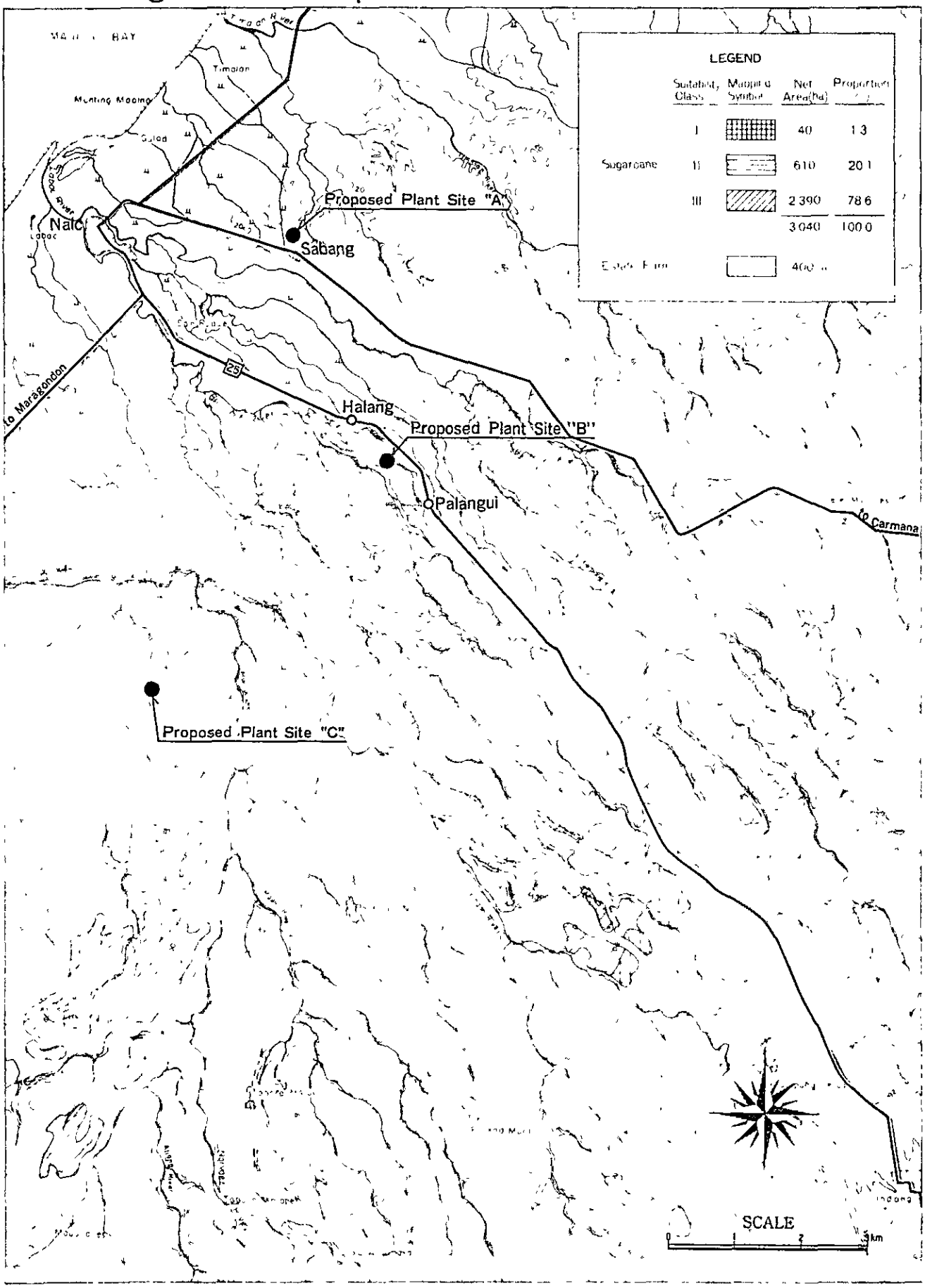
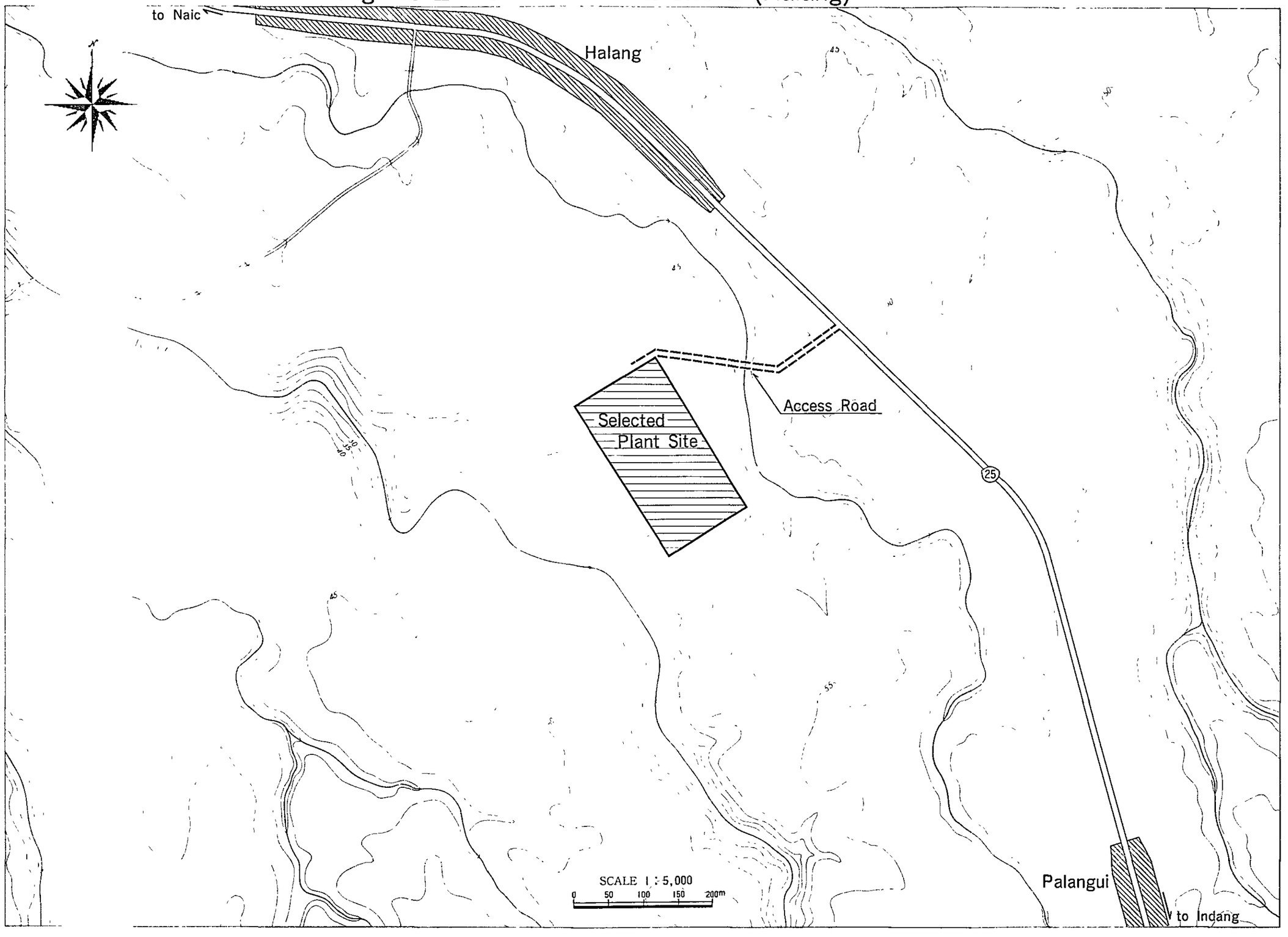


Fig. Ⅶ-2 Selected Plant Site B (Halang)



Proposed site A: Vicinity of Sabang
Proposed site B: Vicinity of Halang
Proposed site C: Vicinity of Maragondon

As a result of the site evaluation, the proposed site B was selected as the most suitable location because of the lower transportation cost of sugarcane.

The location of the Alcohol Distillery in Halang is shown in detail in Figure VII-2.

3. Selection of Suitable Process

An outline of the process to be selected is shown as follows: for further detailed information, please refer to the detailed report.

3-1 Extraction of Sugar

Both milling and diffusion processes were comparatively studied. The diffusion process is superior theoretically to recover higher percentage of sugar. However, according to the information obtained from PHILSUCOM and a number of companies operating the diffusers, the process has little flexibility against fluctuations in sugarcane quality. Consequently there are many cases, in which the process is unable to demonstrate its originally expected performance. Accordingly conventional milling process is selected in this study. However, as the diffusion process is somewhat superior with respect to construction and maintenance costs, it may be evaluated favorably whenever the performance stability for fluctuations in sugarcane quality is achieved. Therefore, development of the diffusion process should always be watched.

3-2 Clarification and Concentration of Sugarcane Juice

In the Interim Report, clarification and concentration processes of sugarcane juice were adopted. As a result of the final review, clarification process was adopted, but concentration process not.

(1) Clarification process

Because of adoption of the yeast recycling process for fermentation, the clarification process is required to prevent microbial contamination. In addition, it is expected that the clarification process will decrease formation of scale in the mash column.

(2) Concentration process

In the Interim Report, the concentration process was adopted for two reasons: 1) higher initial sugar content of the fermentation medium was required and 2) initial sugar content of the fermentation medium can be kept uniform. As a result of further review, sucrose content of sugarcane was found higher than expected, and therefore the necessity of concentration process stated in 1) above disappeared and that stated in 2) above is not major factor compared with 1) above. Furthermore, since the construction cost of approximately 7,000 x 10^3 pesos could be saved by eliminating the concentration process, it was concluded that the concentration process is not adopted.

3-3 Fermentation

A comparative evaluation was made for batch, yeast recycling and continuous fermentation processes. The continuous fermentation process is currently in the course of development according to relevant literatures and expected to be favorable in view of the low construction and operating costs. However, it will take a considerable time prior to commercialization and also involves many technical problems to be solved. Accordingly, this study adopted the yeast recycling process which is the most advanced fermentation process at present with the result of actual experience, though the process requires higher technique in operation and maintenance than the batch process.

In addition, since studies on heat resisting enzyme and high efficiency microbes are extensively being made in recent years, the trend of the studies needs careful attention.

3-4 Distillation

A comparative evaluation was made on the distillation processes with respect to such aspects as operating pressure, dehydration agent and type of tray.

(1) Distillation process

A comparative study was made on both atmospheric and pressurized distillation processes. The pressurized process is superior in view of the construction cost, consumption of steam, etc.

However, the pressurized process involves many technical problems to be solved such as corrosion of column materials, and scale formation of the mash column owing to higher distillation temperature. On the contrary, the atmospheric distillation process has many commercial experiences and also is easy to operate, and therefore this study has adopted the atmospheric process.

(2) Dehydration agent

A comparative study was made on benzene, cyclohexane and trichloroethylene as dehydration agent. Difference among them is very little. This study selected benzene because of easy availability and many commercial experiences in Japan.

Furthermore, a study was made on the use of gasoline as dehydration agent taking note of the fact that fuel alcohol is mixed into gasoline at the end. However, this is still in the course of investigation and it is too early to adopt for industrial purpose. Therefore gasoline was not considered in this report.

(3) Type of trays

As the type of trays to be adopted in mash and rectification columns, bubble cap trays were adopted because of their high distillation efficiency and wide flexibility for load fluctuation. On the other

hand, sieve trays were adopted for dehydration column and benzene recovery column for their high efficiency and inexpensive cost.

4. Considerations on Distillery Planning

The following points have been considered in planning the Distillery:

4-1 Measures for Maintenance

As Alcohol Distillery is located near Manila, a large scale maintenance as well as maintenance required during a long plant shut-down was assumed to be handled by outside contractors. Only facilities required for daily maintenance during the normal operation are included in the Distillery together with the required technicians.

4-2 Environmental Countermeasures

Environmental problems will be as a rule treated in accordance with the requirement of the National Pollution Control Commission (NPCC). A study of waste water treatment was especially carefully conducted:

(1) Waste water countermeasures

A comparative study on waste water countermeasures was made on four methods, such as lagoon, activated sludge, and anaerobic digestion processes and utilization as irrigation water. An estimated annual expenditure on utilization as irrigation water is approximately 400×10^3 pesos, while the other processes require $2,000 - 6,000 \times 10^3$ pesos. Therefore, inexpensive utilization as irrigation water was adopted.

Furthermore, a waste water pit was considered for the purpose of holding waste water for 36 hours before it is sprinkled to the cane field

and suspending its supply to the field in the event of heavy rainfall in order to prevent an outflow of waste water into rivers.

(2) Countermeasures against air, noise and odor pollution

Preventive facilities were considered to meet the requirement of the NPCC standard.

4-3 Safety Measures

Safety measures shall be complied with the requirement of 1) the Fire Code of the Philippines and Regulation and 2) the National Fire Codes (U.S.A.). Installation of fire extinguishers, lightning rods, dikes, explosion proof type electrical equipment was especially considered.

4-4 Utilization of By-products

A study of by-products such as bagasse, carbon dioxide and yeasts was made. As the result, carbon dioxide is expected to be profitable when used for soft drink after manufacturing liquefied carbon dioxide. However, both bagasse and yeasts are difficult to utilize because of unfavorable economics.

4-5 Instrumentation System

Instrumentation systems were studied considering the requirement from the process, cost of instrumentation equipment, maintenance problems, etc.

4-6 Inland Transportation of Equipment

As the result of the survey, it was found that there are both sea route and high way route for transportation. There will be no serious problems to be expected when the equipment debarked at Manila Port is transported to the Alcohol Distillery site.

5. Conceptual Design of Alcohol Distillery

The conceptual design was made on the premises of the items stated in the Chapters 1 through 4. In this design stage, the capacity of the Alcohol Distillery was assumed 60 kl/d.

(1) Process flow

The process flow is shown in Drawing VII-15. The concentration process adopted in the Interim Report was eliminated in this design.

(2) Material balance

A material balance is shown in Drawing VII-16.

(3) Consumption of chemicals and utilities

Consumption of chemicals and utilities are shown in Table VII-18. In addition, a balance of steam and electricity was prepared in detail Drawing (VII-17) through (VII-19).

(4) Equipment list

An equipment list was prepared in Table (VII-22).

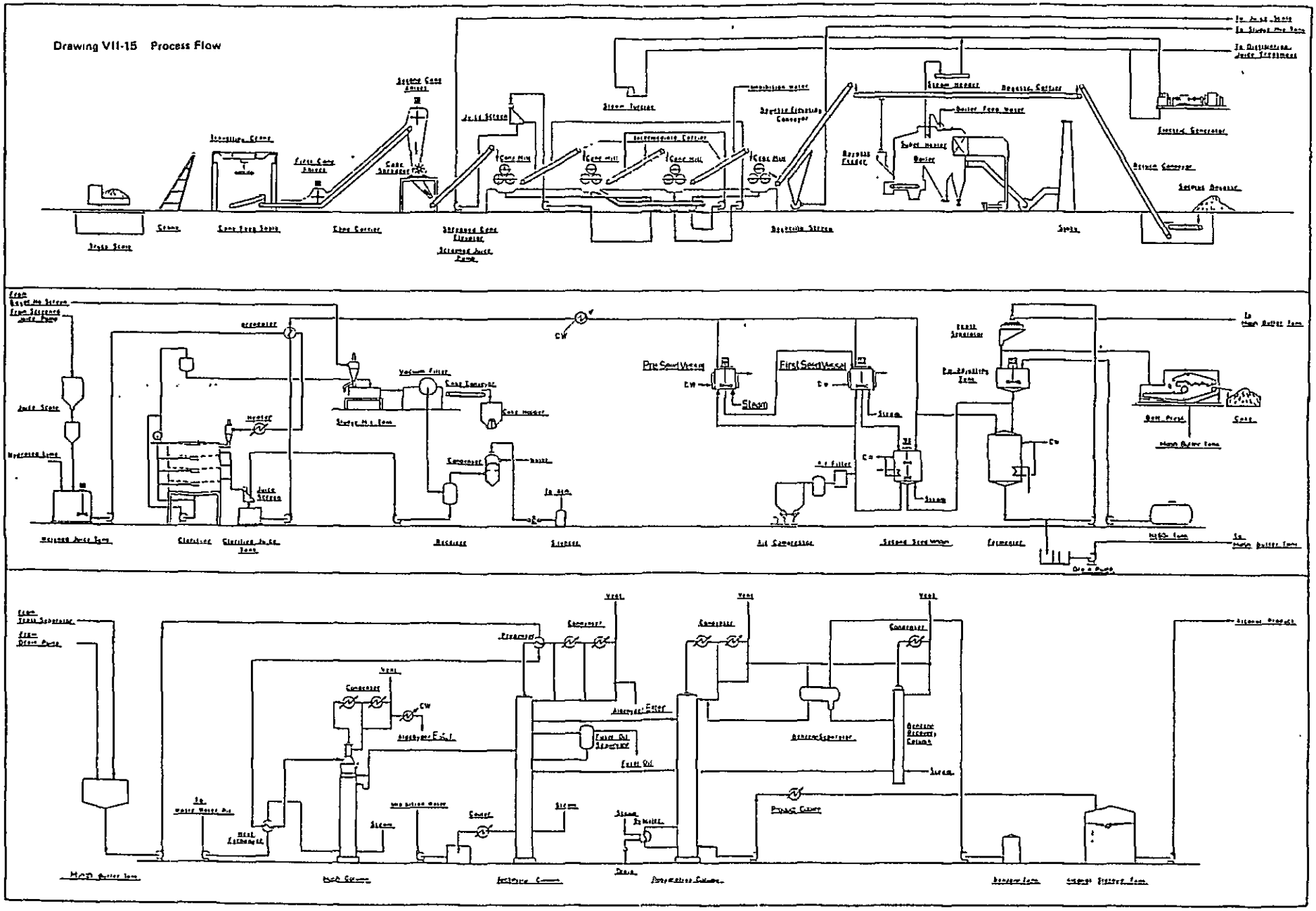
(5) Spare parts

Spare parts of 20% - 200% depending on the equipment were considered.

