THE FEASIBILITY STUDY
ON
THE DEVELOPMENT
OF
SUGARCANE MOLASSES FERMENTATION
INDUSTRY
IN
THE REPUBLIC OF INDONESIA

(SUMMARY)

JULY, 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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SUMMARY

I. Preface

1. Background and Objectives

The Government of Replublic of Indonesia is implementing production increase policies to become self-supporting on sugar, and as the result of this effort, the production of cane molasses, a byproduct of the sugar production, will increase to a million tons in 1986 from the current level of half million tons a year.

Since the price of cane molasses greatly fluctuates affected by the international market prices, the Indonesian government thought it essential that the cane molasses is converted to products of high added values by employing a fermentation industry, and requested the Japanese government a feasibility study to plan an industry development for utilization of sugar production byproducts.

Upon receipt of this request, Japan International Cooperation Agency (JICA) dispatched a preliminary survey mission to Indonesia for 11 days from August 31, 1982, and the mission and Indonesian government concluded and signed a "Scope of Work (S/W). This report describes the results of field researches conducted for about a month from November 28, 1982 in accordance with the S/W and results of further studies made in Japan afterward.

2. Scope of the Study

The field research mission was to select a site for plant construction out of the following three proposed sites and to select up to five products out of the proposed seven proposed products, as well as reviewing the feasibility of industrialization on each item.

Proposed plant sites

Panji Sugar Factory, in Situbondo area, eastern Java
Pesantren Baru Sugar Factory, in Kediri area, eastern Java
Ex Comal Sugar Factory, in Pekalongan area, central Java

Proposed products

- Ethyl alcohol (Ethanol)
- Mono Sodium Glutamate (MSG)
- Yeast
- L-Lysine
- Antibiotics
- Citric acid
- Acetic acid and vinegar

II. Sugar Industry in Indonesia

1. Outline of World Sugar Industry

The sugar demand is not growing in the world scale. The estimated stock from 1982 to 1983 is 36 million tons indicating apparent state of overstock. By the countries, India ranks at the top by producing 8.51 million tons a year, and South Africa is at the 10th by producing 2.18 million tons.

2. Sugar Production and Price in Indonesia

	Production (Million tons)	Consumption (Million tons)	Import (Million tons)
1981	1.30	1.80	0.50
1984 (schedule)	2.22	2.21	–
1989 (schedule)	3.26	3.15	–

At present, there are 51 sugar factories belonging to PTP and 9 sugar factories of private enterprise. Most of them are located in the Java Island, with only 3 factories located in other than Java. Majority of these factories are small in the scale and the productivity is low with the number of operation days ranging from 80 to 190 days a year.

BULOG, governmental agency, solely operates on sugar management, storage, distribution and price determination, and sugar itself is owned by Bank Bumi Daya.

The price structure of sugar as of December, 1982 is as follows.

Ex-factory price	35,000 Rp/100 kg
Distributor purchase price	46,000 Rp/100 kg
End user market price	50,000 Rp/100 kg

At a sugar factory in the eastern Java, the cost was about 38,000 Rp/100 kg. This high cost is attributable to the high purchase price of sugar cane and low productivity.

The trend of ex-factory prices is shown below.

May, 1974	7,599.8 Rp/100 kg
Nov. 1974	9,088 Rp/100 kg
Nov. 1975	10,907.7 Rp/100 kg
May, 1977	13,434 Rp/100 kg
May, 1978	15,557 Rp/100 kg
June, 1979	18,794.8 Rp/100 kg
May, 1980	22,553.7 Rp/100 kg
Oct. 1980	30,705.6 Rp/100 kg
Apr. 1981	35,000 Rp/100 kg

3. Molasses Situation in Indonesia

Generally, the yield of sugar from sugarcane is 9 – 11%, and cane molasses 3.5 – 4.5%. The Indonesian cane molasses is good in the quality on the sugar contents, but has a defect of high ash contents. Higher ash contents cause troubles like scaling to the equipment in the fermentation process, and such cane molasses is not prefereable as the material for fermentation industry.

Being influenced by the international market prices, the cane molasses prices fluctuated largely as shown below.

