THE SUGAR INDUSTRY IN HAWAII: AN ACTION PLAN

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State Capitol, Room 004
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FOREWORD

This study on the sugar industry in the State of Hawaii was prepared in response to House Resolution No. 216, H.D. 2, adopted during the 1987 legislative session. House Resolution No. 216, H.D. 2 (Appendix A), requested the Legislative Reference Bureau to make recommendations for an action plan for Hawaii's sugar industry.

This report is a result of a collaboration of the Bureau's research staff. The chapter of the report which presents an overview of the international, national, and Hawaii sugar situations was prepared by Joyce Kahane. Jean K. Mardfin was responsible for the portion of the report which discusses the problems and opportunities of Hawaii's sugar industry and the impacts of the closing of sugar companies in the State. Chapter 5 was jointly done by the two researchers. Susan Jaworowski conducted interviews with selected sugar company managers on the neighbor islands, as well as participated in certain interviews on Oahu.

We wish to gratefully acknowledge the cooperation and assistance of the Hawaiian Sugar Planters' Association, the sugar companies in the State of Hawaii, the Department of Health, the Governor's Agriculture Coordinating Committee, the International Longshoremen's & Warehousemen's Union, and the University of Hawaii College of Tropical Agriculture and Human Resources.

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Chapter 1

INTRODUCTION

House Resolution No. 216, H.D. 2 (see Appendix A), requests the Legislative Reference Bureau to develop an action plan for Hawaii's sugar industry, including recommendations designed to help the sugar industry continue to contribute to the State's economic and social well-being. The Resolution's rationale for the State to help the sugar industry is that the sugar industry has been an important industry in Hawaii, "having been a pillar of the economic development of the islands" and "has contributed to what is now Hawaii's leading industry, tourism, because every acre planted in sugar cane...is an acre free of concrete, green and lush, preserving the image of Hawaii which sustains residents and draws millions of visitors every year"; and that the sugar industry has been "hard hit by a reduction in the amount of sugar consumed by Americans, the growing use of alternative sweetners (sic), the reduction of federal price supports, and competition from subsidized sugar producers in foreign countries".

Methodology

In order to develop an action plan for Hawaii's sugar industry, the principal data gathering activities consisted of the following:

(1) Reviewing certain printed material on the sugar industry, including but not limited to, prior studies on the nation's and Hawaii's sugar industry;

(2) Interviewing individuals whose work is related to Hawaii's sugar industry, such as those associated with the Hawaiian Sugar Planters' Association, sugar companies, the Governor's Agriculture Coordinating Committee, the state Department of Health, the International Longshoremen's & Warehousemen's Union, and the University of Hawaii College of Tropical Agriculture and Human Resources; and

(3) Surveying all sugar companies to learn about their particular company, and to obtain their views on specific measures the State can take to aid the sugar industry.

Organization of the Report

The report is presented as follows:

Chapter 1 introduces the report.

Chapter 2 provides an overview of the international, national, and state sugar situations.

Chapter 3 discusses the problems and opportunities of the Hawaii sugar industry.

Chapter 4 describes the impacts of the closing of sugar companies in the State.

Chapter 5 reports the Bureau's findings and action plan.

Chapter 2

OVERVIEW

Hawaii's sugar industry, like other sugar operations in the United States, has faced economic adversity. The problems that confront the sugar industry are tied closely to political and economic forces at the international and national levels. Therefore, prior to examining the specifics of Hawaii's sugar industry, a brief discussion of the broader international and national sugar situation, which impinges on Hawaii's sugar operations, is presented.

International

Production and Consumption

Sugar, a highly traded commodity, is produced in about one hundred countries in the world (see Exhibit 1). The European Economic Community,[1] produced about twenty-one per cent of the total world production in 1985, and the Soviet Union, Brazil, Cuba, India, and the United States, together with the European Economic Community, produced over half of the world's sugar (see Exhibit 2).

Cane sugar is suited to tropical and subtropical areas, such as Hawaii, while beet sugar is grown in cooler temperate climates. In the 1985/1986 sugar crop year, the total world production of sugar amounted to approximately 98.1 million metric tons, 61.7 million metric tons produced from sugarcane and 36.4 million metric tons from sugarbeets (see Exhibit 3).

About seventy nations exported about 29.8 million metric tons of sugar to approximately one hundred and fifteen countries. Approximately seventy-five per cent of world sugar consumption occurs within countries where the sugar crop is produced, and therefore only twenty-five per cent of the world's consumed sugar is involved in international trade [2].

Exhibit 1

SUGAR SUPPLY AND DISTRIBUTION BY COUNTRIES, 1985

(Metric Tons - Raw Value)

(To convert to Short Tons, multiply by 1.1023)

COUNTRIES	SUPPLY		DISTRIBUTION	
	Production	Imports	Consumption	Exports
NORTH AMERICA				
Canada	60,000[a]	1,157,956	1,050,000[a]	65,329
U.S.A.	5,415,398	2,274,669	7,289,629	364,435
TOTAL	5,475,398	3,432,625	8,339,629	429,764
EUROPE				
Albania	33,000[a]	21,981[b]	55,000[a]	0
Austria	468,184	0	347,585	40,566
Bulgaria	115,000[a]	485,000[b]	455,000[a]	204,666[c]
Cyprus	0	25,191[b]	20,000[a]	0
Czechoslovakia	840,000[a]	122,623	800,000[a]	248,319
E.E.C.[d]	13,860,040	1,295,333	10,515,377	4,280,366
Finland	102,532	64,747	201,838	6,828
French Terr.[e]	0	8,465[b]	8,000[a]	0
German Dem. Rep.	797,972	265,022	757,370	221,705
Gibraltar	0	1,206[b]	1,000[a]	0
Hungary	579,045	0	517,740	43,806
Iceland	0	12,500	11,000[a]	0
Malta	0	18,190	17,173	0
Norway	0	179,930	175,079	0
Poland	1,840,900	25,000	1,690,400	186,307
Portugal	15,000[a]	575,000	330,000[a]	4,176[c]
Romania	585,000[a]	62,564[b]	720,000[a]	132,630[c]
Spain[f]	1,090,000[a]	76,067	960,000[a]	0
Sweden	368,658	13,822	385,544	4,510
Switzerland	138,833	174,390	287,054	326
Turkey	1,397,831	54,000[b]	1,347,830	308,109
U.S.S.R.	8,600,000[a]	4,476,969	13,250,000[a]	175,109
Yugoslavia	970,000[a]	54[b]	900,000[a]	15,342[c]
TOTAL	31,801,995	7,958,054	33,752,990	5,872,765
CENTRAL AMERICA				
Bahamas	0	6,529[b]	7,000[a]	0
Barbados	101,414	100	13,576	77,840
Belize	109,520	0	6,380	95,530
Bermuda	0	3,185[b]	2,200[a]	0
Costa Rica	230,000[a]	0	150,000[a]	3,075[c]
Cuba	7,889,240	0	886,782	7,209,008
Dominican Rep.	920,699	0	303,900	721,607
El Salvador	278,926	0	159,262	115,479
Guatemala	500,000[a]	0	280,000[a]	127,764[c]
Haiti	50,000[a]	18,299[b]	62,000[a]	0
Honduras	235,095	0	119,619	102,484
Jamaica	210,000[a]	23,632[b]	100,000[a]	152,113[c]
Mexico	3,491,559	0	3,547,541	66,194
Neth. Antilles	0	8,581[b]	8,000[a]	0
Nicaragua	250,000[a]	0	155,000[a]	36,566[c]
Panama	160,313	0	79,034	77,737
St. Christopher-Nevis	27,455	0	2,159	25,189
Trinidad	80,000[a]	28,418[b]	65,000[a]	62,046[c]
Other C. America[g]	0	18,663[b]	17,000[a]	0
TOTAL	14,534,221	107,407	5,964,453	8,872,632
SOUTH AMERICA				
Argentina	1,187,761	0	973,786	157,176
Bolivia	175,000[a]	0	189,000[a]	16,876[c]
Brazil	8,455,484	0	5,797,131	2,608,706
Chile	351,086	28,000[b]	402,000	0
Colombia	1,366,893	0	1,043,644	294,934
Ecuador	300,000[a]	0	324,000[a]	25,398[c]
Guyana	257,688	0	31,326	230,386
Paraguay	80,000[a]	12,000[b]	80,000[a]	0
Peru	710,000[a]	2,000[b]	650,000[a]	90,540[c]
Suriname	10,000[a]	63[b]	15,000[a]	0
Uruguay	90,000[a]	2,000[b]	100,000[a]	4,451[c]
Venezuela	470,000[a]	238,000[b]	720,000[a]	0
TOTAL	13,453,912	282,063	10,325,887	3,428,467

SUGAR SUPPLY AND DISTRIBUTION BY COUNTRIES, 1985 (cont.)

(Metric Tons - Raw Value)

(To convert to Short Tons, multiply by 1.1023)

COUNTRIES	SUPPLY		DISTRIBUTION	
	Production	Imports	Consumption	Exports
ASIA				
Afghanistan	3,000[a]	35,980[b]	80,000[a]	0
Bangladesh	94,327	72,000[b]	230,000[a]	0
Brunei	0	6,234[b]	6,000[a]	0
Burma	101,000[a]	0	100,000[a]	0
China	5,200,000[a]	2,214,000[b]	6,350,000[a]	200,000
China (Taiwan)	689,805	0	476,315	205,570
Hong Kong	0	147,101	110,000[a]	15,827
India	7,015,972	1,781,235	8,974,358	40,757
Indonesia	1,704,878	3,266[b]	1,794,390	0
Iran	700,000[a]	625,303[b]	1,300,000[a]	0
Iraq	0	582,806[b]	600,000[a]	0
Israel	0	233,227[b]	250,000[a]	0
Japan	927,852	1,986,404	2,891,377	3,804
Jordan	0	95,000[b]	135,000[a]	0
Kampuchea	0	5,000[a]	5,000[a]	0
Korea, D.P.R.	0	120,000[a]	120,000[a]	0
Korea, Rep. of	0	858,133	515,603	336,199
Kuwait	0	52,024[b]	70,000[a]	2,023[c]
Lao, D.P.R.	0	6,000[a]	6,000[a]	0
Lebanon	0	54,290[b]	60,000[a]	0
Macao	0	3,000[a]	3,000[a]	20
Malaysia	70,000[a]	619,039	600,000[a]	93,203
Maldives	0	5,723[b]	5,500[a]	0
Mongolia	0	42,128[b]	42,000[a]	0
Nepal	28,000[a]	10,023[b]	35,000[a]	0
Pakistan	1,450,000[a]	27,000[b]	1,400,000[a]	0
Persian Gulf	0	103,542[b]	125,000[a]	0
Philippines	1,664,845	0	1,339,825	594,845
Saudi Arabia	0	259,000[b]	400,000[a]	0
Singapore	0	146,114	130,000[a]	3,409
Sri Lanka	17,000[a]	380,066[b]	320,000[a]	0
Syria	50,000	357,303	385,000	0
Thailand	2,392,763	0	721,468	1,781,004
Vietnam, S.R.	184,000[a]	14,018[b]	211,000[a]	16,043[c]
Yemen Arab Rep.	0	206,000[b]	200,000[a]	0
Yemen Dem. Rep.	0	64,000[b]	80,000[a]	0
TOTAL	22,293,442	11,116,595	30,071,836	3,292,704
AFRICA				
Algeria	0	531,900[b]	600,000[a]	0
Angola	50,000[a]	52,000[b]	100,000[a]	0
Benin	5,000[a]	29,100[b]	30,000[a]	0
Botswana	0	40,647	37,000[a]	0
Burkina Faso	10,000[a]	28,491[b]	35,000[a]	0
Burundi	0	9,190[b]	7,000[a]	0
Cameroon, U.R.	70,000[a]	6,339	75,000[a]	205
Cape Verde	0	8,022[b]	9,000[a]	0
Cent. Afri. Rep.	0	8,892[b]	5,000[a]	0
Chad	8,000[a]	21,703[b]	30,000[a]	0
Comoros	0	3,000[a]	3,000[a]	0
Congo	25,000a	19,321b	20,000a	24,454c
Djibouti	0	29,930[b]	8,000[a]	30,000[a]
Egypt, Arab Rep.	900,000[a]	711,000[a]	1,600,000[a]	0
Ethiopia	191,252	0	144,167	26,865
Gabon	12,000[a]	1,195[b]	15,000[a]	5,000[a]
Gambia	0	60,647[b]	30,000[a]	30,000
Ghana	0	34.050[b]	30,000[a]	0
Guinea	5,000[a]	36,130[b]	35,000[a]	0
Guinea Bissau	0	2,778[b]	3,000[a]	0
Ivory Coast	125,000	32,448[b]	125,000	22,210
Kenya	370,000[a]	68,000[b]	400,000[a]	0
Liberia	3,000[a]	10,400[b]	10,000[a]	0
Libya	0	226,000[b]	150,000[a]	0
Madagascar	99,017	11,847	83,550	34,925
Malawi	154,455	0	61,694	142,588
Mali	20,987	26,534[b]	40,000[a]	0
Mauritania	0	23,290[b]	25,000[a]	0
Mauritius	683,576	0	38,889	571,190
Morocco	433,131	243,477	707,037	0

SUGAR SUPPLY AND DISTRIBUTION BY COUNTRIES, 1985 (cont.)

(Metric Tons - Raw Value)

(To convert to Short Tons, multiply by 1.1023)

COUNTRIES	SUPPLY		DISTRIBUTION	
	Production	Imports	Consumption	Exports
AFRICA (Continued)				
Mozambique	60,000[a]	30,000[b]	90,000[a]	9,955[c]
Niger	0	31,504[b]	15,000[a]	0
Nigeria	50,000[a]	518,000[b]	550,000[a]	0
Rwanda	2,000[a]	17,700	9,500	0
Senegal	65,000[a]	1,147[b]	75,000[a]	0
Sierra Leone	5,000[a]	14,465[b]	18,000[a]	0
Somalia	54,000[a]	28,000[b]	90,000[a]	0
South Africa	2,540,377	28,767	1,367,612	1,025,226
Sudan	450,000[a]	11,576[b]	470,000[a]	0
Swaziland	395,884	0	22,434	379,874
Tanzania, U.R.	105,000[a]	21,624[b]	126,000[a]	11,684[c]
Togo	0	51,557[b]	50,000[a]	0
Tunisia	16,981	191,695	211,908	4,331
Uganda	34,000[a]	884[b]	35,000[a]	0
Zaire	65,000[a]	30,429[b]	85,000[a]	0
Zambia	143,182	0	112,911	9,089
Zimbabwe	455,643	8,046	224,661	219,587
Other Africa[h]	0	3,551[b]	3,500[a]	0
TOTAL	7,607,485	3,265,276	8,013,863	2,547,183
OCEANIA				
Australia	3,438,516	0	764,398	2,651,424
Fiji	366,717	380	35,723	419,143
New Zealand	0	174,000[b]	170,000[a]	0
Papua New Guinea	*30,050*	*679*[b]	*26,620*	*11,383*[c]
Western Samoa	2,500[a]	346[b]	3,000[a]	0
Other Oceania[i]	0	12,778[b]	12,000[a]	0
TOTAL	3,837,785	188,183	1,011,741	3,081,950
WORLD TOTAL	99,004,236	26,350,567	97,480,399	27,525,465

[a] Estimated.
[b] As reported by countries of origin.
[c] As reported by countries of destination.
[d] European Economic Community--Belgium, Denmark, France (Metropolitan, Guadeloupe, Martinique, Reunion, French Guiana), Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, and United Kingdom.
[e] Including St. Pierre & Miguelon, New Caledonia and French Polynesia.
[f] Peninsula and Balearic Islands only.
[g] Including Leeward and Windward Islands.
[h] Including Equatorial Guinea, St. Helena, Sao Tome and Syschelles.
[i] Including Pacific Islands.

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), pp. 23-25.

Exhibit 2

WORLD'S 10 LARGEST PRODUCING, EXPORTING, IMPORTING & CONSUMING NATIONS

1985 - Metric Tons, Millions

Producers		Exporters		Importers		Consumers	
Country	Tons	Country	Tons	Country	Tons	Country	Tons
EEC	13.9	Cuba	7.2	USSR	4.8	USSR	13.3
USSR	8.6	EEC	4.3	USA	2.3	EEC	10.5
Brazil	8.5	Australia	2.7	China	2.2	India	9.0
Cuba	7.9	Brazil	2.6	Japan	2.0	USA	7.3
India	7.0	Thailand	1.8	India	1.8	China	6.4
USA	5.4	So. Africa	1.0	EEC	1.3	Brazil	5.8
China	5.2	Dom. Rep.	0.7	Canada	1.2	Mexico	3.6
Mexico	3.5	Philippines	0.6	So. Korea	0.9	Japan	2.9
Australia	3.4	Mauritius	0.6	Egypt	0.7	Indonesia	1.8
So. Africa	2.5	Fiji	0.4	Iran	0.6	Poland	1.7
Total	65.9		21.9		17.8		62.3

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 21.

