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**SUGAR INDUSTRY
IN INDONESIA**

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table
map

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**WORKSHOP ON SUGAR-CANE DIVERSIFICATION
AND MARKET COOPERATION FOR
SELECTED DEVELOPING COUNTRIES
YOGYAKARTA, INDONESIA**

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SUGAR INDUSTRY IN INDONESIA
MAY, 1994

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I. OVERVIEW OF PRESENT SITUATION

1. Historical Background

Sugar industry in Indonesia was started in the 17th century. It was initially part of the Dutch colonialism to exploit the available huge labor force and fertile soil of Java. It was for this reason that the system for cultivating cane was irrigated rice field, called Reynoso system. Further development of the industry was concentrated in Java.

In early 1930's, Indonesian sugar industry reached its peak. With cane area of 187,125 ha and 178 sugar factories in operation, Indonesia produced approximately 2.5 million tons in 1931, and ranked only after Cuba as the second biggest cane sugar exporting country.

In the following years however, the industry declined considerably due to world depression (1933-1936), but it almost backed to normal again in 1937-1940 before World War II started. During Japanese occupation (1942-1945) and physical revolution (1945-1950) the sugar production dropped drastically as lots of sugar factories were destroyed, leaving only 50 factories still operating.

First phase of Indonesian Development Plan covering 25 years, started in 1968 and implemented in five successive Five Year Development Programs, put emphasis on increasing farmer income, raw material added value, devisa, and making available the raw material needed for its own industries.

In the last year of the Five Year Development Program (1968-1973), sugar production hardly surpassed 0.9 million tons per year and the government still had to import sugar to meet the domestic demand.

Attempts to increase cane sugar production to meet the domestic need was continuously done. In the Second Five Year Development Program (1973-1978), the government formulated an intensive effort to rebuild its cane sugar industry. The principal change is the issuance of Presidential Decree No. 9, 1975 which put land rental for cane cultivation into an end, and replace it with a program called Intensification of Smallholder Sugarcane Planters. To implement the decree, a series of regulations : credit system, sharing policy, rehabilitation of existing sugar factories and building the new ones, extensification to wetland and dryland soil particularly outside Java as well as the marketing system were formulated.

During the Third Five Year Development Program (1978-1983), the government had determined that domestic sugar need should be met by its own production. It means that cane sugar industry has to be able to self sustain.

Unfortunately, out of the 18 sugar factories being planned to build in the Fourth Five Year Development Program (1983-1988), only nine - seven of which are government owned and the other two are private - can be implemented. Eventhough, through extensification in outside Java islands, cane sugar production has increased from 1.250 million tons in 1981 to 2.483 million tons in 1993. The considerable increase however is not necessarily put Indonesia self reliance, as sugar import is still continuing.

Progress in sugar industry will trigger development in related industries as well. With 69 sugar factories having milling capacity of 190,000 ton per day to process cane harvest from an area of 420,000 ha, it will provide huge raw material to other industries which use sugar factory by products : bagasse for pulp and paper industry, and mushroom industry, molasses for alcohol manufacturing, animal feed, monosodium glutamate, acetic acid and l-lysine industry.

To be able to self reliance in the era of GATT and AFTA, cane sugar industry and sugar planters with the support from related government agencies try to improve production efficiency, both in the field and in the sugar factory, and mechanical planting of cane in islands other than Java.

2. Sugar Factory : Number and Capacity

The number of sugar factory in Indonesia is 69. Most of them (58 factories) are in Java and the rest scattered in other islands. Milling capacity ranges from 1,000 to 10,000 ton cane per day (TCD) with an average of 2,750 TCD, and hence a total of 190,000 TCD.

Table 1. The Number of Existing Sugar Factory and Their Milling Capacity

Milling capacity (TCD)	Number of sugar factory		Total
	Java	Outside Java	
< 1,000	1	-	1
1,000 - 2,000	27	-	27
2,000 - 3,000	15	3	18
3,000 - 5,000	13	4	17
5,000 - 10,000	2	4	6
Average 2,750	58	11	69

In 1995, Indo Lampung Sugar Factory is expected to start operation so that the total number of operating sugar factory is 70. With milling capacity of 8,000 TCD, it will mill cane harvest of 20,000 ha.

During the Sixth Five Year Development Plan (1994-1998) it is projected to build three new sugar factories in Lampung, South Sumatera, each with milling capacity of 10,000 TCD to serve 20,000 ha cane plantation.

The spatial distribution of the existing sugar factories is depicted in Appendix 1.

3. Area, Cane, and Crystal Production

Cane cultivation in Indonesia covers an area of 420,000 ha, with 310,000 ha of which is in Java while the rest - 110,000 ha - is in other islands. Sugar production in 1993 is 2,483 million ton.

With cane extensification to the dryland coupled with implementation of new sugar factory in island other than Java and intensification in the wetland, it is estimated that sugar production in the Sixth Five Year Development Plan will be 3 million tons. Twenty five percent contribution of sugar production is expected from sugar factories outside Java to step by step lessen the burden of those factories in Java.

Cane area and sugar production from 1989 to 1993 is shown in the following table. Sixty percent of the area, either in or outside Java, is dryland area.

Table 2. Area and production of cane during
Fifth Five Year Development Program

Item	1989	1990	1991	1992	1993
1. Area (ha)	339,943	364,977	386,384	404,439	420,690
2. Cane production (t/ha)	78.9	76.9	72.9	79.1	78.6
3. Sugar content	7.64	7.55	7.99	7.21	7.50
4. Sugar crystal (t/ha)	6.04	5.81	5.83	5.70	5.890
5. Sugar production (t)	2,047,429	2,119,590	2,252,506	2,306,430	2,482,720

4. Supply of Raw Material

Cane cultivation, particularly in Java, is initiated in the beginning by sugar factory by renting the necessary area from the farmers. In many occasions, the rental system for cane planting is a source of conflict between the involving parties, and is now considered inappropriate with respects to the Five Principles of the Republic. Starting in 1975, the government replaces it through Presidential Decree No. 9, 1975 with Intensification of Smallholder Sugar Planter.

