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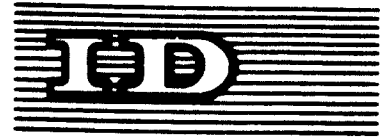
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CANE MOLASSES FERMENTATION ALCOHOL INDUSTRY IN FIJI*

by

Ram Karan**

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** The Fiji Sugar Corporation Ltd., Suva, Fiji

1. Background Information:

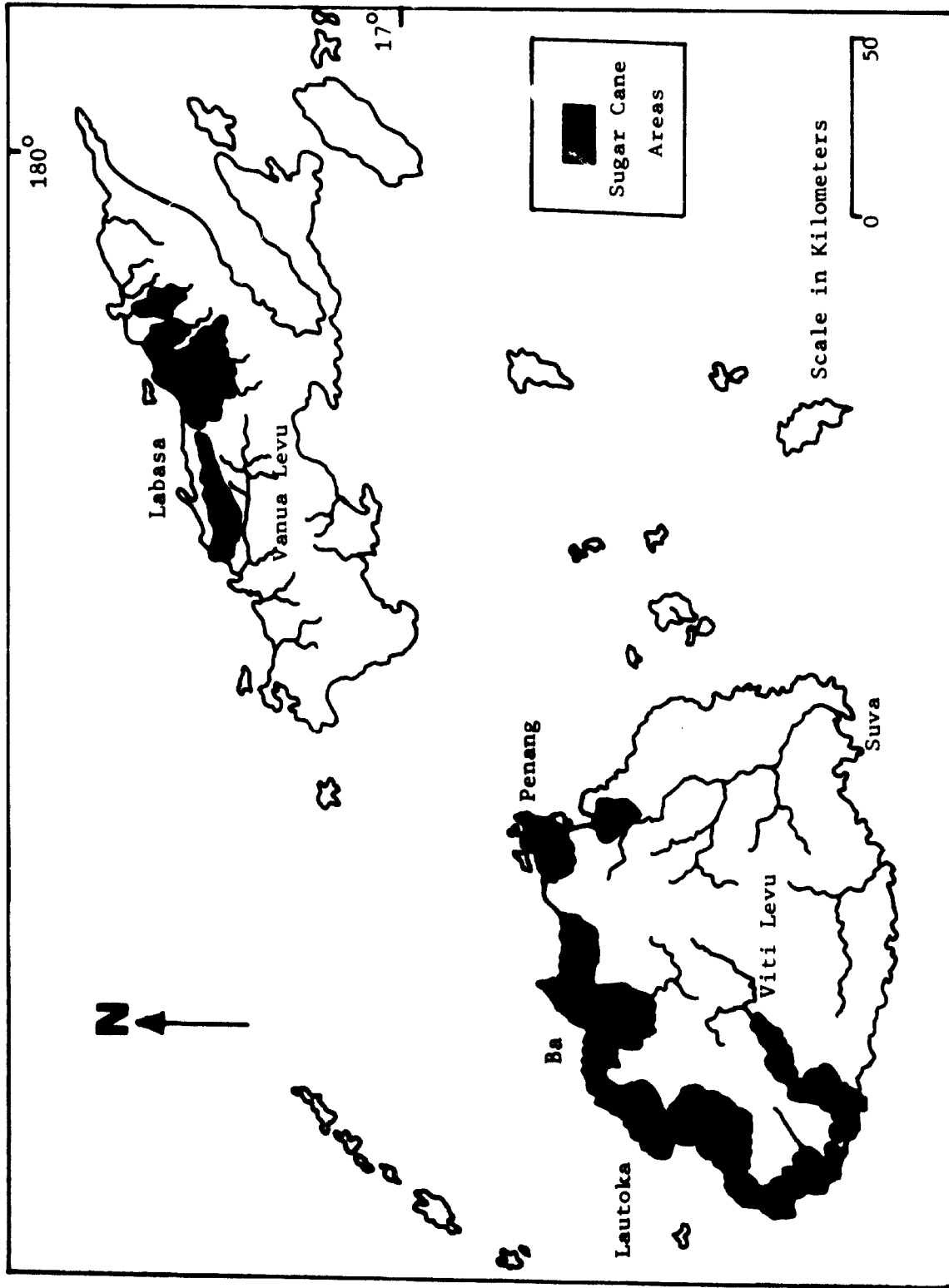
1.1 Geographical. Fiji is an archipelago of over 300 islands situated in the South Pacific Ocean. The total land area is approximately 18,000 square kilometers, more than 87% of which represents the two major islands of Viti Levu and Vanua Levu. The climate is tropical with temperatures ranging from 20°C to 32°C while rainfall ranges from 1750 mm to 3000 mm per year. The major crop of the country, sugar cane, is grown on the leewards side of the two major islands, Viti Levu and Vanua Levu. (See figure 1).