Exhibit 3

WORLD SUGAR PRODUCTION, CONSUMPTION, IMPORTS & EXPORTS

1985/86

Millions, Metric Tons - Raw Value

Region	Production			Consumption	Imports	Exports
	Beet	Cane	Total			
North America	2.8	6.4	9.2	11.8	3.2	0.7
South America	0.4	12.8	13.2	10.9	0.1	3.2
Central America	0.0	1.8	1.8	0.9	--	1.0
Caribbean	0.0	8.5	8.5	11.5	0.1	7.6
European Community	14.4	0.0	14.4	11.5	3.0	6.6
Other West Europe	1.0	0.0	1.0	1.3	0.5	0.1
East Europe	5.5	0.0	5.5	6.0	1.0	0.9
U.S.S.R.	8.3	0.0	8.3	13.3	5.5	0.3
North Africa	0.5	1.4	1.9	8.1	2.1	3.0
Other Africa	0.0	5.9	5.9		1.0	
Middle East	2.0	0.3	2.3	5.2	2.8	0.1
Asia	1.5	20.9	21.4	26.1	7.8	3.3
Oceania	0.0	3.7	3.7	1.0	0.2	3.0
Total*	36.4	61.7	98.1	97.6	27.5	29.8

* Rounded

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 21.

A total of 97.6 million metric tons of sugar was consumed in the 12-month period from October 1985 through September 1986 (see Exhibit 3), with the excess sugar supplementing the existing world sugar stock-piles, estimated at 46.8 million metric tons. The existence of a large supply of surplus sugar, known as the "world residual sugar market", serves to depress sugar prices, which it has in recent years (see Exhibit 4).

Controlled Markets and "Free" or World Sugar Markets

As well as being one of the world's most traded food commodities, sugar is also a heavily regulated commodity. Most governments have established measures to insulate themselves from market price fluctuations and consequently much of the sugar produced in the world is traded in controlled markets.

Governments protect their country's sugar industry by a variety of domestic sugar programs, such as government ownership of all or parts of a sugar industry, quotas, price supports, grower and export subsidies, and long-term trade agreements that price sugar above "free" or world sugar prices. For example, in Australia, protection has included an import embargo, controlled prices, and a system for pooling proceeds from higher priced domestic contract sales with lower priced government-supported export sales. In Japan, levies on sugar imports have been used to subsidize high-cost domestic producers. In Brazil, a government agency has set prices and has been the sole export agent.[3] Farmers producing sugar in the United States are supported by the government at a higher level than farmers growing other crops, and the United States and Japan provide the highest level of government support to sugar, compared with certain other countries (see Exhibit 5). Trade agreements outside of the world market include the European Economic Community's Lome Convention with African, Caribbean, and Pacific nations; and barter agreements between Cuba and Soviet Bloc countries.

The price of sugar under such controlled arrangements does not reflect the price of sugar on the world market. Under preferential and trade agreements of the controlled market, sugar prices averaged twenty-one cents

Exhibit 4

WORLD SUGAR PRODUCTION, CONSUMPTION & STOCKS & IMPACT ON WORLD SUGAR MARKET PRICES

1973-1986 - Raw Value

Sugar year Oct./Sept.	Metric tons production	Metric tons consumption	Stocks, metric tons actual	Stocks, metric tons desirable[b]	Stocks, metric tons surplus	World sugar market No. 11 contract cents per lb.*
1973/74	80.0	80.0	17.3	20.0	(2.7)	9.61
1974/75	78.5	77.1	18.9	19.3	(0.4)	29.99
1975/76	81.7	79.2	21.0	19.8	11.2	20.49
1976/77	86.3	81.9	24.8	20.5	4.3	11.58
1977/78	92.7	86.2	30.0	21.6	8.4	8.11
1978/79	91.3	89.6	31.0	22.4	8.6	7.82
1979/80	84.6	89.5	24.2	22.4	1.8	9.66
1980/81	88.5	88.5	24.2	22.1	2.1	29.04
1981/82	100.6	89.4	34.0	22.4	11.6	16.93
1982/83	101.3	93.8	41.4	23.5	17.9	8.42
1983/84	96.5	95.8	42.5	24.0	18.5	8.49
1984/85	100.2	96.7	46.0	24.2	21.8	5.18
1985/86[c]	98.1	97.6	46.4	24.4	22.0	4.04
1986/87[d]	100.1	99.7	46.8	24.9	21.9	6.05

[a] World market for surplus, "homeless" sugar, f.o.b. Caribbean.
[b] Based on 25% "rule of thumb" held to be desirable.
[c] Preliminary.
[d] Estimate.
* Calendar year, average.

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 22.

Exhibit 5

Percentage of Farmers' Income Attributed to Direct and Indirect Support Received From Their Governments

	0-9%	10-24%	25-49%	50-74%	75-99%
Beef	Australia* Canada U.S.	New Zealand*	Taiwan	EC* Japan South Korea	
Corn	Canada EC		Taiwan U.S.	South Korea	
Dairy		New Zealand*	Australia* EC* U.S.*	Canada*	Japan
Rice	Thailand*	Australia*	EC U.S.* Taiwan*	South Korea	Japan
Soybeans	Canada U.S.*	Taiwan	EC	Japan South Korea	
Sugar		Australia* Taiwan*	Canada EC*	Japan U.S.	
Wheat	Australia*	Canada* EC*	EC* U.S.*	South Korea Taiwan	Japan

*net exporter

Source: National Journal, July 4, 1987, p. 1720.

a pound while sugar traded on the world sugar market averaged six cents a pound in 1986.[4] It is estimated that sixteen per cent of the sugar consumed was traded at world sugar market prices.[5]

Sugar prices are said to be among the most unstable in international trade because of the relatively small shares of the world sugar production freely traded in international markets. Due to the small and largely residual character of the world sugar market, world crop changes and shifts in government sugar policies tend to have disproportionate effects. In periods of crop failure, governments may temporarily restrict exports to meet domestic needs, thus intensifying world price increases. In periods when output exceeds domestic needs, supplying nations may attempt to "dump" their surpluses on the world market, lowering the world price. Another source of instability is the inability of sugar producers to adjust production rapidly in response to changing economic conditions.[6]

Therefore, the world sugar price is not a competitive price that fully reflects underlying cost and demand conditions. A considerable fraction of sugar sold on the market is sugar that cannot be absorbed by preferential systems, or consumed in the producing countries, often in highly protected markets.[7]

International Sugar Agreement

The United States and more than seventy other countries entered into the International Sugar Agreement of 1977, with the main objective of price stability and a second goal of raising developing exporting countries' earnings by increasing the international sugar trade. The Agreement instituted an export quota and reserve stocks system to support world sugar prices within the agreed-upon price range, initially being eleven to twenty-one cents a pound, and later raised to thirteen to twenty-three cents a pound. Various responses are triggered at specified prices to maintain prices within this range, such as quotas when sugar prices are low, free trade when prices are moderate, and stock releases as prices rise toward the upper end of the range.

However, the Agreement has not been effective in maintaining world sugar prices within the prescribed range, primarily because the European Economic Community, the world's largest sugar producer and second largest exporter, is not a member, and therefore has not been constrained to hold sugar off the market during times of low sugar prices.[8]

Another way that the international sugar problem is being addressed is through the General Agreement on Tariffs and Trade. At the 1986 meeting in Uruguay, sugar was included in the agenda of trade talks by the ninety-two nation organization.[9]

United States

Sugar and Sweetener Market

The United States sugar and sweetener market consists of a variety of products, as follows:

Kind of Sweetener	Per cent of the Market
Sucrose sugar (cane and beet sugar)[10]	41
Dextrose and glucose corn syrups	15
High-fructose corn syrup	31
Saccharin and other non-caloric sweeteners	12
Honey and edible syrups	.01

As seen above, domestic and imported cane sugar and domestic beet sugar constituted forty-one per cent of all caloric sweeteners used. Forty-six per cent of the sweeteners consumed were corn sweeteners: high-fructose, glucose, and dextrose corn syrups. The consumption of sweeteners has risen since 1970. However, the consumption of refined sugar has decreased while the consumption of high-fructose corn syrup has risen dramatically (see Exhibit 6).

Exhibit 6

U.S. PER CAPITA CONSUMPTION OF ALL SWEETENERS IN POUNDS - 1970 - 1986

Cal. Year	CALORIC SWEETENERS												NON- & LOW CALORIC SWEETENERS			
	Refined cane and beet sugar				Corn				Minor Caloric[a]							
	U. S.A.		Imported (Cane)	Total	Syrups		Dextrose	Total	Honey	Edible syrup	Total	Total caloric[b]	Saccharin	Aspartame	Total non & low caloric[c]	Total all
	Beet	Cane			High-fructose	Glucose										
1970	31.3	25.0	45.4	101.7	0.7	14.0	4.6	19.3	1.0	0.5	1.5	122.5	5.8	0	5.8	128.3
1971	30.6	22.9	48.6	102.1	0.9	14.9	5.0	20.8	0.9	0.5	1.4	124.3	5.1	0	5.1	129.4
1972	30.3	25.3	46.7	102.3	1.3	15.4	4.4	21.1	1.0	0.5	1.5	124.9	5.1	0	5.1	130.0
1973	30.2	24.7	45.9	100.8	2.1	16.5	4.8	23.4	0.9	0.5	1.4	125.6	5.1	0	5.1	130.7
1974	25.8	20.8	49.0	95.6	3.0	17.2	4.9	25.1	0.7	0.4	1.1	121.9	5.9	0	5.9	131.5
1975	30.1	24.6	34.4	89.1	5.0	17.5	5.0	27.5	1.0	0.4	1.4	118.1	6.1	0	6.1	124.2
1976	32.0	22.4	39.0	93.4	7.2	17.5	5.0	29.7	0.9	0.4	1.3	124.4	6.1	0	6.1	130.5
1977	29.8	22.9	41.5	94.2	9.5	17.6	4.1	31.2	1.0	0.4	1.4	126.8	6.6	0	6.6	133.4
1978	27.4	22.9	41.2	91.5	12.1	17.8	3.8	33.7	1.1	0.4	1.5	126.6	7.1	0	7.1	133.7
1979	26.5	21.1	41.7	89.3	14.9	17.9	3.6	36.4	1.0	0.4	1.4	127.1	7.4	0	7.4	134.3
1980	26.9	24.3	32.5	83.6	19.1	17.6	3.5	40.2	0.8	0.4	1.2	125.1	7.7	0	7.7	132.8
1981	25.6	21.5	32.4	79.4	23.2	17.8	3.5	44.5	0.8	0.4	1.2	125.1	8.0	0.2	8.2	133.3
1982	25.4	23.5	24.9	73.7	26.7	18.0	3.5	48.2	0.9	0.4	1.3	123.2	8.4	1.0	9.4	132.6
1983	23.1	24.0	23.9	71.1	30.7	18.0	3.5	52.2	1.0	0.4	1.4	124.6	9.5	3.5	13.0	137.6
1984	21.5	21.8	24.2	67.6	36.3	18.0	3.5	57.8	1.0	0.4	1.4	126.7	10.0	5.8	15.8	142.5
1985	NA	NA	NA	63.3	45.0	18.0	3.5	66.5	1.0	0.4	1.4	131.2	6.0	12.0	18.0	149.2
1986	NA	NA	NA	61.0	45.8	18.0	3.5	67.3	1.0	0.4	1.4	129.7	5.5	13.0	18.5	148.2

[a] Dry basis.
[b] May not add precisely due to rounding.
[c] Assumes saccharin 300 times as sweet as sugar; aspartame 200 times.

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 15.

Production and Consumption

In the United States, sugar is grown domestically and is also imported from foreign sources. In 1986, the United States produced seventy-eight per cent of the sugar consumed, and the remainder was imported from thirty-nine nations, regulated by country-by-country quota allocations.[11]

Sugarcane is grown and milled in Florida, Hawaii, Louisiana, Texas, and in the Commonwealth of Puerto Rico. Sugarcane is a one-year crop, except in Hawaii where it averages two years. Florida is the leading raw cane sugar-producing state, followed by Hawaii, Louisiana, Texas, and Puerto Rico. However, Hawaii produces the most sugar per acre. Sugarcane growers in Hawaii and the three Mainland states supply about 3.26 million short tons of sugar.[12]

Sugarbeets are grown in about twelve mid-west, great plains, and western states, predominantly in Minnesota, California, Idaho, and North Dakota. Sugarbeet growers produced 3.33 million short tons of beet sugar in 1986. Domestic and imported raw sugar is refined in refineries located in 20 states.[13]

High-Fructose Corn Syrup

The United States sweetener market has been transformed by the introduction in the 1970's of a process for mass-producing high-fructose corn syrup. As shown in Exhibit 6, from a clearly commanding position, sugar has moved to one of shared importance with other sweeteners, especially high-fructose corn syrup. The markets in which high-fructose corn syrup has made the greatest inroads are the soft drink market, frozen dairy products, cereal, and bakery products. High-fructose corn syrup is produced mainly from corn, although it can also be produced from wheat, potatoes, cassava, and other starches.

The success of high-fructose corn syrup is due to its being priced consistently lower than sugar and its technical substitutability for sugar. It

is as sweet or sweeter than regular sugar. However, its widespread use is limited because it is commercially available only in liquid form, effectively limiting its use to industrial applications which are not dependent on sugar's crystalline structure and other functional properties of its dry state. Should a low-cost crystalline fructose product be developed, the potential for absorbing more of the sugar market could be substantially greater. An insignificant amount of crystalline fructose, at a substantial price, is currently sold in the United States.[14]

Artificial and Other New Sweeteners

Saccharin and aspartame are the main commercially available non-caloric sweeteners in the United States. Market gains of these two sweeteners appear limited to soft drinks because of technological limitations and government approvals needed for use in various products. Total consumption of such products makes up only a small portion of the United States sweetener market.

United States Sugar Legislation

Sugar legislation in the United States dates back to 1789, when the first Act of the first Congress placed an import duty on sugar to raise revenues for the government. Sugar tariffs provided a major source of revenue to the federal government, until income and corporate taxes were instituted early in this century.

Modern sugar legislation dates from 1934, when the first Sugar Act was passed. The basic principles of the Act were followed in subsequent sugar acts over the succeeding forty years, until 1974, when the Sugar Act was discontinued by Congress. From 1974 until 1981, there was no cohesive national sugar policy in the United States. This seven-year period was chaotic for most American sugar producers. Excess world production, failure to achieve an effective International Sugar Agreement, and little control of subsidized sugar imports into the United States threatened the survival of the domestic sugar industry. At the same time, high-fructose corn syrup began

penetrating the liquid sweetener market, intensifying price competition within a shrinking market.[15]

After 1976, various administrative and legislative measures designed to help the United States sugar industry were passed. In 1981, sugar was included as a permanent program with other major farm commodities in national farm policy legislation, The Agriculture and Food Act of 1981, known as the Farm Act.

The law is designed to keep United States sugar producers in business by protecting them from competition from subsidized foreign sugar imports, to help the country maintain some self-sufficiency in sugar production, and to provide consumers with an ample supply of sugar at reasonable prices. No cash payments or other governmental grants are involved, and it was the intent of Congress that the program be administered without cost to Congress.

Elements of the program include a nonrecourse sugar loan program under which sugar processors of raw cane or refined beet sugar can place sugar under loan to the Commodity Credit Corporation with the sugar as full collateral for the loan. Loan rates were set at an average of seventeen cents per pound of raw sugar, and authority to impose import fees or quotas to sustain the price of sugar is also part of the program.

The sugar price support program in the 1981 law was extended in the Food Security Act of 1985, with minor changes, technically until September 30, 1990, but will continue to cover the sugar industry until 1991, because of the nature of the crop year. The minimum loan rate is eighteen cents per pound through the life of the bill. Congress directed the Administration to extend the import quotas.