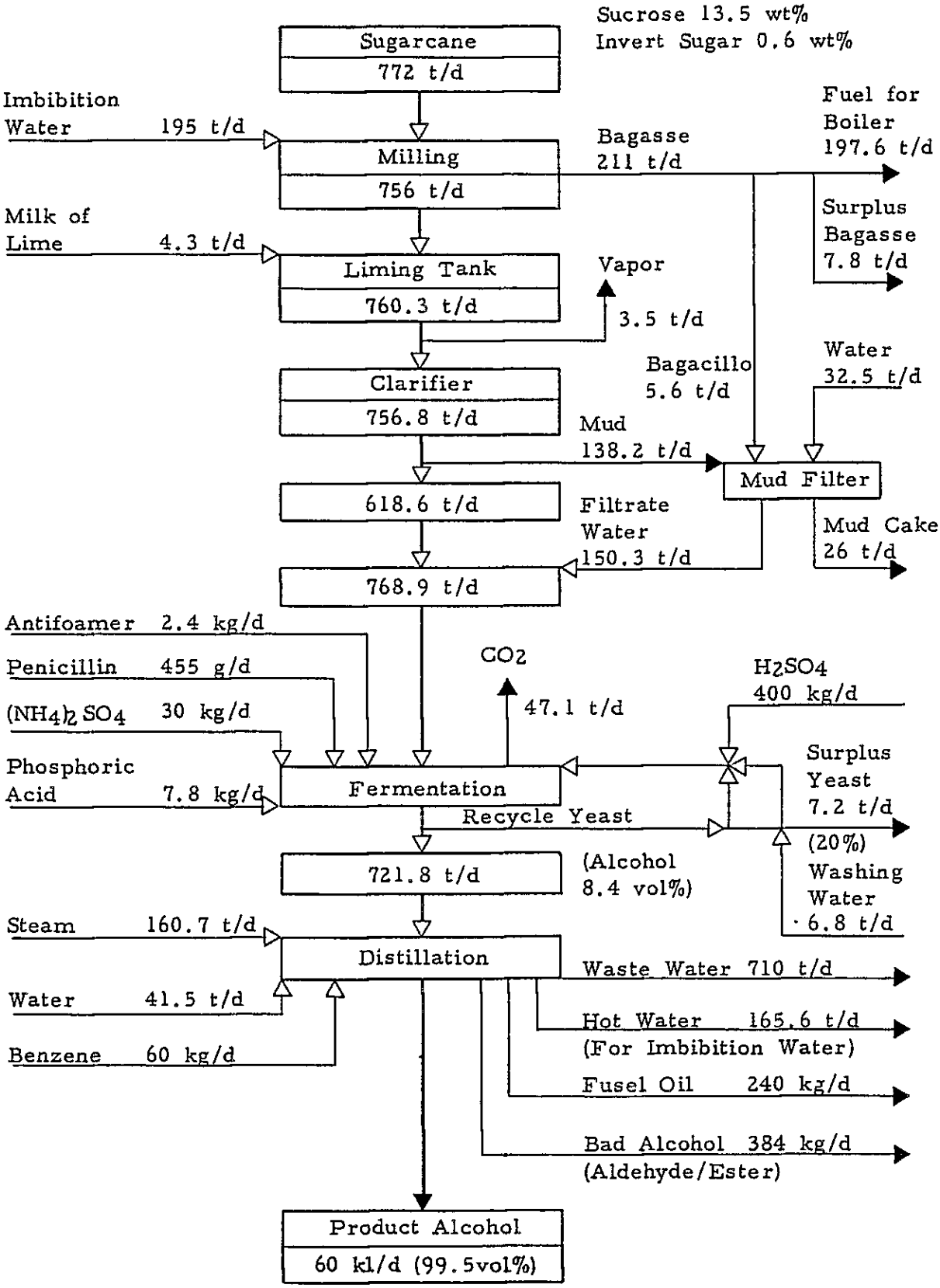
(6) Plot plan

A plot plan is shown in Drawing VII-30. The required site area will be 32,500 m^2 (130 m x 250 m).

Drawing VII-15 Process Flow



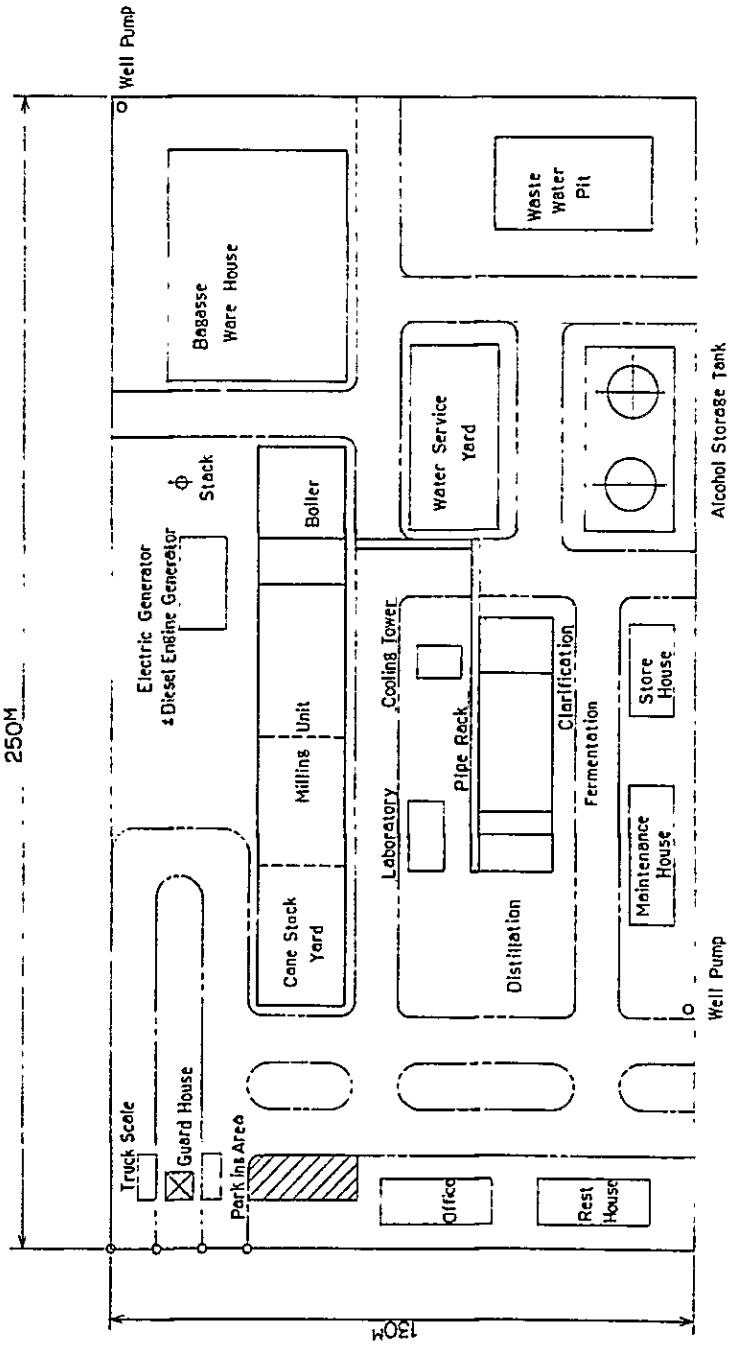
Drawing VII-16 Material Balance



Tavle VII-18 Consumption of Raw Material, Chemicals and Utilities

	Raw Material, Chemicals and Utilities	Consumption/d	Consumption/ kl - Alcohol
1	Sugarcane	772 t	12.87 t
2	Well Water	2,832 t	47.2 t
3	Electric Power	19,200 KWH	320 KWH
4	Benzene (For Distillation) Initial Running	 3.08 t 60 kg	 1 kg
5	H_2SO_4 (98%) (For Fermentation)	400 kg	6.7 kg
6	Antifoamer (For Fermentation)	2.4 kg	40 g
7	Lime (100%) (For Clarification)	600 kg	10 kg
8	Penicillin (For Fermentation)	455 g	7.6 g
9	$(NH_4)_2SO_4$ (For Fermentation)	30 kg	0.5 kg
10	Phosphoric Acid (For Fermentation)	7.8 kg	0.13 kg
11	NaOH (100%)(For Demineralizer etc)	150 kg	2.5 kg
12	HCl (100%) (For Demineralizer etc)	100 kg	1.7 kg
13	Corrosion Inhibitor (For Cooling Water)	27 kg	0.45 kg
14	Slime Inhibitor (For Cooling Water)	1.2 kg	20 g
15	Phosphoric Acid Soda (For Boiler)	4.9 kg	82 g
16	Hydrazine (For Boiler)	7.3 kg	122 g
17	Bagasse (For Fuel)	197.6 t	3.3 t

Drawing VII-30 Plot Plan



(7) Construction schedule

A construction schedule is shown in Drawing VII-31. Major steps are as follows:

1)	Beginning of design work	November 1984
2)	Completion of Distillery and beginning of test-run	October 1986
3)	Beginning of commercial operation	January 1987

The required construction period of the Alcohol Distillery will be two years and the test-run two months.

(8) Organization and personnel required

An organization and the required personnel are shown in Figure VII-4. The plant organization will consist of 3 departments, namely Administration, Production and Maintenance Departments, with a total of 132 employees. As for the estate concerned, 61 employees are required in total according to the detailed report prepared by the Agricultural Sector Team. A grand total of employees will be 193.

(9) Construction cost

The plant construction cost at a capacity of 60 kl/d on the basis of 1981 cost value is estimated at 120,460 x 10^3 pesos. An expected proportion of the imported and domestic goods will be 48.9% and 51.5% respectively. The detailed figures are shown in Table (VII-23).

The aforementioned figures are based on the conceptual design of the Alcohol Distillery with a production capacity of 60 kl/d. However, the expected capacity based on the crop yield of sugarcane surveyed by the Agricultural Sector Team has turned out to be 48 kl/d. As a reference, therefore, a technical information of the distillery with a capacity of 48 kl/d is described in Appendix 5. The financial and

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Drawing VII-31 Project Schedule

CLIENT Philippine National Alcohol Commission	PLANT Alcohol Distillery	LOCATION Cavite, Philippines	REV.

NO.	ITEM
1.	Basic Design
2	Detail Design
3	Manufacturing & Supply of Equipment & Materials
3-1	Milling Unit
3-2	Boiler & Electric Generator
3-3	Other Equipment
3-4	Supply of Materials
3-5	Shipping
4	Civil Work
5	Election
6	Piping
7	Electrical & Instrumentation Work
8	Mechanical Test
9	Test Run

1981: 11 12
1985: 1 2 3 4 5 6 7 8 9 10 11 12
1986: 1 2 3 4 5 6 7 8 9 10 11 12
1987: 1

Commercial Run

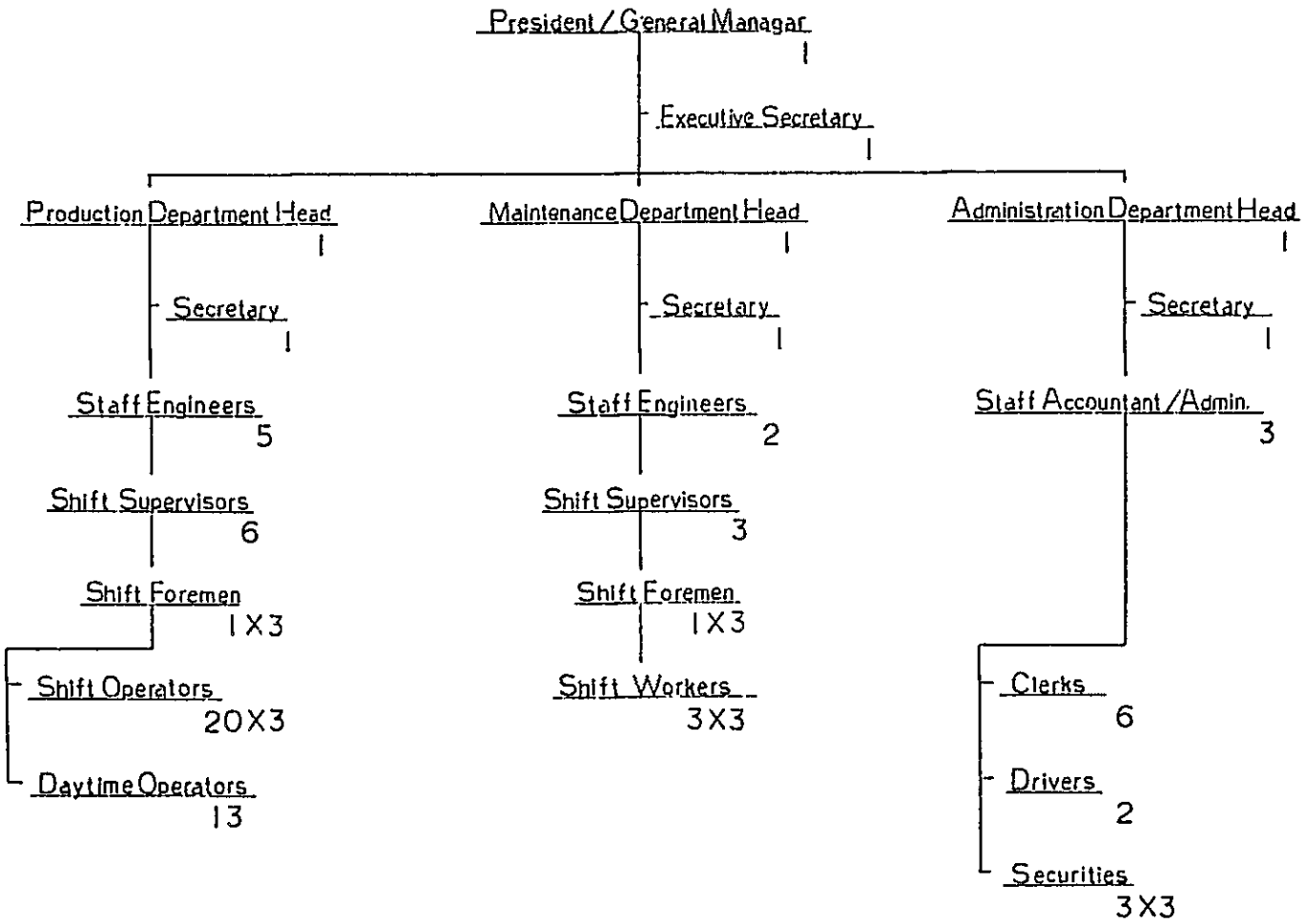
LEGEND

PLANT ENG'G & MECHANICAL DESIGN
PROCUREMENT
FABRICATION
INSPECTION
TRANSPORTATION
CONSTRUCTION

COPY

S - 18

Fig. VII-4 Organization Chart for 60 kl/d Alcohol Distillery



Kinds of Personnels	No. of Personnels
President/Gen. Manager	1
Executive Secretary	1
Depart. Heads	3
Secretaries	3
Staffs	10
Shift Supervisors	9
Shift Foremen	6
Shift Operators	60
Shift Workers	9
Daytime Operators	13
Clerks	6
Drivers	2
Securities	9
Total	132

economical calculations to be described later adopt 48 kl/d as the capacity of the Distillery.

6. Energy Balance

Detailed studies on the energy balance have shown the ratio of output to input energy to be 13.5.

III. FINANCIAL AND ECONOMIC ANALYSIS

1. Financial Analysis

The financial analysis covers the estate owned by the alcohol plant and plant itself. It is estimated that the production capacity is 48 kl/d and operating days are 200 d/y. The analysis is made for 24 years.

1-1 Study Cases

(1) Base case

As adopted ordinarily in the Philippines for financial analysis, the constant price basis of the year of start of operation is used and the deflation of interest is disregarded.

1) Investment concerning agricultural roads and bridges for independent farmers

Studies are made as to whether or not agricultural roads and bridges for individual farmers should be included in the capital for this project.

(Unit: %)

	Without Infrastructure	With Infrastructure
EIRR on I	9.2	7.9
EIRR on E	16.8	12.9

As indicated in the above Table, when the said infrastructure such as roads and bridges is included in the capital requirement, FIRR on I decreases by 1.3%, lowering the profitability. As the tax revenue to the Government will increase after start of commercial operation, when this project is realized, it is assumed that the agricultural roads and bridges for the independent farmers are eliminated from investment of the project, leaving them as Government investment.

2) Establishment of estate

Studies are made concerning establishment of an estate.

(Unit: %)

	With Estate	Without Estate
FIRR on I	9.2	7.9
FIRR on E	16.8	12.7

As shown in the above Table, the installment of estate improves profitability and contributes to the stable operation of the plant. Therefore, the estate is preferably established.

Accordingly, for the Base Case, the constant price basis of the operation start-up year and thereafter is used; the deflation of interest is disregarded; the agricultural roads and bridges are eliminated from the investment; and the estate is installed.

(2) Sensitivity analysis of base case

Analyses are carried out using the changes of product prices, raw material prices, construction costs and interests, and using molasses as sub-raw materials for the increase of operating rate.

(3) Reference cases

As reference cases, the following analyses are conducted.

1) Case where escalation is considered even after the start of commercial operation, and incentives are also taken into consideration.

2) Case where the constant price from the year of start of commercial operation is used, and no incentives are considered.

3) Case where escalation is considered even after the start of commercial operation, and no incentives are taken into consideration.

4) Case where the Distillery capacity is assumed 60 kl/d with the constant price after the start of operation and with incentives.

1-2 Total Capital Requirement and Operating Costs

(1) Total capital requirement

The total capital requirement is composed of the fixed capital and the working capital.

1) Fixed capital

Included in the fixed capital are land acquisition, construction costs, preoperating expenses, initial chemicals and interest during construction period.

2) Working capital

The cash generated from the sales of sugarcane before commercial operation in the years of 1985 and 1986, and the sales amount of alcohol produced in the test run exceeded the amount of the initial working capital. Therefore, no extra requirement is considered as initial working capital.

As the total capital requirement, $186,172 \times 10^3$ pesos is estimated for the estate and alcohol plant.

(2) Operating costs

Operating costs are composed of raw material cost, variable costs and fixed costs.

1) Raw material cost

An escalation rate for raw material cost is set at 7%/y from now to 1987, and the cost in 1987 is estimated at 240 pesos/t.

2) Variable costs

Utilities such as electricity, water and fuel can be provided under a self-supply system. Therefore, only chemicals that need to be introduced from outside the system are considered. The escalation rate for these costs are set at 7%/y from now to 1987.

3) Fixed costs

Considered as fixed costs are operation and maintenance costs for the estate, labor costs, property taxes, insurance, general expenses, plant overhead, depreciation, and interest.

1-3 Sales

In view of the nature of this project, it is assumed that all the products produced can be sold. An escalation rate for alcohol price is set at 8% from now to 1987.

1-4 Premises for Financial Analysis

Premises for financial analysis are as follows.

(1) Period

The periods subjected to financial analysis are the construction period from 1983 to 1986 (4 years) and the years during operation from 1987 to 2006 (20 years).