From then on, cane planting is done by the farmers with guidance from sugar factory, Estate Service, and Mass Guidance. Financial support and fertilizer are provided by Village Unit Cooperation and Banks. The harvest is then sent to the sugar factory who responsible to mill it.

4.1. Cultivation System of the Sugar Factory

Some sugar factories have their own area, mostly under dryland condition. They plant their own area under their own management, and mill their own harvest to convert it into sugar crystal.

Sugar factories, both in and outside Java, adopt mechanical cultivation to plant their own area. Human labor is used only for planting, harvesting, and other works which inevitably should be done by human being.

Before 1976, cultivation system was only limited to Reynosc. However, ratoon system is now commonly adopted both in wetland and in dryland. In wetland area, only two ratoons are used, while in dryland area, more than two ratoons are commonly practiced. The land area which utilization right is granted to the sugar factories is 122,458 ha, distributed as shown in the following table :

Table 3. Distribution of Land Utilization Right Among Sugar Factory

No.	Sugar factory	Province	Area (ha)
1.	Jatiroto Sugar Factory	East Java	4,971
2.	Semboro Sugar Factory	East Java	,532
3.	Asembagus Sugar Factory	East Java	1,307
4.	Ngadirejo Sugar Factory	East Java	,706
5.	Pesantren Baru Sugar Factory	East Java	1,054
6.	Jatitujuh Sugar Factory	West Java	7,492
7.	Subang Sugar Factory	West Java	4,606
8.	Tersana Baru Sugar Factory	West Java	5,300
9.	Sei Semayang Sugar Factory	North Sumatera	7,436
10.	Kuala Madu Sugar Factory	North Sumatera	6,257
11.	Cintamanis Sugar Factory	South Sumatera	12,516
12.	Bunga Mayang Sugar Factory	Lampung	6,605
13.	Gunung Madu Sugar Factory	Lampung	18,715
14.	Gula Putih Mataram Sugar Factory	Lampung	17,006
15.	Pelai Hari Sugar Factory	South Kalimantan	3,172
16.	Bone Sugar Factory	South Sulawesi	4,825
17.	Camming Sugar Factory	South Sulawesi	5,984
18.	Takalar Sugar Factory	South Sulawesi	7,000
19.	Naga Manis **) Sugar Factory	North Sulawesi	2,899
20.	Indo Lampung ***) Sugar Factory	Lampung	2,073
T o t a l			122,458

- *) to be increased into an approximately 22,000 ha
 **) to be increased into a minimum of 20,000 ha
 ***) to be increased into a minimum of 20,000 ha

4.2. Intensification of Smallholder Sugar Planter System

Starting the first phase of Indonesian Development Plan, emphasis is put on increasing farmer income, raw material added value, devisa, labor employment and the development of agro-industrial and agro-business related to cane sugar industry.

Intensification of Smallholder Sugar Planter, termed TRI in Indonesian language, is a mass guidance program for cane based on Presidential Decree No. 9, 1975, directed particularly for Java. Main points of the program are formulated by Mass Guidance Council, of the Department of Agriculture. Program implementation is under similar unit but at the province level, regency level etc. down to the lowest level following administrative hierarchy.

TRI is implemented in the working area of sugar factory by consistently adopting wetland-based cane cultivation using Reynoso method. For dryland area, cultivation is done following recommendations from ISRI (Indonesian Sugar Research Institute). Support of the farmers is manifested in the form of their active participation in mass as land holding of most farmers is normally very small, less than 0.4 ha. The government offers incentive to the farmers who participate in the program by providing them with soft term loan, and special extension service for cane cultivation.

Just as any other Mass Guidance Program, i.e. an intensification program for a certain commodity set by priority, TRI is supported by integrated coordination involving Village Unit Cooperation, financial banks, Agricultural Extension workers in the field, and other related government agencies aside from the farmers themselves. Sugar factory plays the role of processing the harvest.

4.3. Sharing and Trading System of Sugarcane

4.3.1 The system

Presidential Decree No. 9, 1975 states that farmers who intend to plant cane may join mass guidance intensification program. It is expected that through this program, sugar production, and hence farmer income, will be increased.

a. The sharing system

In TRI program, farmers, individually or in group, plant cane in their own land. In this scheme, farmers supply the raw material to the sugar factory which will then mill and process their harvest into crystal sugar through a sharing system. Using this system, accounting can only be made after the harvest is processed into sugar, or at most after periodic report of milling activity is made.

b. The trading system

This system is actually just being put into trial. It is started in 1991, and is called Guideline on Buying System in Mass Guidance Program of Intensification of Smallholder Sugar Planter Project, shortened as Propan SPT-TRI. It is put into practice to formalize cane trading between farmers who join TRI program and the sugar factory, and examine how well it works with respect to eventual goal of increasing cane sugar production and farmer income.

Results of the evaluation of Propan SPT-TRI will be used as consideration in the formulation of new policy, improvement of the transport service so that it is quicker, simpler, clearer, and open to the farmer, and making working partnership among farmer, Village Unit Cooperation, and sugar factory closer.

4.3.2 Basis of the Sharing and the Trading

a. Basis of the Sharing

In accordance with the Letter of Minister of Agriculture, on his capacity as Chairman of Mass Guidance Council, No. 04/SK/Mentan/Bimas/V/1992 on Sharing Regulation for farmers whose cane harvest is processed by a certain sugar factory states that sharing is based on crystal sugar ratio. The ratio is estimated in two stages. In the first stage, a temporary ratio estimate is computed based on crystal sugar ratio obtained from analysis of first extraction of cane juice over milled cane. In the second stage, effective ratio of a certain plot or area is computed using temporary ratio corrected by periodical factor correction. The correction factor is calculated from temporary ratio and actual sugar yield obtained over the total amount of cane being milled for that particular period. Sharing is based on this derived ratio.