Opponents of the sugar program argue that it conflicts with a trade liberalization policy, especially the effort to eliminate import quotas; that the costs of the program are in excess of the benefits; and that the program maintains high-cost sugar production in the United States, while restricting

the possibilities of expanding production where sugar can be produced more cheaply.[16] Moreover, as one analyst put it, "While President Reagan's heralded Carribean Basin Initiative and other aid projects are designed to promote political and economic stability and control illegal migration and drug trade, repeated sugar quota cuts since 1982 have worked in the opposite direction".[17] Proponents of sugar supports contend that the United States sugar industry is being made the scapegoat for economic conditions in Third World countries, and that the priority of the United States government should be to safeguard domestic industries, rather than the economies of foreign countries. Also, without a price-support system, the United States would eventually become entirely dependent on the volatile world market to determine who would supply the sugar consumed in the United States, how much would be supplied, and at what price.

The latest proposal to change the current sugar price support system was introduced into Congress by Senator Bill Bradley, supported by thirty-four lawmakers, primarily from urban areas, on November 17, 1987.[18] There are now three bills before Congress designed to achieve these purposes.[19] Bradley's legislation would reduce the sugar price support from eighteen cents to twelve cents a pound over the next four years and increase the sugar import quota by 500,000 tons per year for four years. A spokesman for Hawaii's sugar industry said the proposal would drive most of Hawaii's sugar companies out of business in the next two years.[20] It is probable that this bill will die in the Senate because it does not have the support of the Senate Committee on Agriculture, Nutrition, and Forestry. However, it is possible that such a provision may be attached to another vehicle.[21]

The most recent news from Washington, D.C. is that a 25 per cent cut was ordered by the Reagan Administration in the sugar import quota for 1988, to about 750,000 tons. Although this appeared to be good news for the sugar industry, showing an apparent willingness to use quotas to prop up the domestic sugar prices, as required by the 1985 sugar provisions of the Farm Act, sugar industry officials wondered if the administration had not cut the quota more than needed, to bring the sugar support program under more intense fire by legislators, the State Department, consumer groups, and

others, to have the sugar program terminated prior to its scheduled expiration. There is also a one-year plan to import 400,000 tons of sugar from the Caribbean and the Philippines, in the 1988 fiscal year, in addition to the sugar covered by the import quotas. This one-year plan, pushed by Senator Daniel Inouye, would not depress sugar prices because the extra tons would be re-exported after being refined. A sugar industry executive stated that this plan would "remove some of the heat" generated by the import quota cut.[22]

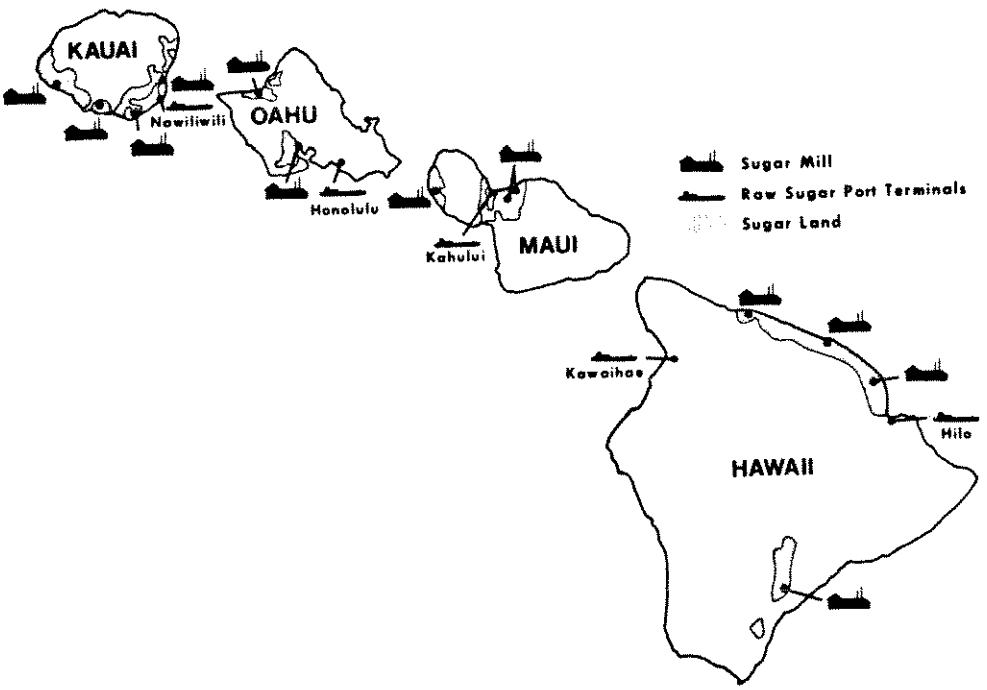
Certain individuals associated with Hawaii's sugar industry perceive that the success of sugar in Hawaii is really out of their hands, and that its survival depends heavily on the continuation of domestic protection for sugar because of the nature of the world sugar market, the lack of an international sugar agreement, the diminished consumption of sucrose in the United States, and the penetration of high-fructose corn syrup into the sweetener market. One observer wrote, the "...sugar industry on Kauai sits on a precarious perch as it watches the approach of 1991, the year federal price support for sugar ends. If price supports are not renewed, many predict the imminent demise of sugar, not only on Kauai, but throughout the state".[23] According to Mr. Francis S. Morgan, President and Chief Executive Officer of Hamakua Sugar Company, "...the two critical industry requirements for the future are first, to continue to reduce our costs, and second, to maintain the essential features of the sugar provisions of the Farm Act, at least through their expiration in late 1991."[24] According to a member of Senator Inouye's staff in Washington, D.C., it is too soon to predict the fate of the sugar provisions of the Farm Act.[25]

Hawaii

The State's sugar companies are located along the coastlines of four islands of the State (see Exhibit 7). In 1986, 184,181 acres of the State's land was devoted to sugarcane, with 21,000 acres used for purposes such as mill sites, private roads, and irrigation systems.[26] Exhibit 8 describes Hawaii's present sugar situation, in regard to total caneland acreage; acreage harvested; production; tons of sugar harvested per acre; number of

Exhibit 7

HAWAII'S SUGAR ISLANDS



Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 4.

Exhibit 8

HAWAIIAN SUGAR COMPANIES, 1986 (Raw Value)

Company	Parent Company	Total Cane Acreage	Acreage Harvested	Production (Short Tons)	Tons Sugar Harvested Per Acre	No. of Employees	Crop Diversification	% of Isle Electricity Supplied 1986
BIG ISLAND		69,072	28,665	329,170				26%
Hilo Coast Processing Company (HCPC)				93,292 for growers"a"		500		19%
Hamakua Sugar Company, Inc.		34,688	15,252	171,651	11.25	1,000	feedlot slaughterhouse	7%
Ka'u Agribusiness Company, Inc.	C. Brewer and Co., Ltd.	16,018	5,579	64,227	11.51	434	macadamia nuts, oranges, coffee	
Mauna Kea Agribusiness Company, Inc.	C. Brewer and Co., Ltd.	15,743	6,441	78,434	12.18	No response	macadamia nuts	
United Cane Planters' Coop.		2,623	1,393	14,858	10.67	89 independent growers		
MAUI		46,099	21,925	302,839				18.5%
Hawaiian Commercial and Sugar Company	Alexander & Baldwin, Inc.	35,890	16,515	229,228	13.88	1,300 potential 90 vacant positions	no alternative crops	17%
Pioneer Mill Company, Ltd.	Amfac, Inc.	7,611	4,001	53,726	13.43	346	cocoa	1.5%
Wailuku Agribusiness Company, Inc.	C. Brewer and Co., Ltd.	2,597	1,409	19,885	14.11	150 yr. round 50-75 seasonal	macadamia nuts pineapple	
KAUAI		43,155	20,916	241,086				38.4%
Gay & Robinson		2,678	1,233	20,375	16.53	No response	No response	
Kekaha Sugar Company, Ltd.	Amfac, Inc.	8,351	4,004	54,012	13.69	358	cocoa, coffee Chinese tallow protea	2.8%
The Lihue Plantation Co., Ltd.	Amfac, Inc.	14,936	7,646	78,941	10.32	550	coffee, tea, cocoa, macadamia nuts	28%
McBryde Sugar Co., Ltd.	Alexander & Baldwin, Inc.	12,379	5,700	54,488	9.56	441	no alternate crops	6.9%
Olokele Sugar Company, Ltd.	C. Brewer and Co., Ltd.	4,812	2,333	33,271	14.26	220	no alternate crops	.7%
OAHU		25,855	12,076	169,357				
Oahu Sugar Company, Ltd.	Amfac, Inc.	14,023	6,823	96,891	14.20	514	potatoes, sweet corn, alfalfa, landscape materials, foliage plants	
Waialua Sugar Company, Inc.	Castle & Cooke, Inc	11,832	5,253	72,466	13.78	430	no response	
TOTAL		184,181	83,583	1,042,452	12.47	6,510		

a. Sugar processed by Hilo Coast Processing Company.
b. Sugar processed by Hawaiian Commercial & Sugar Company.
c. Sugar processed by Olokele Sugar Company.

Source: Hawaiian Sugar Manual, 1987 (Hawaii: 1986), pp. 5, 7; Legislative Reference Bureau survey, September 1987; Hawaii Electric Light Company; Kauai Electric Company; Maui Electric Company.

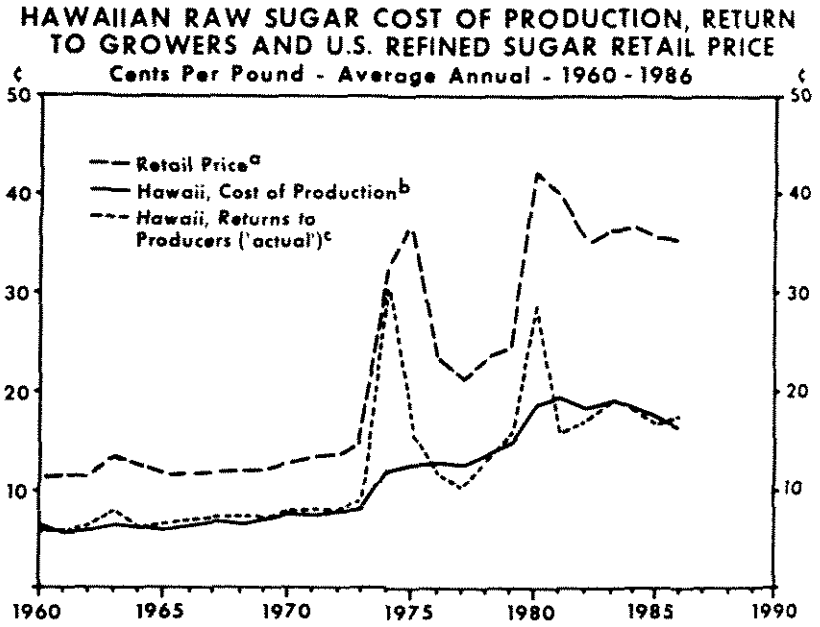
employees; diversification of crops; and the percentage of island electricity supplied by each company.

In 1986, the Hawaii sugar industry produced 1,042,452 tons of raw sugarcane. The average tonnage of sugar per harvested acre was 12.47 tons, ranging from 9.56 to 16.53 tons per acre. Sugar companies have diversified their operations to some extent, growing crops such as macadamia nuts, coffee, oranges, cocoa, chinese tallow, protea, tea, potatoes, sweet corn, alfalfa, landscape materials, and foliage plants, and operating a feedlot and slaughterhouse. A substantial portion of the electricity on Kauai, the Big Island, and Maui is purchased from sugar companies. Approximate employment at sugar companies in the State totals 6,510 individuals, occupying factory, field, clerical, supervisory, and other positions.[27]

Increases in raw sugar production, in addition to operating efficiencies and lower fuel costs, enabled the industry to reduce its average cost of production in 1986 (see Exhibit 9). The 1986 cost of production was $312.10 a ton and 15.61 cents a pound. This was $20.67 a ton, and one cent a pound below the costs of production in 1985.[28] The sugar industry reduced its costs seventeen per cent, from 1982 through 1986. In order for the sugar industry to be competitive, and survive as a major component of the American sweetener industry, the industry is aiming to make a similar gain, by the end of 1991, targeting the average cost of sugar to be in the twelve cent a pound range.[29]

Moreover, the sugar industry is pursuing new marketing strategies. Grocery product ideas which are being examined by the sugar industry include "turbinado" sugar, raw sugar that has not been refined to the point of whiteness, which may draw on consumer interest in less processed foods, and "left-handed" sugar, a product still in the development stage, which looks and tastes like ordinary sugar, but has no calories.[30] Also, the industry is attempting to stimulate a demand for sugar, by using generic advertisements on television to promote sugar.[31]

Exhibit 9



[a] U. S. price granulated sugar at retail.
[b] Hawaii cost of production (raw value basis) is weighted average annual cost of producers who grow and mill sugarcane. Source: HSPA. (Note: From 1956-1971, cost of transportation of raw sugar and molasses was paid by the producers; since 1972 by C&H; thus costs have been slightly lower than they would have been without the change, but returns have been reduced by the same amount.)
[c] Returns to Hawaii producers represent sales of raw sugar and molasses by C&H. Does not include compliance payments made under the U. S. Sugar Act which terminated in 1974. Such payments averaged less than 1/2 cent per pound. Does not include payments under the 1977 U.S. program which amounted to 2-3/4 cents per pound for one crop only.

Source: Hawaiian Sugar Manual 1987, (Hawaii: 1986), p. 6.

Chapter 3

PROBLEMS AND OPPORTUNITIES IN THE SUGAR INDUSTRY OF HAWAII

Introduction

In 1981 the report entitled "Hawaii's Sugar Industry" by Bruce Plasch (hereinafter referred to as Plasch)[1] was released by the state Department of Planning and Economic Development (now the Department of Business and Economic Development). That study was intended to:

(1) Analyze where Hawaii's sugar industry was headed,

(2) Recommend ways to strengthen the sugar industry and/or make a smooth transition to replacement activities, and

(3) Assess the effect of the sugar industry on land use, water use, transportation, and other private and government decisions.

Regarding the sugar industry in Hawaii, Plasch said:[2]

> In conclusion, the long-term outlook for Hawaii's sugar industry should reflect cautious optimism. Most sugar producers will probably survive, but with modest profits except for those occasional years when world sugar prices are high. Hawaii sugar operations, however, that are potential candidates for being closed include producers that have relatively high production cost, lack the financial resources needed to survive years of abnormally low sugar prices, or use land for which there are more profitable uses, such as urbanization.

House Resolution No. 216, H.D. 2 (1987), asked that an action plan for the sugar industry be developed based upon a study of all factors affecting the industry. While some conditions such as oil prices have changed since

1981, the Plasch study was a comprehensive review of the sugar industry and many of its findings are still relevant today. Therefore, given the time limitations of producing an action plan for the Hawaii sugar industry by the 1988 legislative session, the Bureau has used the Plasch study as the basis upon which to build this part of the report. In order to determine what has happened to Hawaii's sugar producers since 1981, the Bureau reviewed the problems identified by Plasch which increase the cost of operations and which threaten Hawaii's sugar industry's already shaky profit margins. Information was collected through interviews (or questionnaires) with government agencies, labor leaders, and sugar company operators.

This chapter is divided into three parts: (1) a short description of the remaining sugar companies in Hawaii, (2) problems in the industry, and (3) opportunities for the industry. The problems affecting individual sugar companies vary so that in some operations environmental issues are of foremost concern while in other cases the problem is one of pressures from urbanization. In general, the problems identified by Plasch continue to be the industry's problems today.

PART I. HAWAII SUGAR COMPANIES

The following information has been gathered from interviews and questionnaires. This information is intended to be brief, and is meant to provide highlights of each operation. If relevant, special problems faced by that company are described. Exhibit 8 in chapter 2 also provides a chart comparing the operations of sugar companies in Hawaii.

Since the Plasch report was published, the Puna sugar company shut down in 1982. All other sugar operations are still in business, including Oahu Sugar, Pioneer Mill, and the Hilo Coast Processing Company (HCPC) which were identified by Plasch as having potentially shaky futures. The overall picture of the sugar industry is one of streamlining, developing cost-saving methods, and increasing yields.

The Island of Hawaii

The sugar companies operating on the island of Hawaii are Hilo Coast Processing Company (HCPC), C. Brewer's Ka'u Agribusiness, and Mauna Kea Agribusiness, and the independently owned Hamakua Sugar Company.