1.2 Population. The population of the country of about 600,000 is concentrated mainly around the cane growing belt and the capital city of Suva, where major non-sugar industries are based. The average annual growth rate for the past five years has been +1.8 per cent.

1.3 Economy. The economy of the country is primarily agricultural based and sugar is the backbone of the economy. Proceeds from sugar and molasses account for about 65% of the country's foreign exchange earnings.

The main economic aim of the Government is to breakaway from the country's over dependance on sugar cane and to diversify into other agricultural products and encourage more secondary industries.

SUGAR CANE AREAS.



2. Brief History of Sugar Industry:

The development of the industry dates back to late 19th century. The Colonial Sugar Refining Co Ltd (now CSR Ltd) which started the industry sold its assets in 1973 to the Government of Fiji which owns 98% of the shares in The Fiji Sugar Corporation Ltd (FSC). As the sole miller in Fiji, FSC operates the four mills, three on the island of Viti Levu and one on Vanua Levu.

Ten year production data is shown in the table below :

<u>Year</u>	<u>Sugar Cane</u>	<u>Sugar</u>	<u>Molasses</u>
	tonnes	mttq	tonnes
1969	2,376,923	304,045	108,191
70	2,885,983	360,847	107,179
71	2,545,218	321,649	85,023
72	2,238,375	302,938	76,985
73	2,495,540	301,237	95,170
74	2,151,308	273,490	70,898
75	2,159,982	272,407	75,941
76	2,282,877	295,859	81,315
77	2,674,162	362,377	105,169
78	2,849,378	346,689	106,066
79 (Est)	3,310,000	424,000	109,000

3. Brief Note on Energy Use in Fiji:

Although there has been no detailed study of end-use energy demand in Fiji, it is estimated that total consumption was 763,000 tonnes of coal equivalent in 1977 or about 1280 kg per person about half of which was imported commercial fuel and half indigenous non-commercial. It is estimated that half of all energy was used in industry, a fourth for

transport and a fourth for commercial and domestic use (Table 1).

Table 1
Gross Energy Consumption
in Fiji by Percentage - 1977

Sector	Imported		Local		Total
	Petroleum	Coal	Bagasse	Wood	
Industrial	10.6	2.9	32.4	-	45.9
Transport	25.5	-	-	-	25.5
Domestic	6.4	-	-	16.2	22.6
Commercial & Miscellaneous	5.9	-	-	0.1	6.0
TOTAL	48.4	2.9	32.4	16.3	100.0

Petroleum fuel accounts for nearly all transport energy and 90% of electricity generated for public demand. Bagasse accounts for the bulk, over 95% of energy demand, of the sugar mills.

Gross Energy Consumption

Fuel	Quantity	Total 10 ³ GJ	%
Bagasse	756,000 tonnes	15,755	51.0
Coal	22,500 "	617	2.0
L P G	2,200 "	109	0.4
Wood (oven dry)	207,500 "	4,088	13.3
Petroleum Fuels	274 x 10 ⁶ l	10,250	33.3
TOTAL		30819	100.0

During the early 1970's petroleum fuel imports accounted for about 5½% of GDP compared to 8% since 1974. During the past two years GDP in current dollars has risen about 20% while the import cost of fuels sold locally rose by 45%.