Crystal sugar shared by a farmer is calculated using the following formula :

$$\text{Farmer share} \quad : \quad T = 50.8 + 1.60 \times R$$

$$\text{Sugar factory share} \quad : \quad P = 100 - T$$

where R is crystal sugar ratio of the respective farmer harvest milled by the sugar factory. Multiplying T by R/100 will produced the amount of sugar shared by the farmers. All computations are done after all harvest of the corresponding farmer or a group of farmers have been completely milled and the crystal sugar ratio is determined.

Aside from sugar, farmers get their molasses share amounting 1.86 kg for each 100 kg cane harvest, and it is given in cash : Rp 80/kg.

b. Basis of the Trading

Buying of cane harvest is made by the cane sugar factory starting in 1991. The buying system follows the instruction of Estate Directorate General in his letter No. 28/HK.050/SK/DJ.BUN/04/93 called Guideline on Buying System in Mass Guidance Program of Intensification of Smallholder Sugar Planter Project, shortened as Propan SPT-TRI. As mentioned earlier, this system is actually just being put into trial. Harvest weight and cane quality based on crystal sugar ratio in first extraction of cane juice will determine the amount of money that should be paid by the cane sugar factory to the farmers. Payment is done in the cane sugar factory after weighing and determination of crystal sugar ratio is completed.

The value of the molasses is also taken into account, and as in the sharing system, it is also regulated by the Minister of Agriculture as the Chairman of National Mass Guidance Council.

5. Equipment of Cane Sugar Processing

Starting in 1976, most sugar factories have been rehabilitated with loan from the World Bank, ADB, credit from commercial banks or its own saving. Rehabilitation of old sugar factories, particularly replacing the inefficient equipment with the more modern one, takes place up to now. Newly built sugar factories, both in and outside Java, are facilitated with modern machineries and equipments.

Milling unit powered by steam engine or steam turbine in newly rehabilitated sugar factories, is normally used by most sugar factory for cane juice extraction. It is just PG Kedawung and PG Bunga Mayang which use cane diffuser for the extraction. The boiler station usually operates water tube boiler type with pressure at 20 kg/cm². But some sugar factories is still operating smoke tube boiler type with 7-8 kg/cm² pressure. Electricity to power the sugar plant has been able to be produce by the sugar factories themselves using turbine alternator. Diesel generator is used to supply electrical power for first run. It then stays idle, and serve as back up only. Processing has been done mostly using equipment support continuous operation, such as continuous purification, single or multi-trays continuous clarifier, rotary vacuum filter, and evaporators.

Vacuum pan commonly in use is batch type with or without stirrer. Just two sugar factories : PG Gunung Madu and PG Bunga Mayang, which have used continuous pan for the production of low grade sugar. Continuous centrifugal has already used for all centrifugation stages, but for high grade sugar production, the figure is fifty-fifty.

6. Cane Sugar Production Cost and Price

The lowest milling capacity of sugar factories now operating is 1,000 TCD, and the maximum one of 10,000 TCD giving an average milling capacity of 2,750 TCD.

Sixty sugar factories use double sulfitation and the other nine factories use double carbonatation method.

Marketing and distribution is totally under the authority of Bureau of Logistic as the sole distributor of cane sugar in the country. If the government has to import sugar in case domestic production is below the market demand, importation is also done by the same bureau.

Price components of cane sugar is regulated by the Minister of Finance through Order No. 439a/KMK.013/1992 dated 29 April 1992 as follows :

Table 4. Price Components (Rp./q) and Technical Specification of Varying Sugar Classifications

Price Component	SMS [*] IA	SMS IB	SMS IC standard	SMS I	SMS II
1. Sugar Provenue	79,200.00	79,200.00	79,200.00	79,200.00	78,700.00
2. Sugar Tax (4%)	3,168.00	3,168.00	3,168.00	3,168.00	3,148.00
3. PPK (10%)	8,236.80	8,236.80	8,236.80	8,236.80	8,184.80
4. Insurance	20.00	20.00	20.00	20.00	20.00
5. Exploitation and Management Fee	500	500	500	500	500
6. Bank interest	6,985.83	6,985.83	6,985.83	6,985.83	6,942.26
7. Management of Bureau of Logistic	500	500	500	500	500
8. Government Special Project	100	100	100	100	100
9. Sugar price	98,710.63	98,710.63	98,710.63	98,710.63	98,095.06
Specification					
a. Minimum remittance	70	67	62	60	56
b. Size of crystal sugar	0.9-1.1	0.9-1.1	0.8-1.0	0.9-1.1	0.8-1.0
c. Water content (max)	0.1	0.1	0.1	0.1	0.2
d. Polarization	99.8	99.7	99.6	99.5	99.4

* SMS = Superieur Hoofd Suiker

7. Projection of Cane Sugar Production and Consumption in the Sixth Five Year Development Plan

In the last five years, cane sugar production is always increasing though it is still far below what it is projected in the Fifth Five Year Development Plan. With the adoption of rice self sufficiency policy, it is expected that there will be a change in land utilization for cane planting. Irrigated fields area will be dominated by rice, and just a smaller wetland area is available for cane. This reduction is exaggerated by land-use conversion from wetland area for industry, human settlement, and other non-agricultural purposes.

With Act No. 12/1992 on Crop Cultivation comes into effect, farmers may have their own choice on what crop to plant with the eventual consequence that the number of those planting cane in their own wetland will also reduce.

Increasing cane sugar production is then done through improving land productivity and extensification directed to dryland, both within and outside Java.

The projection of cane sugar production at the end of the Fifth Five Year Development Program and in the Sixth Five Year Development Plan is depicted in the following table.