1977	15,200 Rp/ton
1978, first half	16,500 Rp/ton
second half	24,750 Rp/ton
1979, first half	30,950 Rp/ton
second half	36,100 Rp/ton

1980, first half	58,200 Rp/ton
second half	71,900 Rp/ton (≑ US$120)
1981, first half	50,000 Rp/ton
second half	50,000 Rp/ton
1982, August	20,000 Rp/ton

In the world scale, 30 to 34 million tons of molasses are produced yearly, out of which 10 million tons are from beet. 6 to 7 million tons of cane molasses are produced in each area of Asia, north, central and south Americas, and cane molasses production in Indonesia occupies less than 10% of the Asian production.

In Europe and America, molasses is used mainly as animal feed. In the South America, it is used mainly as the raw material for ethanol fermention and in Asia raw material for fermentation. The molasses demand in Asian countries can be broken down as follows.

Japan	800,000 tons/year
Korea	400,000 tons/year
Formosa	100,000 tons/year

Molasses producing Asian countries are severely competing each other on export to these countries.

III. Markets of Molasses Fermentation Products in Indonesia

1. Scope from Molasses Consumption (1980)

Production, domestic consumption and export of cane molasses in 1980 are as shown below.

Cane molasses production 380,000 tons	Domestic consumption	275,000 tons
	Breakdown	
	Ethanol	135,000 tons
	MSG	123,000 tons
	Yeast & Pellet	17,000 tons
	Export	105,000 tons

2. **Ethanol**

There are 13 ethanol fermentation plants, out of which 3 belong to PTP. While old plants using conventional technologies are not efficient with the unit consumption of cane molasses being 4 against ethanol, the unit consumption of the plant which was constructed based on the latest Austrian technologies is as low as 3.36. The ethanol production capacity of the whole of Indonesia is 194.5 Kℓ/day. With this capacity, 58,000 Kℓ can be produced if the number of operation days is 300 per year, but the actual production is around 26,100 Kℓ.

The "Gasohol Programme" is being reviewed as a project to increase domestic consumption of ehtanol. At present, the total consumption of petroleum products is Indonesia is 22 million Kℓ (7 – 10% of Japan's consumption), out of which 7.2 million Kℓ are used for transportation fuel, and 3.7 million Kℓ or about half of it is gasoline. If ethanol is mixed in the quantity of 10% of the gasoline, it creates ethanol consumption of 0.37 million Kℓ, which is equivalent to consumption of 1.2 million tons of cane molasses.

At present, ethanol is mainly used in the domestic industries and the competition with the recovered methanol from the textile industry is very keen. If the Gasohol Programme is promoted as the governmental policies, development of the ethanol industry using cane molasses is possible. Since we adopt the immobilized yeast method for the ethanol production, the new plant will be able to produce ethanol more economically than the current method because of the higher efficiency and less amount of investment.

3. **Glutamic Acid (GA) and Mono Sodium Glutamate (MSG)**

In Indonesia, there are 3 integrators, which vertically produce GA and MSG from cane molasses, and 6 converters which produces MSG only out of GA purchased from outside sources, and 2 more companies are constructing GA plants. The GA production capacity of the 3 integrators is 36,000 tons/year, and if it is added with the capacity of the 2 plants being constructed, the annual production capacity is 45,000 tons, which is equivalent to 54,000 tons when converted to MSG. On the other hand, the MSG domestic consumption in 1981 is estimated to be 30,000 – 35,000 tons, or the production capacity is far greater than the consumption. To increase the domestic MSG consumption, the food processing industry must be developed. Trying to sell GA or MSG in the export market is not too easy since competition with neighboring countries, especially with China, is very keen.

4. **Bakery Yeast**

Indonesia is annually importing 1,500 to 2,000 tons of active dry yeast from France and other countries and this amounts to US$2 million. There is a domestic yeast producer, PT Indo Fermex, who mainly produces compressed yeast. While the people's eating habits of relying on rice mainly cannot be changed all of sudden, there is a trend of shift to bread eating in urban areas, and for the future, self-supply of bakery yeast must be reviewed.

5. **Feed Yeast**

The number of farm animals is increasing, and as the result, the production of compound feed is increasing. There are 32 compound feed producers and 7 of them are large scale producers. The statistics indicate that in 1980, about 600,000 tons (or equivalent to 60,000 million Rp) of compound feed were produced in the eastern Java, and about 3 million tons in the whole country. For the protein source, which is the most important part of the feed, Indonesia depends on imported soybean meal and fish meal, and it is possible to replace these protein sources with the feed yeasts for animal produced from cane molasses through the fermentation process.