(2) Operating rate

The operating rate for 1987, initial year, is set at 67%, and thereafter at 91%, 95% and 98%, and for 1991 and thereafter is set at 100%.

(3) Consideration for price escalation

Before the year of commencement of commercial operation of the alcohol plant, escalations are considered, while for 1987 and thereafter, a constant price basis is used.

(4) Exchange rate

The exchange rate (1 US$ = 8 pesos = ¥230) is used.

(5) Funds arrangement plant

1) 25% of capital requirement is financed with paid-up capital (own capital funds) and 75% on long term loan.

2) Long-term and short-term loan

The interest rate of long-term loan is set at 8%/yr, and that of short-term loan at 18%/yr.

(6) Income tax

The rate of income tax is set at 35% of profit, and that of local tax at 3%.

(7) Incentives

Considered as incentives are:

1) Shortening of depreciation period
2) Carryover of operating loss

3) Exemption of customs duties and taxes for imported machinery and equipments
4) Treatment of preoperating expenses as depreciable cost

1-5 Results of Financial Analysis and Discussion

1-5-1 Results of financial analysis of base case

(1) Operating cost

Operating costs are shown in the following Table.

(Unit: Pesos/l)

	1990	1995	2000
Variable costs (Including raw material expenses)	2.67	2.68	2.68
Fixed costs	5.17	2.94	2.05
Total	7.84	5.62	4.73

The sales price of product alcohol is 6.93 pesos/l, and therefore, the operating costs in 1990 exceed the sales price. However, in 1995 and thereafter, the sales price exceeds the operating costs, because depreciation and interest that occupy large proportion of the fixed costs go down every year.

(2) Debt service coverage ratio (DSR)

DSR, which shows loan repaying capability, is over 1 in 1987, and in each year thereafter.

This project will be involved in some difficult financial arrangements at first, but it will become capable of repaying its debt, and will be in a position of self-support.

(3) Profitability

The profitability of Base Case is shown in the Table below.

(Unit: %)

FIRR on I	9.2
FIRR on E	16.8

As shown in the above Table, FIRR on I, an indicator of profitability, is 9.2%. This value suggests that though the profitability of this project is not so high, it can produce some profit.

While, FIRR on E, an indicator of profitability against own capital (equity), is 16.8%. As this value is over the actual interest rate, this project is considered attractive to investors.

1-5-2 Sensitivity analysis of base case

The results of a sensitivity analysis conducted on Base Case are as follows.

(1) Changes in product price

The price of product alcohol in 1987 is varied by ±10%, and studies are conducted on the effects of such changes given on profitability.

(Unit: %)

	Basic Price (6.93 Pesos/l)	+10%	-10%
FIRR on I	9.2	12.1	6.4
FIRR on E	16.8	27.3	<-10.0

As shown in the above Table, the effect of product alcohol price on the profitability is significant.

The sensitivity analysis of the Base Case is carried out on the premise that the product alcohol price will rise 8% per year from now to 1987, which is 1% higher than operating costs. As indicated in the above Table, the effects of product alcohol price on the profitability are so great that the PNAC's basic policy, namely when the gasoline price is raised, one half of the rise should be reflected on the sales price of product alcohol, is suggested to be reconsidered.

(2) Changes in raw material price

Studies are made to see the effects on the profitability of lowering the raw material price in 1987 from 240 pesos/t to 210 pesos/t or 180 pesos/t.

(Unit: %)

	Basic Price 240 pesos/t	210 pesos/t	180 pesos/t
FIRR on I	9.2	10.5	11.8
FIRR on E	16.8	21.4	26.1

As shown in the above Table, the profitability is enhanced by lowering the raw material price.

(3) Changes in construction cost

Studies are made on the effects exerted on the profitability of varying the total capital requirement within the range of ±10%.

(Unit: %)

	Basic Case	+10%	-10%
FIRR on I	9.2	8.2	10.3
FIRR on E	16.8	13.8	20.9

As indicated in the above Table, capital requirement exerts less significant effects on FIRR on I.

(4) Changes in interest

For sensitivity analysis of interest, studies are conducted on the effects exerted on FIRR on E by varying the 8%/yr of the Base Case to 6%/yr and 10%/yr.

(Unit: %)

	Basic Case (8%/yr)	6%/yr	10%/yr
FIRR on E	16.8	21.0	13.6

As seen from the above Table, interest exerts significant effects on FIRR on E. Therefore, it is essential to procure funds of low interest in order to make this project attractive to investors.

(5) Changes in operating load (using molasses as sub-raw material)

When molasses is used as sub-raw material, the operation days per year are increased from 200 days to 300 days with increase in the total fund by 3.7%. Studies are made on two cases, one with the molasses price of 1,010 pesos/t, and the other with 810 pesos/t.

(Unit: %)

	Base Case	Molasses (1,010)	Molasses (810)
FIRR on I	9.2	14.9	15.9
FIRR on E	16.8	39.2	43.5

As indicated in the above Table, when molasses is used as a sub-raw material and the operation days per year are increased, the profitability is improved. However, this case should be carefully considered in view of the facts that molasses itself can earn foreign currencies by export and that as the molasses is more easily treated by annexed distilleries of Model-I or II, this project has to compete with the Model-I and Model-II of the Alcogas Project for procurement of molasses.

1-5-3 Results of financial analysis of reference cases

The results of financial analysis conducted on the reference cases are as shown under.

(1) Case for which escalation and incentives are taken into consideration and its sensitivity analysis

The FIRR on I and FIRR on E of the case for which escalation and incentives are considered are compared with the Base Case.

(Unit: %)

	Base Case	Escalation Case
FIRR on I	9.2	16.3
FIRR on E	16.8	32.9

As shown in the above Table, when escalation is considered, the profitability is improved remarkably. A period of 24 years is subjected to the study and escalation is estimated to prevail throughout the study period. The escalation rate is considered as an uncertain factor, but it affects the results of IRR largely, and therefore, this case study poses a question as to certainty.

Sensitivity analysis with an escalation as a basic case are omitted in this summary. Please refer to the detailed edition.

(2) Case for which the constant price basis is used and no incentives are considered

The results are shown in the following Table.

(Unit: %)

	Base Case	Without Incentives
FIRR on I	9.2	7.1
FIRR on E	16.8	10.7

As shown in the above Table, when no incentives are considered, the profitability of this project is lowered. Accordingly, various incentives are essential in order to assure the profitability of this project.

(3) Case for which escalation is considered, but no incentives are considered

The results are shown in the following Table.

(Unit: %)

	Escalation Case	Without Incentives
FIRR on I	16.3	14.0
FIRR on E	32.9	26.2

When incentives are not taken into consideration, the profitability goes down.

(4) Case for which the distillery capacity is set at 60 kl/d with constant price basis and incentives

The foregoing studies are based on the Distillery capacity of 48 kl/d corresponding to the sugarcane yield expected from the cropping pattern of individual farmers in which upland rice is planted for one year in every four years for the purpose of soil recovery, as proposed in the report of the Agricultural Sector Team. If the individual farmers are supposed to follow monoculture system for sugarcane cultivation without the said upland rice plantation, the Distillery capacity can be raised to 60 kl/d. Assuming 60 kl/d as the Distillery capacity, the results of the financial analysis turn out to be as below.

FIRR of 60 kl/d as Distillery Capacity

(Unit: %)

	Base Case (48 kl/d)	(60 kl/d)
FIRR on I	9.2	11.7
FIRR on E	16.8	25.9

As seen from the above, the profitability of this project is improved appreciably if the Distillery capacity is raised from 48 kl/d to 60 kl/d. The value of FIRR on I, which is about 12%, indicates that this project is worth promoting for realization as far as the financial profitability is concerned.

2. Economic Analysis

The results of economic analysis are as shown under. As to the details of the analysis, please refer to the detailed edition.

2-1 Economic Internal Return Rate (EIRR)

Referring to the estimation by the World Bank, namely the price of crude oil will rise at the annual rate of 3% at a constant price basis, and assuming that the economic price of alcohol will rise at the rate of 3%, EIRR is calculated with individual farmers, estate and alcohol plant as objects of calculation. As a result of this calculation, the value of EIRR, 9.7%, is obtained.

When this value is studied by taking into consideration the fact that the social rate of discount in the Philippine Government is 9%, and the fact that the guidelines on EIRR rate issued by various international organizations indicate 8-15%, this project may be said to have reasonable economic value, and to be worth being promoted forward.

2-2 Indirect Benefits of This Project

As indirect benefits of this project, the following can be expected.

(1) Increase of employment opportunity

The objectives of this project are not only to build alcohol plant for marketing Alcogas, but also to develop agriculture and provide more opportunity of employment. It is estimated that approximately 190,000 man-days of working opportunity will be increased by the realization of this project.

(2) Propagating effects on related industries

As propagating effects on related industries, an increase in the demand for iron materials, cement, etc. incidental to the establishment of alcohol plant, upbringing of the construction and engineering industry, an increase in the demand for submaterials accompanied by the operation of plants and shipment of products, can be expected.

(3) Contribution to the local development of economy

When this project is realized, a direct and indirect contribution to the development of transport and commercial sectors of Maragondon Area can be expected through development of agriculture and its maintenance, as well as through construction of plant and their commercial operation.

IV. OVERALL EVALUATION AND RECOMMENDATION

1. An overall evaluation and recommendation based on the consolidation of the findings made by both Agricultural and Industrial Sector Teams.

(1) Results of economical analysis

With reference to the escalation projection of crude oil made by the World Bank, which has higher escalating rate than other commodities by 3% per annum, an economical analysis was performed on individual farm houses, estate and a distillery, assuming the economical price of alcohol to be escalated at the same 3% per annum as crude oil. The EIRR was found at 9.7%.

In view of the fact EIRR guidelines established by various international organizations are as a rule in the range 8-15%, the EIRR of this project shows a satisfactory value. Furthermore, the following indirect advantages are expected; an employment opportunity of approximately 190,000 man-days; repercussion effect to the related industries; and contribution to the economical development of the regions, etc. Therefore, it is well considered that this would be a worthwhile national project which should be promoted from an economical point of view.

(2) Results of financial analysis

A financial analysis on the Alcohol Distillery and the Estate was performed. As a result, the FIRR on I was found to be 9.2%. Judging from the figure, the profitability of this project is not very high, but on a fair level.

In addition, the FIRR on E was found at 16.8% which is higher than the prevailing interest rate, and therefore it is considered an attractive project for investors.

1) Various types of incentives

In view of the fact that this project has the character of national project, various types of incentives are granted to the project as follows:

a) Shortened period of depreciation
b) Carry-over of operating loss
c) Tax exemption of the imported machinery and material
d) Authorization of preoperational expenses as recognized depreciation object

If the said incentives were not approved, the profitability of this project would be decreased by approximately 2% in terms of the expected FIRR on I, which would make the project unattractive. Therefore, the aforementioned incentives referred in paragraphs a) through d) are indispensable.

2) Establishment of estate

As a result of studies made on whether or not the establishment of an estate which is a plantation farm belonging to the plant is necessary, it has been found that estate establishment is preferable as it will augment the FIRR on I by about 1%, and further can stabilize the operation of the Alcohol Distillery.

3) Farm roads and bridges for independent farmers

A total investment of about 24,400 x 10^3 pesos is required for the farm roads and bridges for individual farmers. Inclusion of this investment cost into the project cost will decrease the profitability by 1.3% of the FIRR on I.

In the event of realization of this project, it is recommendable that the said farm roads and bridges shall be implemented by

the general expenditures of Governmental investment so that the cost thereof shall not be imposed on the project.

4) Sale price of the product alcohol

In making a financial analysis, sale price of the product alcohol was assumed to be escalated at 8% per annum until 1987. As the sensitivity analysis shows clearly, the profitability of this project will be greatly influenced by the sale price of the product alcohol.

Accordingly, it is required to revise the basic policy of PNAC that the sale price of the product alcohol will be reflected by only a half of the price hike of gasoline when the price is escalated.

5) Use of molasses as secondary raw material

Increase of the yearly working days from 200 days to 300 days utilizing molasses as secondary raw material, brings about the result that the profitability of this project will be improved by approximately 5-6% in terms of the FIRR on I.

However, in view of the fact that there is a possibility to obtain foreign currencies by selling molasses, and that there may be possible competition with Model-I or II of the Alcogas Project to utilize molasses, it is recommendable that this project, which is of Model III type, should not rely too much on the use of molasses, and therefore the use of molasses should not be considered as prerequisite.

6) Effect of larger Distillery capacity

If it is assumed that individual farmers within the project area adopt monoculture system for sugarcane cultivation, the capacity of Distillery can be raised from 48 kl to 60 kl/d. FIRR

on I in this case turns out to be about 12% showing appreciable improvement over the case of 48 kl/d.

(3) Stronger support to performing enterprise by Government

In the course of materialization of this project, the enterprise which is to promote the project shall be identified and supported effectively by the Government.

2. Recommendation by the Agricultural Sector Team

(1) Research and development on sugarcane as raw material for alcohol production

At present PHILSUCOM is fulfilling its major role in studies of sugarcane which are merely studies as raw material of sugar. It is recommended that studies for the development of new varieties of sugarcane as raw material of alcohol be commenced.

(2) Promotion of campaign to farmers for cultivating sugarcane

At present sugarcane development technicians (SDT) are performing the movement to popularize the new variety, to transfer new technique, etc. It is recommended to encourage the movement using more SDT from the present level of 2000 ha per person to, say, 500 ha per person.

(3) Reinforcement of field fund system

As for financing of field fund on sugarcane, the Republic Planters Bank (RPB) is providing the Agricultural Sugar Crop Loan (ASCL), but since the terms and conditions of ASCL loan is severe, it is required to review possibility of loosening the loan conditions.

3. Recommendation by the Industrial Sector Team

(1) Manufacturing technology of alcohol

As for biomass energy, various research and development studies are under way, including those related to effective way of producing alcohol. It is required to continuously observe such trend of new technology, but in actual planning of any distillery, it is necessary to confirm if the technology has been commercially proven. It is necessary to remember that in many cases even a technique which shows excellent performance in the pilot plant size may bring many troubles at the stage of commercialization.

FEASIBILITY STUDY REPORT

ON

ALCOGAS PROJECT

IN

MARAGONDON, CAVITE

THE REPUBLIC OF THE PHILIPPINES

VOLUME II

MAY 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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Abbreviations and Symbols

Unit and Conversion

(1) Length

mm	Millimeter
cm	Centimeter
m	Meter
km	Kilometer
in	Inch (1 in = 2.54cm)

(2) Area

cm^2	Square centimeter
m^2	Square meter
ha	Hectare (1 ha = 10,000m^2)

(3) Volume

m^3	Cubic meter
Nm^3	Normal cubic meter
l	Liter
kl	Kiloliter
bbl	Barrel (1 bbl = 159 l)

(4) Weight

g	Gram
kg	Kilogram
t	Metric ton
picul	1 picul = 63.25kg
lb	Pound (1 lb = 0.0454kg)

(5) Time

sec	Second
min	Minute
h	Hour
d	Day
m	Month
y	Year

(6) Temperature

°C	Degrees centigrade
°F	Degrees fahrenheit

(7) Others

cal	Calorie
kcal	Kilocalorie
A	Ampere
V	Volt
W	Watt
kVA	Kilo volt ampere
Hp	Horse power (1 Hp = 746 W)
%	Percent
vol%	Volume percent
wt%	Weight percent
ppm	Parts per million
pH	Hydrogen ion concentration
kg/cm^2	Kilogram per square centimeter
mmAq	Millimeter aqua
t/d	Tons per day
t/y	Tons per year

Exchange Rate

Yen	Japanese yen (1 U.S.dollar = 230 yen)
U.S.$	U.S.dollar
PESO	Philippine peso (1 U.S.dollar = 8.0 pesos)

Organization and Company

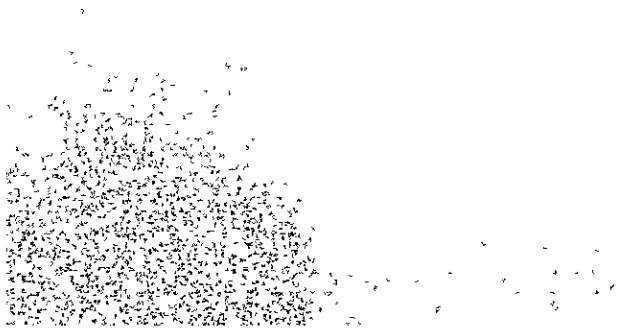
PNAC	Philippine National Alcohol Commission
PHILSUCOM	Philippine Sugar Commission
PNOC	Philippine National Oil Company
MOI	Ministry of Industry
MOA	Ministry of Agriculture
MOE	Ministry of Energy
MOF	Ministry of Finance
MONR	Ministry of National Resources
BOI	Board of Investments
NPCC	National Pollution Control Commission
NWRC	National Water Resources Control
CB	Central Bank of the Philippines
EEI	Engineering Equipment Inc.
EDC	E.D.C. Construction Co.
UNITEC	UNITEC Engineering Corp.
TOYO	Toyo Construction Co., Ltd.
VICMICO	Victorias Milling Co., Inc.
A.M.ORETA	A.M.ORETA & Co., Inc.
ASIAN	Asian Alcohol Corp.
JICA	Japan International Cooperation Agency
MC	Mitsubishi Corp.

Finance and Economy

IRR	Internal Rate of Return
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return

CHAPTER I

INTRODUCTION



1. Background and Objective of Study

(1) The first and second oil price increases greatly affected all countries in the world, and especially non-oil producing countries have come to suffer seriously from poor trade balance and extremely high inflation rate. Under these circumstances, much effort is being made to use substitute energies such as fermented alcohol produced from agricultural sources as being promoted in Brazil under the national energy policy.

(2) The Philippine government has also determined the Alcogas Project for the aims such as saving of foreign currencies, increase of employment opportunities, stabilization of the sugar industry and development of related domestic industries by using the alcohol as automobile fuel. The project is promoted as a national project and various incentives and development measures are being reviewed.

The Philippine government made a request to the Japanese government for cooperation on implementation of the feasibility study (abbreviated as study hereunder) of the project.

(3) Upon receiving the request, the Japanese government has consigned the dispatch of a preliminary survey team with the Japan International Cooperation Agency. After conferring with related organs of the Philippine government, the preliminary survey team determined to implement a feasibility study for the project and the Minutes of Meeting that contains basic structure of the study and study items were signed by the two parties on December 16, 1980.

(4) Based on the Minutes of Meetings dated December 16, 1980, the first survey team consisting of an Agricultural Sector Team and Industrial Sector Team visited the Philippines in March 1981. During the visit of the first survey team, the Philippine side made a request of changing the project site from Dasmariñas, Cavite to Maragondon, Cavite.