Table 5. Projection of Planting Area, Total Sugar Production and Sugar Yield (t/ha) at the end of the Fifth Five Year Development Program, and in 1994-1998.

Year	Location	Area (ha)	Total Sugar Production (ton)	Sugar Yield (t/ha)
1992/1993	Java	310,154	1,929,957	6.21
	Outside Java	110,494	552,763	5.00
1993/1994	Indonesia	421,068	2,482,720	5.90
	Java	318,760	2,007,398	6.30
1994/1995	Outside Java	124,640	633,104	5.08
	Indonesia	443,400	2,640,502	5.96
1995/1996	Java	329,720	2,111,962	6.41
	Outside Java	133,280	695,102	5.22
1996/1997	Indonesia	463,000	2,807,064	6.06
	Java	337,940	2,189,868	6.48
1997/1998	Outside Java	141,278	744,973	5.27
	Indonesia	479,218	2,934,841	6.12
1998/1999	Java	337,000	2,292,948	6.80
	Outside Java	148,680	759,256	5.11
1999/2000	Indonesia	485,680	3,052,213	6.28
	Java	341,870	2,345,228	6.86
2000/2001	Outside Java	150,180	797,791	5.31
	Indonesia	492,050	3,143,019	6.39

Source : Production Plan in Sixth Five Year Development Program, Secretary of Indonesia Cane Sugar Council

In the near future, cane sugar consumption is expected to increase due to population growth, better social welfare, and increased consumption of cane sugar based industries. The increase is estimated approximately 3.2 % per year, or 14 kg/man/year.

As anticipation of the expected consumption increase, cane sugar production should also be increased proportionally.

8. Support from Training Institute

Sugar industry has already been supported for some time by existing training institute. The later had produced a number of graduates in agronomy, agricultural machinery, and agricultural chemistry needed by the industry. As early as 1950, Minister of Agriculture had formally opened State Sugar College in Yogyakarta. In 1960, State Sugar College was renamed as State Sugar Academy. Most engineers and chemists working in sugar factories are graduates from the above education institute.

Finally, State Sugar Academy is once again renamed. Its new name is Estate Training Institute which not only offers training on cane sugar related matters, but also other estate crops as well. With this change, it becomes a center of human resource development of estate subsector.

9. Support from Research Institute

Research supports in agronomy, technology, and waste treatment is continuously provided by ISRI as it is the only research institute working on cane sugar related matters. It contributes a lot in breeding, mechanized cultivation, machinery development, biotechnology of cane and its by products, and waste treatment.

Success has been achieved in developing improved cane varieties which have better quality, higher sugar content, and resistant to pests and diseases as cane stem borer, leaf borer, ratoon stunting disease, yellow streak etc. Just to name a few of them are POJ 3016, 2876, 3067.

ISRI has already released several cane varieties to cane planters and the sugar factory, either in Java or outside Java such as Ps56, Ps57, Ps58, Ps59, Ps60. Sugarcane varieties commonly planted are Ps56, Ps57, Ps58, Ps60, BZ123, BZ148, and Q90.

BZ123 and BZ148 which have high fiber content and slow maturity, dominates the sugar planting in Java as the characteristic of slow maturity lessen the risk of loss due to illegal harvest. It is also superior with respect to pests disease resistance.

10. Support from Manufacturers

Since the building of new sugar factories and rehabilitation of the old ones through loan from World Bank, ADB, Export Credit Facility, Government Fund, Own Capital, and financial banks, Indonesian manufacturers have gained experience in manufacturing cane sugar equipments. Most equipments such as milling station, boiler, purification unit, packing machine, electric generator, can be made by government own companies (PT Barata, BBI, Bima) and private companies as well. However, some equipments such as steam turbine, big electrical motors, heavy duty pump, cane blower and controller, are still have to be imported.

11. Cooperation Among Cane Sugar Producing Countries

Cooperation among cane sugar producing countries is not only limited to the Asian Countries, but it also reach producing countries in other continents. Cooperation is manifested in terms of changing of information, technical visit, cane sugar trade, and international sugar congress held by International Society of Sugar Cane Technologist) where Indonesia is the host country in 1986.

Joint venture among developing countries : Pakistan, India, and Taiwan, has successfully built new sugar factory in Indonesia. Foreign investment is also coming from Malaysia, and it is hoped that other countries may do so.

Investment in cane sugar industry outside Java is still widely opened, particularly for private companies either in country or foreign. Similarly, investment for industry to process by products of cane sugar factory such as industry of monosodium glutamate, L-lysine, mushroom, particle board, medium density fiber, is very welcome either in or outside Java.

II. Development of Cane Sugar By Product Industry and Waste Treatment

1. Development of Cane Sugar By Product Industry

With the increasing cane sugar production from one Five Year Development Program to the other, cane sugar by products as well as waste materials - solid, liquid, and gaseous - will also increased. As development is geared toward sustaining cane sugar industry, the possible damage of the environment should always be taken into consideration, and hence pollution controlled is absolutely has to be exercised.

Molasses which in the beginning of 1960 is mostly exported and only a small portion is used by government owned and private companies as raw material for methanol production, in the 1970's it has been utilized for the production of monosodium glutamate, glutamic acid, acetic acid, and L-lysine by private companies. Eventhough molasses production increases from one year to another year, most of it can be domestically consumed, and only 20% is exported.