It is said that PT Sumber Protein is already producing 200 tons of feed yeast monthly, which contain 48% of crude protein and 5 – 6% of moisture, selling for 250 – 280 Rp/kg.

If feed yeast is mixed in the quantity of 3% of the 3 million tons of compound feed, it can amount to 90,000 tons, consuming 360,000 tons of cane molasses. Accordingly, production of feed yeast for animal is very pormising as an effective use of cane molasses, provided that technical services on how to use the compound feed can be given, the overall develops to the extent of a fair size market is established and that the production does not require any excessively large cost that is unforeseeable at this moment.

6. **Antibiotics (Corynecin)**

Indonesia imported medicines in the amount of US$600 million in 1980, including the following antibiotics.

Penicillin	62 tons	US$5,400,000
Streptomycin	29 tons	US$1,500,000
Tetracycline	182 tons	US$6,400,000
Chloramphenicol	99 tons	US$4,900,000
Others	396 tons	US$22,800,000
Total	768 tons	US$41,200,000

Generally, materials for medicines must be made from very pure raw materials, and there is no example of producing antibiotics from cane molasses, with an exception of Corynecin which can be easily converted to Chloramphenicol.

The Indoneisan government is making an effort to realize that the people receive advanced medical treatment by 2000 A.D. and it is studying domestic production of antibiotics. Although the fermentation process of Corynecin requires more advanced technologies than those of ethanol and feed yeast and many problems may be anticipated, we believe that Corynecin production is one that has to be pursued as it goes along the national policy.

7. Citric Acid

There are 6 producers of citric acid in Indonesia and they use cassava as the raw material and employes the surface culture process. The product is supplied mainly in the form of Ca-citrate. The total consumption is estimated to be about 2,000 tons, which is not a large quantity.

In the world scale, citric acid is produced in the quantity to 350,000 – 400,000 tons a year out of molasses or glucose through the fermentation process.

8. Acetic Acid and Vinegar

The most superior method of acetic acid production is the petrochemical process. Also, while vinegar can be produced by oxidization of ethanol, the market is extremely small. Imported quantities of these in 1981 are shown below.

Acetic acid	4,000 tons	US$3,000,000
Vinegar	400 tons	US$130,000

9. Resume

Based on the market researches of products utilizing the sugar production by-products in Indonesia, the conclusion can be made that fermentation industries of ethanol, feed yeast for animal and Corynecin are promising.

IV. Basic Design of Fermentation Plant

1. Selection of the Site

The Ex Comal Sugar Factory in Pekalongan area in the central Java was selected as the appropriate site. The selection was determined based on various standards such as industrial water, raw material, fuel, transportation, site and waste water treatment. Water is especially important to the fermentation industry, and in the Ex Comal Factory, 500 ℓ/sec., that is 43,200 m^3/day, of water can be taken from the Comal river. Additionally, the existing building in the Ex Comal factory is good and the site condition and environmental of the factory are favorable.

2. Production Capacity

The scheduled increase of cane molasses of PTP 15/16, which controls the central Java sugar factories, is about 47,000 tons as shown below.

1981 production	91,968 tons
1984 production	139,154 tons
Production increase	47,186 tons

We planned a plant capacity to consume this annual production increase.

Ethanol	10,000 Kℓ (33,000 tons of cane molasses)
Feed yeast	3,300 tons (13,200 tons of cane molasses)
Corynecin	19 tons (2,200 tons of cane molasses)

This plant capacity is appropriate also from the viewpoint of the industrial water availability.

3. Production Quantity and Unit Consumption

	Ethanol	Feed Yeast	Corynecin
Plant capacity	30 Kℓ/day	10 tons/day	56 kg/day 112 kg/batch
Cane molasses consumption	99 tons/day	40 tons/day	13 tons/batch
Product specification	95 V/V%	Water content up to 10%	98% purity, powder
Manufacture process	Immobilized yeast	Batch process drum dryer	Batch process butanol extraction
Operation hours	24 h/day	24 h/day	24 h/day
No. of operation days	336 days/year	336 days/year	336 days/year
Production	10,080 Kℓ	3,360 tons	18.8 tons
Unit consumption			
Cane molasses	3.3 tons/Kℓ	4.0 tons/ton	111.3 tons/ton
Electricity	148 KWH/Kℓ	$4,332 \times 10^3$ KWH/ton	400×10^3 KWH/ton
Steam	2.89 tons/Kℓ	18.88×10^3 tons/ton	1.625×10^3 tons/ton

Corynecin is converted to Chloramphenicol by having it reacted to dichlor methyl acetate in methanol. The yield that is obtained generally is 725 kg Chloramphenicol out of 500 kg Corynecin.