(5) Upon receiving the request, the Agricultural Sector Team conducted a preliminary survey of Maragondon, Cavite, and concluded that the Maragondon area should be studied as the site for this project. Based on this conclusion, articles related to the project site and processes in the Minutes of Meetings dated December 12, 1980 were amended, and a separate Minutes of Meetings related to the amendment was signed on June 4, 1981.

(6) Accordingly, study was conducted, based on the Minutes of Meetings dated June 4, 1981, on concrete items for the Model III of Alcogas Project. The study objectives of the Industrial Sector Team are feasibility studies of industrialization of an alcohol distillery having a capacity of approximately 60 kl/day in Maragondon, Cavite, as a part of the Alcogas Project, from technical and economical standpoints.

(7) The study consists of Phase-I and Phase-II. In Phase-I, the optimum raw material is to be selected from sugarcane, cassava and sweet potato, and in Phase-II, details are reviewed on the optimum material selected in Phase-I.

(8) The Japanese survey team consisting of the Agricultural and Industrial Sector Teams presented to PNAC the interim report on the results of the Phase-I study to the effect that "sugarcane is the most suitable raw material for alcohol production among sugarcane, cassava and sweet potato in Maragondon, Cavite", and PNAC understood thereof.

(9) This is the final report prepared by the Industrial Sector Team summarizing the detailed study on technical and economical feasibility of alcohol production plant assuming the use of sugarcane as the raw material based on the results of the Phase-I study.

2. Premises of Study

(1) Proposed distillery site

Maragondon, Cavite in the outskirts of Manila, the Philippines.

(2) Capacity and number of operating days of the alcohol distillery

Capacity	:	Approx. 60 kl/day (50-60 kl/day)
Normal operating days/year	:	200 days/year (Increase to 300 days/year shall be reviewed.)

(3) Fuel for the alcohol distillery

Priority is given to non-fossil type fuel in view of the ultimate goal of the ALCOGAS Project.

(4) Power and water supply for the alcohol distillery

The basic policy is to establish self-supporting system on utilities. That is, the distillery should generate the power which it consumes and an required industrial water supply source is to be established.

(5) Distribution, storage and consumption of the Alcogas

These subjects are out of the study scope, but efforts are to be made to obtain correct information on distribution, storage and consumption of the Alcogas to be reflected in the report.

(6) Raw material to be studied in Phase-II

Sugarcane

3. Method and Procedures

The objective of Phase-II study is to evaluate sugarcane as the raw material through detailed technical and economical analyses. The study in the Phase-II was conducted both in the field and in Japan in the manner as stated in the following paragraphs. The method and procedures employed in the Phase-I study were omitted in this report as the same had been described in detail in the Interim Report.

3-1 Field Survey

In the Phase-II, the field survey was performed for the period of 20 days from November 23, 1981 through December 12, 1981. The major survey items were as follows:

(1) Agreement of the major assumptions of the study in the Phase-II with the related Philippine authorities such as PNAC, MOF and BOI.

(2) Performance of field survey and related investigation for final selection of an alcohol distillery site.

(3) Visits to plants producing alcohol and sugar as well as to construction firms in the Philippines for study and investigation of process details, by-products and domestic plant construction expenses.

3-2 Home Office Work

The actual field survey results were reviewed and studied in Japan in the following procedures.

(1) The production capacity was presumed to be 60 kl/day.

(2) As for major processes listed below, comparative study was made on possible alternatives.

1) Extraction process
2) Pre-treatment process
3) Fermentation process
4) Distillation process
5) Dehydration process and agent

(3) As for the pollution control, waste water treatment was mainly studied with care in view of the nature of the alcohol distillery.

(4) The energy balance, the by-product utilization and instrumentation system were also studied in detail.

(5) Based on the aforementioned review, the conceptual design of a 60 kl/day distillery was conducted.

(6) Construction cost of a 60 kl/day distillery was calculated.

(7) The distillery capacity of 60 kl/day was modified and reduced to 48 kl/day, reflecting the sugarcane yield as determined by the study of the Agricultural Sector Team.

(8) Construction cost of a 48 kl/day distillery was calculated.

(9) Fixed cost including escalation was calculated.

(10) Variable cost including escalation was calculated.

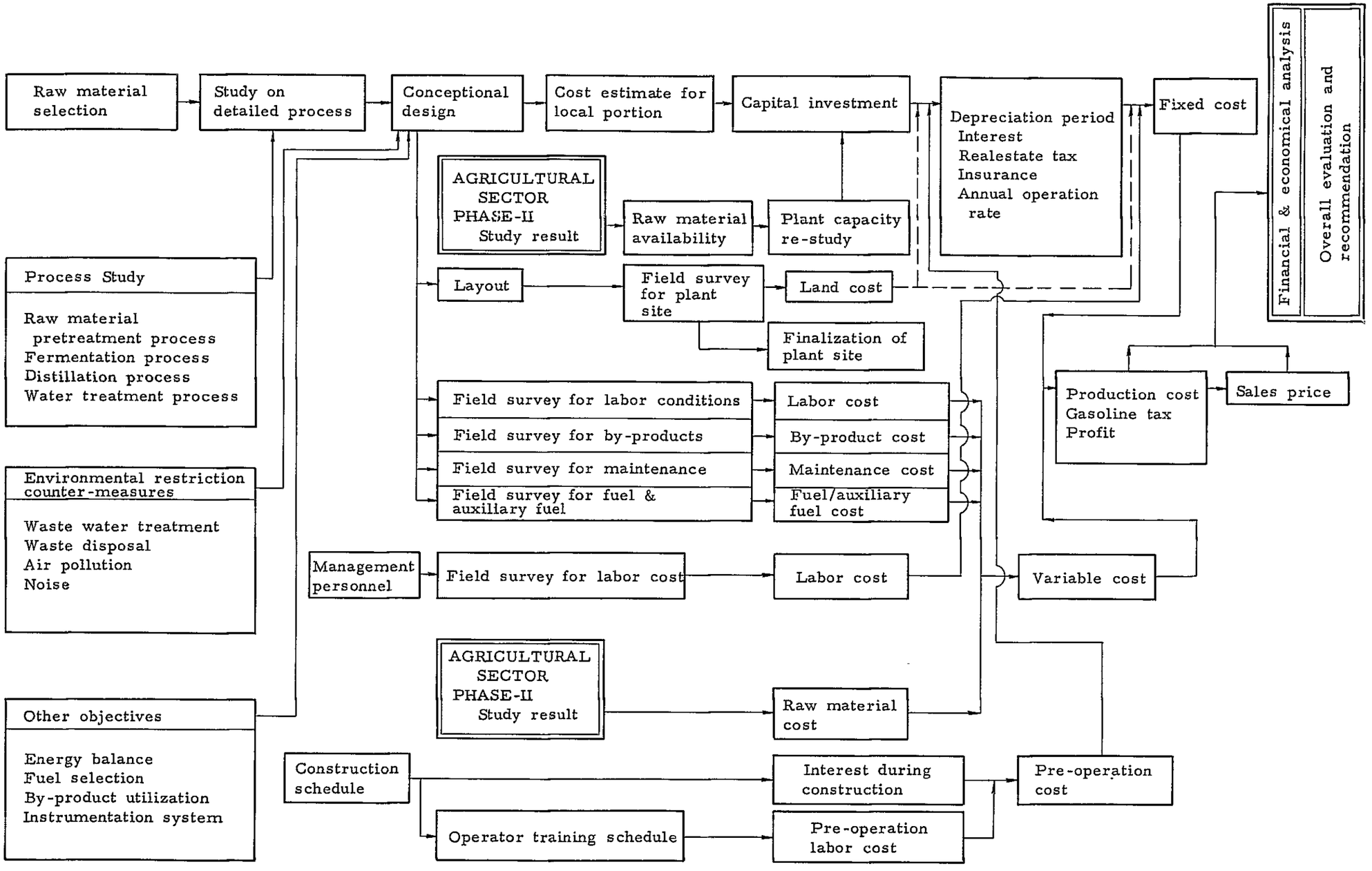
(11) The product manufacturing cost was calculated based on the fixed and variable costs. The basic sale price of the product alcohol was set at 4.37 pesos per liter, plus escalation to be taken into account.

(12) The financial analysis was conducted based on the product manufacturing cost and turn-over.

(13) The economical analysis was conducted, applying shadow prices against sale price and expenses.

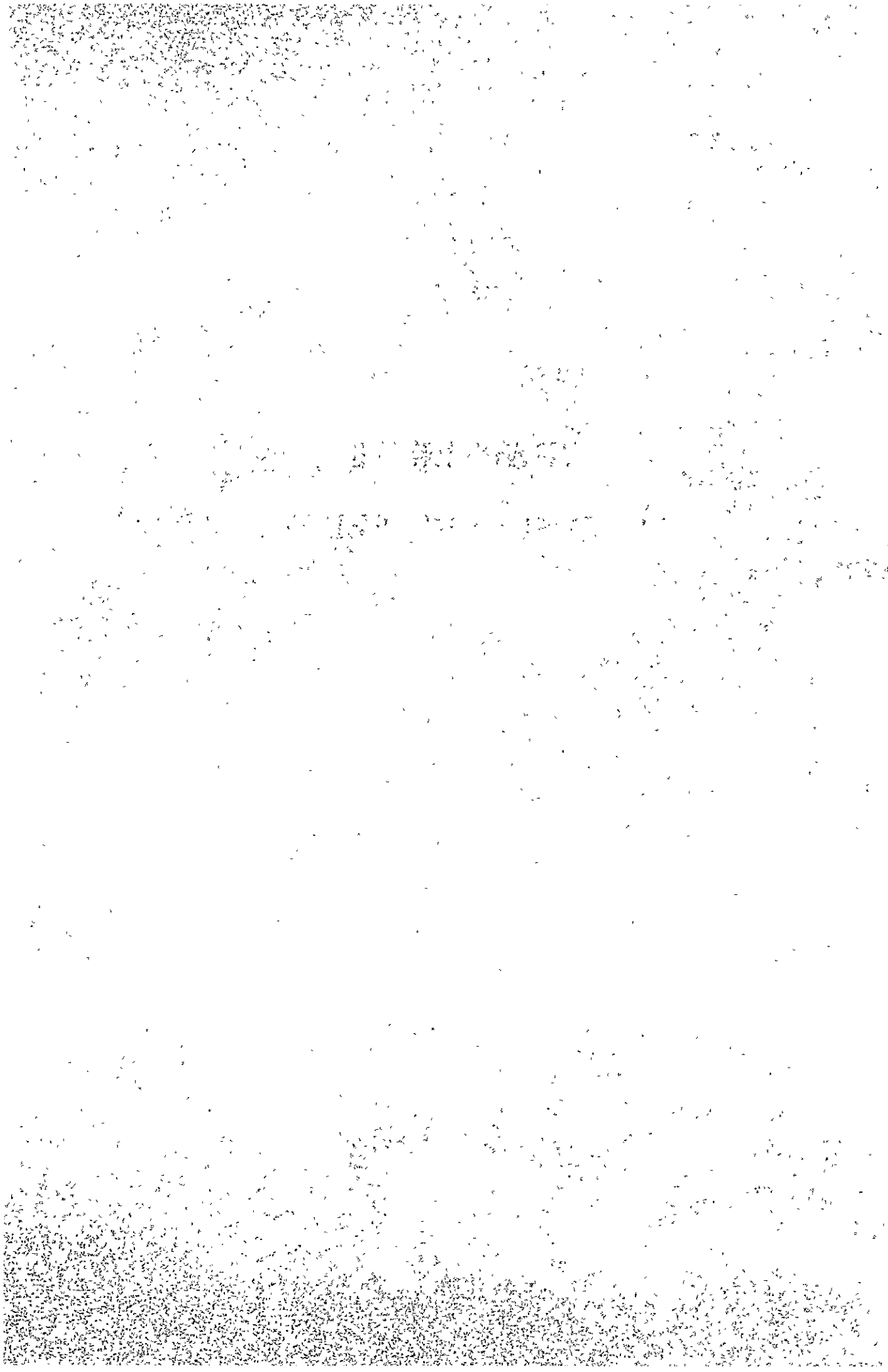
(14) These results were consolidated into the overall evaluation and recommendation of the project. The method and procedures stated in the above are summarized in Fig. I-1.

Fig. I-1 Phase-II Study Procedure Sequence



CHAPTER II

FIELD SURVEY REPORT



This report covers not only the third field survey but also the first and second field surveys conducted in the Phase-I in order to enable comprehensive understanding of the entire field surveys.

1. The First Field Survey

1-1 Objective

Based on the "Minutes of Meeting" (including Implementing Agreement) signed on December 16, 1980 by the JICA preliminary survey mission and the Philippine team, the Phase-I field survey team visited the Republic of the Philippines.

The Phase-I field survey team consisted of the Agricultural Sector and Industrial Sector Teams.

The Industrial Sector Team visited related Philippine governmental offices, related Japanese firms in the Philippines and related Philippine firms to confer on the following subjects. They also visited the site where the distillery would be built, for the following objectives:

(1) Confirmation of the Minutes of Meeting.

(2) Collection of information and data needed for the Phase-I study.

(3) Confirmation of the study procedure for the Phase-I study.

The conferences were conducted along the talking paper contents (study procedure drafts and questionnaires) that had been prepared in advance.

1-2 Members of First Survey Team

Table II-1 Members of the First Survey Team

Name		Function
Mr.J.Ono	Team Leader	Project Manager
Mr.K.Tanabe	Sub. Leader	Raw material, Economy & Finance
Mr.M.Ozaki	Sub. Leader	Process & System
Mr.S.Ichihara	Engineer	Plant & Equipment
Mr.S.Nishiyama	Engineer	Off-site Facilities
Mr.A.Hashimoto	Economist	Economy & Finance
Mr.H.Yasuki	Advisor	JICA
Mr.T.Hattori	Advisor	MITI

1-3 Survey Schedule

The first field survey team conducted a field survey over 10 days from March 19, 1981 to March 28, as shown in the following schedule:

Table II-2 Schedule of the First Survey Team

Date		Schedule
March 19	THU.	Ar. Manila (PR-431)
20	FRI.	Visit to Japanese Embassy & JICA Meeting with PNAC
21	SAT.	Visit to Canlubang Sugar Estate
22	SUN.	Data Consolidation
23	MON.	Survey of Dasmariñas, General Trias & Maragondon. Visit to JETRO
24	TUE.	Meeting with PNAC
25	WED.	Meeting with Philsucom, MOE, BOI
26	THU.	Meeting with Japanese Company Meeting with Local Fabricator
27	FRI.	Meeting with PNAC, MOF Visit to Japanese Embassy & JICA Meeting with Japanese Company
28	SAT.	Lv. Manila (NW-004)

1-4 Related Philippine Counterparts and Organizations

(1) Philippine National Alcohol Commission (PNAC)

Mr. H.C.Zayco	Executive Director
Dr. H.L.Rosario	Deputy Director
Mr. N. Balce	Chief. Industrial Service
Mr. F. Lorilla	Chief. Planning & Administration
Mr. R. Carating	Agricultural Service
Miss P. Librando	"
Mr. A. Fortuno	Industrial Service
Mr. N. Ventigan	Planning & Administration
Mr. O. Miranda	"
Miss J. Lagos	"

(2) Ministry of Agriculture (MOA)

Mr. P. Evangelista
Miss E. Abanstillas

(3) Philippine Sugar Commission (PHILSUCOM)

Dr. R.G.Camurungan
Mr. R.R.Covar

(4) Board of Investment (BOI)

Mrs. G. Santos
Mr. L. Gauuar

(5) Ministry of Energy (MOE)

Mr. G. Makasiar

(6) Engineering Equipment Inc.

Mr. C.T.Logan
Mr. R.B.Maglalang
Mr. R.C.Cabrera

(7) Canlubang Sugar Estate

Mr. B.S.Hiben

(8) Mitsubishi Corporation

Mr. M. Osugi

(9) Kawasaki Heavy Industries

Mr. I. Fujishima

(10) The Zenitaka Corporation

Mr. K. Suzuki
Mr. H. Okamura
Mr. A. Terashima

1-5 Outlined First Field Survey

1-5-1 Confirmation of minutes of meetings (dated December 16, 1980)

(1) All points contained in the Minutes of Meeting except the proposal of changing the site from Dasmariñas to Maragondon and necessary items associated with the change, as outlined in the next paragraph, were confirmed with PNAC.

(2) PNAC proposal of site change

1) PNAC proposed to the first field survey team a change of the site from Dasmariñas, that had been stipulated in the Minutes of Meetings to Maragondon for the following reasons:

a) The majority of sugarcane cropped in Dasmariñas is used by the Canlubang sugar plant and it is difficult to obtain a sufficient amount of sugarcane for alcohol production.

b) Industrialization is planned in Dasmariñas and the surrounding area and the undeveloped area available for sugarcane cultivation is limited to about 900 ha, which is far less than 5000 to 6000 ha needed for the project.

c) A land prices in Dasmariñas are relatively high.

2) This proposal was made on March 24, but the Maragondon area was investigated by the first field survey team on March 23. The survey results are given in the following:

a) Survey results of the Agricultural Sector Team

(i) The land is considerably undulated with complicated details, and irrigation is not easy.

(ii) The ownership situation of the land must be thoroughly checked to make sure that sufficient land area is available.

b) Survey results of the Industrial Sector Team

(i) There is no problem as a site from an industrial viewpoint.

3) Based on the above survey results, it was determined that the Agricultural Sector Team is to run a preliminary survey of the Maragondon area, as agreed by the related Japanese governmental organs and JICA headquarters.

4) The preliminary survey run by the Agricultural Sector Team resulted in the conclusion that the Maragondon area must be fully investigated.

5) According to the conclusion of this preliminary survey, the Minutes of Meeting dated December 16, 1980 was partially amended on June 6, 1981, and the amended Minutes of Meeting became effective.

1-5-2 Collection of information and data in Phase-I study

The required information and data based on the questionnaires brought from Japan were collected.

(1) General information

General information related to the Alcogas project was collected with main emphasis placed on the recent situation and administrative promotional policies.

(2) Information related to plant construction expenses

Information mainly on the abilities of Philippine machinery manufacturers, the labor situation, and legal problems were collected.

(3) Information related to site conditions

It was not possible to collect sufficient information due to change of site requested from the Philippine side.

(4) Information related to financial analysis

Information, such as costs of plant management, method of depreciation, prices of auxiliary chemicals used by the plant was collected extensively.

(5) Information related to sugar plants

A visit was made to the Canlubang sugar plant and information was collected.