Production capacity of the companies in Indonesia in producing ethanol, acetic acid, monosodium glutamate, and L-lysine is as follows :

Table 6. Capacity of molasses processing factories

Registered capacity of alcohol producing factories :	
	liters/year
1. PD. Aneka Kimia	16,000,000
2. PT. Basis Indah	5,500,000
3. PSA Comal I PT Perkebunan XV-XVI (closed at present)	5,700,000
4. PT. Indoacidatama (ethanol and acetic acid)	30,433,000
5. PSA. Jatiroto/PTP XXIV-XXV	7,500,000
6. PG. Madukismo	4,000,000
7. PT. Madusari Murni Indah	10,850,000
8. PT. Malindo Raya	10,000,000
9. PSA. Palimanan/PTP XIV	4,525,000
10. PT. Permata Sakti	5,220,000
11. PT. Starcaso Perdana	3,600,000
T o t a l	103,728,000

Registered capacity of monosodium producing factories:	
	Ton
1. PT. Palur Raya	12,000
2. PT. Sasa Inti	44,100
3. PT. Ajinomoto	36,000
4. PT. Miwon Indonesia	24,000
5. PT. Indomiki	16,800
6. PT. Ajinex International	27,000
7. PT. Glutama Indorasa	24,000
8. PT. Monosari Glutama	18,000
9. PT. Bumas Rajawali Prabhawa	30,000
10. PT. Sheil Samsung Astra (L-lysine)	20,000
11. PT. Sahid Mekosin Kujang Lestari	10,000
12. PT. Sembada Widyacita Miwon	36,000
T o t a l	297,900

Single cell protein derived from molasses for animal feed has also been produced by an alcohol factory in Lawang, East Java.

Based on the registered capacity of the existing factories, molasses produced from all sugar factories might be totally consumed.

Production efficiency improvement of sugar factory lead to the over production of bagasse. It has been supplied to Leces Paper Mill in Lawang, Pulp Factory (PG. BungaMayang), and Mushroom Factory in Dieng. Attempts are being made for the area close sugar factory in East Java and central Java to use young leaves as animal feed. It is anticipated that this kind of animal feed might be exported.

In the future, cane sugar factory with large capacity has the possibility of developing electrical energy production using its tremendous production of bagasse, and markets it to the community and other industry through State Electrical Company. This possibility is now being discussed with USAID for funding.

Bagasse surplus of one of the sugar factory in Lampung has been used by a certain private industry to produce furfural.

In principles, by products of cane sugar industry poses no technical problem for their utilization. What is limiting for its development is the limited fund, high production cost, interest rate, and limited domestic market.

Hard work of related institutions - cane sugar factory, research institute, manufacture, commercial banks - is a must to make the intended development come into realization. Private sector whose competitive ability is in a much better condition has been successful in developing industry for by products from cane sugar industry as already mentioned in the other part of the paper.

2. Handling of Waste Products of Cane Sugar Industry

To optimize handling of cane sugar waste products, sugar factories adopt high standard efficiency in house keeping, soil and water conservation, waste treatment with easily adapted technology for handling solid, liquid, and gaseous waste products. Liquid waste products are normally handled biologically using microorganism obtained from ISRI. The microorganism is then cultured in aerated ponds. Trisuperphosphate and ammonium sulphate is applied to the ponds.

ISRI plays an important role in how to handle liquid waste products from cane sugar industry. The waste treatment it developed does not need high installation cost.

Solid waste product, locally known as "blotong", is used for organic fertilizer of cane plant, or used as fire wood. Gaseous waste material, particularly exhaust pipe, is handled with installing dust collector.

III. EXPERIENCE AND PROBLEMS FACED BY RESEARCHERS, MANUFACTURERS, AND USERS IN SUGARCANE PRODUCTION

1. Experience with Technology Development

Two contradicting conditions affect sugar technology development. In the first place, insufficient domestic production to meet the domestic demand understandably stimulates the development of technology development and efficiency in sugar industry. The increase in sugar production will lead to more by product and waste material production which eventually will pertain the sugar factory with serious problem in pollution control. In the other side is the worldwide surplus of sugar production. It stimulates the need for improving of the technology which utilizes cane sugar industry by product to support the existence of the later.

It is widely recognized that technology development is started and as part of research activities. The pertaining problem with technology development is the seemingly slow transfer of technology from research institution to the practitioners. On top of it is the limited amount of available fund.

The slow transfer of technology to the practitioners, or the technology may not even reach the practitioners, may be associated with the structure within and inter research institutions, and the end user. The limited research fund is an obstacle for evaluating laboratory research findings in the field as field experiment or demonstration plots.

Research on technology development of sugar industry by product is hampered by the fact such industries which owned by sugar factories is relatively few due to the limited capital of the government owned sugar factories and marketing problem of the products. Most industries on sugar by product are owned by private companies, or multinationals. Multinational normally has already had a sophisticated R & D facilities in their home base. The government owned sugar factories are just suppliers of the raw material needed.

From the processing scheme, there are approximately 60 utilizable by products, of which only 10 is presently being used. Many are in surplus. What industry and what technology to develop is also problematical as there is no detail comparative study of the economy of the industries when in fact the existing technology requires big investment. It is therefore prerogative to look for a relatively cheaper one. Normally, data from pilot plant or experimental plant, and industrial scale economic data is needed in technology selection.

It is therefore appealed that ISRI, particularly its research group working on utilization of by product and waste from cane sugar industry, to pioneer in developing the industry, a small scale one using the existing equipment. It will be beneficial if there is an economist in the group.

After sales service also poses a problem to cane sugar and related industries. It is normally provided by big suppliers, but if it should come from overseas, it costs considerably.

Eventhough Indonesia has its own quality standardization measure, known as SII, in many respects it may not be necessarily the same as the standard of the importing country, where the export is destined for. As the product of cane sugar by product is intended for export, product quality should be properly thought. Standard test of most raw material from cane sugar by products can now be handled by ISRI.

2. Supporting Institutions and their Capacities and Capabilities

2.1. Indonesian Sugar Research Institute (ISRI)

ISRI is the only cane sugar research institute in Indonesia. Founded in 1887, it is known worldwide as the institution which produces POJ or Ps sugar varieties. Structurally, ISRI is under Indonesian Cane Sugar Industry Association through its Advisory Boards. It is located in Pasuruan, East Java, with branch offices and experimental field scattered all over Indonesia where the sugar factory located.