4. Waste Water Treatment

The effective method to treat waste water from the fermentation plant is to separate it to high concentration fraction and low concentration fraction. The former is evaporated and mixed with excess bagasse for utilization as fertilizer or soil conditioner. The latter is diluted with water down to the level of regulation value and discharged into a drainage.

The summaries of these processes are as shown below.

i) High concentration fraction

600 Kℓ/day
↓
Condensed solution 102 Kℓ/day (Solid content 45%)
↓
Bagasse 300 tons + Urea 0.65 tons
↓
3-month aging
↓
Fertilizer 319 tons/day

ii) Low concentration fraction

BOD 1.2 tons/day
↓
Cooling water 42,000 m^3/day
↓
BOD 30 ppm or below
↓
Discharged into drainage

As a utilization method of bagasse, we describe cultivation of pleuroteus cystisus using a compost in which bagasse is mixed with lime cake and rice bran.

5. Utilities Requirement and Its Capacity

The table below summarizes the utilities and facility capacities to treat the fermentation plant waste water.

	Utilities requirement	Facility capacity
Steam (ton/h)	39.1	50
Electricity (KWH/h)	3,055	4,120
River water (m^3/day)	43,200	43,200
Well water (m^3/day)	125	150
Air (Nm^3/h)	25,500	26,000
Chilled water (USRT)	1,038	1,200

6. **Economical Investigation of Basic Design**

We analyzed the financial situation of the plan of producing three items of ethanol, feed yeast and Corynecin but determined that there would be no possibility of industrializing the feed yeast and Corynecin since these required huge amounts of energy expenses making the cost extremely high. The results of financial analysis on ethanol and Corynecin (excluding feed yeast) indicate a good possibility of industrializing the two items. Accordingly, this report mainly describes the two items. The results of financial analyses are summarized in the table below. The reference data on feed yeast is given in the Appendix.

	3-item production plan Ethanol 30 Kℓ/day Fodder yeast 10 tons/day Corynecin 56 kg/day	2-item production plan Ethanol 45 Kℓ/day Corynecin 56 kg/day
Capital investment	17,600 million Rp	12,500 million Rp
ROI after tax	-10.33%	13.37%
Remarks	Unable to recover the investment even in 15 years.	Industrialization is possible.

7. **Sugar Recovery from Cane Molasses**

Sugar recovery from molasses using the column chromatography is being mainly applied to beet molasses, and there is only one successful example of industrializing sugar recovery from cane molasses according to the information obtained from FINNSUGAR ENGINEERING. There is another recovery method of methanol precipitation, but the process has not been applied in the industry scale.

V. Plant Facility Design

1. **Production Facilities**

The major facilities are shown below.

Ethanol production facilities

1st column	75 m^3 x 1, coil 50 m^2
2nd column	40 m^3 x 1, coil 25 m^2
Holding tank	120 m^3 C.S.
Mash column	25 stages, ϕ2,000
Conc column	50 stages
Ethanol storage tank	1,000 m^3 x 1

Corynecin production equipment

Make up tank	20 m^3 x 1
Seed tank	2 m^3 x 1, 10 m^3 x 1
Fermenter	80 m^3 x 3
Broth tank	80 m^3 x 1
Balance tank	10 m^3 x 1

2. **Raw Material and Utility Facilities**

Cane molasses storage	1,000 m^3 x 1
Heavy oil tank	1,000 m^3 x 1
Cane molasses makeup tank	1,000 m^3 x 2
Boiler	2-shell reflection type
Air compressor	2-stage turbo type 25,000 Nm^3/h, 2 kg/cm^2

3. **Waste Water Treatment Facilities**

High concentration fraction storage	500 m^3, made of concrete
Evaporator	30 t/h, plate type, triple effect
Condensed solution storage	1,000 m^3 x 1

4. **Auxiliary Facilities**

Micro organism handling, analysis, electrical, communication and sanitation facilities.

5. Plant Layout

This plant is to be built in the existing sugar factory.