1-5-3 Confirmation of Phase-I study procedure

The plan of the first field survey team on the Phase-I study procedure was explained to PNAC and the plan was accepted.

2. The Second Field Survey

2-1 Objective

The Minutes of Meeting dated December 16, 1980 was agreed by JICA and the Philippine team on June 4, 1981 with the partial amendment for the site change to the Maragondon area.

Based on the Minutes with the partial amendment, the Phase-I field survey team visited the Republic of Philippines.

The Phase-I field survey team consisted of the Agricultural Sector Team and the second field survey Industrial Sector Team and each sector team conducted a field survey as follows:

Agricultural Sector Team	From June 17 to July 31
Industrial Sector Team	From July 13 to August 1

The second field survey Industrial Sector Team conferred with related organizations and conducted field surveys at the scheduled site five times for the following purposes:

(1) Collection of information and data needed for the Phase-I survey.

(2) Confirmation of the Phase-I study procedure

The conferences were conducted according to the talking paper contents that had been prepared in advance.

2-2 Members of Second Survey Team

The table below shows the second survey team organization.

Table II-3 Members of the Second Survey Team

Name		Function
Mr. I. Mase	Team Leader	Project Sub. Manager
Mr. S. Nishiyama	Engineer	Off-Site Facilities
Mr. H. Sekiguchi	"	Process
Mr. T. Otomegawa	"	Fermentation Process
Mr. Y. Ueha	"	Facilities & Equipment
Mr. T. Ohishi	"	Civil & Architecture
Mr. Y. Fukuda	"	Field Work
Mr. T. Sasaki	Economist	Raw Material & Finance
Mr. M. Ishida	"	Finance & Economy
Mr. H. Yamada	Advisor	MITI
Mr. J. Hada	"	JICA

2-3 Survey Schedule

The second survey team conducted a field survey for 20 days from July 13, 1981 to August 1 as in the schedule shown below.

Table II-4 Schedule of the Second Survey Team

Date		Schedule
July 13	MON.	Ar. Manila (PR-431)
14	TUE.	Visit to Japanese Embassy & JICA Meeting with PNAC
15	WED.	Visit to Maragondon (Mayor's Office) Survey of the Site
16	THU.	Courtesy Call to Gevernor of Cavite Survey of the site Meeting with Local Fabricator

17	FRI.	Meeting on Financial Items Meeting with Local Fabricator
18	SAT.	Survey of Equipment Transportation Survey of the Site
19	SUN.	Data Consolidation
20	MON.	Meeting with NWRC (NIA), PNAC & PNOC
21	TUE.	Visit to Naic (mayor's Office) Meeting with Local Company
22	WED.	Visit to Negros Island Visit to VICMICO (Sugar & Alcohol Plant)
23	THU.	Visit to ASIAN Alcohol Distillery
24	FRI.	Meeting with MOL Meeting with Local Fabricator
25	SAT.	Survey of the Site
26	SUN.	Data Consolidation
27	MON.	Visit to Canlubang Sugar Estate
28	TUE.	Visit to Bataan Refining Corporation Meeting with PHILSUCOM
29	WED.	Meeting with PNAC
30	THU.	Measurement & Survey of the Site
31	FRI.	Visit to Japanese Embassy & JICA
August 1	SAT.	Lv. Manila (JL-742)

2-4 Related Philippine Counterparts and Organizations

Philippine Authorities

(1) PNAC

Dr. E.L. Rosario	Miss P. Librando
Mr. R. Carating	Mr. N.S, Ventigan
Mr. A. Fortuno	

(2) PNOC

Mr. H.S. Salvante
Mr. A.R. Villanarzo
Mr. M.C. Berbano

(3) MOA

Miss E. Abastillas
Mr. C.F. Herbera
Mr. H.B. Marges
Mr. D.F. Valenzuela

(4) BOI

Mrs. G. Santos

(5) MOF

Miss C. Legaspi

(6) Central Bank

Mr. F. Corona

(7) Cavite Provincial Office

Governor Mr. J.R. Remulla
Mr. E. Tikoka
Mr. S. Gonzales

(8) Maragondon Mayor's Office

Mayor Mr. T. Linas
Miss S.E. Anico

(9) Naic Mayor's Office

Mr. M.G. Grisostomo
Mr. F.N. Pcosta

(10) National Water Resources Council

Mr. L.M. Sosa

(11) PHILSUCOM

Dr. R.G. Camurungan
Mr. M.T. Perez

(12) Nasutra

Mr. J.L. Dator
Mr. L.V. Montebon
Mr. F.R. Betia
Mr. R.J. Dizon

Philippine & Japanese Companies

(1) EDC Construction & Development Corporation

Mr. E.D. Carmen

(2) VICMICO

Mr. R.A. Deypalen
Mr. N.A. Florcruz

(3) Asian Alcohol Corporation

Mr. B.E. Caisido
Mr. A.S. Rosal
Mr. J.S. Clavano
Mr. R.G. Peñaflor

(4) Toyo Construction

Mr. O. Satoh
Mr. S. Maezima

(5) Philippine Transworld Company Incorporation

Mr. S. Kariya

(6) Engineering Equipment Corporation

Mr. C.T. Logan	Mr. H.U. Gonzales
Mr. B.Z. Cariño	Mr. R.L. Mallare
Mr. R.B. Maglalang	

(7) Pacific Engineering Company Incorporation

Mr. N.Z. Malabanan	Mr. R.C. Alconga
Mr. B. Samonte	

(8) Advance Engineering Corporation

Mr. I.T. Mañego	Mr. W.S. Penuliar
Mr. A.A. Abanilla	Mr. M.F. Fonollera

(9) A.M Oreta Incorporation

Mr. A.S. Suaco	Mr. V.O. Viola

(10) Drilling Corporation of Asia

Mr. B.R. Beniamin	Mr. S. Enriquez

(11) Canlubang Sugar Estate

Mr. B. Hibek	Mr. B. Meneses

2-5 Outlined Second Field Survey

2-5-1 Results of survey

(1) Alcohol distillery site

The following factors were reviewed collectively through field surveys conducted 5 times and conferences with the Agricultural Sector Team held 4 times:

1) Raw material transportation
2) Water resources
3) Land utilization problems and land prices
4) Electricity supply
5) Others

As the result, the alcohol plant site was determined as shown in Fig. II-1. The site was selected for the following reasons:

1) Raw material transportation

For convenience of raw material transportation, the plant should be located in the central area of sugarcane cultivation. Also, since the sugarcane cultivation area is in topography of higher at the north and lower at the south, for convenience of truck transportation of raw materials, the preferable plant site location is toward the south from the central area.

2) Water resources

The alcohol plant consumes industrial water at a rate of 40 to 60 liters per second. Either river water or well water is permitted for the plant, but if limited to river water, there are the following rivers near the plant site:

Maragondon river	600ℓ/s
Balsahan river	30ℓ/s

The Maragondon river is the only one that can be useful. However, installing the plant close to the Maragondon river bears problems on raw material transportation and in constructing an access road. As to well water, it was found that if a deep well of 200 m is drilled, the required amount of water is available without affecting inhabitants' lives in the neighborhood. Therefore, the conclusion was made to drill a well.

3) Land utilization problems and land prices

The most favorable site for the alcohol plant is a current sugarcane field or an abandoned area from previous sugarcane cultivation, and areas such as paddy fields or orchards, should be avoided as much as possible.

The site as shown in Fig. II-I is not being used at present, and the site is inexpensive, about 5 pesos/m^2.

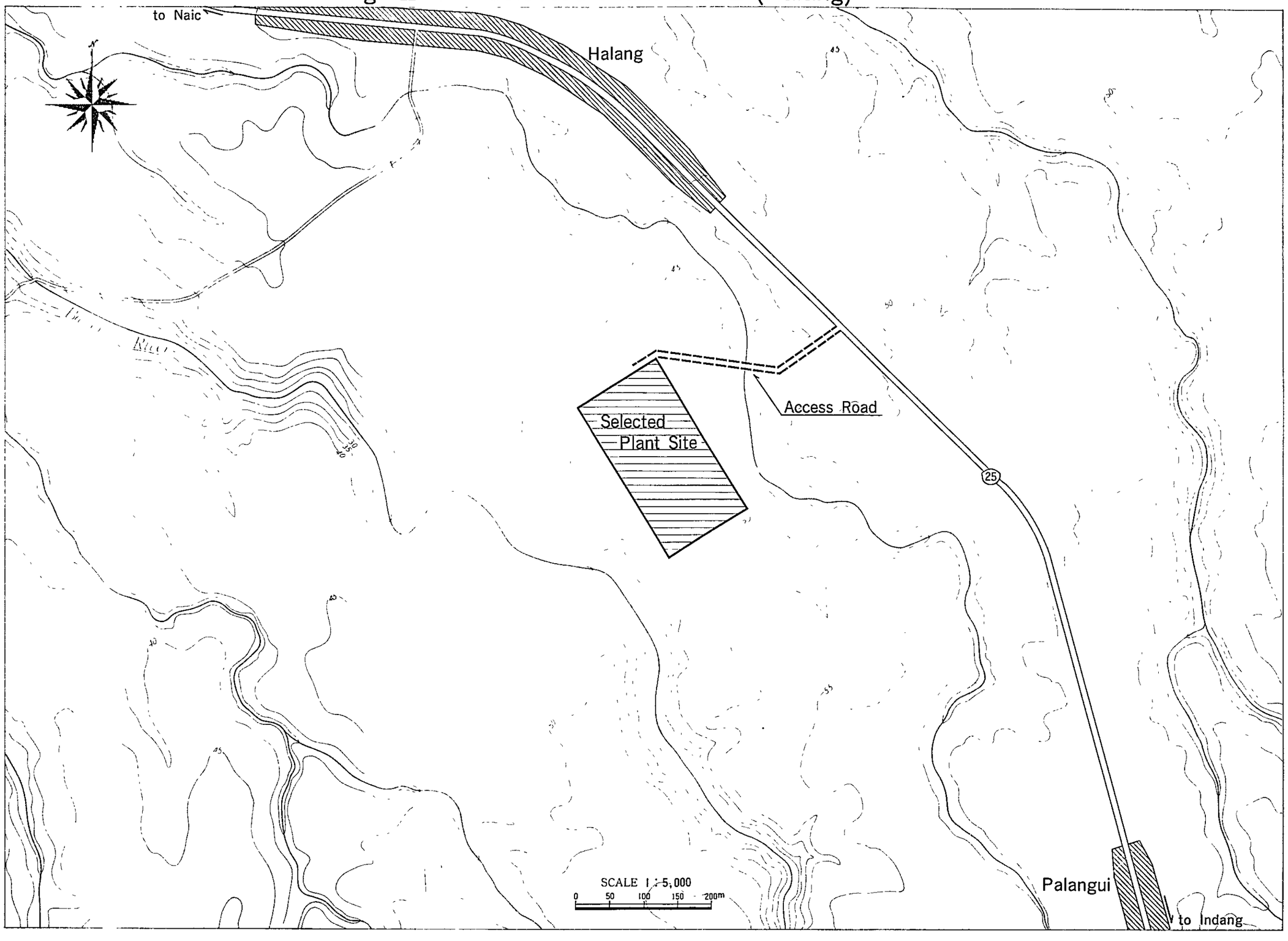
4) Access road

For transportation of heavy machines and equipment necessary during plant construction, the preferable plant site is close to the No. 25 or No. 301 national roads.

5) Electricity

Power supply for construction of the plant and its operation is obtained by using generators to be installed anew. Therefore, there is no concern related to the existing public power supply.

Fig. II - 1 Selected Plant Site B (Halang)



6) Others

The second field survey team had conferences with the governor of the Cavite province and municipal offices of Maragondon and Naic for infrastructure surveys on the site where the alcohol distillery should be built.

(2) Current situation of plant construction machine manufacturers and contractors in the Philippines

The following are outlines of investigation results on more than 10 machinery manufacturers and contractors in Philippines:

1) The majority of necessary steel materials must be imported.

2) Most of the civil engineering and architectural materials necessary are available in the Philippines.

3) The majority of rotary machines must be imported.

4) Though tanks, vessels and heat exchangers are available in the Philippines, they must be carefully reviewed for quality and price.

5) The majority of electrical instruments must be imported.

6) Field installation in the Philippines bears no problems.

Based on the above situation, further review is necessary if the PNAC basic policy of procuring 50% or more in the Philippines ought to be achieved.

2-5-2 Main understanding and confirmation

(1) Contents of the Minutes of Meeting dated June 4, 1981 were mutually agreed.

(2) Items to be confirmed related to data presentation requested to PNAC

1) Boring was not conducted this time. Instead, the soil bearing power is to be estimated from the columnar section and a field survey by civil engineering and architectural specialists.

2) The second survey team obtained water samples and requested quality analysis to PNAC. PNAC requested NIA to analyze the samples, but there are some items where analysis method is not clear. The second survey team is to clarify these unclear points.

3) Information on environmental regulatory values was obtained from PNOC. However, in Philippines, the standards have been set only on environmental regulatory values and not on drainage. Therefore, it is concluded that the second survey team should submit review materials on the relationship between drainage control system expenses and drainage quality (BOD) within 2 months.

4) The production facilities are to be designed on the basis of 25% starch concentration of cassava and sweet patato.

5) The second survey team is to submit price, quantity and quality information on the molasses and crude alcohol being imported into Japan.

6) As to spare parts, PNAC requested actual values for each item in reports of Phase-II, and the second survey team promised supply item.

7) PNAC requested to enlarge the storage tank capacity for the product alcohol from the 15-day capacity to a 30-day capacity, and the second survey team agreed to it.

(3) Other points confirmed

1) It was mutually agreed that land prices, land development expenses and expenses for industrial water supply and drainage facility installation are to be included in the facility installation expenses.

2) PNAC notified that the sales price of the product alcohol would be 4.37 pesos per liter.

3) PNAC agreed to calculating the seismic factor and wind pressure according to the National Structural Code.

(4) Major items related to financing and economics agreed and confirmed

1) Financing plan

a) Debt/Equity ratio 75 : 25

b) Conditions on long term loan
- Interest rate 7.75%
- Repayment schedule 3 years grace period
  12 years repayment

c) Conditions on short term loan
  18% secured
  20% unsecured

2) Project life 20 years

3) Rate of operation per year

Case I	First year	70%
	Second year	85%
	From the third year and onward	100%

Case II	First year	80%
	Second year and onward	100%

Decision is to be made somewhere between Cases I and II, depending on the raw material situation as determined by the Agricultural Sector Team.

4) Annual operation days 200 days

If needed 300 days/year

5) Depreciation

a)	Period	Plant facilities	15 year depreciation with 10% remaining as salvage value
		Buildings	20 year depreciation with no remaining salvage value
b)	Depreciation method		By fixed amount or fixed rate

6) Escalation

Based on the current price bases

7) Various incentives

a) Taxes

i) Duty on imported machines

No import duty is charged if the ratio of imported machines is within 50% of the total investment.

ii) Tax exemption on machines procured in Philippines applicable.

iii) Corporate income tax

Per Presidential Decree No. 1789

iv) Sales tax

No tax is to be charged since the product is sold by PNOC.

v) Major local taxes

Corporate income tax	3% of income
Fixed asset tax	0.1% of total assessed values

b) Others

Various other incentives are being considered.

8) Items of fixed and variable expenses

Mutually agreed.

9) Alcohol demand analysis

Since the entire quantity of product alcohol is bought up by PNOC at 4.37 pesos per liter, no survey is to be conducted on alcohol demand.

10) Economical analysis

To be conducted in Phase-II.

11) By-products

PNAC requested financial management calculation in Phase-I basically without considering by-products, and to calculate a

separate case to include by-products as a sensivity analysis. The second field survey team agreed to it.

2-6 Report Preparation

An Interim Report will be submitted to the Philippine side toward the end of October.

3. The Third Field Survey

3-1 Objective

3-1-1 The Japanese Survey teams consisting of the Agricultural Sector and the Industrial Sector Teams reached the conclusion that "sugarcane is the most suitable raw material for alcohol production among comparatively examined sugarcane, cassava and sweet potato in Maragondon, Cavite" and the Interim Report on the results of the Phase-I study was presented to PNAC and PNAC understood thereof.

3-1-2 For the Phase-II study following the Phase-I study, the Japanese Survey Teams by the Agricultural Sector and the Industrial Sector Teams conducted the field survey respectively According to the following schedule.

Agricultural Sector Team: November 8 through December 14, 1981
Industrial Sector Team: November 23 through December 12, 1981

3-1-3 Major items covered by the Industrial Sector Team in the period between November 23 through December 12 are as follows:

(1) Discussions and confirmations about major assumption and conditions for the Phase-II study with the Philippine authorities such as PNAC, MOF and BOI.

(2) Visits to the proposed plant site for site evaluation and related surveys in order to determine the final site.

(3) Visits to existing alcohol plants, sugar plants and construction firms in the Philippines for detailed process, by-product and construction expense surveys. All these surveys were conducted in accordance with the talking paper prepared in advance.

3-2 Members of Survey Team

The members of the Third Survey Team are as follows:

Table II-5 Members of the Third Survey Team

Name		Function
Mr. I. Mase	Team Leader	Project Sub-Manager
Mr. K. Tanabe	Sub. Leader	Raw Material, Economy & Finance
Mr. S. Ichihara	Engineer	Plant & Equipment
Mr. S. Nishiyama	"	Off-Site Facilities
Mr. H. Sekiguchi	"	Process
Mr. Y. Fukuda	"	Field Work
Mr. Y. Hashimoto	"	Finance & Economy
Mr. T. Hattori	Advisor	MITI

3-3 Survey Schedule

The third field survey team conducted a field survey for the period of 20 days from November 23 to December 12, 1981 as follows:

Table II-6 Schedule of the Third Survey Team

Date		Schedule
November 23	MON.	Ar. Manila (PR-431)
24	TUE.	Visit to Japanese Embassy and JICA Meeting with Japanese Company
25	WED.	Meeting with PNAC
26	THU.	Meeting with Japanese Company Meeting with Local Company
27	FRI.	Meeting with Local Fabricator
28	SAT.	Survey of Distillery Site
29	SUN.	Data Consolidation
30	MON.	Data Consolidation
December 1	TUE.	Survey on Electric Power Meeting with Agricultural Sector Team
2	WED.	Visit to Sugar Factory in Panay Visit to MOL, NEDA
3	THU.	Visit to Sugar Factory in Panay Visit to MOF, BOI
4	FRI.	Visit to Alcohol Factory in Cebu Visit to NEDA
5	SAT.	Survey of Distillery Site
6	SUN.	Data Consolidation
7	MON.	Visit to Sugar Factory at Nasugbu Visit to Local Company
8	TUE.	Visit to Sugar Factory at Balayan Meeting on Financial & Economic Matters
9	WED.	Meeting with Local Company
10	THU.	Making Report
11	FRI.	Meeting with PNAC Visit to Japanese Embassy and JICA
12	SAT	Lv. Manila (JL 742)

3-4 Major Philippine Authorities Members

3-4-1 Philippine authorities

(1) PNAC

Dr. E.L. Rosario	Miss J.S. Lagos
Mr. N.V. Balce	Mr. A.S. Fortuno
Mr. F.M. Lorilla	Mr. R.B. Carating

(2) PNOC

Dr. M.C. Berbano	Mr. D.C. Babor

(3) BOI

Mrs. G.Santos

(4) MOF

Miss C. Legaspi

(5) Central Bank

Mr. F. Corona

(6) PHILSUCOM

Dr. R.G. Camurunga	Mr. R.R. Coval

(7) MOL

Mrs. C. Pineda

(8) MEDA

Mr. P. Samson
Miss L.B. Conception
Miss J.P. Afica
Mr. B.N. Kamina

3-4-2 Philippine & Japanese companies

(1) San Miguel

Mr. R. Suare

(2) FEMOLA

Mr. J.M. Brias

(3) National Steel Corporation

Mr. A.S. Dizon
Mr. G.S. Gimenez
Mr. R.C. Alcantara

(4) Filipino Metal Corporation

Mr. W.O. Tan

(5) Goodyear Steel Pipe Corporation

Mr. B. Tiu

(6) Caling-Lambunao Sugar Mill, Inc.