Efforts to exploit indigenous energy sources have had little impact except for the development of a 40 MW hydroelectric scheme planned for completion in 1981. Investigations are underway to exploit geothermal energy potential and offshore drilling operations in the search for petroleum is scheduled to begin soon. It is expected that petroleum imports will increase in volume by 2% to 7% annually over the next decade depending upon economic growth rates if alternatives to petroleum products are not found.

4. Exploitation of Domestic Energy Resources:

During the past two years there has been two regional meetings in Suva on energy planning. The first was in 1976 mini-symposium on ocean thermal energy conversion (OTEC) organised by UN Coordinating Committee for Offshore prospecting in South Pacific (CCOP/SOPAC) and Government's Mineral Resources Division. The meeting concluded that the OTEC has great potential in Fiji in the long run but this depends upon major technological developments over which it has no control.

The second meeting was a workshop for rural energy planning in mid 1977 organised by the UN Economic & Social Commission for Asia and the Pacific (ESCAP) and the University of the South Pacific (USP) emphasising practical aspects of biogas, wood, solar, minihydro, wind and conventional energy resources.

The consensus was that the 'alternative' energy systems are currently very expensive but that conditions in the Pacific Islands (good solar & wind conditions, small scale of demand, dispersed population with no possibility of grid system for electricity reticulation to remote areas and island) are excellent for demonstrating their economic viability.

Some effort has gone into exploiting indigenous energy resources on large and small scale. The most notable of which is the \$80 million hydroelectricity project having a 40 MW generation capacity. Upon completion in 1981 it will supply 70% of public electricity demand and save about 63 million litres of petroleum fuel.

Limited work has also gone into the development of solar water heaters, wind powered generators and wood stoves for cooking in rural areas.

Finally studies have been carried out on the viability of producing anhydrous alcohol from local molasses for blending with gasoline.

5. Industrialisation of Molasses:

From time to time, suggestions have been put forward to ferment molasses for the production of ethanol for blending with imported fuel. To date two feasibility studies have been carried out by FSC to evaluate the viability of this project. Unfortunately the economics of this project does not look attractive at the present. It may be worth looking very briefly at the findings.

5.1 Fiji Gasoline Consumption. In Fiji, gasoline consumption for 1975 to 1977 inclusive is given as :

	<u>'000 litres</u>		
	<u>1975</u>	<u>1976</u>	<u>1977</u>
Fiji	51,230	50,174	54,732
Other Islands *	15,354	15,980	71,788
TOTAL	<u>66,584</u>	<u>66,154</u>	<u>71,788</u>

*Tonga, Western Samoa and Tuvalu are supplied from Fiji.

It is estimated that future sales growth will be between 1-2% annually. Hence an average annual total consumption for the 1980's will be of the order of 80 million litres.

5.2 Power Alcohol Production Requirements. At present only standard 15% v/v blend ratio is being considered. At yields of 280 - 300 litres of anhydrous alcohol per tonne of molasses, annual molasses usage would be in the order of 40,000 - 45,000 tonnes. At an average molasses production level of 90,000 tonnes per annum, there is no problem of raw material availability for power alcohol manufacture.

5.3 Gasoline Price Structure. Present day gasoline imports from Singapore are based upon OPEC crude oil prices:

	<u>\$US/litre</u>
FOB price ex-Singapore	0.130
C & F to Suva Port	0.009
Insurance at 0.08%	Negligible
Landing to shore tanks	0.001
Untaxed gasoline in depot	<u>\$US0.140/litre</u>
With tax at \$US13.8 cents per litre	
taxed gasoline in depot is	<u>\$US0.278/litre</u>

Anhydrous Alcohol Price Structure:

At an average molasses price of F\$30/tonne (current price F\$40/tonne FOB) and yielding 300 litres anhydrous alcohol per tonne molasses, an order of magnitude of selling price for power alcohol will be : US\$0.480/litre.