VI. Schedule for Plant Construction and Operation

1. Plant Construction Plan

The fermentation plant, including the outdoor tanks, will be constructed in the area of 23,000 m^2 (with the existing building as its center) in the total plant site of 376,550 m^2.

All civil engineering and construction conditions, and various conditions for inland transportation, storage, installation and test operation of imported machinery and equipment are clearly described.

The training and education will be conducted in the following steps.

1) Dispatch of supervisors at the construction stage

2) Dispatch of supervisors and managers to the construction site by the general contractor

3) Dispatch of supervisors at the test operation stage

4) Training of techniques and operation methods by the general contractor

5) On the job training by supervisors

6) Training of engineers and foremen and above in Japan

2. Plant Operation

The total number of employees will be 200. A general manager controls them in a two-department system of Production Department and Administration Department. The work system is on three shift for 336-day operation a year. A stock for 1 to 1.5 month operation will be carried on each of the necessary materials.

3. Construction and Test Operation Schedules

The plant construction will be completed in one year and 5 months after the construction start. After the completion, the plant will have one month of test operation and 1.5-month performance test.

Utility Requirements for 2-item Production

	Utility requirement	Facility capacity
Steam	25.5 tons/h	35 tons/h
Electricity	1,358 KWH/h	2,500 KWH/h
River water	24,600 m^3/day	36,000 m^3/day
Well water	87 m^3/day	120 m^3/day
Air	3,520 Nm^3/h	4,000 Nm^3/h
Chilled water	334 USRT	400 USRT

VII. Required Investment and Fund Plan

1. Basic Conditions of Estimation

1) Currency exchange rate — US$1 = ¥240 = Rp 695

2) Estimation period and price — Prices as of January, 1983

3) Price escalation

Foreign currency portion	5%
Local currency portion	10%

2. Investment (up to March, 1986)

The price escalation is applied to the project cost based on the prices of January, 1983 and in accordance with the project schedule. As the result, the investment required up to

March, 1986 at which time the operation start is scheduled, is as shown below.

Necessary investment

Foreign currency	¥3,596,176,000	(Rp 10,211,217,000)
Local currency		Rp 2,268,159,000
Total		Rp 12,479,367,000

(The interest on loans during the construction is not calculated in.)

3. **Fund Procurement Plan**

Owned capital	Rp 4,450,000,000	(35%)
Loang-term loans	Rp 8,474,905,000	(65%)
Total	Rp 12,924,905,000	(100%)

VIII. Financial Analysis

1. **General Conditions for Financial Analysis**

1) Price escalation is to be applied up to March, 1986 at a rate of 5% per annum on imported items and 10% per annum on domesitc items. The prices will be fixed after the operation start of April, 1986.

2) Project life 15 years

2. **Specific Conditions for Financial Calculations of the Basic Design**

1) Production and Sale

	Ethanol	Corynecin
Annual Production	15,120 Kℓ	18,816 kg

2) Operation

Apr. '86 – Mar. '87	80%	70%
Apr. '87 – Mar. '88	90%	85%
Apr. '88 – Mar. 2000	100%	100%
Sales price	Rp361,220/Kℓ	Rp 32,521,000/ton

3. **Variable Costs**

The variable costs of ethanol (per 1 Kℓ) and Corynecin (per 1 kg) are as follows.

Ethanol	Rp 130,606/Kℓ
Corynecin	Rp 34,140,163/ton

4. **Fixed Cost**

1) Depreciation

The numbers of years applied for depreciation are as follows.

Machinery & equipment/contingency	8 years
Buildings and structures	20 years
Expenses before operation start, interest during construction & others	5 years

2) Maintenance and repair expenses

Machinery & equipment/contingency	3%
Buildings and structures	2%

3) The fire insurance premium is 1% of the purchase price of the tangible asset.

4) Annual personnel expenses (200 people) About Rp 366,900,000

5) Long-term borrowing

Loan conditions

Grace period	4 years
Repayment period	10 years (after grace period)
Interest rate (per annum)	13.5%
Repayment	Twice a year

5. Tax and Dividend

1)	Tax	Tax rate	45%
2)	Dividend	Rate	15%

6. Result of the Financial Analysis

1) Manufacturing cost

The maximum and minimum manufacturing costs of 1 Kℓ ethanol and 1 ton Corynecin are as follows.