Research activities of ISRI include agronomy, cane sugar technology, instrumentation and machinery, by product technology, and sosio-economics dealing with cane sugar and sweeteners. It employs 500 research workers, of which 10 are Ph.D. holders. They work in group differing in field of interest. One of them is Research Group on Utilization of Cane Sugar By Product and Waste. This group consists of two Ph.D. holders, two MS holders, three S1 graduates, three senior high school graduates, and eight laboratory technicians. Pilot plant or experimental plant is also facilitated to this group to do their research, whose emphasis is on fermentation process.

2.2 Estate Training Institute (LPP)

As already mentioned in point 1.8, Estate Training Institute is a venue for Human Resource Development of Estate Subsector. One of the objectives of its implementation is to develop and improve the capability of those working with government owned sugar factories and other estates, as well as those working in private ones of similar field. Emphasis is given on the managerial and technical skills. With respect to utilization of cane sugar by product, LPP is considered to have the capability to improve man power in estate industry, as subject who directly involved in the development of cane sugar by product industry. This believe comes from the fact that LPP has the necessary supporting facilities : laboratory, practical garden, and other facilities, for training.

2.3 Indonesian Sugar Council

The Secretary of Indonesian Sugar Council coordinates policy formulation on how large the cane area is to supply the raw material needed by the sugar factories, what applied technology adopted, price, marketing and distribution system, human resource improvement and cane sugar related trading system.

Members of the council are Minister of Agriculture, Minister of Cooperative, Head of Bureau of Logistic, Minister of Finance, BKPN, BPPT, Directorate General of Industry, Directorate General of Internal Affair, BPN, Board of National Development Planning, Minister of Transmigration, Minister of Internal Affair with Minister of Agriculture as the chairman of the council.

2.4 Bureau of Logistic

To handle control on supply and price, the Indonesian government assigns the responsibility of marketing and distribution of cane sugar to Bureau of Logistic. It purchases domestic cane sugar production as well as import. Most of domestic cane sugar production (\pm 96%) is normally purchased by the bureau with price fixed by the government as shown in Table 4. It is for this reason that cane sugar price is relatively stable.

3. Development of Training Programmes and Training Capabilities

3.1 ISRI

ISRI offers training programs and education to improve research personnel of sugar factory. The training is done in ISRI. Training outside ISRI might be formal or non-formal one. To improve capability in research management and research conducts, researcher might be sent to university or other institution, either in country or abroad. However, the number is still relatively low due to the limited fund available when in fact it is need by many.

3.2 Estate Training Institute

For its training programs, Estate Training Institute has 77 teaching staff : 3 Ph.D. holders, 39 MS holders, and 35 S₁ graduates with various disciplines. To improve its teaching staff, LPP has formulated its own development program, short term and long term, either in country or abroad. The funding comes from the World Bank through various projects : Nucleus Estate Smallholders Project (NES), Tree Crops Human Resource Development Project (TCHRDP), Tree Crops Processing Project (TCPP) to name a few.

IV. Cooperation Needs in Future Development of Sugarcane Diversification

1. Technical and Economic Cooperation Needs in Sugarcane Industry

As already mentioned before, there are still many by products which are not utilized yet. The most important ones are molasses and bagasse. In this respect, cooperation is needed for training of research staff, feasibility study, marketing and capital.

1.1 Molasses

The technology needed for molasses utilization is molasses enrichment. It is needed to improve its quality, as raw material for fermentation, particularly for molasses coming from sugar factories in eastern part of East Java. If it is possible, it might be further processed to produce sweeteners.

1.2 Bagasse

Bagasse might be processed into particle board, medium density fiber, furfural etc. with clear advantages : to handle the environmental pollution problem, to reduce wood consumption, to reduce the sugar factory needs of fire wood, and lastly it is economical.

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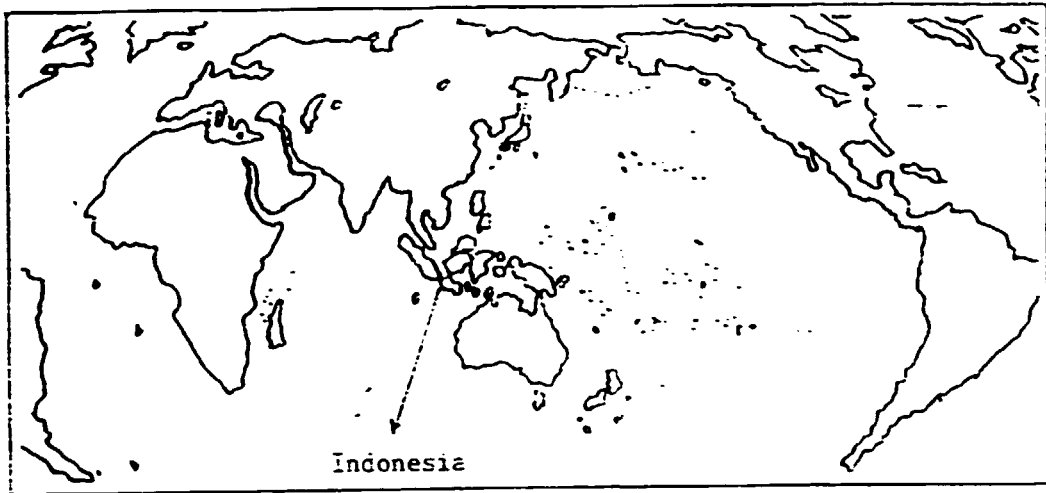
DATA ON CANE SUGAR PRODUCTION OF INDONESIA FROM 1930-1993