The Hilo Coast Processing Company has recently announced it is considering shutting down its operations unless it receives relief in two areas, relief from EPA regulations requiring treatment of HCPC's mill waste water and its contract to sell electric power to the local electric utility company.[3]

Plasch's assessment in 1981 of HCPC's operations was: "From 1976 until recently the Hilo Coast sugar industry was unprofitable, accumulating debts of $32.5 million. At its current cost of production, it will probably remain unprofitable during the occasional periods of low world sugar prices."[4]

The Hilo Coast Processing Company processes cane from Mauna Kea Sugar Company and from eighty-nine independent cane farmers called the United Cane Cooperative. The number of independent cane farmers has been dwindling. In 1974 there were 450 independent cane farmers. Independent farmers grew sugar on land ranging from 5 acres to 480 acres and produced about 14,858 short tons of sugar in 1986 while Mauna Kea produced 78,434 short tons of sugar. HCPC processed a total of 93,292 short tons of raw sugar for Mauna Kea and the independent farmers.

HCPC operates forty-six weeks of the year, employs 500 people and provides about 19 per cent of the Big Island's electricity requirements. HCPC's major concerns have been meeting EPA's rule on water quality standards and seeking an increase in the rate of return on electricity sold to the local electric utility.[5]

HCPC (and Hamakua Sugar Company) processes cane which contains a large amount of dirt. The EPA has set limits on the amount of soil that can be discharged into the ocean. The state DOH issues permits which allow

discharge of the mill's waste water if it meets national standards. There has been disagreement between the State and EPA on whether HCPC's discharge waters meet these standards, but the State has continued to issue permits. According to the HCPC, the alternative would be a shutdown of operations (see also this chapter, section on water pollution).

The second problem faced by HCPC is its return on electricity sold to the power company. HCPC's long-term contract to sell electricity to Hawaii Electric Light Company (HELCO) at a fixed rate of return has been described as unprofitable by the sugar company. According to published news reports, when HCPC negotiated its contract in the 1970s, the price of oil was $2.80 a barrel. Today oil is about $19 a barrel. HCPC's contract pre-dated federal legislation tying the cost of purchased power to the price of oil. Thus HCPC, unlike other producers of alternate energy, did not receive protection from fluctuations in oil prices.[6] The HCPC contract continues until 1994.[7]

This problem is presently being studied by the Public Utilities Commission which is examining the rates being paid to sugar companies in Hawaii with firm power contracts which preceded PURPA regulations and section 269-27.2(c), Hawaii Revised Statutes, which established floor prices to encourage the development of alternate sources of energy. The commission's report is expected to be submitted to the legislature prior to the convening of the 1988 Regular Session. Early news reports indicate that the State (through the Public Utilities Commission) will not "...intervene to help Hilo Coast improve contract conditions."[8]

Like HCPC, Hamakua Sugar has also struggled against many odds to stay in business. It employs about 1,000 people. Hamakua supplies about 7 per cent of the island's electricity. Hamakua's feedlot and slaughterhouse, like alternative crops, are cost-saving activities. Cattle are fed sugarcane byproducts such as bagasse, then slaughtered and offered for sale through local grocery markets. Through careful marketing techniques, such as cutting meat as requested instead of in the usual mass production method, Hamakua has been successfully competing with mainland beef.

Another cost-saving move was closing one of two mills and operating the remaining mill at capacity to produce high grade sugar, which gets a better price from C&H, the California refinery. Hamakua Sugar is committed to staying in the sugar business for as long as possible.

Ka'u Agribusiness, a C. Brewer Company, employs 434 workers in its sugar division. Ka'u has diversified into macadamia nuts (3,600 acres), oranges, and coffee (1 acre each) and may not stay in sugar if it becomes unprofitable. It has 16,018 acres in sugarcane.

Mauna Kea Agribusiness has about 1,700 acres in macadamia nut trees, and plans to stay in sugar as long as possible. It has 15,743 acres in sugarcane and in 1986 produced 78,434 short tons of sugar.

Kauai

Kauai has five sugar companies: Gay and Robinson, a privately owned company, Kekaha and Lihue which are Amfac subsidiaries, McBryde, an Alexander and Baldwin company, and Olokele, a C. Brewer company.

Gay & Robinson Sugar Company plans to stay in sugar as long as possible. In 1986 it produced 20,375 short tons of sugar which was processed by Olokele Sugar Company. Gay & Robinson produced the most tons of sugar per harvested acre of all sugar companies in the State: 16.53 tons. The next highest figures were for Olokele Sugar at 14.26 tons and Oahu Sugar at 14.20 tons per harvested acre.

Lihue Plantation produced 78,941 short tons of sugar in 1986 and about 28 per cent of Kauai's electrical power. It employs 550 people and has 167 acres in alternate crops.

Kekaha Sugar plantation produced 54,012 short tons of sugar in 1986 and had a total of 8,351 acres in sugarcane. It has diversified into cocoa, coffee, Chinese tallow, and protea. About 2.8 per cent of Kauai's electricity is generated by Kekaha Sugar Company.

Olokele Sugar Company employs 220 people and supplies almost 1 per cent of Kauai's electrical needs through hydroelectric power. It will try to stay in business for as long as possible (10 years or more) by cost-cutting measures such as sharing equipment, and working cooperatively with other plantations like Gay and Robinson.

McBryde Sugar Company employs about 440 workers and has 12,379 acres in sugarcane cultivation, more than half of which is leased land (7,061 acres). It supplies about 7 per cent of Kauai's electrical needs to the island electric utility company, Kauai Electric Company.

Maui

Maui has three sugar companies: Hawaii Commercial Sugar (HC&S), an Alexander and Baldwin company, Wailuku Sugar Company, a C. Brewer company, and Pioneer, an Amfac subsidiary. The Maui companies reported the unique problem of not having enough workers.

HC&S sugar lands receive only 15 inches of rain annually and sugar growing prevents the area from becoming a wasteland. HC&S has more than 35,000 acres in cane. HC&S supplies 17 per cent of Maui's electric power and could employ 1,300 people, but about 90 of these positions remain vacant due to a labor shortage on Maui.

Wailuku Agribusiness will be out of sugar by the end of 1988. Pineapple will take the place of former sugar lands. There are now 600 acres in pineapple, but this will expand to 2,500 acres after 1988. Another 1,300 acres are in macadamia nuts. This company employs about 150 year-round and between 50 to 75 seasonal workers.

Plasch reported Pioneer Mill Company to be one of the lowest producers in the State and one with high production costs. Pioneer was considered threatened by urbanization although to a lesser extent than Oahu Sugar.[9] According to HSPA data for 1986, Pioneer produced 13.43 tons of sugar per

harvested acre which is not as good as Gay & Robinson's 16.53 tons per harvested acre, but higher than McBryde's 9.56 tons per harvested acre.

Oahu

Two sugar companies are located on Oahu, Waialua Sugar, a Castle and Cooke company, and Oahu Sugar, an Amfac Company.

Waialua Sugar reported in early 1987 that it would shut down over a two year period. An effort to buy the plantation through an employee stock ownership plan fell through in July 1987. However, on September 24, 1987 Castle & Cooke announced that Waialua would be operating for at least two more years unless world sugar prices fell drastically.[10] Waialua employs 430 people and the latest news to keep it open until 1989 postpones the day of reckoning for these employees.

According to HSPA data for 1986, Waialua Sugar produced 13.78 tons of sugar per harvested acre.

Plasch reported that "the major concern over Oahu Sugar Company is the long-term threat from urbanization. The pressures for urbanization are intense, as indicated by recent development trends, economic incentives, and recent plans and proposals. If there should be excessive loss of land and water to urban use, then Oahu Sugar Company will, in time, lose its economies of scale and be forced to close."[11]

At the time Plasch made this prediction, Oahu Sugar Company used 18,240 acres for sugarcane. As of 1986, 14,023 acres were in sugar, a loss of about 4,000 acres.[12] Like Waialua Sugar, Oahu Sugar produces a high amount of sugar per harvested acre: 14.20 tons in 1986.

PART II. THE PROBLEMS

Factory Smoke

The environmental rules governing factory smoke are contained in chapter 11-60, Hawaii Administrative Rules (Department of Health), relating to air pollution control.

The federal Environmental Protection Agency (EPA) and the state Department of Health (DOH) have regulations and rules, respectively, which are designed to maintain a healthy environment for people in Hawaii. The environmental problems facing the sugar industry result from the age-old search for how to balance the interests of the public for clean air and water against the desire of the industry to produce sugar at the lowest possible cost. Air quality rules require, for example, that the smoke emitted from sugar mill boiler smokestacks have an opacity of forty per cent if the stack was built before 1972 and a twenty per cent opacity if built after 1972. ("Opacity" means a state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view.) According to Plasch: "In order to meet the 20 per cent-opacity standard whenever a new boiler is installed, it will be necessary to spend at least $750,000 for 'multi-cyclones' and possibly up to $1.2 million if 'wet scrubbers' should be required."[13]

Sugar mills affected by these regulations have followed these guidelines by properly outfitting smokestacks to meet these requirements, but the question remains whether the benefits justify the costs. In Plasch's words, "...most of the time the occasional gray smoke is quickly dissipated by tradewinds (and) most sugar mills are located in rural areas far removed from densely populated areas."[14]

Field Burning

The environmental rules governing field burning are also contained in chapter 11-60, Hawaii Administrative Rules (Department of Health).

Sugarcane fields are burned to remove leaves before harvest. Burning also rids the fields of rodents which is desirable to control rodent-borne diseases. After proper application by a plantation, the DOH issues field burning permits for up to one year from date of approval.[15] Even with a permit, the plantation must take into consideration such factors as the wind direction, rainfall in the preceding twenty-four hours, size of area to be burned, and time of day (no night time burning is permitted) before actually firing a field. In addition, no agricultural burning is allowed on certain "no burn" days when meteorological conditions "result(s) in widespread haze on the island".[16] In 1981, Plasch reported that the possibility of banning field burning was still far off. As of 1987, the DOH continued to issue field burning permits on every island.

The pollution from smoke and ash has often caused citizen complaints from residents downwind. Open field burning of sugarcane does cause air pollution, but according to the industry, only for a few days out of the two-year growing cycle. The Health Department acknowledged that it is a nuisance and aesthetically undesirable. For citizens with chronic respiratory diseases like emphysema, the exposure to field burning particulates and smoke can adversely affect health. However, the sugar companies have not found an economical alternative to field burning. Instead, the sugar companies have taken positive steps by calling residents with respiratory illnesses to warn them of upcoming burning so that those individuals can leave the area during the burning.

According to Plasch the ban on field burning would require companies to haul and dispose of trash at the mill, although burning the trash for electrical power may be a way to partially offset these added costs.[17]

In August 1987, the EPA and DOH announced the results of a preliminary study on the burning of pre-harvest sugarcane on Maui in April 1986. The announcement reported that the limited study did "...not suggest a significant health hazard exists," but the study also "...did not include the assessment of any risk to nearby populated areas."[18]

The press release also reported:[19]

> DOH is currently reviewing existing data collected by the department's Health Surveillance Program to determine whether there are any unusual patterns of illness in populated areas close to sugar cane cultivation. The health status of residents in areas where cane has been grown will be compared to that of residents in other areas of the State over a 10-year retrospective period. It is anticipated that this review will be completed in October 1987.
>
> In addition, the DOH is working with the EPA in developing another study to determine the extent to which those living downwind of a burning canefield may be exposed to the compound identified in the preliminary EPA study. This air sampling study would provide quantitative data that may be useful in determining possible health risks to residents in affected areas.

In contrast to sugar mill smoke emissions, the balance is tipped in favor of field burning and the sugar industry over the public's concern for ash and smoke free conditions. However, as more areas near sugar fields become residential, the public pressure to ban field burning will probably increase.

Field Chemicals

Any ban of agricultural chemicals by EPA can hamper sugar production, because some amount of field chemical use is inevitable in the agricultural business to control insects and plant diseases. The goals in this problem area are to reduce chemical usage to as little as necessary and to as short a time as possible. Ninety-six per cent of all field chemicals used by Hawaii sugar plantations are herbicides. The top four herbicides being used are: ametryn, atrazine, diuron, and dalapon (see Exhibit 10). These chemicals are of relatively low toxicity (see Exhibit 10-A). However, atrazine has been found in ground water and if not eventually banned, may at least be required to carry a precautionary label. These four herbicides are used by all plantations only in the first six months of the two-year crop cycle.

Exhibit 10

CPCs USED BY HAWAII'S SUGAR INDUSTRY IN 1984

Active ingredient*	Brand name	% total use
Herbicides—weed control		96.4
ametryn†	Evik 80	
atrazine†	Aatrex 80 or 90	
diuron†	Karmex	
dalapon†	Dowpon	
2, 4-D	DMA-6	
glyphosate	Roundup, Rodeo	
hexazinone	Velpar	
asulam	Asulox	
terbacil	Sinbar	
picloram	Tordon	
silvex	Kuron	
metribuzin	Sencor	
Growth regulators		2.2
glyphosate	Polado	
ethephon (experimental)	Ethrel	
Fungicides—disease control		0.8
benomyl	Benlate	
methyl thiophanate	Topsin M	
Insecticides—insect control		0.2
heptachlor	Heptachlor 2EC	
chlorpyrifos	Dursban	
Rodenticides—rat control		0.4
zinc phosphide	Zinc Phosphide Oat Bait	
pindone	Pival Oat Bait	
		100

* CPCs are sold by brand name as diluted formulations of the active ingredient.

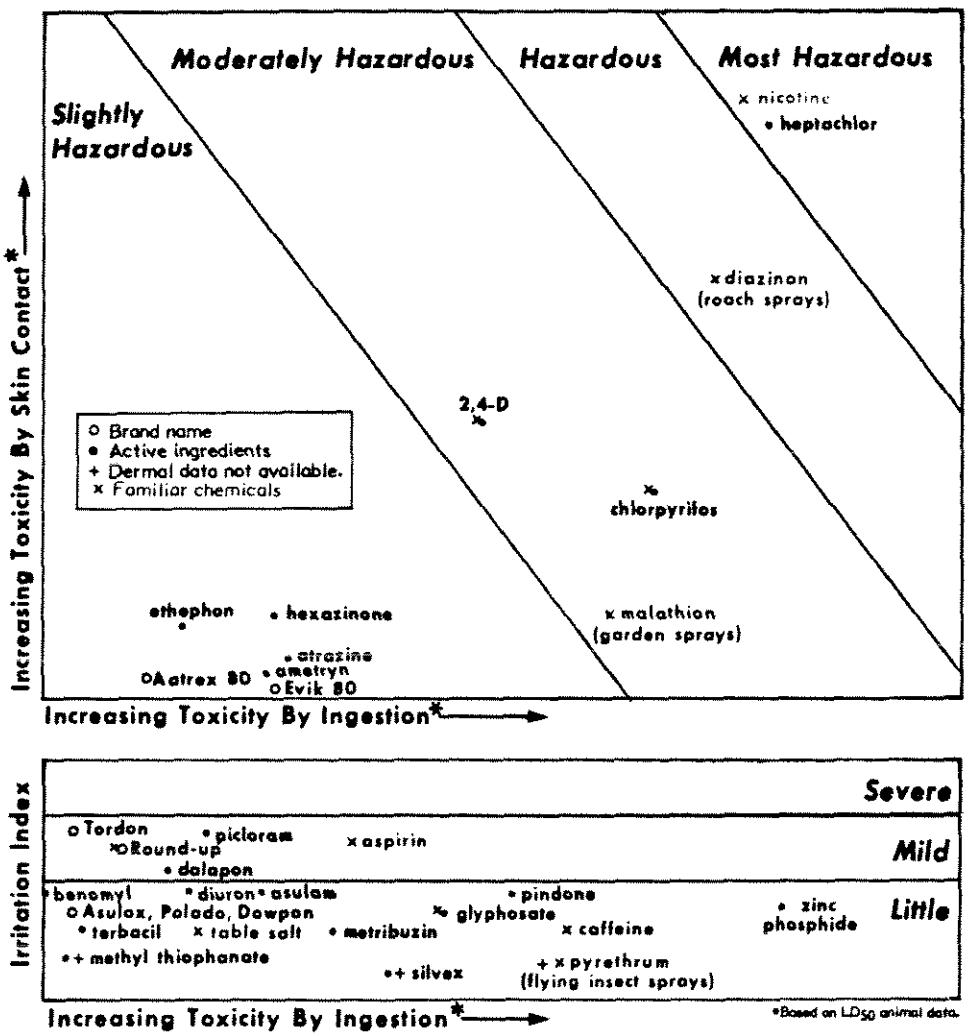
† These four compounds represent 84% of the total chemicals used.

The top four herbicides represent the sugar industry's major CPC use and are applied in the first 6 months of the 2-year crop cycle. The rest of the CPCs are for selective problems requiring lesser quantities: e.g., growth regulators are applied in small amounts to increase sugar yields; fungicides are used in seed treatment tanks; insecticides are rarely needed because of biological controls (heptachlor is being phased out and replaced by a physical method to control ants; chlorpyrifos is used to control mosquitoes in waste water areas); rodenticides are used only where there are lots of rats.