To this must be added the distribution, blending and overhead costs of : US\$0.044/litre.

Therefore total selling price to oil distributors before tax is : US\$0.524/litre.

With tax at 13.8 cents per litre taxed alcohol in Suva depot is : US\$0.662.

This selling price represents an increase of 58% on the present day bought-in price of gasoline by the oil distributing companies.

Obviously the manufacture of power alcohol at this point in time is economically unjustifiable. Of course the economics will change depending upon the variation in the world prices of oil and molasses.

We are, however, aware of the fact that the project can be viewed as a means of saving foreign currency and providing opportunities for employment in the country.

Our view is to monitor constantly the economics and make a move when conditions begin to become favourable.

Further advantages could be obtained since by mixing alcohol with gasoline it would be possible to import a lower grade of gasoline and to avoid the use of lead compounds for anti-knock purposes.

6. Future Prospects:

The preceding exercise clearly shows that at present it is not economically feasible to manufacture power alcohol in Fiji. This situation could change in the future.

Most forecasters are predicting demands for OPEC oil reaching 45 million barrels per day by the mid 1980s. But unless the price of crude oil doubles it must be doubtful whether OPEC will be able to produce more than 42 million barrels per day. The situation is further complicated by Iranian cuts in crude production and its uncertain future crude oil policy.

At the same time, New Orleans market for molasses could be subject to change. Approximately 85% of molasses is used for animal feed and the market sensitivity is governed by US grain harvest. Further it is anticipated that there will be a greater demand for molasses in the future for production of fermentation alcohol. Hence tighter market conditions for molasses should improve selling prices but it is impossible to predict trends at this stage.

The future opportunities for power alcohol production in Fiji must depend upon the differential market conditions of gasoline and molasses. It is possible that by late 80's the conditions may become favourable.

7. Export Market for Alcohol:

The volatile nature of the international alcohol market makes it very difficult to justify an investment of the order of US\$6 million in an alcohol plant. The main market, we believe, will be Japan.

8. Potable Distillery:

Whilst the production of ethanol has proven to be uneconomic, the Corporation is going ahead with plans to install a small potable alcohol distillery for the production of rum, gin, vodka and a small quantity of absolute alcohol for local requirements.

The planning and designing work is quite far advanced and we are hopeful that the distillery will be in production in late 1980.

Management and staff training for the operation of the distillery will be provided by consultants for an initial period of 5 years. This project, no doubt, will put us in good stead for any future developments on manufacture of ethanol.

9. Constraints:

(a) Pollution Treatment.

The greatest inhibition on the growth of a major molasses fermentation industry will be the threat to the environment from stillage effluent. To produce 15 million litres per year of anhydrous alcohol a pollution load of 15 tonnes per day of BOD can be expected.

It probably is worth mentioning that an earlier project was abandoned by the Government due to unsatisfactory and inadequate method put forward by the interested party for effluent disposal.

The Government is very keen to maintain the ecological balance and is therefore quite strict on environmental control measures.

(b) Professional Skills:

No distillery exists in Fiji and therefore the management and process skills required for the successful operation of a distillery is currently not available in Fiji. It is hoped that the potable distillery will provide the much needed training in the required areas.

(c) Capital Requirements:

Although not a major constraint an investment of US\$6 million for erecting and commissioning a distillery may pose some problems to a commercial enterprise.