Year	Harvest area (ha)	Sugarcane milled (t/ha)	Crystal sugar ratio (%)	Sugar Crystal		Number of sugar factory
				t/ha	Ton	
1930	196,592	130.6	11.32	14.8	290,705	179
1935	28,262	139.9	12.46	17.4	49,260	38
1940	83,522	137.8	12.79	17.6	147,248	92
1945	-	-	-	-	-	-
1950	27,783	38.3	10.59	9.4	25,977	30
1955	72,312	100.5	11.17	11.23	813,344	51
1960	72,428	82.3	10.89	8.96	651,810	53
1965	37,408	84.3	10.53	8.82	775,950	55
1970	81,677	96.4	9.06	8.73	715,312	55
1975	104,777	92.8	10.51	9.76	1,035,952	56
1980	188,772	72.8	9.00	6.55	1,249,946	59
1985	277,614	76.3	8.14	6.21	1,725,179	64
1990	364,977	76.9	7.55	5.81	2,119,509	67
1993	420,680	78.6	7.50	5.90	2,482,720	68

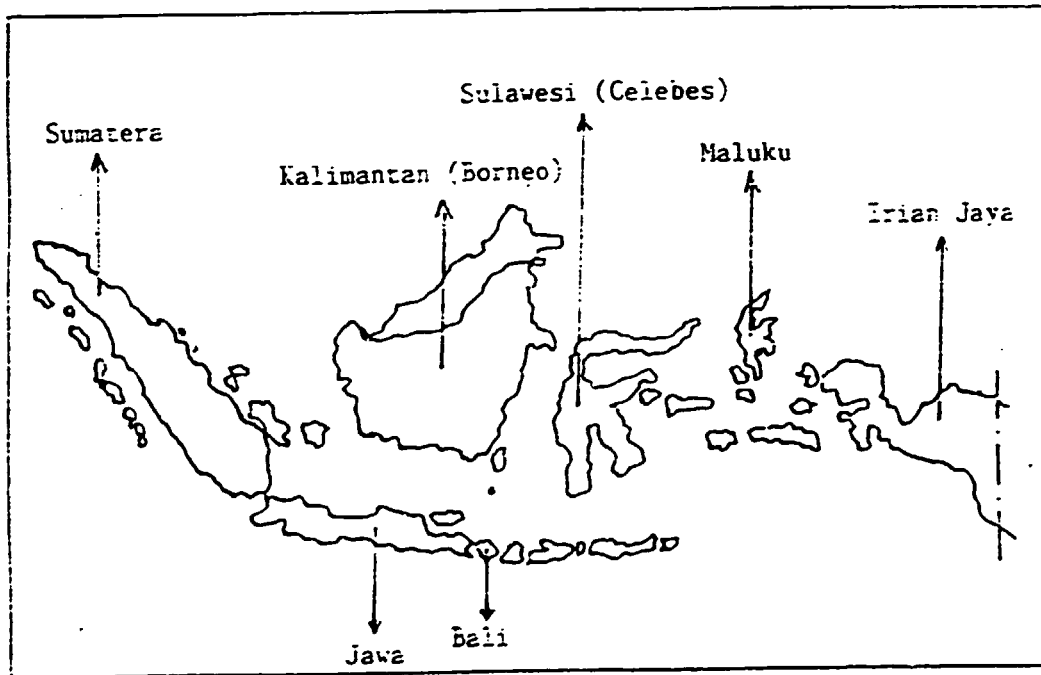
Attachement 2**SURPLUS OF BAGASSE**

Sugar Factory	As of Milling Session 1992	As of August 1993
JAVA		
1. PTP XIV	0	74.927
2. PTP XV-XVI	0	15.431
3. PTP XXI-XXII	0	106.871
4. PTP XXIV-XXV	8.847	0.257
5. PT BAPIPPUNDIP	0	46.648
6. PT KEBON AGUNG	0	25.454
7. PT MADUBARU	0	2.350
Subtotal 1 (Java)	8.847	280.037
OUTSIDE JAVA		
1. PTP XXIV-XXV	0	2.173
2. PTP XXXI	55.350	52.995
3. PTP XXXII	0	4.186
Subtotal 2 (outside Java)	55.350	59.354
T o t a l (INDONESIA)	64.197	339.391