Source: Sugar News (Brochure) HSPA.

Exhibit 10-A

RELATIVE ACUTE TOXICITY
SUGAR CPCs AND OTHER FAMILIAR CHEMICALS



Source: Sugar News (Brochure) HSPA.

Growth regulators make up another two per cent of all field chemicals used, and the remaining two per cent are distributed among fungicides (used only on seeds), insecticides, and rodenticides.

Exhibit 10-A shows the kinds of herbicides, fungicides, insecticides, and rodenticides used in the sugar industry and their relative toxicity by skin contact or by ingestion. The sugar industry is keenly aware of the potential risks of using field chemicals and through the HSPA conducts research to find non-chemical alternatives such as biological control against insect pests or special designs for drip tubes such as a parallel ridge barrier to prevent ants from damaging irrigation drip holes.

Water Pollution

The environmental rules governing water quality standards are contained in chapter 11-54, Hawaii Administrative Rules (Department of Health).

Hilo Coast Processing Company (HCPC) and Hamakua Sugar Company process cane which contains a large amount of dirt. The EPA has set limits on the amount of soil that can be discharged into the ocean. The state health department issues permits which allow discharge of the mill's waste water if it meets national standards. There has been disagreement between the State and EPA on whether HCPC's discharge waters meet these standards, but the State has continued to issue permits. According to HCPC, the alternative would be a shutdown of operations. Perhaps it is possible to change harvesting methods to reduce the amount of soil collected with the cane. However, until it becomes economical to modify harvesting methods it is unlikely that any change is forthcoming.

Water Supply

Growing sugar requires a great deal of water. According to the state Department of Agriculture: "Sugar cane irrigation accounts for by far the greatest amount of water used: approximately 820 million gallons per day (MGD) statewide, or about half of the state's total daily water

consumption."[20] (See Exhibits 11 and 12 from Agriculture TRD, pp. II-113, II-114.) It goes on: "According to figures in the 1980 Annual Overall Economic Development Program, sugar generates an annual return of only $.30 for each 1,000 gallons of water consumed."[21]

Plasch reported that nearly 1-1/2 tons of water are required for each pound of raw sugar produced.[22] Sugar companies rely on rain in some areas, surface water carried through a series of ditch systems in other areas, or drill their own wells. "Where average yearly rainfall exceeds seventy-five inches, the crop usually is not irrigated. Irrigation by the furrow method normally requires an application rate of about 10,000 gallons per day (gpd) per acre. In contrast, the drip method of irrigation requires about 6,000 gpd per acre. Some 70,000 acres of sugarcane are presently drip-irrigated."[23] The industry uses drip irrigation as much as possible to use water more efficiently but the fact that sugar plantations require a great deal of water for their crop would put this industry in direct competition with residents and visitors as more land is put into housing, hotels, and other commercial activities which increase the demand for water.

The state Agriculture Functional Plan includes a policy to improve agricultural water resource management. The agriculture Technical Reference Document states in Implementing Action C (1)(d): "In implementing water use regulation, give priority consideration, where justified for the benefit of Hawaii's people, to the maintenance of adequate water sources, supplies, and facilities for continued existing and planned beneficial agricultural uses." Its Comment states:[24]

> Hawaii State Plan priority guideline, (section) 226-103(h)(3), (Hawaii Revised Statutes) encourages the restriction of new urban development where water is insufficient for both agricultural and domestic uses.... (parenthetical material and emphasis added)

It would therefore appear that where water supply is inadequate, sugar plantations would be favored by the State over urban development in the same area.

Exhibit 11

IRRIGATED AGRICULTURAL LAND, 1978
In Acres by Crop, County and Method of Irrigation

	State	Hawaii	Maui	Oahu	Kauai	Furrow	Sprinkler	Drip
TOTAL	179,997	19,588	72,355	51,238	36,816	73,867	54,120	52,010
Sugar	122,447	6,988	48,205	31,438	35,816	73,367	3,620	39,460
Pineapple	37,000	-	21,000	16,000	-	-	36,600	400
Vegetables	3,600	1,100	1,100	1,300	100	-	1,800	1,800
Orchards	9,800	8,000	800	500	500	-	200	9,600
Field Crops	2,350	500	750	1,000	100	-	2,350	-
Forage Crops	2,800	2,000	200	500	100	-	2,800	-
Other	2,000	1,000	300	500	200	500	750	750

Source: Hawaii State Agriculture Functional Plan: Technical Reference Document, Dept of Agriculture Honolulu: June 1985, p. II-113.

Exhibit 12

AGRICULTURAL AND OTHER WATER USES
In Million Gallons Per Day

	State	Hawaii	Maui				Oahu	Kauai
			County	Maui	Molokai	Lanai		
Total Sustainable Yield (a)	6,030	2,940	1,264	1,144	115	5	783	1,043
Total Water Use 1980 (b)	1,710	173	591	586	4	1	448	498
Ag Water Use Total 1980	1,117	15	515	511	3	1	246	341
Ground water	375	5	131	130	-	1	193	46
Surface water	652	10	357	354	3	-	44	241
Recycled water	90	-	27	27	-	-	9	54
Ag Water Use Total 1978 (c)	981	109	370	-	-	-	259	246
Sugar	820	47	323	-	-	-	211	240
Pineapple	49	-	28	-	-	-	22	-
Vegetables	24	7	7	-	-	-	9	1
Orchards	36	30	3	-	-	-	2	2
Field Crops	16	3	5	-	-	-	7	1
Forage Crops	21	15	2	-	-	-	4	1
Other	15	7	2	-	-	-	4	1

(a) DLNR, Water Resources Development Functional Plan, Technical Reference Document, October, 1982, page III-24.

(b) U.S. Geological Survey, 1980 Water Use Survey, DLNR Report R71, June 1984.

(c) USDA Soil Conservation Service, unpublished data, March 1978. State totals only, island data calculated from irrigated acreages (Table 17) and following assumed water use rates in gallons/acre/day: sugar (6,700), pineapple (1,350), vegetables (6,700), orchards (3,700), field crops (6,700), forage crops (7,400), other (7,450).

Source: Hawaii State Agriculture Functional Plan; Technical Reference Document, Dept. of Agriculture, Honolulu: June 1985 p. II-114.

In 1987, the state legislature enacted a water code to manage and protect the State's water, for example, by requiring water users to obtain permits in areas where water supplies are threatened.[25]

In response to the Bureau's questionnaires and interviews, some sugar companies expressed concern that the water code might result in regulations which will increase the cost of water or severely restrict usage. It is too early to know what effect the water code will have on sugar operations, but the implementation of the water code will be carefully monitored by the sugar industry to see what effects new regulations would have on supply of water and costs.

Liability Insurance and Workers' Compensation

The sugar industry is like other businesses in its condemnation of the costs of doing business in Hawaii. This includes the costs of liability insurance, workers compensation, and taxes.

Urbanization

Plasch reported in 1981 that at least two sugar plantations were being seriously threatened by urbanization: Pioneer Mill and Oahu Sugar.[26] In 1984, the DPED pointed out:[27]

> The (sugar) industry uses resources in the form of land and water that would otherwise be available for other purposes, although competition for land between sugar and other uses has become less keen as more of the marginal cane lands have been removed from production. While urbanization has put pressure on sugar lands adjacent to existing residential and commercial activities, there are thousands of acres of marginally productive lands, classified as agriculture, that could be tapped for urban expansion before prime sugar lands need be considered. Sugar lands most affected by the pressure of urbanization are those of the 14,000-acre Oahu Sugar Co., in the Ewa District of Oahu, and the 8,000-acre Pioneer Mill

> Co., in West Maui adjacent to the major resort destination of Kaanapali. Since 1980, about 4,000 acres have been taken out of production at Oahu Sugar as an economy move and in anticipation of future urban development (West Beach for example). The primary threat to these two operations is not that urbanization will completely devour them in the near future, but rather that the amount of cane available could drop below the level needed to economically sustain the processing mills on both plantations. (emphasis added)

Summary of Problems

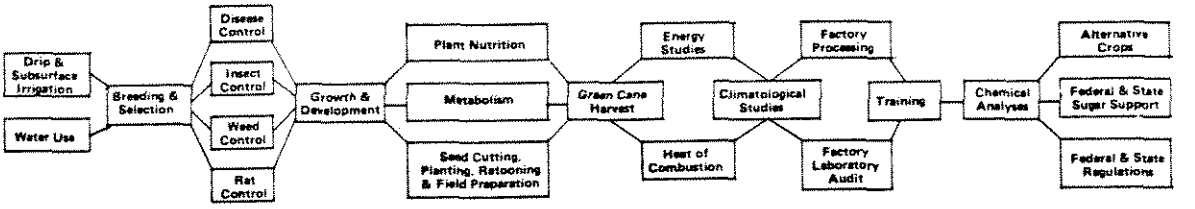
Exhibit 13 describes the sugar industry's analysis of problem areas and the priority of each problem, some of which have been described above.[28]

The top ten priority problem areas are: (1) federal and state sugar support, (2) breeding and selection, (3) disease control, (4) rat control, (5) plant nutrition, (6) drip and subsurface irrigation, (7) weed control, (8) seed cutting, planting, ratooning, and field preparation, (9) water use, and (10) factory processing. Except for priority number one, that of federal and state sugar support, all of the remaining top ten priority issues depend on research by HSPA. These problems have been identified by the sugar industry and reported in the State Agriculture Functional Plan, Technical Reference Document since 1985. Other state functional plans for water, energy, and the economy have also examined the role of the sugar industry vis a vis relevant State functions. For example, the State Water Resources Development Plan examined the issue of assuring adequate water supplies for crops, including sugarcane[29] and examined the issue of water-related energy production (i.e. hydroelectric power generation)[30] (see parts of this chapter dealing with water supply and energy). Thus the issues faced by the sugar industry have been examined by a number of state departments and data have been gathered for several years on the effect of the sugar industry on the resources and future of Hawaii. The problems being faced by the sugar industry are not new problems.

Exhibit 13

SUGAR INDUSTRY ANALYSIS NO. 3

March 10, 1982



PROBLEM AREA	*HIGH PRIORITY BOTTLENECKS*
1. DRIP & SUBSURFACE IRRIGATION	**PRIORITY 6.** Insufficient information on drip and subsurface irrigation systems: (a) The economics of using sewage effluent in drip irrigation are not fully understood. Technical problems persist–plugging continues to pose a threat: Virus, chemical and nutrient questions persist. (b) Drip irrigation hardware on the market is not completely satisfactory. (c) Plugging of drip and subsurface tubing continues to be a problem. (d) Backwash water from sand filters continues to be a problem. (e) Many fields on plantations are relatively small (100 acres); installation and operation costs for these fields are high on a per acre basis.
2. WATER USE	**PRIORITY 9.** Data are not available on a number of aspects of water use, especially in drip irrigation. Lack of knowledge of water utilization and stress measurements.
3. BREEDING & SELECTION	***PRIORITY 2.*** *Lack of new varieties* for improved yield and resistance to potential new diseases and pests. Lack of sufficient genetic diversity to increase yields, provide disease and insect resistance. Lack of varieties with adequate stress resistance.
4. DISEASE CONTROL	**PRIORITY 3.** Disease assessment, identification and control need continual study.
5. INSECT CONTROL	**PRIORITY 12.** **Amdro Ant Bait:** Need to find a replacement for heptachlor to protect drip irrigation tubes from any damage. Heptachlor may not be available after 1983. **Heptachlor:** Use of heptachlor in drip fields may have undesirable effects on biological control in sugarcane fields. Also, there may be undesirable side effects. **Sugarcane Weevil:** Inadequate control of the New Guinea sugarcane weevil, a major pest of sugarcane. **Yellow Jacket:** Inadequate control of ground nesting wasp, the western yellow-jacket, *Vespula pensylvania*. **Mosquito Control:** Insecticides are not available to adequately control mosquito breeding in mill water irrigated fields causing problems in surrounding areas. **Budmoth:** Lack of control of sugarcane budmoth, *Decardarchise flaciatriata*.
6. WEED CONTROL	***PRIORITY 7.*** *Insufficient data available on herbicides* and their use. (a) EPA registration requirements have reduced the number of herbicides available for use in the industry. (b) Data needed on varietal differences in herbicides response.
7. RAT CONTROL	**PRIORITY 4.** Effective rat control is being made more difficult by the loss of rodenticides found to have potential secondary hazards. New rodenticides are not available as replacements, however, a pellated zinc phosphide bait needs evaluation.
8. GROWTH & DEVELOPMENT	**PRIORITY 17.** Insufficient information on crop growth and development. (a) New growth regulators are needed to improve productivity. (b) Registration required for use of ethrel. (c) Basic information lacking on varietal reaction to ripeners and herbicides. (d) Flowering in cane fields reduces yields.
9. PLANT NUTRITION	**PRIORITY 5.** Insufficient information on plant nutrition,soils and fertilization. (a) Data on N nutrition and utilization are insufficient to determine efficiency and savings that may be realized, especially under drip irrigation. (b) The response of varieties to nutrients in *terms of applications are not completely understood.* (c) The understanding of soils, fertilizer, and plant responses and interactions is incomplete. (d) Service function needed for nutrient analyses. (e) Methods for the distribution of fertilizer by drip irrigation are not known. (f) Data needed for legumes and other crops as sources of nutrient or additional revenue. (g) Effects of secondary trace elements are not understood in relation to growth. (h) Total yield potential for any given environment not known. (i) Role of mycorrhizae unknown.
10. METABOLISM	**PRIORITY 19.** Insufficient information available on cane metabolism. (a) Further information needed about N metabolism. (b) Do not have sufficient knowledge on movement and storage of sugar. (c) Phloem substances not adequately separated and characterized.
11. SEED CUTTING, PLANTING, RATOONING, & FIELD PREPARATION	***PRIORITY 8.*** *(a) Mechanical seed cutting systems* in the past have produced low quality seed: Hence, handcutting of seedcanes is performed to produce high quality seed pieces to ensure good germination–a labor-intensive operation. (b) Lack of optimal agricultural practices to achieve better stands of cane in the field.
12. GREEN CANE HARVEST	**PRIORITY 18.** Threatened ban on cane burning is a continuing problem.
13. ENERGY STUDIES	**PRIORITY 11.** Insufficient information available to maximize production and minimize consumption of energy on plantations. (a) Need for industry-wide coordination of information and action relating to energy regulations, production, consumption and conservation. (b) Insufficient information on combustion of bagasse and trash equipment and practices. (c) Energy costs are *increasing rapidly, thus significantly increasing* the cost of producing sugar. (d) Insufficient information available to optimize utilization of sugarcane for energy and other uses. (e) Energy potential of sugarcane not available.
14. HEAT OF COMBUSTION	**PRIORITY 21.** Heat of combustion information is needed for materials having fuel potential.
15. CLIMATOLOGICAL STUDIES	**PRIORITY 22.** Insufficient information on climatic effects. (a) The full relations of climatic factors and their interactions to sugar yield are not known. (b) Methods for obtaining medium range weather forecasts for planning plantation operations have not been developed.
16. FACTORY PROCESSING	**PRIORITY 10.** (a) Lotus roll evaluation. More reliable data than are presently available are needed on the performance of the "lotus" top roll. (b) Clarification of juices with high soil levels. Soil levels in mixed juice entering the boiling house have increased significantly at a number of factories over the past several years. Better ways of handling these high soil levels are needed. (c) *Development of up-to-date saturation temperature data. Curves relating saturation temperature refractometer solids, and purities* of Hawaiian boiling materials are out-of-date, the most recent being about 20 years old. (d) Review of molasses exhaustibility relationship. The present molasses exhaustibility equations may no longer be accurate enough for predicting the expected purities of Hawaiian molasses. (e) Measurement of centrifugal washing efficiency. No standard method is in use for measuring the efficiency of the centrifugal washing process. Also, double washing, a process which is reported to be more effective than single washing, is little used on our factories. (f) Characteristics of pan boiling materials. Information on the constituents causing difficulties in pan boiling is inadequate. (g) Ash removal from cane juice/syrup. The ash present in cane juice limits the amount of sucrose that can be recovered by crystallization. Various membrane processes, such as reverse osmosis (RO), ultrafiltration (UF) and electrodialysis (ED) offer means of removing at least some of this ash, thus permitting greater sucrose recovery. Also some of the ash constituents (notably potash) have economic value. Work was done many years ago on ED and on RO but the economics were *not favorable. There* has been considerable improvement in membrane technology since that time, however so that another look at these processes is justified. The RO process also offers possibilities for partial concentration of juice into syrup with less consumption of energy than by conventional evaporation. (h) Enzymatic destruction of dextrans in cane juice. Insufficient information is available on the economics of using immobilized enzymes (destranases) to destroy destrans in cane. (i) Laboratory refractometer evaluation. The determination of refractometer solids in factory products is a fundamental measurement in factory control. The Bausch and Lomb precision refractometer, the standard laboratory instrument in the Hawaiian sugar industry, is no longer manufactured, spare parts are not available. (j) Use and disposal of toxic materials by factory control laboratories. Mercuric chloride has been widely used as a preservative, especially for extracts and juice samples by factory control laboratories. Lead subacetate is the specified clarifying agent when samples are prepared for polarization: Factory control is based on the results of this measurement. These agents are toxic, heavy salts. Their use may have to be restricted or banned due to regulations governing the disposal of materials containing these substances. At present there is no practical method of treating mercury- and lead- containing samples prior to disposal from factory control laboratories. Also there are no practical alternatives to these compounds at present. (k) Measurement of molasses "tack". A practical and rapid method to measure the tackiness or stickiness of molasses is presently not available. (l) Evaluation of on-line bagasse moisture meters. On-line measurement of bagasse moisture would be helpful in monitoring mill operation and the fuel value of bagasse. (m) Development of improved pan control system. Present pan control systems while generally adequate are capable of further improvement. (n) High liming of remelt sugar. Remelt sugar from the low-grade strikes is circulated back to the commercial strikes for reboiling. It is high in color, thus increases the color of the sugar produced from them. (o) Evaluation of cane juice decolorizing agents. Current information on the economics of a number of potentially useful juice decolorizing agents (i. e. chlorine, ozone, alum, etc.) is either lacking or is inadequate.
17. FACTORY LABORATORY AUDIT	**PRIORITY 13.** Improper and/or incorrect sampling, analysis and calculations result in unreliable and misleading factory performance and production data.
18. TRAINING	**PRIORITY 20.** Both new personnel who are potential field and factory superintendents and 1st and 2nd line supervisory personnel who have been working over a long period are often lacking in knowledge of the fundamentals of the various factory processes and agronomic principles.
19. CHEMICAL ANALYSES	**PRIORITY 14.** Insufficient information is available on analysis of pesticides. Plantations need assistance with these analyses.
20. ALTERNATIVE CROPS	**PRIORITY 16.** As a hedge against future detrimental sugar prices, it is most desirable to have fore-knowledge as to what other crops with strong market potentials can be successfully grown in Hawaii.
21. FEDERAL & STATE SUGAR SUPPORT	**PRIORITY 1.** Federal and State support. The existing support levels at the cost of production in the 1981 farm act for sugar does not provide adequate protection for the Hawaiian sugar industry. Favorable trade status for the Caribbean sugar growers will also have an adverse effect on Hawaiian markets.
22. FEDERAL & STATE REGULATIONS	**PRIORITY 15.** Compliance with Federal and State regulations cause economic hardship. Threatened ban of cane burning, odor of mill waste water and OSHA regulations are continuing problems.