Ethanol (Kℓ)	Rp 230,100 – 165,900
Corynecin (ton)	Rp 121,551,700 – 61,669,000

The ethanol manufacturing cost is much lower than the sales price and the profitability here is high. However, the Corynecin manufacturing cost is higher than the sales price, and Corynecin production alone cannot make profit.

2) Loss/Profit calculation and Fund flow

This project has a high profitability since the high profit on ethanol can cover the loss on Corynecin. Shortage of fund is not anticipated during the 15 year project life and the sales profit rate is favorable.

3) Internal Rate of Return (IRR)

The internal rate of return of this project is as shown below.

ROI before tax	15.5%
ROI after tax	13.37%
ROE after tax	11.42%

If ethanol can be sold as planned by this project, this project is very feasible from the above analysis also.

IX. Economic Evaluation

1. Economic Internal Rate of Return (ERR)

The economic internal rate of return of this project is as follows.

ERR	23.44%

This project is feasible from the standpoint of the national economy.

2. Economical Effect and Significance

1) Ethanol

The characteristic point of the ethanol production described in this report is its superiority in the unit consumption of the cane molasses. Supposing that 15,000 Kℓ of ethanol is produced a year, the saving of cane molasses will amount to as much as 10,000 tons, when compared with the conventional process.

Also, if the ethanol thus produced is used to replace the gasoline, the consumption of gasoline being imported can be reduced by about 300,000 Kℓ, or US$120 million, per year.

2) Corynecin

No profit can be expected based on the financial analysis of the Corynecin production, but if it is produced in the form of being benefited by the profit of ethanol production, it becomes the first antibiotics produced in Indonesia from the stage of the starting material up to the end product, and its technical meaning is great.

In 1981, Indonesia imported Chloramphenicol amounting to about US$5 million. Since domestic production of Corynecin can reduce the foreign currency expenditure for import, the significance of domestically producing Corynecin to the national economy is great.

CONCLUSION

To summarize the study results, we can conclude on the feasibility of this project as follows.

1. Plant Site

The three sites proposed in the Scope of Work are in the same conditions on the availability of the cane molasses, the main raw material of this project.

However, in consideration of the quantity of the water that is available, which is essential for the fermentation industry, we selected Ex Comal under the control of PTP 15/16 in Pekalongan area of central Java as the optimum plant site.

2. Fermentation Product Out of Cane Molasses

As the results of thorough investigation and analysis of the market situation and future potential on the 7 products proposed in the Scope of Work, we consider it preferable that Indonesia must study the industrialization of ethanol, Corynecin (antibiotic) and feed yeast. However, for the time being, the project is to be limited to a fermentation complex of model type producing only ethanol and Corynecin in consideration of the investment amount and profitability.

3. Ethanol as an Alternative Energy

Ethanol can be produced most simply by fermentation process of cane molasses, and the profitability is good even at the cane molasses price of Rp 20,000/ton. However, since the market of industrial alcohol is very limited at present, large demand of ethanol would open the market when the government has established the alternative energy policy for use of ethanol mixing with gasoline or diesel oil.

4. Internal Rate of Return of This Project

If the conditions in the preceding clause are satisfied, the investment for the fermentation complex to produce 45 Kℓ/day ethanol (15,000 Kℓ per year) and 56 kg/day Corynecin (19 tons per year), including waste water treatment facility, will amount to Rp 12,500 million. The ROI after tax is 13.37%, and the project is quite feasible from the financial analysis viewpoint.

RECOMMENDATION

1. If the system that allows ethanol be utilized in Indonesia as alternative energy, this project can be regarded feasible from the financial viewpoint. Therefore, various actions such as the preparation of bid specification must be proceeded by determining the contractor.

2. SBPN or PTP should have contact to Ministry of Health or CHIMIAFARM (National drug manufacturer) for further processing of Corynecin to Chloramphenicol.

3. It is recommended that a national institute for fermentation technology is to be established to develop the basic technology for the fermentation industry. The purpose of such institute are, firstly, to strengthen the fundamental activity on fermentation research and, secondly, to cultivate the technical service functions for marketing and how to use technology of the product. For PTP, which manages the sugar production and sales like a private company, it is essential that some fixed percentage of the sales amount is directed for such research purpose so as to raise the added value of their own molasses through fermentation.