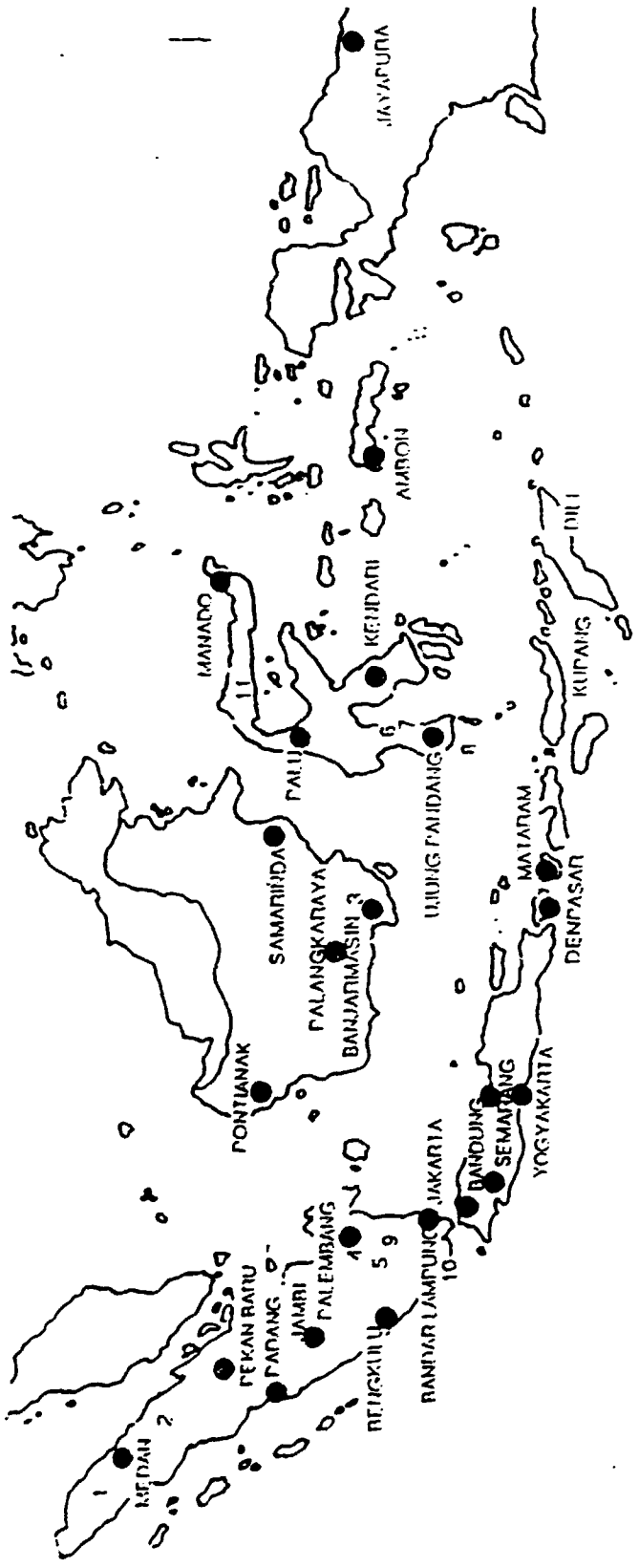
INDONESIA ON THE WORLD MAP



THE MAP OF INDONESIA

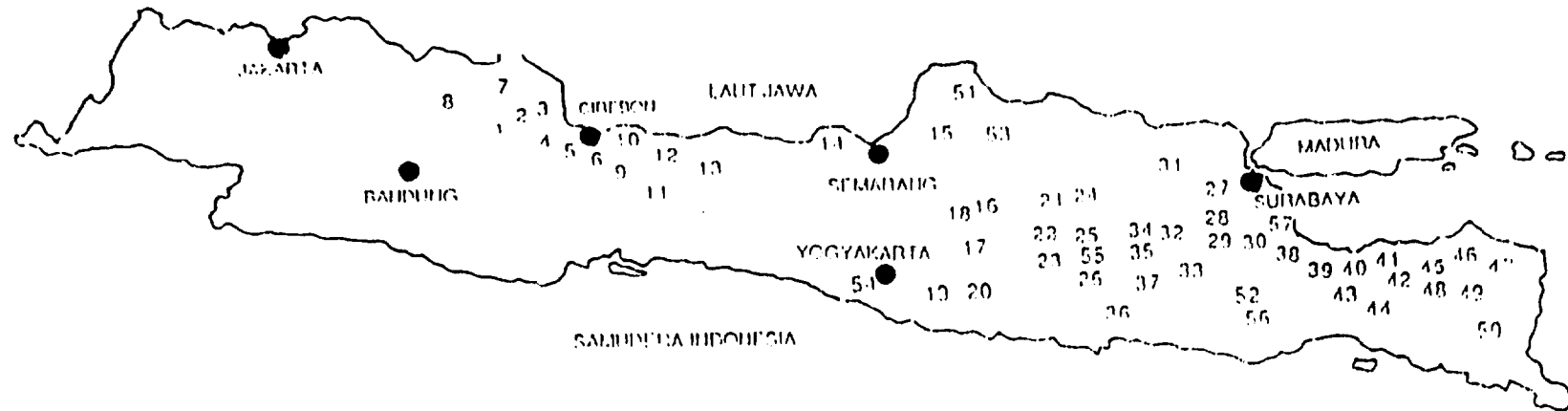


SUGAR FACTORIES OUTSIDE JAVA



1. PT Kuala Madu
2. PT Sei Semayang
3. PT Pelahhari
4. PT Cinta Manis
5. PT Bunga Mawang
6. PT Bone
7. PT Canning
8. PT Takalar
9. PT Gunung Madu
10. Gula Putih Malatam
11. PT Paguyaman

SUGAR FACTORIES IN JAVA



- | | | | | | |
|---------------------|---------------------|------------------|-----------------------|--------------------|------------------------|
| 1. PG Fadhapaten | 11. PG Pangla | 21. PG Kalibagor | 31. PG Gempollrejo | 41. PG Gending | 51. PG Palis Baru |
| 2. PG Jatiwangi | 12. PG Sumberharjo | 22. PG Soedhono | 32. PG Jombang Baru | 42. PG Papatlan | 52. PG Kebon Agung |
| 3. PG Cempel | 13. PG Siagi | 23. PG Purwadadi | 33. PG Culi | 43. PG Jatiroto | 53. PG Trangleil |
| 4. PG Sindang Laut | 14. PG Cepiring | 24. PG Rejosari | 34. PG Lestari | 44. PG Semburo | 54. PG Madukismo |
| 5. PG Karang Suwang | 15. PG Rendeng | 25. PG Pagottan | 35. PG Merican | 45. PG De Maas | 55. PG Rejosagung Baru |
| 6. PG Ircana Baru | 16. PG Mojo | 26. PG Kanogoro | 36. PG Pesantren Baru | 46. PG Wringinanom | 56. PG Krehet Baru |
| 7. PG Jatitujuh | 17. PG Tasikmadu | 27. PG Krian | 37. PG Ngadirejo | 47. PG Olean | 57. PG Candi |
| 8. PG Subang | 18. PG Colomadu | 28. PG Watulole | 38. PG Mojopanggung | 48. PG Panji | |
| 9. PG Banjaratma | 19. PG Cepet Baru | 29. PG Tulangan | 39. PG Kodawang | 49. PG Asembagus | |
| 10. PG Jatibarang | 20. PG Gondang Baru | 30. PG Krenboeng | 40. PG Wonolangan | 50. PG Prajelan | |