Source: State Agriculture Functional Plan Technical Reference Doc., Dept. of Agriculture, Honolulu, June 1985.

In the environmental area, the sugar industry has managed to retain its advantage over its problems because field burning, field chemical use, and dumping of some amount of dirt into the coastal waters continue. In general, the state Department of Health has leaned towards helping the sugar industry instead of frustrating it. The Department of Health has continued to grant permits for agricultural field burning and discharge of muddy mill waste water off the Hamakua coast and has worked with the industry within the rules established by EPA.

PART III. THE OPPORTUNITIES

Opportunities in the sugar industry have been limited to finding new crops for sugar lands and new ways to use sugarcane as biomass for energy, or for other byproducts from the cane plant.

Alternative Crops

Alternative crops, diversified agriculture, aquaculture, and similar activities can be viewed as ways to supplement sugar or to replace sugar. Plasch reviewed the historical difficulties in identifying crops to replace sugar.[31] Sugar lands amount to 184,181 acres statewide as of 1986.[32] Although this represents a decline of 34,600 sugarcane acres between 1980 to 1986, it would be difficult to find enough alternative crops to fill all of these acres (see Exhibit 14, from Agriculture TRD p.II-87). In some areas sugarcane lands can be used by no other crop because of the nature of the land such as the quantity of rainfall, soil, terrain, and other conditions. But the more likely problem would be whether there would be a market for the products if all available sugar lands could be fully utilized. Plasch concluded:[33]

> In summary, crops which have the potential to replace sugar must be suitable for export, must cost relatively little to transport overseas; must thrive in Hawaii under the same growing conditions as does sugar; must be resistant to diseases, insects, and predators that thrive in Hawaii and must have some unique characteristics

Exhibit 14

ACREAGE OF AGRICULTURAL COMMODITIES
By County, 1984

COMMODITY	STATE	HAWAII	MAUI	OAHU	KAUAI
SUGAR	188,400	70,900	47,200	26,400	43,900
PINEAPPLE	35,000	-	23,200	11,800	-
LIVESTOCK[1]	1,091,800	814,650	226,730	21,140	29,280
Beef (grazing)	1,086,090	814,650	226,730	21,140	29,280
Dairy	4,370	1,510	1,890	760	210
Swine	250	10	80	130	30
Poultry & Eggs	150	20	-	110	20
Other livestock	940	90	850	-	-
ORCHARD CROPS	25,400	22,100	200	800	900
Macadamia Nuts	16,900	15,500	[3]	[3]	[3]
Papaya[2]	2,590	2,165	20	85	320
Coffee	2,000	2,000	-	-	-
Banana	990	320	75	450	135
Guava	875	320	[3]	[3]	[3]
Avocado	505	[3]	[3]	[3]	[3]
Other fruits	1,540	[3]	[3]	[3]	[3]
FLOWERS & NURSERY PRODUCTS	1,715	994	277	406	38
VEGETABLES & MELONS[2,4]	5,235	2,000	1,800	1,400	5
Lettuce	730	370	235	125	[3]
Tomato	280	130	125	20	[3]
Other Vegetables & Melons	4,225	1,500	1,440	1,255	[3]
FIELD CROPS	9,833	(59)	8,643	[3]	437
Forage & Grain	8,993	[3]	[3]	[3]	[3]
Seed Corn	840	[3]	[3]	[3]	[3]
WETLAND CROPS	435	[3]	[3]	[3]	[3]
Taro	370	65	80	[3]	225
Watercress	35	[3]	[3]	[3]	[3]
Lotus Root	30	[3]	[3]	[3]	[3]
AQUACULTURE PRODUCTS[5]	475	45	26	369	35
PLANTED FOREST (1983)[6]	46,279	17,835	15,263	7,036	6,145
TOTAL ACREAGE, ALL COMMODITIES[7]	1,404,572	928,530	323,419	69,351	80,965
TOTAL ACREAGE, DIVERSIFIED COMMODITIES[7]	1,181,172	857,630	253,019	31,151	37,065
TOTAL ACREAGE, DIVERSIFIED COMMODITIES IN CROP[8]	42,600	25,100	11,000	3,400	1,700

1. Source: Table C-1.
2. Acres harvested.
3. Data combined under State total to avoid disclosure of individual operations.
4. State total excludes watercress and lotus root.
5. Source: Aquaculture Development Program Office, Department of Land and Natural Resources, records.
6. Source: The State of Hawaii Data Book 1984, Table 589, page 598.
7. Total here does not equal the total in Statistics of Hawaiian Agriculture 1984 due to the inclusionof livestock, aquaculture, and planted forest.
8. Excludes sugar, pineapple, livestock, aquaculture, and planted forest.

Source: State Agriculture Functional Plan, Technical Reference Document, Department ofAgriculture (Honolulu: June 1985), p. II-87.

which give Hawaii a competitive advantage sufficient to overcome Hawaii's high costs.

A recent study by K. K. Seo for HSPA sought to determine the economic viability of producing four products from bagasse, producing sugar esters from sugar, and growing two alternative crops: alfalfa and potatoes. The overall conclusions of this study were not encouraging:[34]

(1) The manufacture of pulp and paper, particle board or medium density fiberboard, activated carbon, or sucrose esters will not be economically viable in Hawaii in the foreseeable future.

(2) There is a limited market potential for growing alfalfa with some prospect of making a profit. Profitable cultivation of potatoes is possible, but would be riskier than growing alfalfa.

(3) The conversion of bagasse into cattle feed has the potential to be profitable but in a limited market.

There are four major difficulties that have led to these findings. First, very small plants (in terms of acreage) can more than satisfy the local demand, but small plants are unable to benefit from economies of scale. Consequently, production costs in Hawaii will be higher than elsewhere.

Second, most of the products studied would require a large capital outlay in the face of an uncertain return on investment.

Third, in many cases, a dominant technology appropriate to the use of sugar or bagasse as raw materials is lacking.

Fourth, except for the growing of alfalfa and potatotes on a relatively small scale, the local market cannot absorb more than a small fraction of the output of even the smallest viable plant,

> while our geographical isolation from the mainland and other export markets guarantees freight rates that would make Hawaiian products non-competitive. (Parenthetical material added)

Several sugar companies are already planting alternative crops such as macadamia nuts, pineapple, orange, and coffee (see description of Ka'u and Wailuku agribusinesses in Part I). Wailuku Agribusiness expects to be out of sugar and into pineapple, among other crops, by the end of 1988 and Ka'u Agribusiness with a few acres in macadamia, orange, and coffee may be considering alternative crops to supplement its sugar production.

As this report was being prepared for printing, late breaking news indicated the publication of a book, "A Profile of Economic Plants", published by Transaction Books, Rutgers--the State University, New Brunswick, New Jersey. This book lists more than 1,160 plants which could be grown on agricultural lands now or formerly in pineapple and sugar production. According to this news article:[35]

> This book is an outgrowth of the so-called Sugar Lands Project, a federally funded search for alternate crops that may some day be grown on the thousands of acres of agricultural land now in sugar and the thousands more that now lie fallow because of the decline of the sugar and pineapple industries....
>
> Sugar Lands is a two-fold effort. One part resulted in the computerized Hawaii Natural Resources Information System (HNRIS), which is an on-line information system that stores a vast amount of information detailing Hawaii's land and its many characteristics.
>
> The second is a huge library of information, also stored on computer, of worldwide crops that have been studied from an agricultural and economic perspective for possible cultivation in the Islands.

Aquaculture, the growing of animals or plants in fresh, salt, or brackish water, is reported to provide 400 jobs in both commercial production and in technology transfer, research and training in 1983. As of 1983, there were 400 acres in commercial production.[36] Like other alternatives being considered as replacement or alternative crops, it is unlikely that aquaculture can utilize all of the thousands of acres of land presently in sugar. However it can be a valuable addition to the State's economic ventures into diversification.

Sugar and Energy

In its search for continued viability, the sugar industry has turned to developing ways to use its byproducts in alternative energy products. For example, ethanol can be produced from sugar and molasses[37] and bagasse has been burned to generate steam for electricity for many years. In addition to using sugar to produce alternate energy, the industry has looked to new crops to grow on sugar lands. Some of these crops may be food sources (see section on alternative crops) or plants for biomass.

Sugar mills generate electricity by burning bagasse, fuel oil, and by using hydroelectric power where available. The electricity is used to power the sugar mill's factory and irrigation pumping needs. Excess power is sold to the island's electric company. If mills close, the loss of electric power provided by these mills could have a significant effect on the local power company, particularly on Kauai where the combined contribution from all Kauai sugar plantations amount to 38 per cent of the island's total electrical power[38] (see Exhibit 15, Summary of Electrical Generation and Electricity used by Sugar Plantations, 1981 and Table 2, chapter 4).

The use of sugar for ethanol production, as biomass for energy, and as feed for cattle, are only a few ways to use sugar and its byproducts in a fashion probably unimagined by the earliest sugar growers of the 1800s. The HSPA, some sugar companies, and DBED are involved in various kinds of research which could lead to the growing of sugarcane not for sugar, but for its byproducts. In a 1987 information release, DBED reported: "Although

Exhibit 15

SUMMARY OF ELECTRICAL GENERATION AND ELECTRICITY USED BY SUGAR PLANTATIONS: 1981

ISLAND-PLANTATION	POWER PLANT: Gen. capacity, nameplate (KW)		POWER PLANT: Typical power distrib. (KW)		GENERATED (KWHX10^6)		PURCHASED (KWHX10^6)	SOLD (KWHX10^6)				USED[a] (KWHX10^6)
	Steam	Hydro/Diesel[b]	Fld & Fac	Utility[c]	Steam	Hydro/Diesel[b]	Quantity	Firm	Standby	Unsch'd	Total	Quantity
HAWAII												
Theo Davies Hamakua Sugar Co.												
Haina Factory	15,000	800H	2,500	+3,000	20.96	0.39H	0.06			8.96	8.96	12.45
Ookala Factory	9,000		3,800	+500	10.49		1.48			0.92	0.92	11.05
Hilo Coast Process. Co.	23,800		5,100	+16,000	141.27		0.53[d]	106.64			106.64	35.16
Ka'u Sugar Co., Inc.	2,500	700D	2,500	0	14.97	0.21D	0.31				0	15.49
Puna Sugar Co., Ltd.	12,500		3,700	+4,700	68.74		0.99	38.00	2.34		40.34	29.39
ISLAND TOTAL	62,800	800H/700D			256.43	0.39H/0.21D	3.37				156.86	103.54
KAUAI												
Kekaha Sugar Co., Ltd.	6,500	1,500H	4,200	+1,000	22.23	6.61H	1.31			5.91	5.91	24.24
Lihue Plantatn. Co., Ltd.	20,000	1,300H	4,000	+12,000	99.76	5.73H	0.39	59.65	11.40		71.05	34.83
McBryde Sugar Co., Ltd.	15,000	4,700H	7,000	+3,600	27.19	32.85H	0.49			16.40	16.40	44.13
Olokele Sugar Co., Ltd.	2,800	500H/900D	2,200	+200	7.58	3.48H/0.36D	1.07			0.63	0.63	11.86[e]
ISLAND TOTAL	44,300	8,000H/900D			156.76	48.67H/0.36D	3.26				93.99	115.06
MAUI												
Hawaiian Commercial & Sugar Co.		5,900H	31,000	+1,000		11.04H	7.08[f]			9.97	9.97	152.78
Paia Factory	8,000				29.98							
Puunene Factory	24,000				114.65							
Pioneer Mill Co., Ltd.	14,000	300H	5,000	+1,000	35.06	0.00H[g]	8.77			7.29	7.29	36.54
ISLAND TOTAL	46,000	6,200H			179.69	11.04H	15.85				17.26	189.32
OAHU												
Oahu Sugar Co., Ltd.	17,500		17,500	-3,500	76.67		39.81			0.11	0.11	116.37
Waialua Sugar Co., Inc.	10,000		10,000	0	45.28		12.64			1.67	1.67	56.25
ISLAND TOTAL	27,500	0			121.95	0	52.45				1.78	172.62
STATEWIDE TOTAL	180,600	15,000H/1,600D			714.83	60.10H/0.57D	74.93				269.89	580.54

a Includes transmission losses and electricity used to operate power plant auxiliaries.
b H denotes hydroelectric generator.
D denotes diesel engine generator.
c +indicates plantation delivery to utility.
-indicates utility delivery to plantation.
d Includes 0.30 x 10^6 KWH purchased by Mauna Kea Sugar Co., Inc.
e Includes 0.21 x 10^6 KWH used by Gay and Robinson.
f Includes 1.55 x 10^6 KWH purchased by Wailuku Sugar Co.
g Less than 0.01 x 10^6 KWH.

Source: State Energy Plan Technical Reference Document, DPED (Honolulu: Oct. 1982), p. III-21.

the Hawaiian sugar industry burns nearly 3 million tons of bagasse to generate process steam and electricity, the industry still consumes approximately 350,000 barrels of fuel annually in factory boilers when bagasse is unavailable."[39]

In addition to bagasse from sugarcane, plants being tested for economic feasibility as different kinds of biomass to produce electricity and liquid or gaseous fuels include leucaena, eucalyptus, napier grass, and sweet sorghum. The State of Hawaii (through DBED) provided funds for 1986 ($150,000) and 1987 ($120,000) to HSPA to establish the biomass-to-energy test facilities. Test plots of 9 to 12 acres are located on five islands: Hawaii, Kauai, Maui, Molokai, and Oahu.[40]

Hawaii's dependence on petroleum fuel might be decreased and the sugar industry revitalized if new sources of energy can be competitively produced from biomass crops. Because of the lag time between initiation of research and the discovery of alternative energy sources, it is in the State's interest to help fund alternate energy research even during a period of low oil prices, in order to be prepared if and when oil price hikes do occur.