Mr. R. Borres

(7) Batangas Sugar Central, Inc.

Mr. T.A. Quintas
Mr. S.E. Tasico
Mr. H. Santos

(8) Central Azucurera de Don Pedro

Mr. R. Piamonte
Mr. P. Modalec

(9) Passi Sugar Central

Mr. S.C. Ditching
Mr. J.B. Tarador
Mr. B.C. Carrido
Mr. J.E. Perce, Jr.
Mr. R.C. Bernaje

(10) Rizal Metal Products

Mr. A.C. Sa
Mr. J. Ang

(11) Toyo Construction Co.

Mr. O. Satoh
Mr. M. Tsubota
Mr. S. Maejima

(12) Niagara International Const. Corp.

Mr. V.Y. Pimental
Mr. D.T. Bautista

(13) Advance Engineering Corp.

Mr. M.G. Manego
Mr. S. Canicula, Jr.
Mr. R. Buenviajo

(14) Engineering Equipment, Inc.

Mr. A.M. Mandi
Mr. C.T. Logan

(15) A.M. Oreta & Co., Inc.

Mr. Viola

(16) Pacific Engineering Corp.

Mr. Z.C. Lindo, Jr.	Mr. R.C. Alconga
Mr. J.C. Cariaso	Mr. E.D. de la Cruz

3-5 Summary of the Third Field Survey and Conferences

3-5-1 Results of the survey

(1) Alcohol distillery site selection

In compliance with PNAC's request to compare several candidate sites for the erection of an alcohol distillery, the Team visited potential sites four times and selected three sites, namely A, B and C as shown in Fig. II-2.

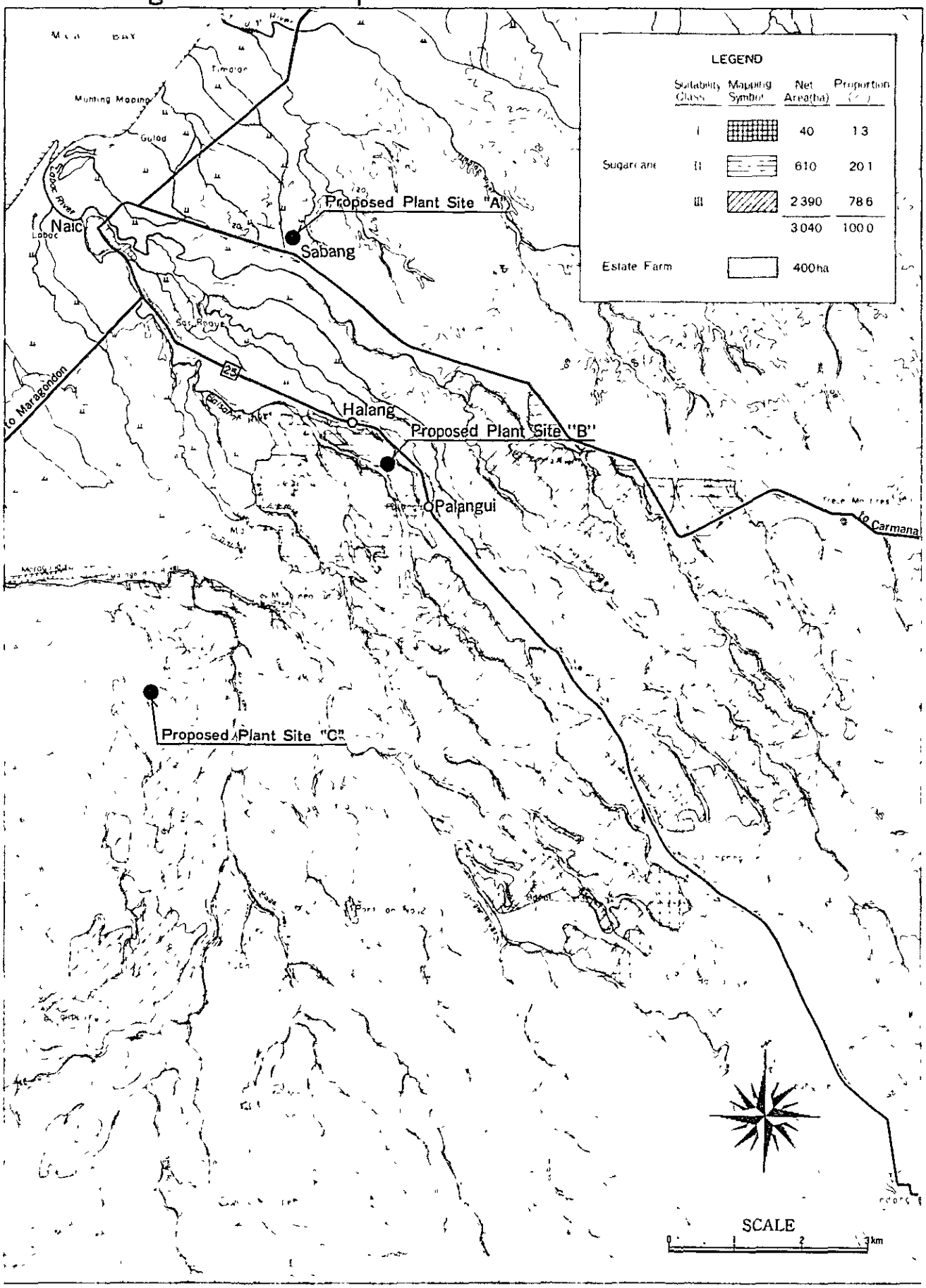
In selecting these sites, consideration was made to the following requirements:

i. Rice field should be avoided.
ii. The site should be reasonably flat.
iii. The site should be located reasonably near paved roads.

Selection of the most suitable one among these three candidate sites was done through home office work in Japan taking the following points into consideration.

i. Transportation cost of the raw material sugarcane
ii. Easy access of plant equipment and materials to the plant site during construction
iii. Availability of industrial water
iv. Distance from the populated areas
v. Site development cost

Fig. II-2 Proposed Plant Sites



(2) Visits to sugar mills

The Team visited PHILSUCOM as well as four other sugar mills to compare and evaluate the diffusion process and the milling process adopted by them for sugar extraction from cane.

Evaluation of the diffusion process appeared to differ at each mill and therefore further study was made in Japan for the final evaluation. The findings and observations of this survey are as follows:

1) The diffusion process, if properly operated, improves the sugar recovery rate by 1 - 2%.

2) It cannot respond flexibly to variations of available quantity of raw material (sugarcane) and it has to be bypassed in case the plant needs to be operated at low load.

3) It requires more maintenance than the milling process, resulting in frequent shutdown.

4) It requires more energy than the milling process. Through these visits, the Team also found that the total sugar content in cane harvested in Maragondon region surveyed is somewhat higher than that of cane in other regions of the country. Namely, the 12% content assumed in the Phase-I study was increased by 1 - 2% in the Phase-II. Further detailed study was made by the Agricultural Sector Team to decide on the percentage to be adopted in the Phase-II study. As the result it was decided to use 14.1%.

(3) By-products utilization

Possibility of recovering CO_2 and waste yeast as by-products was investigated:

1) CO_2

CO_2 is expected to have a fairly good marketing possibility in view of a growing market of soft drinks, ice cream, and refrigerated foods, where CO_2 is consumed, but additional capital investiment is required to liquefy CO_2 or transform it into dry ice. Therefore, whether or not such additional innestsment can be justified was studied through home office work.

2) Waste yeast

Utilization of waste yeast appears rather difficult as compared to CO_2. One possibility is to use it as animal feed but it has to compete with American soya beans which are cheaper and better in quality (richer in protein). Further study was made in Japan but the best may was to bring it back to cane field to use as fertilizer.

(4) Local procurement of equipment and materials

In this field survey, the local engineering firms, equipment manufacturers and construction firms were contacted to obtain information on equipment and materials that could be procured locally. The results of this survey was reflected in estimating the construction cost of alcohol distillery, the proportion of the local procurement (50% minimum), etc.

1) Steel plate, bar, angle bar, channel, welded pipe and other construction steel materials are manufactured in the Philippines and hence available for domestic procurement. However, the quality control of some of domestic materials appears not to be strict enough and hence the use of one grade larger size is recommended.

2) Equipment

The survey results are generally similar to those of the second field survey. Namely, rotating machinery should be imported while plant equipment such as vesels, columns and heat exchangers could be locally manufactured.

3) Instrumentation, electrical equipment and materials

Cable duct, panel and low voltage electric wire, etc. are locally procurable but instruments and motors have to be imported.

4) Other field construction machinely and consumables are available for procurement in the Philippines but the rental of cranes and other construction machinery is fairly high. Therefore, their mobilization plan should be examined in details for reducing the construction cost.

3-5-2 Assumptions of financial and economic analyses

Conferences were held with PNAC, BOI, MOF, NEDA, Central Bank, etc. on the assumptions in performing the financial and economic analysis.

The significant features of the financial and economic analyses in the Phase-II as compared to those of the Phase-I are highlighted as shown below.

i. Integrated financial analysis covers not only the industrial sector but also the agricultural sector.

ii. Escalation factors are taken into consideration in implementing the financial analysis.

iii. Economic analysis is also conducted.

Focusing on the above points, the basis and conditions of financial and economic analysis are described as follows:

(1) Financial analysis

The integral financial analysis of industrial and agricultural sectors covers the alcohol plant and estate. The following cases are included in the financial analysis.

i. Performance of sensitivity analysis with escalation and incentives.

ii. Performance of sensitivity analysis without escalation but with incentives.

iii. Performance of financial analysis with escalation but without incentives.

iv. Performance of financial analysis without escalation and incentives.

1) Short and long term loan interest:

Long term loan	8%
Short term loan	18%

In the cases without escalation, the said interests are deflated.

2) Project life:

23 - 24 years, including 3 years of construction period. The project life is determined based on the study made by the Agricultural Sector Team.

3) Rate of operation:

The target plant load is 60% for 1st year, 80% for 2nd year and 100% 3rd year, but subject to revision (as shown in other chapters) based on the results of the study by the Agricultural Sector Team.

4) Escalation:

a) The escalation rate of operating cost is in the range of 5 to 10%/year. In the determination of the escalation rate, the Philippine GNP price index projected by NEDA is referred to.

b) The escalation rate of construction cost is assumed to be 10 to 12% in view of galloping inflation rate in the Philippines in recent years.

c) The escalation rate of raw material sugarcane is in the range of 5 to 10%, but final decision is made based on the results of the study by the Agricultural Sector Team.

d) The escalation factor of product alcohol is 1 to 2.5% higher than that of the operating cost.

The financial analysis with escalation is conducted with the assumptions if a) - d) above and event the case study without escalation incorporates the escalation factors up to the time of plant start up.

5) Economic analysis

Economic analysis is conducted with shadow prices applied to the sale price and cost.

3-6 Procedure

Furthering the Phase-II study, the significant points are as follows:

i. On the part of the Industrial Sector Team, the alcohol plant capacity is assumed to be 60 kl/day and this value is to be modified if necessary based on the raw material harvest figure to be determined by the Agricultural Sector Team.

ii. Comparative study of alcohol distillery processes is performed.

iii. A draft of the final report is to be mailed out so as to reach PNAC one week prior to the presentation by the Japanese Team to the Philippine counterparts, which is scheduled to take place at the end of March.

CHAPTER Ⅲ

PHASE-I STUDY RESULTS

The results of the Phase-I study have already been reported in details in the Interim Report. The results are summarized in the following.

1. Objective of Phase-I Study

The objective of this study is to find the most suitable raw material among sugarcane, cassava and sweet potato for alcohol distillery in Maragondon, Cavite.

2. Premises of Phase-I Study

2-1 Alcohol Distillery Capacity for Each Raw Material

The capacity of an alcohol distillery depends on the yield of raw material, the unit consumption and the harvesting period of each raw material. The relationship of these factors is summarized in Table III-1.

Table III-1 Comparison of the Three Candidate Crops

	Sugarcane	Cassava	Sweet Potato
Raw Material Production (t)	164,990	41,900	33,520
Crop Consumption (t/kl-Al.)	15.25	6.5	6.5
Alcohol Production (kl/y)	10,819	6,450	5,160
Annual Plant Operation (d/y)	200	90	120
Plant Capacity (kl/d)	54	72	43

As can be seem from the table, the production capacity of the distillery is 54 kl/d, 72 kl/d and 43 kl/d for sugarcane, cassava and sweet potato, respectively.

2-2 Selection of Production Process for Each Raw Material

In selecting the process for production of alcohol from sugarcane, cassava or sweet potato, our basic policy has been as follows:

(1) To employ process that has been proven in commercial scale production.

(2) To perform detailed comparison and evaluation of each process unit in Phase-II.

(3) To use same process for cassava and sweet potato as they are both starchy materials with the starch content being the same at about 25 percent by weight and as nearly the same degree of fermentation was obtained in the fermentation tests conducted at the laboratory.

2-3 Selection of Candidate Sites for Distillery

Based on the field survey of the project site, the vicinity of Halang was selected in Phase-I study as the candidate site for the installation of alcohol distillery, while comparative study with other candidate sites was reserved for Phase-II.

3. Results of Phase-I Study

3-1 Outline of Alcohol Distillery

Outline of alcohol distillery for each raw-material is given in Table III-2.

Table III-2 Outline of Alcohol Distillery

	Sugarcane	Cassava	Sweet Potato
Plant capacity (kl/d)	54	72	43
Annual Operation (d/y)	200	90	120
Plant Site Area (m^2)	32,500	32,500	32,500
Construction Schedule (m)	24	24	24
Number of Personnels	132	148	148
Plant Investment Cost (10^3 pesos)	115,930	106,670	81,410

4. Overall Evaluation

4-1 Results of Financial Analysis

The results of financial analysis of each raw material are summarized in Table III-3.

Table III-3 Comparison of Financial Analysis

	Sugarcane	Cassava	Sweet Potato
IRR on Investment (%)	3.5	minus	minus

As is obvious from the table, sugarcane is superior to other two in terms of IRR on investment. However, even IRR figure of 3.5% for sugarcane was not satisfactory and it was further examined in Phase-II, with inflational effects and other factors taken into consideration.

4-2 Energy Balance

The energy balance of each raw material is given in Table III-4, where the energy consumption of the agricultural sector and the industrial sector is assumed to be 1.0.

Table III-4 Energy Balance

	Sugarcane	Cassava	Sweet Potato
Energy Output	17.75	0.81	0.80

From the table, it is seen that sugarcane is superior to others in terms of energy balance. The energy balance figures less than one for cassava and sweet potato are due to use of timber to be brought in from outside as fuel for these two raw materials.

4-3 Evaluation from Agricultural Technology Aspect

In maragondon region under study, people in the agricultural sector are experienced in large scale cultivation of sugarcane but not experienced in cultivation of cassava and sweet potato. Therefore, much time will be spent before they can achieve the target yield of the latter two crops form the given land.

In this respect, too, sugarcane is most suitable.

4-4 Evaluation from Industrial Technology Aspect

In terms of experience on industrial utilization of candidate crops for alcohol production, sugarcane has been well-proven in Brazil, while sweet potato in Japan and other countries.

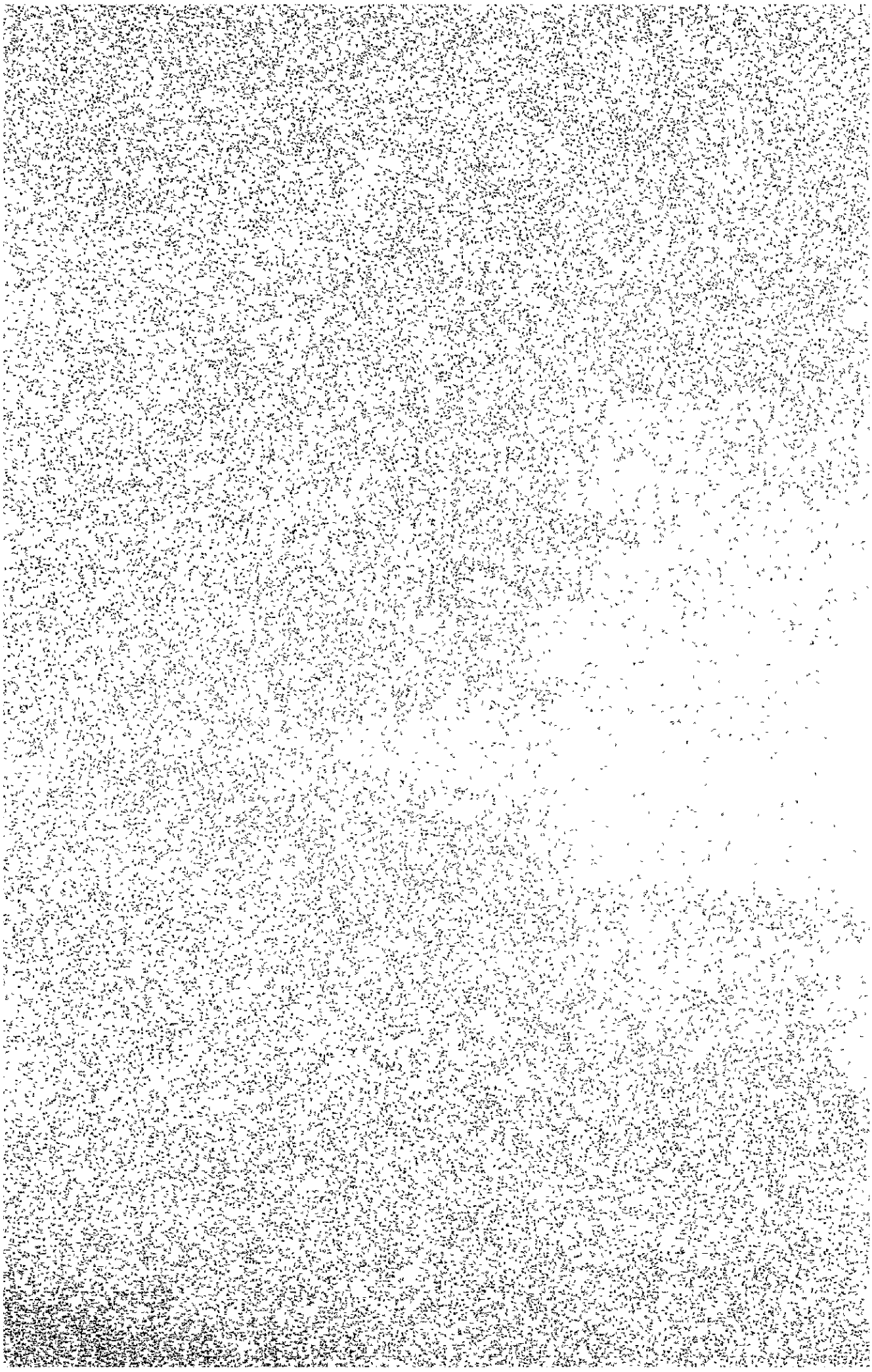
On the other hand, cassava lacks experience on industrial utilization for alcohol production.