4. Cane Molasses price

   The cane molasses is divided into the sugar factory and the farmer who delivered the sugarcane at a rate of 50 : 50 approximately, and the cane molasses in the farmers possession is bought back by the sugar factory at Rp 65,000/ton. This purchasing price was set in the latter part of 1980 when molasses price went up to an extremely high level of Rp 71,900/ton, and it is very high comparing with the domestic price is Rp 20,000/ton and export price is US$22.0 at the end of 1982.

   It is true that some incentives will be required to the cane farmers but to stick to this abnormally high price of about 3 times as much as the actual, would endanger the PTP management. It is hoped that the price arrangement should be made to be more realistically.

5. Although this has no direct relation with the fermentation complex plan, we must comment that the processing capacity of existing sugar factory is too small. It is generally said that minimum economical capacity of sugar factory is 3,000 tons cane crushing per

day. Out of the total 60 sugar factories in Indonesia, 45 factories have a capacity less than 2,000 tons a day. This essentially restricts the economy of the manufacturing cost. Since the transportation means have advanced so much, we recommend that the effort will be made to gather small factories unless there is no problem in collecting the sugar-cane. This is an approach to rationalize the production system both sugar and molasses.

ABSTRACT OF SUMMARY

1. Cane Molasses

Good availability, production increase. (Unit: ton)

'76	'80	'82	'84	'86	'88
313,000	491,000	588,000	800,000	1,032,000	1,140,000

2. Consumption Pattern of Molasses

Production 380,000 ton → Domestic consumption 275,000 ton

- for ethanol 135,000 ton
- for MSG 123,000 ton
- for yeast etc 17,000 ton

→ Export 105,000 ton

Dependency on export increase, if domestic consumption not increase.

→ price fluctuate by international market
→ price competetion with Asian countries

3. Present Market for Fermentation Product and Recommendable Item

Item	Ethanol	MSG	Bakery yeast	Feed yeast	Antibiotic	Citric acid	L-lysine	Acetic acid
Production capacity	57,450 Kℓ	54,000 ton	Very small	Very small	–	2,000 ton	–	–
Import quantity	–	GA 2,000 ton	1,500–2,000 ton	–	US$42 million	500 ton	–	4,000 ton
Market size	26,000 Kℓ	30,000 ton	US$2 million	Soybean meal Fish meal	Import only	2,000 ton	–	4,000 ton
Market potential and Future prospect	Transport fuel 7,200,000 kℓ Gasoline 3,700,000 Kℓ 10% blending 370,000 Kℓ	Excess production capacity against to demands	Food intake custom Cold chain distribution	Farm animal increase Compound feed 3,000,000 ton 3% blending 90,000 ton	Advanced medical care along WHO recommendation Chloramphenicol US$5 million	Small market	Premature on market	Not fermentation

Note: investment include waste water treatment facility

4. Investment and Profitability of Project

		Investment	ROI after tax
3 item	Ethanol 30 Kℓ/day Feed yeast 10 ton/day Corynecin 56 kg/day	17,600 million Rp	-10.33%
2 item	Ethanol 45 Kℓ/day Corynecin 56 kg/day	12,500 million Rp	13.37%

5. Profitability of Each Product

	Ethanol	Corynecin	Feed yeast
Variable cost	130,600 Rp/Kℓ	34,140,163 Rp/ton	416,858 Rp/ton
(Molasses (Fuel	89,958 30,915	3,034,038 20,610,240	110,480 257,383
Sales price	361,220	32,521,000	328,000
Fuel consumption	252 L/Kℓ	168 L/kg	2.1 L/kg

Reason of much fuel consumption:

Evaporation for wast water treatment
High temperature for cooling water

6. Essential Condition for Development of Fermentation Project

i. Stable supply of molasses with stable price
ii. Abundant for industrial water and its lower temperature
iii. Establishment of fermentation research laboratory supporting with fundamental technology to industry
iv. To cultivate the function for technical service and marketing to customers

DATA FOR REFERENCE

	Indonesia	Japan
Population	148 million	116.8 million
GNP per capita	US$ 520	US$ 9,689
Growth rate of energy consumption	10.3%	3.1%
Sugar consumption	9.5 kg/year.head	25 kg/year.head
Compound feed production	3 million ton	22 million ton
MSG production	30,000 ton	80,000 ton
Citric acid consumption	2,000 ton	10,000 ton