Other Experimentation

There are other types of experimentation being conducted by Hamakua Sugar, HSPA, and DBED to produce useful byproducts from sugarcane. Much of the work is highly technical and in some cases confidential. In all cases the bottom line must be whether such products will be profitable--a breakthrough that has not yet happened for the sugar industry.

Chapter 4

IMPACTS OF CLOSING SUGAR COMPANIES

Although three sugar companies closed during the 1970s (Kilauea Sugar Company on Kauai in 1971, Kahuku Plantation Company on Oahu in 1971, and Kohala Sugar Company on Hawaii in 1975) and one closed in 1982 (Puna Sugar Company on Hawaii), the Bureau's research indicated that most of the remaining sugar companies are committed to staying in business for at least another ten years. Industry personnel are realistic about the pressures of urbanization, increased costs of production, and the cost of meeting environmental requirements which can reduce profits. However, the industry is also hopeful that with continued research, government lobbying, and innovative management, sugar can survive in Hawaii for many more years.

Economic Impacts

There are about 6,500 employees directly involved in the sugar industry (see Table 1).[1] According to HSPA: "Hawaiian sugar provides about 25,000 direct and indirect jobs in the state (and) direct sugar payroll including the cost of employee benefits, totaled $129 million in 1986."[2]

Employment Multiplier and Income Multiplier

At least one local economist has studied the impact of the loss of sugar to the economy of Hawaii.[3] Hitch reported the employment multiplier in sugar is that for every person directly involved in sugar, there are 2.29 non-sugar jobs indirectly created by the sugar industry. Therefore, 6,500 sugar employees multiplied by 2.29 totals 14,885 non-sugar jobs created indirectly by the sugar industry. Accordingly, closing the sugar industry would affect not only the 6,500 sugar employees but about 14,800 other workers as well. The total figure of about 21,300 workers compares closely with the 25,000 direct and indirect jobs affected reported by HSPA. In 1985, there were 454,000 people employed in the civilian labor force.[4] The 21,000 sugar-

related workers (direct and indirect) represent nearly five per cent of the total civilian employment in Hawaii.

Table 1

Approximate Employment by Occupation at Sugar Companies, 1985

Factory	1,355
Field	3,530
Clerical	190
Miscellaneous	615
Supervisors	820
TOTAL	6,510

Source: Hawaiian Sugar Planters' Association, Hawaiian Sugar Manual, 1987 (Honolulu: 1986), p. 7.

Based on a series of assumptions and calculations, Hitch said that "for every dollar in personal income introduced into the economy from the sale of an export commodity or service, the spending and successive respending of it creates 72 cents of income. This adds 72/100th of a job to the economy for every job created directly (through payrolls) or indirectly (in the purchase of goods and services) by the sugar plantation companies."[5] Hitch also said, "...for every $1 disbursed by the sugar industry in Hawaii, 67 cents becomes personal income in the hands of residents of Hawaii.[6] In other words, 67 cents of the dollar paid a sugar worker stays in Hawaii while 33 cents goes out of State. Using a multiplier of $1.72 for each 67 cents of every sugar income dollar added to the income stream of Hawaii, Hitch arrived at an income multiplier of $1.15. That is, according to Hitch, each dollar of sugar income generates $1.15 of personal income in Hawaii, based on the multiplier of $1.72. Thus, using Hitch's calculations, a direct sugar payroll of $129 million in 1986 generated $148 million to the income stream of Hawaii from the sugar industry. Hitch concluded that using conservative assumptions, "the closing of the sugar industry would be devastating to the state's economy and

would result in the almost complete collapse of the neighbor island economies."[7]

Hitch also speculated that sugar lands offer an attractive natural feature to the tourists who visit these islands and this contributes to visitor satisfaction. If the sugar industry collapsed, these green canefields would return to weeds and scrub, which would have a negative effect on the atmosphere of rural Oahu and the neighbor islands.

Impact on Sugar Employees

Sugar workers (except for Gay & Robinson's employees) are members of the International Longshoremen's and Warehousemen's Union (ILWU). In the event of a sugar industry collapse, most supervisors, clerks, and some skilled factory workers would be able to transfer to other employment sectors, but the bulk of the sugar workers with little education and limited skills may be restricted to other agricultural jobs. According to union officials the most likely types of jobs to which these workers could transfer would be in pineapple, aquaculture, or other diversified agriculture. If they sought jobs in the visitor industry, the kinds of work most sugar laborers would be suited for would be groundskeepers, maintenance personnel, or housekeeping staff.

Tourism, a service industry, would provide a different lifestyle from farming and it is likely that the social impacts on families may be disruptive during a transition from an agricultural to tourism employment base. Such result seemed to be the experience after the 1975 shutdown of Kohala Sugar Company when some former sugar workers found jobs in the visitor industry.[8] Such factors as age, marital status, sex, interest in relocating in order to find replacement jobs, all influence the ease of transition.

How real is the specter of a complete shutdown of the sugar industry in Hawaii? For the short term, about 5 years, it does not appear to the Bureau to be a major possibility. For example, although Wailuku Agribusiness does not plan to be in sugar after 1988, the transition to pineapple is being done

smoothly and without obvious social and economic dislocations. Waialua Sugar operations appear "safe" until 1989. Sugar labor contracts now provide that there shall be no layoffs for the life of a sugar contract (generally one year) and given the average crop age of two years, there would be at least a few years before a plantation can shut down completely. Closings, if they occur, would take place gradually with field workers generally being laid off before other workers, as fields are harvested. Furthermore, a recently enacted "dislocated workers' law" provides that employees be given at least 45 days' notice prior to a closing of a covered establishment.[9]

While it is unlikely that the entire sugar industry will close down at one time, there is a serious possibility that the gradual closure of plantations would mean that the remaining companies cannot maintain the economies of scale needed to stay in business. Absorbing the fixed costs of such things as shipping terminals, warehouses, and research becomes more difficult as the number of companies sharing these costs dwindle. Therefore, what may have started in 1971 as a trickle of shutdowns could mean eventual disaster for the entire industry if sugar companies begin to shut down one-by-one on each island. For example, if Waialua Sugar Company ceased operations, Oahu Sugar may follow soon afterwards because there would not be enough sugar produced to maintain refining operations.[10]

Electricity

Earlier sections of this report made reference to the electrical power generated by several sugar companies (see Exhibit 15 in chapter 3). Table 2 shows the contribution to Hawaii's total electric generation by sugar companies by island. Although the total contribution for all islands is only about 10 per cent, the neighbor islands would be most heavily impacted by cessation of sugar operations which contribute electrical power to the local power company. If the energy contract extends beyond the closure of the sugar company, the power company on the island would not have to absorb the difference until the end of the contract. For example, Puna Sugar which closed in 1982 is still providing electrical energy until 1992.[11] When a sugar company ceases contributing electric power, the island power company would

probably have to install a new power plant of boilers and generators and burn more oil or find other energy sources. Furthermore, since sugar companies sell only their excess power, if its replacement industry uses as much electricity as the sugar industry but does not generate electricity for its own needs, the local power company would have to generate the difference. In 1984 sugar companies generated about 817 million kilowatt hours statewide, used about 540 million kilowatt hours and sold about 319 million kilowatt hours (see Exhibit 16).

Table 2

Contribution to Hawaii's Total Electric Generation by the Sugar Companies, 1986

Island	Percentage of Contribution*
Total - all islands	10.4
Oahu	1.9
Hawaii	36.1
Kauai	38.4
Maui	20

*Includes power derived from bagasse, oil, hydro, and diesel.

a. Department of Business and Economic Development records.

b. Hawaii Electric Light Company

c. Kauai Electric Company

d. Maui Electric Company

Summary of Impacts

If the economic assumptions hold true, a sugar industry shutdown would be devastating for the State of Hawaii. Without suitable alternative employment choices, unemployment rates and welfare costs would increase on

Exhibit 16

Energy Generated, Purchased, Sold and Used by Raw Sugar Plantations, by Islands: 1984

Subject	State Total	Hawaii	Kauai	Maui	Oahu
Electricity (millions of kilowatt-hours)					
Generated*	816.99	265.45	191.35	249.39	110.80
Purchased	41.91	2.12	4.68	9.76	25.35
Sold	319.04	163.52	82.90	61.43	11.19
Used**	539.86	104.05	113.13	197.72	124.96
Gross heat values of boiler fuels (billions of Btu's)					
All fuels	26,089	10,345	4,938	8,080	3,447
Bagasse	23,411	9,215	4,577	6,409	3,210
Fuel oil	2,443	503	258	1,530	152
Other fuels	955	627	102	141	84

*Includes electricity generated by steam and by hydroelectric or diesel engine generators.

**Includes transmission losses and electricity used to operate power plant auxiliaries.

Source: Hawaii Sugar Planters' Association, Energy Inventory of Hawaiian Sugar Plantations - 1984 (Energy Report 22, December 18, 1985), pp. 8-10. Published in: The State of Hawaii Data Book, 1986, Department of Planning and Economic Development, State of Hawaii (Honolulu: 1986) Table 483, p. 456.

all islands, but more so on the neighbor islands where sugar plays a larger role in the economy. One need only look at the effects in Kahuku on Oahu, Kohala and Puna on Hawaii, and Kilauea on Kauai to realize what loss of sugar jobs can do to a community. In 1981 Plasch reported that "to minimize problems resulting from closing a sugar operation, high risk ventures may have to be attempted (and) the community may also become willing to accept activities which it would otherwise oppose because of their negative environmental and social impact."[12]

In the next chapter of this report the Bureau presents its findings and recommendations describing the specific actions which the State of Hawaii might take to help the sugar industry. Some of these recommendations had been made by Plasch in 1981.

Chapter 5

FINDINGS AND ACTION PLAN

Findings

1. Sugar is a highly traded commodity. About seventy nations export sugar to approximately one hundred and fifteen countries. However, about seventy-five per cent of world sugar consumption occurs where the sugar crop is produced.

2. Most governments protect their country's sugar industry by a variety of domestic sugar programs. Under preferential and trade agreements, sugar prices averaged twenty-one cents a pound, while sugar traded on the "free" or world market averaged six cents a pound in 1986.

3. Sugar prices are said to be among the most unstable in international trade because of the relatively small shares of the world's sugar production freely traded in international markets. The freely traded sugar is usually sugar which cannot be absorbed by preferential systems, or consumed in the producing countries.

4. Attempts to establish an effective International Sugar Agreement to stabilize the price of sugar have failed.

5. The introduction of a process for mass-producing high-fructose corn syrup has transformed the United States sugar market, so that the consumption of refined sugar has declined while the consumption of high-fructose corn syrup has risen dramatically.

6. The sugar price support program of the Agriculture and Food Act of 1981 was extended in the Food Security Act of 1985, technically until

September 30, 1990, but will continue to cover the sugar industry until 1991. However, its renewal is uncertain.

7. Certain individuals associated with Hawaii's sugar industry perceive that the survival of the sugar industry depends on the renewal of the essential features of the federal sugar program, as well as continuing efforts to reduce costs related to sugar operations.

8. Problems of the Hawaii sugar operations which were identified by Bruce Plash's study in 1981 remain problems in 1987. Environmental issues of field burning, use of field chemicals, water pollution, pressures of urbanization and water use continue to affect the sugar companies.

9. Hawaii sugar companies have tried to reduce costs of operations by seeking alternate crops for use of sugar lands and alternate uses for sugar byproducts such as bagasse and molasses. Research has been conducted on ways to increase yield from sugarcane, find suitable biomass crops for use in energy generation, and so on. The State of Hawaii, HSPA, the University of Hawaii's College of Tropical Agriculture and Human Resources, and individual sugar companies have been diligently seeking ways to be more efficient and imaginative in the effort to keep sugar in Hawaii.

10. The impact of sugar company shutdowns would have grave economic impacts on Hawaii, especially on the neighbor islands. Unemployment and socio-economic problems will increase. Electric companies which now depend on the availability of excess electric generation produced and sold by sugar companies would have to find new ways to generate the difference if the sugar industry collapses.

Action Plan

The following recommendations are based on a survey of the State's sugar companies and interviews with a variety of individuals and organizations associated with Hawaii's sugar industry. Some of these steps can be taken

immediately. Other steps are on-going and can be initiated when start-up funds are made available for studies and the like.

Lobbying in Support of United States Sugar Legislation

The State can help Hawaii's sugar industry by lobbying Congress for renewal of the domestic sugar program that technically expires in 1990.

Certain individuals interviewed stated that the fate of the sugar industry in Hawaii is largely out of the hands of Hawaii's sugar companies, and instead is highly dependent on federal support of the domestic sugar industry. They perceived that passage of federal legislation to protect sugar is essential to enable the domestic market to compete in a highly controlled international market, where most nations intervene on behalf of their sugar producers, and where the world market price of sugar is highly unstable.

Research

The support of the Hawaiian Sugar Planters' Association research and development program is viewed as being of high priority for helping the sugar industry. As one individual put it, "Research is the salvation of our future."

One of the keys to the survival of Hawaii's sugar industry is to keep prices low, and in order to achieve low prices, production must be as efficient as possible. Research by the Hawaiian Sugar Planters' Association has helped the sugar industry to be more efficient in many areas, including, but not limited to:

(1) Developing new sugarcane varieties, which produce higher sugarcane yields;

(2) Developing irrigation systems;

(3) Controlling pests;

(4) Disposing wastes;

(5) Harvesting and transporting cane; and

(6) Operating factories.

High priority areas of importance to the sugar industry are listed in the technical reference document for the State's Agriculture Functional Plan (see Exhibit 13, chapter 3). Many of these areas involve research.

According to Mr. Sam Caldwell, the director of public affairs of the Hawaiian Sugar Planters' Association, research in all other sugar producing states in the country is entirely funded by state government, sometimes supplemented by United States Department of Agriculture moneys, and conducted at state universities.[1]

Companies engaged in the business of growing sugarcane and manufacturing sugar from it, and individuals connected with directing, managing, or operating the sugar companies are members of the Hawaiian Sugar Planters' Association. Therefore, the Hawaiian Sugar Planters' Association's research benefits all sugarcane growers and processors in Hawaii.

During the last legislative session, the Hawaiian Sugar Planters' Association obtained $2 million from the state legislature, with $250,000 earmarked for alternate crop and byproduct research and development.[2] Certain individuals interviewed perceived that half of the Hawaiian Sugar Planters' Association operating budget should be funded by the state legislature, that is, $3 million a year.

Support of LESA

The Land Evaluation and Site Assessment (LESA) Commission was established to implement a 1978 Constitutional amendment requiring the state legislature to provide standards and criteria "...to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands...." The LESA commission was charged with identifying "important agricultural lands" that the Legislature should set aside according to a classification system developed by the Commission.

The final report of the commission, published in February of 1986, presents standards, criteria, and procedures to identify "important agricultural lands" of the State; standards, criteria, and a process to review requests for the reclassification or redesignation of these lands to meet changing community needs, goals, and objects; an initial inventory of these lands; preliminary maps illustrating the application of the proposed system; and an implementation framework defining the respective roles of involved state and county agencies.

Certain individuals interviewed stated that the LESA report should be used by the Legislature, and agricultural lands should be protected from redesignation to other uses, such as urban. One individual said, "If these lands are assured to stay in agriculture, then people won't be afraid to invest, and look to the future."

Public Education

According to some industry observers, the sugar industry can be helped by a public education program which describes why sugar should continue as an industry in Hawaii. This would include explanations of the economic benefits and aesthetic qualities provided by the sugar industry. A similar parallel can be found in the public relations programs put forth by the visitor industry. A cooperative effort between government and the sugar industry

would have to show that there are mutually beneficial reasons for the continuation of the sugar industry in Hawaii.

The public can also be made aware in layman's terms of the consequences of a collapse of the industry. Assuming no alternative can be found to open field burning and dumping of muddy mill waste waters off the Hamakua coast, educating the public about why such procedures are necessary and unavoidable would mean the development of a public relations campaign. There are trade-offs for regulating the industry which the public may not be aware of, which could affect the long-term economic health of the State.

Lead agencies: DBED, DOE, HSPA.