In this repsect, sugarcane and sweet potato are superior to cassava because of reliability of technology.

Evaluation all these factors together, it is concluded that sugarcane is most suitable as the raw-material for alcohol production.

CHAPTER Ⅳ

ENERGY SITUATION IN THE PHILIPPINES



1. Present Energy Situation

(1) Primary energy consumption

The Philippines highly depends on crude oil for its primary energy requirements, as much as over 90% as of 1979.

Table IV-1 Philippine Commercial Energy Consumption in 1979

(In thousand barrels-of-oil equivalent)

	Volume	Percent
Oil	83538	92.5
Coal	869	1.0
Hydro	4802	5.3
Geothermal	1095	1.2
Nonconventional	10	-
Total	90314	100.0

Source: PNAC

(2) Energy consumption by sectors

About 80% of the total energy is consumed by the transportation and industrial sectors.

Table IV-2 Sectoral Shares of Energy Consumption in 1979

Sector	Percent
Transportation	35.7
Industry	42.8
Commercial	8.4
Residential	13.1
Total	100.1

Source: Ten-Year Energy Program 1980 - 1989

(3) The oil price impact on the economy

The steep rise in crude oil prices which was triggered by the 1973 energy crisis gave a great impact on the economy of the Philippines who relied on the imported oil for the supply of more than 90% of the total energy.

Until 1973, oil importation was no more than 13% of the total import bill, but it reached as high as 32% in 1980.

2. Five-Year Energy Program

The Philippine Government established the Ministry of Energy and formulated Ten-Year Energy Program in 1977 with the purpose of promoting self-reliance in energy and reducing dependence on imported oil. This program included the comprehensive development of energy resources, such as domestic oil and gas exploration, coal exploration, development of hydraulic and geothermal power generation, development of nuclear power and non-conventional energy as well as measures for efficient energy utilization, distribution and marketing. Later in 1980, the Five-Year Energy Program was worked out to cope with continuing escalation of oil price and uncertainty of foreign oil supply, aiming at

the self-reliance in energy and reduction in dependence on oil for an early economic recovery of the Philippines.

(1) Primary energy consumption

The growth rate of the primary energy consumption is expected to be 8% per year, from 98 MMBOE (million barrels-of-oil equivalent) in 1981 to 134 MMBOE in 1985. This program plans to decrease the oil consumption at an annual rate of 1.8% and to reduce the ratio of reliance on oil from 84.5% to 54.9% through the development of the domestic energy. The major sectors to be converted to domestic energy are power generation, industries like cement, etc., and transportation to incorporate the proposed alcogas program. It is estimated that the ratio of total domestic energy will reach 48.9% in 1985 from 23.0% in 1981 as a result of the growth in the domestic energy at an annual rate of 30.6%, of which, non-conventional energy will grow at an annual high rate of 120%, though small in volume, accounting for 4.6% of the total primary energy in 1985.

Table IV-3 Primary Commercial Energy Demand Projections

(In million barrels-of-oil equivalent)

	1981		1985		Rate of Increase (%/Year)
	Volume	Percent	Volume	Percent	
Oil	82.66	84.5	73.46	54.9	-1.8
Coal	2.32	2.4	17.93	13.4	67.0
Geothermal	5.34	5.4	16.34	12.2	31.0
Hydroelectric	7.26	7.4	17.08	12.8	24.0
Uranium	-	-	2.81	2.1	-
Nonconventional	0.26	0.3	6.08	4.6	120.0
Total	97.84	100.0	133.70	100.0	8.1
Total Domestic Energy	22.48	23.0	65.37	48.9	30.6

Source: Five-Year Energy Program

(2) Development of nonconventional energy

It is planned to expand the volume and ratio of commercial nonconventional energy to 6080 MBOE (thousand barrels-of-oil equivalent), 4.6% in 1985 from 50 MBOE, 0.05% in 1980. Even when the plan has been realized, the position in the total energy is very low, however, implementation of this program has great significance in the expansion of employment and the improvement in the social and economic environment for the development of remote area. The typical nonconventional energy sources are alcohol, bagasse, dendrothermal and mini hydroelectric. In addition, utilization of Biogas, small water-impounding, solar energy and wind energy is being planned.

Table IV-4 Energy Contribution of Nonconventional Energy System

(In thousand barrels-of-oil equivalent)

	1981	1982	1983	1984	1985
Alcohol Production	96.20	575.50	1407.50	1964.20	2415.10
Bagasse	55.10	479.80	1247.40	1743.00	2222.30
Dendrothermal	86.00	233.00	433.00	682.00	973.00
Mini Hydroelectric	140.00	390.00	737.00	1133.00	1610.00
Misc.	33.20	68.20	128.50	196.70	286.11
Total	410.50	1746.50	3953.40	5718.90	7506.51

Source: Five-Year Energy Program

3. Alcogas Program

(1) The outline of alcogas program

The Philippine Government established the Philippine National Alcohol Commission, PNAC, in February 1980 in order to promote the production of alcohol which holds the most important position in the development of nonconventional energy. In April 1980, the Alcogas Program was formed. In April 1981, this program was revised to cope

with changes in the circumstances. This program aims to control gasoline consumption by the production of anhydrous alcohol from domestic agricultural raw materials (sugarcane, cassava, sweet potato, etc.) which is to be blended with motor gasoline. The economic and social effects are also expected by the implementation of this program, such as employment promotion in the agricultural area. According to the Alcogas Program revised in April 1981, maximum 15% of the total gasoline consumed is to be converted to alcohol by 1985. The alcohol production plan for 1981 is 82.4 MBOE, and for 1985, 1473.6 MBOE from 14 alcohol distilleries, or 234.300 kl of alcohol.

For accomplishing this program's target, PNAC formulated a plant construction plan, under which alcohol distilleries are divided into the following 3 models.

Model - I

Existing or new distilleries annexed to existing sugar centrals with the production capacity of 30 - 60 kl/d. As these distilleries use sugarcane juice or molasses as raw material produced by the existing sugar centrals, an early operation is possible.

Model - II

Large annexed or autonomous distilleries with the production capacity of 120 - 240 kl/d, for the purpose of supplying alcohol to large consuming areas such as Metro Manila.

Model - III

Autonomous municipal distilleries with the production capacity of 30 - 60 kl/d.

This study covers the above Model - III which aims the following items:

1) Creation of employment and improvement in the economic foundation of agricultural areas, giving an opportunity for additional revenue to the former agricultural occupants.

2) Systematization of small farmers as a strong economic unit.

3) Diversification of raw material and dispersion of production area.

4) An early realization through participation by small farmers.

5) Additional income to the low income earners.

6) Smaller quantity of waste water discharge and the lower treatment cost.

7) Lower investment cost due to the simplicity of the facility.

The plant construction plan and alcohol production plan are shown in Table IV-5 and Table IV-6.

Table IV-5 Power Alcohol Program Target Distillery Capacity and Alcohol Production

YEAR	MODEL I		MODEL II		MODEL III		TOTAL	
	UNITS	MML/Y	UNITS	MML/Y	UNITS	MML/Y	UNITS	MML/Y
1981	2	13.1	-	-	-	-	2	13.1
1982	7	52.5	-	-	-	-	7	52.5
1983	9	91.7	3	72.0	-	-	12	163.7
1984	9	118.5	3	81.6	1	9.0	13	209.1
1985	9	118.5	3	96.0	2	19.8	14	234.3

Source: PNAC

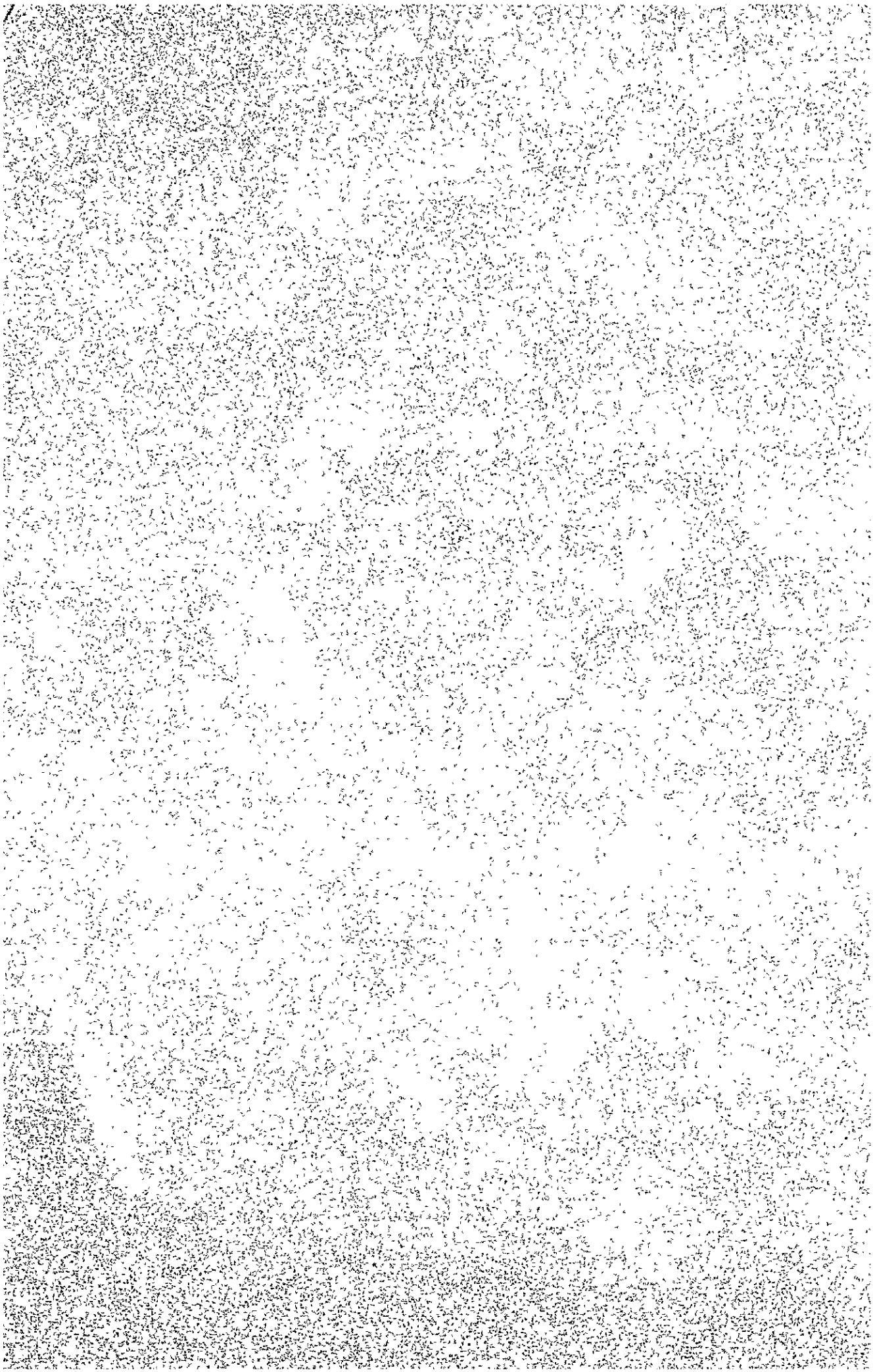
Table IV-6 Power Alcohol Program Projected Alcohol Mix in Gasoline

	ALCOHOL PRODUCTION		GASOLINE DEMAND	AVE. % ALCOHOL
YEAR	MML	MB	MB	IN GASOLINE
1981	13.1	82.4	10,187	0.8
1982	52.5	330.2	9,472	3.5
1983	163.7	1029.5	9,071	11.3
1984	209.1	1315.1	8,838	14.9
1985	234.3	1473.6	8,661	17.0

Source: PNAC

CHAPTER V

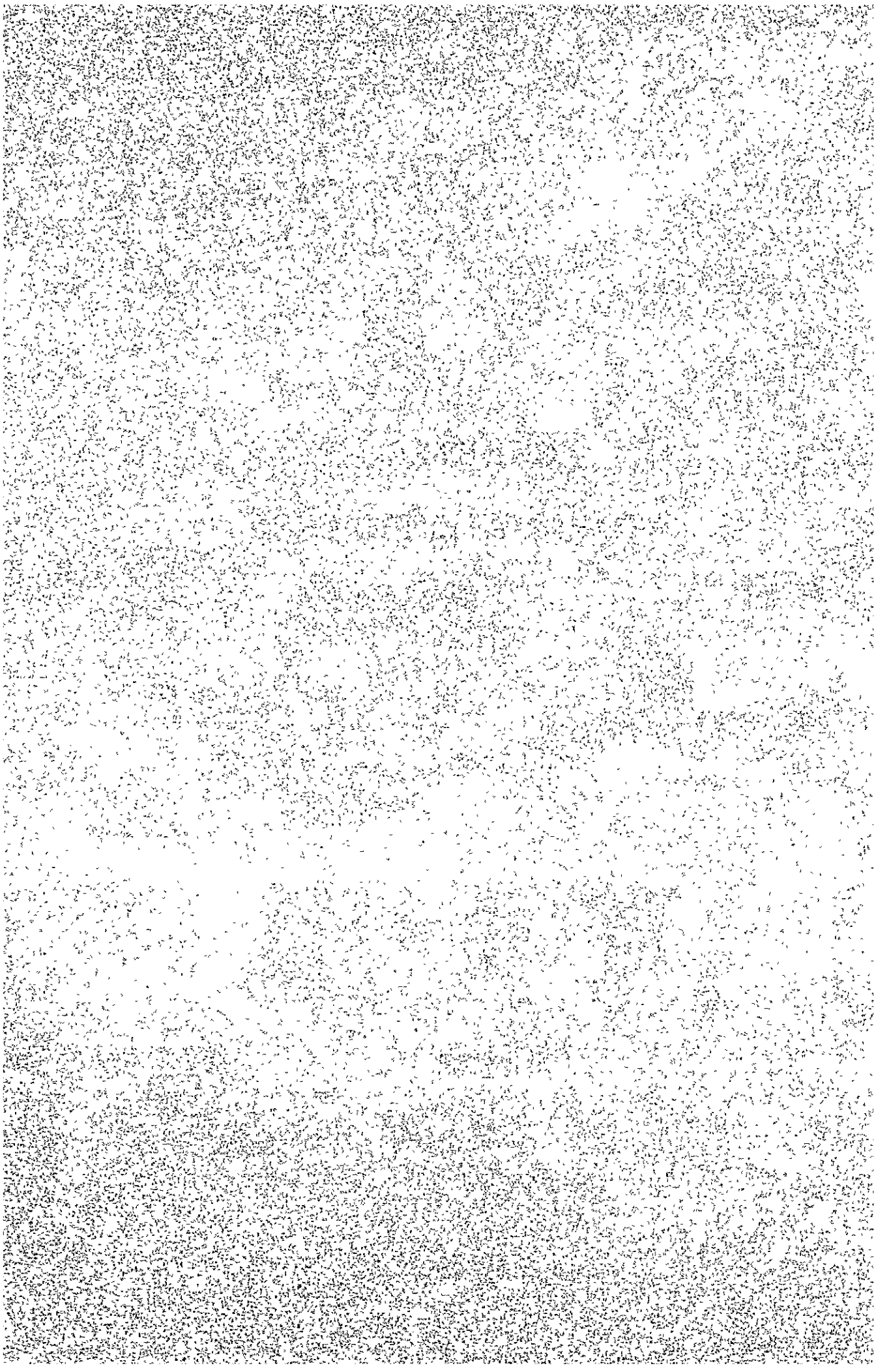
OUTLINE OF THE SITE



An outline of nature and the community conditions around the objective site area is shown in chapter II of the report prepared by the Agricultural Sector Team.

CHAPTER VI

RAW MATERIAL CROP



In the Phase-I, the study was performed to select a raw material from sugarcane, cassava and sweet potato. As the result, sugarcane was selected as the most suitable raw material.

Accordingly, in the Phase-II the Agricultural Sector Team made further studies in more detail regarding the crop yield, sugar contents, etc. relevant to the sugarcane.

Based on the findings, the production capacity of the alcohol distillery was set at 48 kl/d.

The following are the findings of the Agricultural Sector Team:

Plantation area	:	2,380 ha
Crop yield per hectare	:	Approx. 53 t/ha (average)
Crop yield per year	:	123,670 t/y
Sugar contents	:	
Sucrose	:	13.5 wt%
Invert sugar	:	0.6 wt%

The aforementioned sucrose content was revised from 12.0 wt% as adopted in the Phase-I to 13.5 wt% based on teh actual yield in experimental cultivation of sugarcane in the project area.

Furthermore, delivery prices of sugarcane to the distillery were presumed as follows:

1981	160 pesos/t
1987	240 pesos/t

Table VI-I shows the summary of the findings of both the Agricultural and Industrial Sector Teams.