(d) Vehicle Modification:

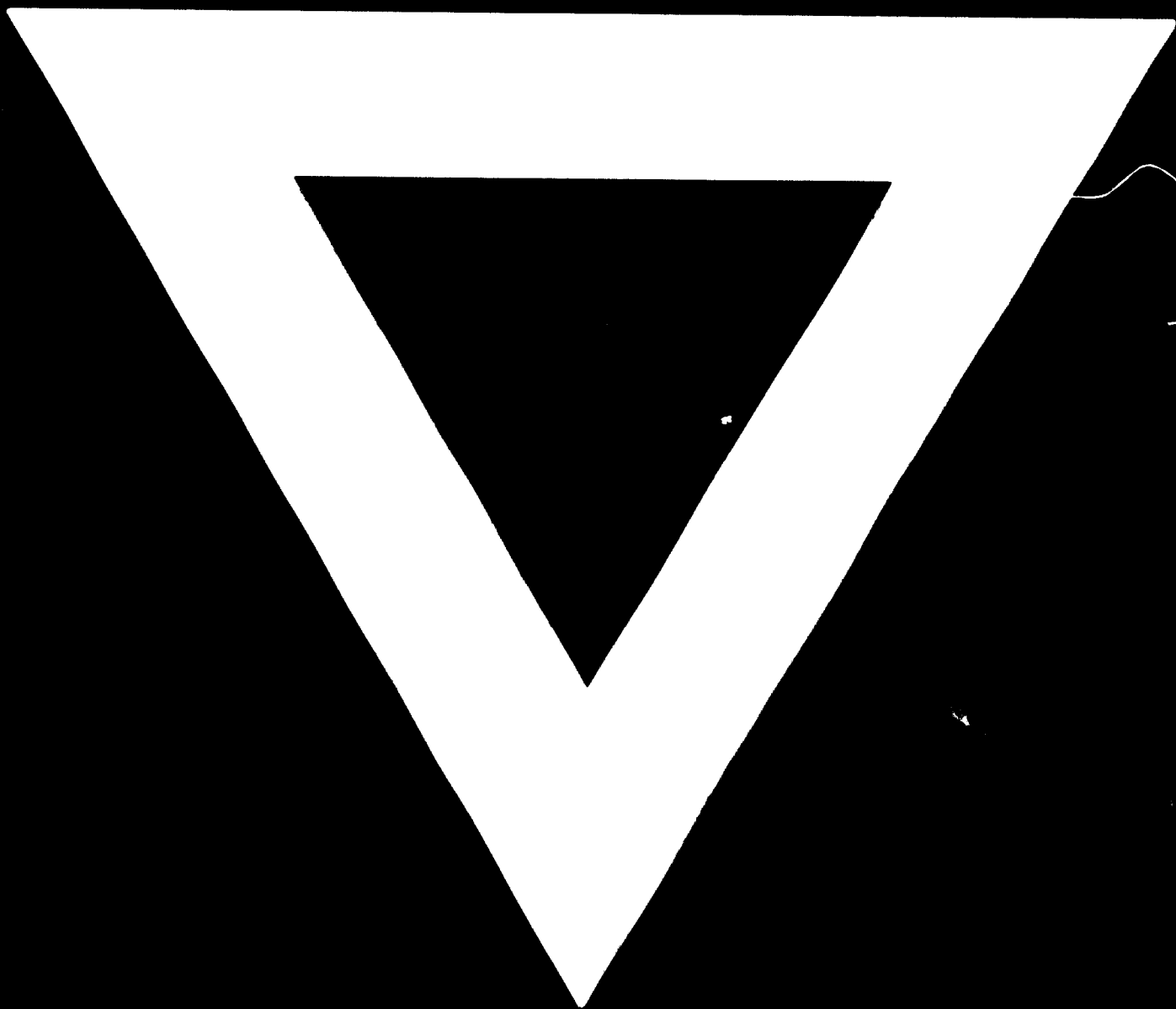
Again a complication of no major nature, it still may pose problems in the Fiji context.

10. Availability of Alternative Raw Materials:

At 15% v/v blending Fiji will have a surplus of molasses for fermentation therefore the need for alternative raw material doesnot arise. Even at 50% v/v blending, Fiji will have sufficient molasses to cater for the local requirement.

Nevertheless crops such as cassava and sweet so m can be cultivated for fermentation process but require comprehensive studies to examine its viability.

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