Energy Production

Hawaii has been at the mercy of oil producing countries for many years. The development of alternative energy products would relieve this dependency. Increased energy self-sufficiency is one of the major objectives of the Hawaii State Plan. In order to achieve these objectives the State Plan policies include promoting the use of new energy sources such as wind energy, geothermal, and ocean thermal energy conversion (OTEC), biomass, hydropower, and direct solar power.[3]

1. The Legislature should continue to fund research into the use of biomass to produce electricity, as it did in 1986 and 1987 to establish biomass to energy test facilities.

Lead agencies: DBED, DOA, HSPA

2. The State should continue research programs to develop new energy systems and sources which could replace petroleum fuels, thereby lowering the cost of energy required by sugar factories and field equipment.

Lead agency: DBED

3. The State should fund a study to examine ethanol fuel as an alternate energy source. Among the issues which should be addressed in the study are:

(a) Determine the feasibility of requiring that all bulk fuel purchases for state-owned vehicles consist of ethanol-blended fuel (either gasoline or diesel blends);

(b) Determine how much financial support can be given for statewide marketing of fuel ethanol and/or ethanol blended fuels;

(c) Develop a program to encourage investors in the production and/or sale of ethanol and ethanol-related products in Hawaii; and

(d) Develop a marketing strategy, including tax and other incentives to support an ethanol fuel industry in Hawaii.

Lead agency: DBED with support from: Tax, DAGS.

Environment

Hawaii has been subject to federal environmental laws which tend to be based on mainland conditions. Often these conditions are not applicable to Hawaii's oceanic location, soil, water, and pest patterns.

1. The State can use its influence to ensure federal environmental regulations are appropriate to Hawaii and when not appropriate, to seek exemptions through congressional lobbying. Since area residents' health must not be compromised, the State can also help the sugar industry by funding and conducting studies similar to those being conducted on open field burning.

Lead agencies: DOH, DOA, HSPA

2. The environmental issue of water pollution is greatest on the Hilo Coast, for HCPC and Hamakua Sugar. At the present time apparently no economically viable alternative exists to the harvesting of cane along with some dirt. The Hamakua area is too wet for open field burning and even with settling ponds, a quantity of mud is dumped into the waters off HCPC's mill. The waters off the Hamakua coast are not a recreational area so limited deterioration of water quality is unlikely to pose health risks. Therefore, the Bureau recommends the continued issuance of permits to HCPC to allow muddy mill waste waters to be released into the ocean along the Hamakua Coast. However, it is also recommended that the State assist the sugar industry to develop harvesting methods which deliver less mud to the mill. A study investigating the harvesting methods in other countries may be useful.

Lead agency: DOH with assistance from HSPA.

3. While the continued issuance of agricultural field burning permits by the DOH reflects state policy to assist the sugar industry, the Bureau recommends the State of Hawaii assist the sugar industry to find alternatives to field burning.

At least one sugar company said that "burning bans should not apply to sugar companies."[4] The Bureau finds that this is not a realistic or practical alternative. The sugar companies which have conducted field burning appear to be good neighbors in that they have tried to warn affected residents prior to burning. Furthermore, preliminary study by EPA seemed to indicate no health risks from these burning programs, although the DOH is continuing to study the problem. The Bureau believes that in the long run the conflict will increase between opponents of field burning and sugar companies, primarily because of the nuisance factor of burning, even assuming no health risks are found. An increase in the number of residents, tourists, or both, will undoubtedly raise the issue whether a suitable alternative to burning does not exist. It would be far better to seek a solution before volatile confrontation requires it. Plasch reported that leaves can be burned for electrical power (see environmental issues, chapter 3). As of 1987, no serious effort seemed

to have been made to seek alternatives to field burning because DOH field burning permits continued to be issued.

Lead agencies: DOH, DBED, HSPA.

Other Recommendations

1. The State should work with each county's transportation department to develop safer, better roads to and from sugar plantations to improve traffic flow and reduce congestion.

The Bureau's interviews and questionnaires revealed that on Kauai and the Big Island, a major problem is safety of the roads to and from sugar plantations and the mills.[5] When large trucks laden with harvested cane use the main streets, traffic is often backed up. At times debris from cane hauling trucks clutter the roadways. While the whole extent of the transportation problem is not known, this is a problem deserving action because it affects the safety of all users of the roadways.

Lead agencies: DOT, County Transportation Departments.

2. The State should begin developing retraining programs for employees.

Many sugar companies responded to the Bureau's questionnaire and interviews with a positive desire and intention to stay in sugar for at least ten years or as long as possible. Realistically, however, some sugar companies, such as HCPC and Waialua Sugar Company occupy more tenuous positions than others. Therefore the Bureau recommends that the State, through the Departments of Labor (DOL) and Education (DOE) identify and develop retraining programs for sugar workers who might lose their jobs over the next decade. An early assessment of the needs and interests of sugar workers would lessen the dislocations which occur when a sugar company announces that it will shut down operations within two years. In the near

term, the DOL could begin with a survey of sugar workers to determine their demographic characteristics such as age, marital status, etc., and their level of existing skills. The DOE could determine what kind of retraining programs need to be developed for the sugar workers from the information derived from the survey. Given enough lead time, retraining programs could be conducted in tandem (in the evenings, on weekends) on a continuing education basis for a smooth transition from one type of employment to another, i.e., after one type of job terminates, the worker, being sufficiently trained, could move directly into the other job without losing time or income for training.

Lead agencies: DOA and DOE

FOOTNOTES

Chapter 2

1. The members of the European Economic Community are Belgium, Denmark, France (Metropolitan, Guadeloupe, Martinique, Reunion, French Guiana), the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, and the United Kingdom.

2. Hawaiian Sugar Planters' Association, Hawaiian Sugar Manual, 1987 (Hawaii: 1986), p. 22.

3. Ibid., pp. 25, 26.

4. Ibid., p. 22.

5. Ibid., p. 22.

6. U.S., Department of Agriculture, Economic Research Service, Sugar: Background for 1985 Farm Legislation, Agriculture Information Bulletin No. 478, 1984, p. 23.

7. D. Gale Johnson, The Sugar Program: Large Costs and Small Benefits (Washington: American Enterprise Institute for Public Policy Research, 1974), p. 43.

8. U.S., General Accounting Office, Report to the Congress by the Comptroller General, U.S. Sweetener/Sugar Issues and Concerns (Washington: 1985), pp. 21-22.

9. Hawaiian Sugar Manual, 1987, p. 26.

10. Sucrose, commonly known as sugar, is a sweet crystallizable colorless substance. Refined cane and beet sugar are approximately one hundred per cent sucrose. Glucose refers to an alternate chemical name for dextrose, and corn syrups obtained by the action of acids or enzymes, or both, on cornstarch. It is less sweet than sucrose. High fructose corn syrups are produced by the enzymatic conversion of a portion of the glucose in corn syrup to fructose.

11. Hawaiian Sugar Manual, 1987, p. 12.

12. Ibid.

13. Ibid., p. 16.

14. U.S., Department of Agriculture, Sugar: Background for 1985 Farm Legislation, p. 30.

15. Hawaiian Sugar Manual, 1987, p. 18.

16. Johnson, The Sugar Program, p. 73.

17. Wall Street Journal, September 26, 1986, p. 1.

18. Senate Bill No. 1877, "The Sugar Supply Stabilization Act".

19. "Report of the Chairman", by Francis S. Morgan (Hawaiian Sugar Planters' Association Annual Meeting, November 23, 1987), p. 3. (Mimeographed).

20. Honolulu Star-Bulletin, November 18, 1987, p. D-4; The Honolulu Advertiser, November 18, 1987, p. A-15.

21. Telephone conversation with Ms. Jennifer Goto, legislative assistant, Office of Senator Daniel K. Inouye, November 23, 1987.

22. Honolulu Star-Bulletin and Advertiser, December 20, 1987, p. B-4.

23. "Waiting for the Westin," Hawaii Business, July 1987, p. 42.

24. "Thirteenth Annual Media Briefing" (Hawaiian Sugar Planters' Association, March 10, 1987, p. 3). (Mimeographed).

25. Telephone conversation with Ms. Jennifer Goto, legislative assistant, Office of Senator Daniel K. Inouye, November 23, 1987.

26. Hawaiian Sugar Manual, 1987, p. 7.

27. Ibid.

28. Ibid.

29. "Report of the Chairman", by Francis S. Morgan (Hawaiian Sugar Planters' Association Annual Meeting, November 23, 1987), p. 3. (Mimeographed).

30. Honolulu Star-Bulletin and Advertiser, December 20, 1987, p. B-4.

31. "Washington Perspective", by Eiler Ravnholt (Hawaiian Sugar Planters' Association Annual Meeting, November 23, 1987), p. 3. (Mimeographed).

Chapter 3

1. Bruce Plasch, Hawaii's Sugar Industry: Problems, Outlook and Urban Growth Issues. (Honolulu: Department of Planning and Economic Development, April 1981), p. 2.

2. Ibid., p. 12.

3. Honolulu Advertiser, November 20, 1987, p. A-1.

4. Plasch, p. 172.

5. Honolulu Advertiser, November 20, 1987, p. A-1; November 21, 1987, p. B-5; and Honolulu Star-Bulletin, November 23, 1987, A-2.

6. Honolulu Advertiser, November 20, 1987 p. A-1.

7. Telephone interview by Jean Mardfin with Norman Lee, engineer, Public Utilities Commission, November 25, 1987.

8. Honolulu Advertiser, November 24, 1987, p. A-14.

9. Plasch, p. 220-223.

10. Honolulu Advertiser, September 25, 1987, p. A-3.

11. Plasch, p. 179.

12. Hawaiian Sugar Manual, 1987, HSPA, (Honolulu: 1987), p. 5.

13. Plasch, p. 165.

14. Ibid., p. 165.

15. §11-60-36(d), Hawaii Administrative Rules.

16. §11-60-34, Hawaii Administrative Rules.

17. Plasch, p. 166.

18. Joint Press Release, EPA and Hawaii Department of Health Services, August 20, 1987, p. 1.

19. Ibid., pp. 1-2.

20. Hawaii, Department of Agriculture, State Agriculture Functional Plan, Technical Reference Document, (Honolulu: June 1985), p. II-112 (hereinafter: Agriculture TRD).

21. Ibid., p. II-118.

22. Plasch, pp. 150-151.

23. Hawaii, Department of Land and Natural Resources, State Water Resources Development Plan, Technical Reference Document, (Honolulu: 1982), p. III-62 (hereinafter: Water Resources TRD).

24. Agriculture TRD, p. II-191.

25. Act 45, Session Laws of Hawaii 1987 codified as Haw. Rev. Stat. Chapter 174C.

26. Plasch, pp. 169-226.

27. Hawaii, Department of Planning and Economic Development, The Hawaii State Plan, Technical Study: Economy, (December: 1984), p. 84 (hereinafter: State Plan, Energy).

28. Agriculture TRD, Appendix A, pp. A-28, A-29.

29. Water Resources TRD, p. III-62.

30. Ibid., P. III-75 to III-79.

31. Plasch, pp. 238-246.

32. Hawaii Sugar Plantation Association, Hawaiian Sugar Manual 1987 (Honolulu: 1987), p. 5.

33. Plasch, p. 240.

34. K.K. Seo, A Study of the Economic Viability of Alternative Uses for Bagasse, Agricultural Land, and Sugar in Hawaii, (Honolulu: HSPA 1986), pp. E-1, E-2.

35. Honolulu Star-Bulletin and Advertiser, December 20, 1987, p. A-47.

36. State Plan, Energy, p. 176.

37. Plasch, pp. 233-235.

38. Telephone interview by Joyce Kahane with Kauai Electric Company, December 15, 1987.

39. DPED announcement, July 28, 1987.

40. Ibid.

Chapter 4

1. State Data Book figures range from 5,751 hourly rated employees in the sugar industry for 1985 and 7,550 field and mill workers for 1985. Differences in definition apparently account for the variation in numbers, therefore, the HSPA total is being used in this report.

2. Hawaiian Sugar Plantation Association, Hawaiian Sugar Manual 1987 (Honolulu: 1987), p. 5.

3. Thomas K. Hitch, How the Collapse of the Sugar Industry Would Impact on Hawaii's Economy, (Honolulu: First Hawaiian Bank 1984).

4. The State of Hawaii Data Book, 1986, Department of Planning and Economic Development, State of Hawaii (Honolulu: 1986), p. 332.

5. Ibid., p. 4.

6. Ibid., p. 5.

7. Ibid., p. 7.

8. Interview with Shoji Okazaki, Office Manager and Legislative Liason and Charlyne Palacio, Administrative Assistant with Jean K. Mardfin and Joyce Kahane, September 30, 1987.

9. Act 377, Session Laws of Hawaii 1987 and Haw. Rev. Stat. sections 394B-2, 5, and 8 to 13.

10. Interview with Sam Caldwell, Director of Public Affairs, HSPA, July 29, 1987.

11. Telephone conversation between Jean K. Mardfin and Charles Kinoshita, Head, Sugar Technology and Engineering Department, HSPA, October 1, 1987.

12. Plasch, pp. 246-247.

Chapter 5

1. Telephone conversation between Joyce Kahane and Sam Caldwell, director of public affairs of the Hawaiian Sugar Planters' Association, November 4, 1987.

2. Session Laws of Hawaii 1987, Act 346, §2.

3. Many of the following suggestions were made by DBED.

4. R.B. Cushnie, President, Ka'u Agribusiness, on LRB Questionnaire, September, 1987.

5. Interview by Susan Jaworowski, Legislative Researcher, LRB, with Don Cataluma, President, Olokele Sugar Company, August 18, 1987 and with Jack Poppe, Executive Vice President and General Manager, Hamakua Sugar Company, August 27, 1987.

HOUSE OF REPRESENTATIVES
FOURTEENTH LEGISLATURE, 1987
STATE OF HAWAII

H.R. NO. 216 H.D. 2

HOUSE RESOLUTION

REQUESTING AN ACTION PLAN FOR THE SUGAR INDUSTRY IN HAWAII.

WHEREAS, the sugar industry in Hawaii is over 150 years old, having been a pillar of the economic development of the islands during that time contributing to the diverse ethnic population which gives Hawaii its unique cultural and social mix; and

WHEREAS, in recent years the sugar industry has been hard hit by a reduction in the amount of sugar consumed by Americans, the growing use of alternative sweetners, the reduction of federal price supports, and competition from subsidized sugar producers in foreign countries; and

WHEREAS, though sugar production still plays a significant role in Hawaii's economy, being the third largest source of export income and providing high-paying jobs, its contribution to Hawaii's economy has steadily declined since 1950, and it now employs only a third as many workers and provides one-twentieth the percentage of state general excise tax revenues; and

WHEREAS, the sugar industry has contributed to what is now Hawaii's leading industry, tourism, because every acre planted in sugar cane (approximately 16 percent of the habitable land area of Oahu, the most heavily populated and developed of the islands) is an acre free of concrete, green and lush, preserving the image of Hawaii which sustains residents and draws millions of visitors every year; and

WHEREAS, the future of the sugar industry is uncertain, with the federal government considering further cuts in price supports, the State's largest sugar grower, Amfac, suggesting it might cease sugar production within ten years, and other sugar growers looking for alternative crops; now, therefore,

HRO/1855m

BE IT RESOLVED by the House of Representatives of the Fourteenth Legislature of the State of Hawaii, Regular Session of 1987, that the Legislative Reference Bureau is requested to develop an Action Plan for Hawaii's sugar industry, including recommendations outlining the measures necessary and actions required to continue the contribution of the industry to the State's economic and social well being; and

BE IT FURTHER RESOLVED that the Action Plan be based upon a study of all factors affecting the future of the sugar industry including but not limited to:

(1) the probable future of federal support of sugar;

(2) the current status of efforts to find new markets for sugar products;

(3) the impact on sugar-related employment; and

(4) the impact on land use of the shift away from sugar production;

and

BE IT FURTHER RESOLVED that for each recommendation, the Action Plan identify the lead agency or unit best able to implement the recommendation and specify the resources required to complete the recommendation; and

BE IT FURTHER RESOLVED that the Hawaii Sugar Planter's Association, the State of Hawaii Department of Agriculture, the United States Department of Agriculture, and the College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, cooperate with the Legislative Reference Bureau in developing the Action Plan; and

BE IT FURTHER RESOLVED that the Action Plan be submitted to the legislature at least twenty days prior to the convening of the Regular Session of 1988; and

BE IT FURTHER RESOLVED that certified copies of this Resolution be transmitted to Hawaii's Congressional Delegation, to the Director of the Legislative Reference Bureau, the President of the Hawaiian Sugar Planter's Association, the Director of the State Department of Agriculture, and the Dean

of the College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa.

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Guide to Government in Hawaii. Eighth Edition. 186 p. $3.00

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