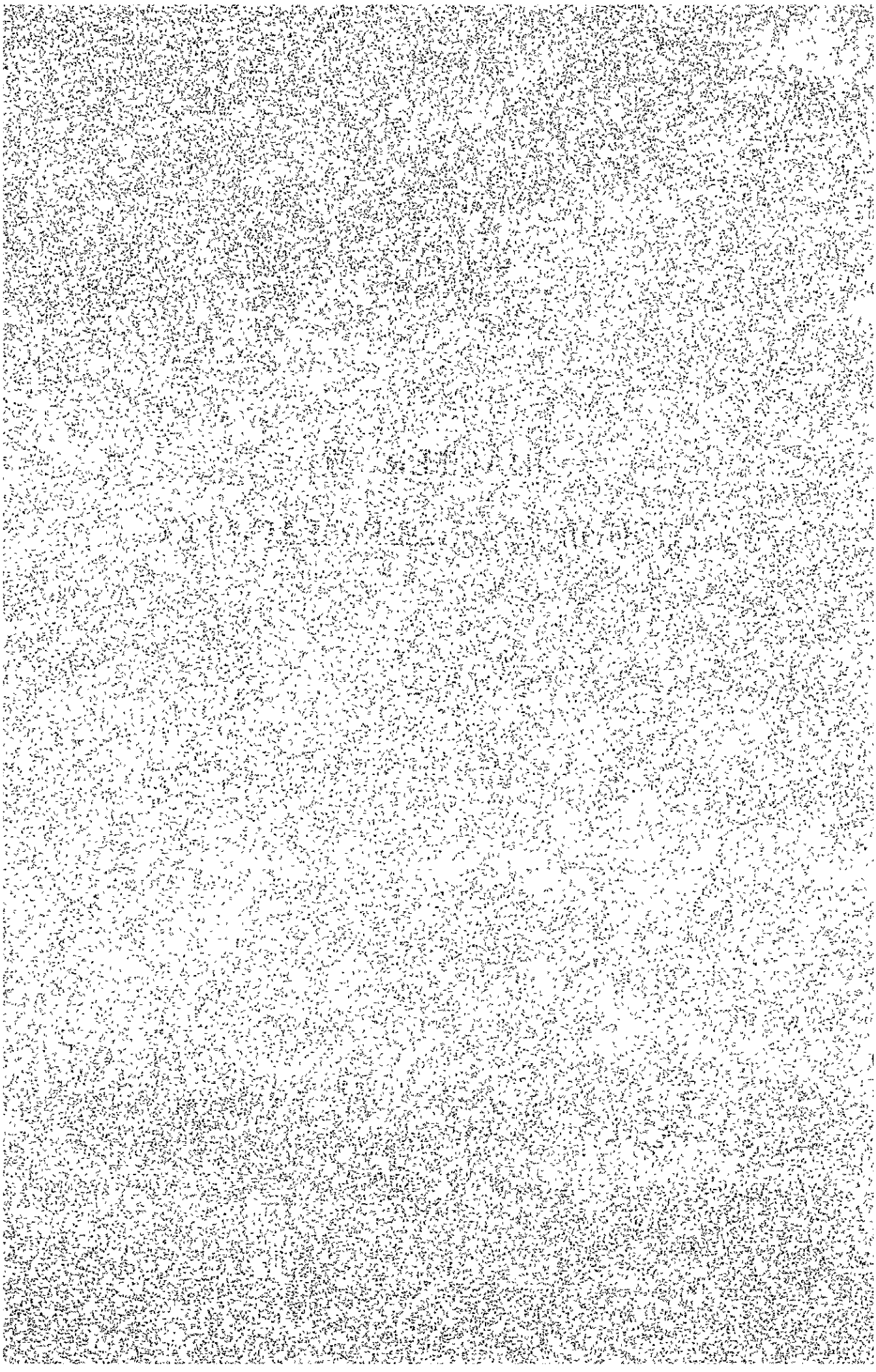
Table VI-1 Study Results on Raw Material Crop

Results of Agricultural Study						
Raw Material Crop	Selected Plantation Area (ha)	Yield (t/ha on av.)	Content of Sugar (wt%)	Production (t)	Unit Price of Crop (Pesos/t)	Harvesting Period (days)
Sugarcane	2,380	52.0	Sucrose 13.5 Invert Suger 0.6	12,3670	240	200 (Nov.-May)

Results of Industrial Study			
Annual Plant Operation (days)	Crop Consumption (t/kl-Alcohol)	Alcohol Production (kl)	Alcohol Plant Capacity (kl/d)
200 (Nov.-May)	12.87	9,609	48

CHAPTER Ⅶ

ALCOHOL DISTILLERY FACILITY



1. Premises of Alcohol Distillery

1-1 Scope of Study

The scope of study of the alcohol distillery is as follows:

(1) The scope of study has been as a rule limited to within the battery limits, but access road from major road, waste water treatment facility and rain water drainage facility are included in this study scope, though they are out of the battery limits.

(2) Utility facilities and electric power facility such as deep well, boilers and generators are included in the scope of study.

(3) Distribution, storage and consumption of alcogas have not been included in the scope of study but related information has been accurately evaluated and reflected in the study.

1-2 Design Basis

The facility design has been based on the followings:

(1) Product alcohol quality : 99.5 vol. % alcohol or over

(2) Raw material : Sugarcane

(3) Alcohol production capacity : 60 kl/d which is a standardized capacity in Alcogas Preject

(4) Annual operating days : 200 days

(5) Operating hours per day : 24 hours

(6) Raw material composition:

The following figures have been adopted in accordance with discussion with the Agricultural Sector Team.

1)	Sucrose	13.5 wt.%
2)	Invert sugar	0.6 wt.%
3)	Fiber	13 wt.%

(7) Product alcohol storage capacity: For 30 day production

(8) Utilities

1) Water

a) Water resource

As the results of test well study undertaken by NIA indicate feasibility of deep wells in the distillery site, such wells have been adopted as the source of water.

b) Quality of water

The results of water quality analysis made by the Survey Team on the samples taken from wells in the vicinity of Halang are shown in Table VII-1 and have been adopted as the design basis.

Table VII-1 Quality of Well Water

Item		Content
Total Hardness (as $CaCO_3$)	PPM	146
Cl^-	PPM	11
Total Silica (as SiO_2)	PPM	176
Methyl-Alkalinity (as $CaCO_3$)	PPM	229
SO_4^{--}	PPM	6
SS		Trace
Oil		Trace
Water Temperature	°C	28

2) Electric power

The following electric power is generated by an in-plant power station.

a) For machinery drive: 440 V, 60 Hz, 3 phases
b) For instrumentation: 110 V, 60 Hz, single phase
c) For lighting: 220 V, 60 Hz, single phase

3) Fuel

Bagasse is used for normal operation and fossil fuel such as diesel oil is used for start-up and in emergency.

(9) Meteorology

Based on the results of field survey, the figures listed in Table VII-2 have been adopted.

Table VII-2 Meteorology Condition

Items		Unit	Value
Temperature	Max.	°C	35
	Ave.	°C	29.5
	Min.	°C	21
Relative Humidity		%	66 to 85
Rainfall	Max.	mm/d	250
Wind Velocity	Max.	km/h	250
Wet Bulb Temp.	Max.	°C	28

(10) Structural design standards

The following figures from the National Structural Code for Buildings have been adopted.

1) Seismic factor

0.1 has been adopted as the design horizontal seismic coefficient.

$V = 0.1\ W$

where V: Total horizontal force on foundation
W: Total fixed load

2) Wind pressure

a) Wind velocity: 175 km/h

b) Wind pressure

Structure height (H)	Wind pressure
9m<H	150 kg/m^2
9m≦H<30m	200 kg/m^2
30m≦H	250 kg/m^2

3) Bearing power of soil

Based on the geology of the distillery site, 20 t/m^2 has been adopted for this study.

(11) Environmental protection regulations

As for the environmental protection, it has been decided to comply with the Rules and Regulations of National Control Committee (1978). Particular points to be noted are as follows:

1) Waste water

i) Waste water from the production facilities is diluted with cooling water and fed to sugarcane fields around the distillery as the irrigation water.

ii) Waste water from the administration building and canteen is treated by septic tank before it is mixed into the irrigation water.

(12) Laws and regulations

The design has been made in compliance with the following laws and regulations.

1) Civil engineering and construction

- o National Building Code
- o National Structural Code for Buildings

2) Boiler and pressure vessel

- o American Society for Mechanical Engineers or equivalent standards

3) Electric facilities

- o National Electrical Manufacturers Association or equivalent standards

4) Instrumentation

- o Instrument Society of America or equivalent standards

5) Fire-fighting facilities

- o The Fire Code of the Philippines and Regulations
- o National Fire Codes (U.S.A.)

6) Materials

- o American Society for Testing and Materials or equivalent standards

7) Rotating equipment

- o Japanese Industrial Standards

8) Environmental protection

- o The Rules and Regulation of National Control Committee (1978)

2. Alcohol Distillery Site

In Phase-I, study was made assuming Halang as possible site for the alcohol distillery. In Phase-II, three candidate sites have been selected and compared for final selection of the site.

2-1 Selection of Three Candidate Sites

In the third field survey of Phase-II, the Survey Team has surveyed the project site four times before selection of the three candidate sites for the alcohol distillery. In selecting these sites, the following requirements have been taken into consideration.

(1) Rice field should be avoided.

(2) The site should offer reasonably flat area of 130 m x 150 m for distillery.

(3) The site should be located near the paved roads to facilitate delivery of equipment and materials required for the construction of the distillery.

In consideration of these requirements, we have selected the following sites as the candidates. Their location is shown in Fig. VII-1, 2.

Candidate site A: Near Sabang
Candidate site B: Near Halang
Candidate site C: Near Maragondon

2-2 Comparison of Candidate Sites

The three candidate sites have been compared in terms of the following.

(1) Transportation cost of raw-material (sugarcane)

This cost has been calculated from the yield of sugarcane in each district within the project area and the unit transportation cost of (0.8 Pesos/t. km).

Fig. Ⅶ - 1 Proposed Plant Sites

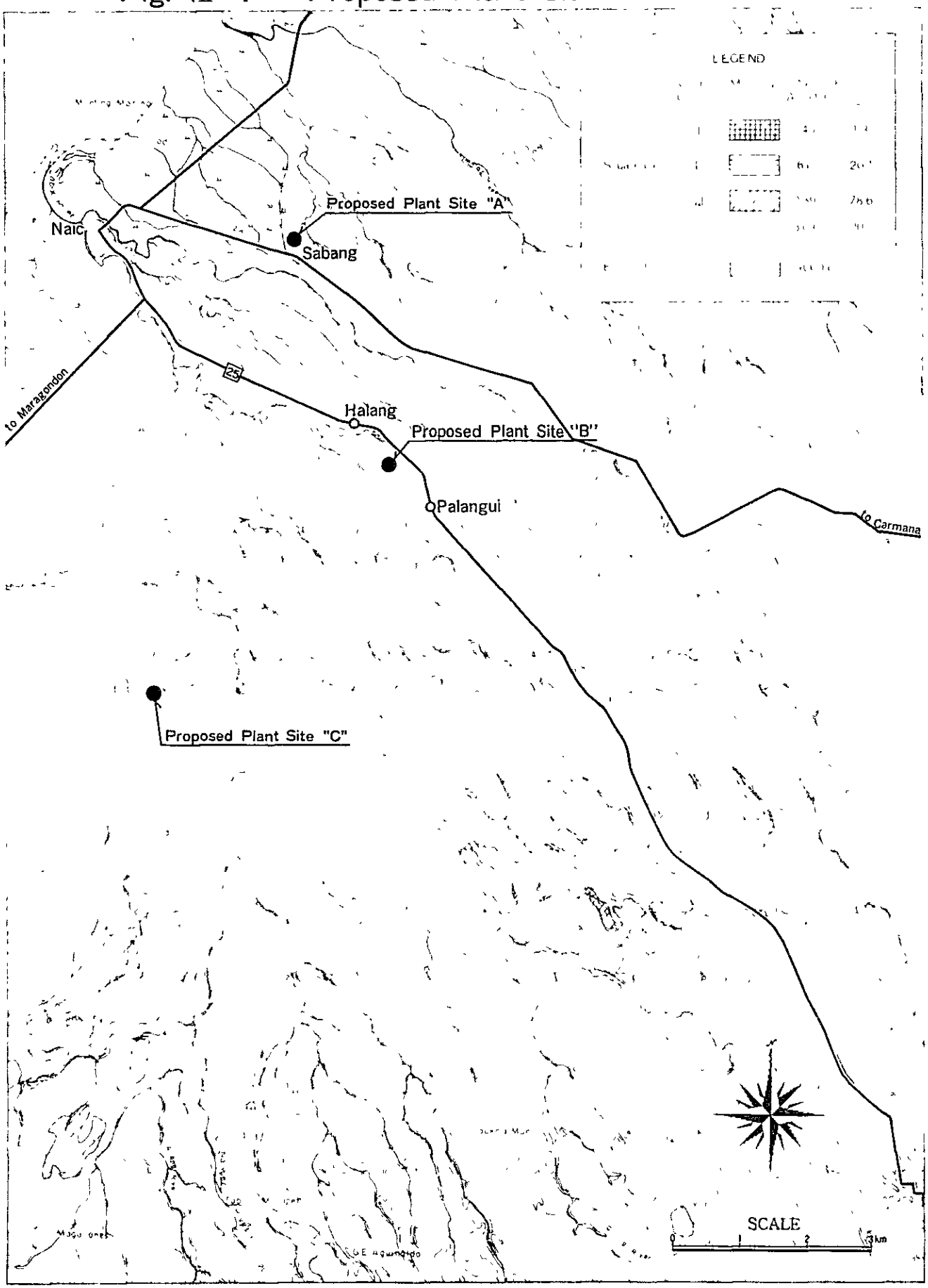
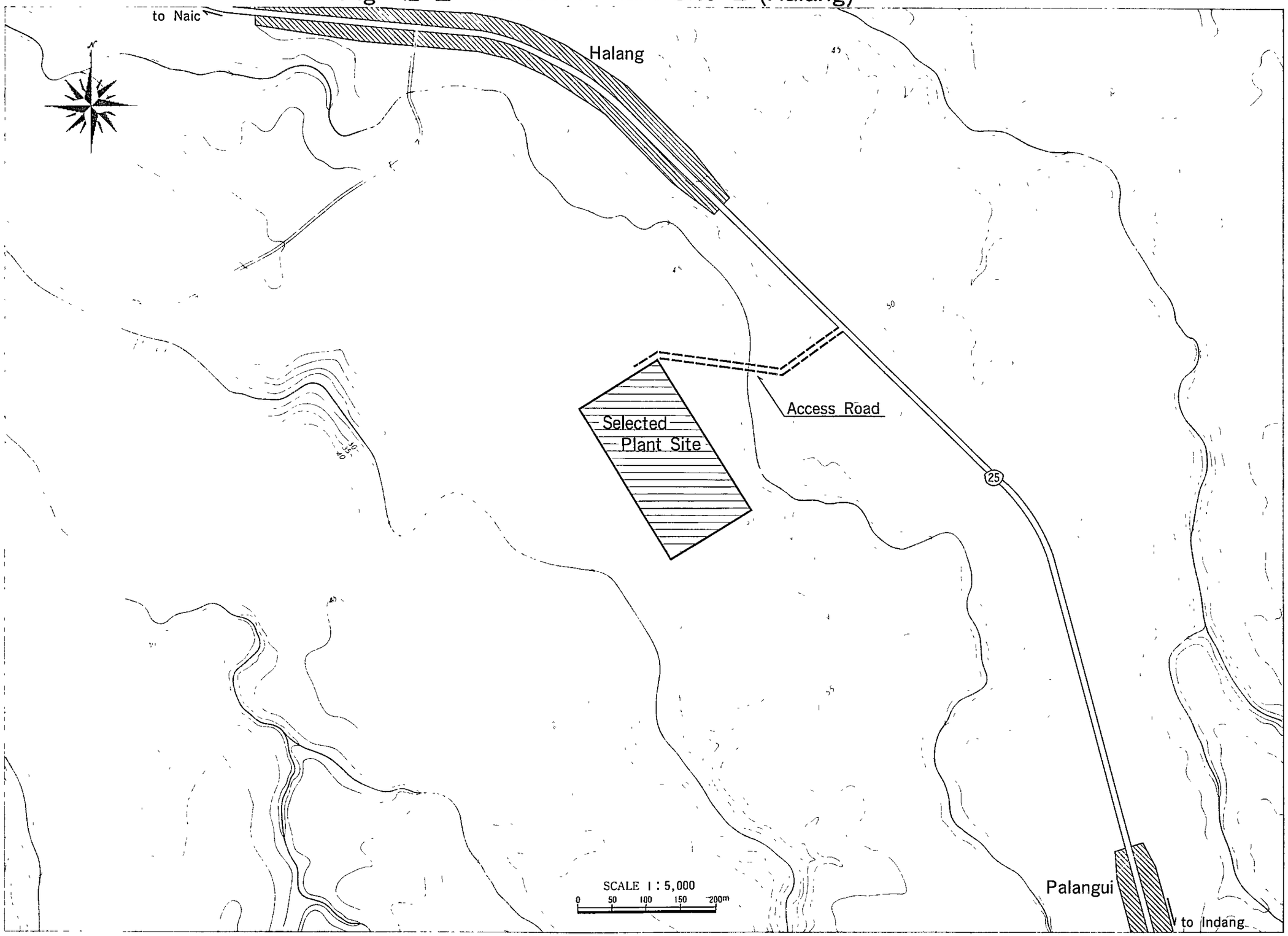


Fig. Ⅶ-2 Selected Plant Site B (Halang)



(2) Access of plant equipment and materials to distillery

Access of distillery equipment and materials to distillery site has been investigated through field survey.

(3) Availability of industrial water

Availability of industrial water has been evaluated based on the results of test well study conducted by NIA.

(4) Distance from inhabitants

Evaluation has been made based on the results of field survey.

(5) Site development cost

The site development cost has been evaluated based on the geography of the three sites.

Comparison of the three candidate sites is summarized in Table VII-3 below.

Table VII-3 Comparison of Candidate Distillery Site

	A. Sabang	B. Halang	C. Maragondon
Transportation Cost (10^3 pesos/y)	2,362	1,712	2,060
Transportation of Equipment & Materials	Easy	Easy	Rather difficult
Industrial Water	Easy (Well water)	Easy (Well water)	Easy (River water)
Distance from Inhabitants	Enough	Enough	Enough
Site Development	Cheap	Cheap	Rather expensive
General Estimation		O	