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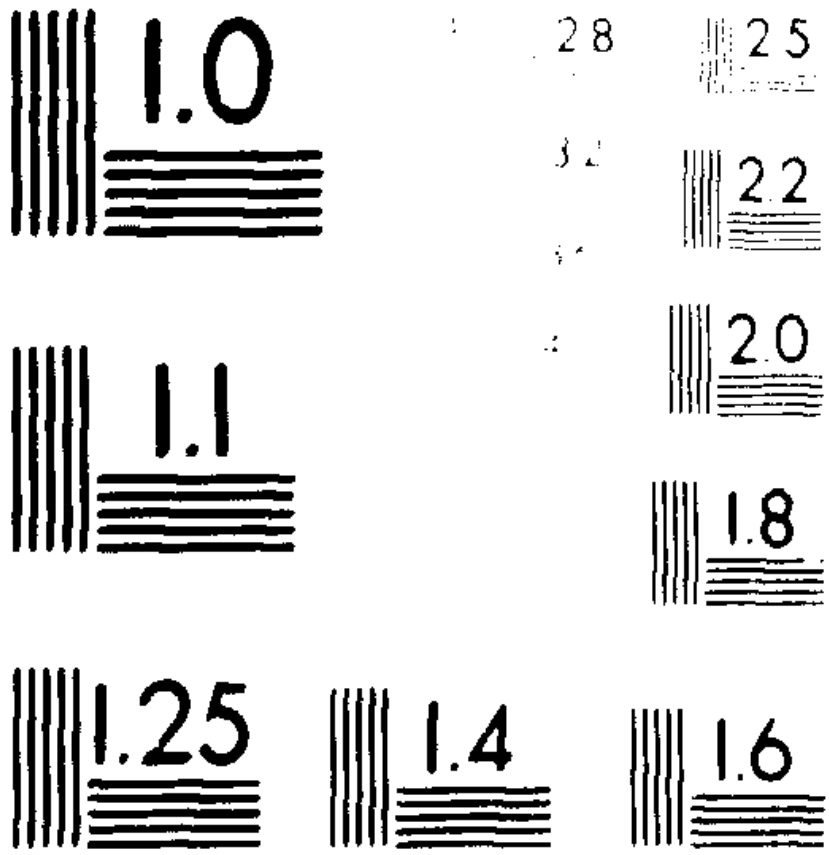

MICROCOPY RESOLUTION TEST CHART

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ENGLISH

REVIEW OF THE DEVELOPMENT PROJECTS OF THE COCONUT INDUSTRY IN THE CARICOM AREA*

Based on the work of P. Catanaoan
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ABSTRACT

Title of project: Evaluation and Recommendations for the Coconut Industry in the CARICIOM Region US/GLO/80/005/11-04.

Duration: 5 August to 28 October 1983

Purpose: To assist the CARICOM Secretariat in reviewing existing coconut industry studies and to act as advisor to authorities and industries on coconut development issues.

1. To identify problems in the coconut industry and the causes of low coconut oil production.
2. To find solutions to the problems identified and propose remedial measures to increase coconut oil production.

Findings: The major cause of low coconut oil production is the lack of copra production due to the following problems:

1. High percentage of unrecovered and wasted nuts.
2. Reduced nut productivity due to neglect.
3. Failure to promote copra production in most of the countries.

The following remedies were proven effective:

1. Clearing and rehabilitation of coconut farms.
2. An effective programme to increase nut productivity and copra production.
3. Improving the viability of copra production.

Currency equivalent (24 October 1983)

US$ 1 = 2.9944 GY$ (Guyana)
= 2.7034 EC$ (East Caribbean)
= 2.4030 TT$ (Trinidad and Tobago)
= 2.0029 BDOS $ (Barbados)
= 2.2531 JA$ (Jamaica)
= 1.98 B$ (Belize)

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INTRODUCTION

The Caribbean Community (CARICOM) is composed of the twelve former British colonies in the Caribbean Region, namely: Antigua-Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Monserrat, St. Kitts-Nevis, Saint Lucia, St. Vincent and the Grenadines and Trinidad and Tobago.

Coconut is one of the Region's important agricultural crops and traditional source of edible oils. In 1970, the CARICOM countries had a total production of 395 million nuts per year but the production dropped to about 292 million in 1978 (Table 3). There are nine coconut processing plants equipped for both copra milling and oil refining. Their total milling capacity is about 83,000 tons per year while the refining capacity is about 56,000 tons per year (Table 2). Due to shortage of copra, the overall plant capacity utilization, in 1980, was about 37.2 per cent for the copra mills and about 54.5 per cent for the refineries (Table 2). The estimated oil consumption in 1985 is about 43,000 tons per year, 37,600 tons as refined oil, 3,100 tons in shortening and margarines and 2,900 tons in soaps (Table 5).

Until 1981, there had been farther decline in production of coconuts, copra and consequently oil supply in the Region. This was attributed to several factors, among which were the age of trees, pests and diseases, neglect of farms, and disastrous effect of hurricanes. Consequently, the edible oil supply-demand situation had changed from surplus to deficit.

At a meeting of the CARICOM Secretariat at St. Kitts on January 1982, the Standing Committee of Ministers Responsible for Agriculture agreed that:

a) the rehabilitation of the coconut industry should be given high priority and that a funding programme for its development should be devised;
b) this programme should include the conduct of an investigative study of the problems affecting the coconut industry.

It is within this context that the proposed evaluation study has been instructed by the CARICOM Secretariat. In January 1983, the Member Governments of the CARICOM requested UNIDO to send an expert in coconut processing to assist the CARICOM Secretariat in reviewing the existing coconut industry studies and development proposals and to act as advisor to authorities and industries in the region on coconut development issues. Specifically, the duties of the expert were:

1. To assist the CARICOM Secretariat in reviewing and following up the processing projects identified by a preceding EDF-financed study:
2. To advise government authorities and idustrialists, inter-alia, on new developments in coconut processing, utilization of by-products, and non-traditional uses of coconut oil:
3. Preparation of detailed report on study results along with recommendations for further action.

On 15 August 1983, after a two-week visit in Saint Lucia, the coconut processing expert reported to the CARICOM Secretariat in Georgetown, Guyana to start working on his studies specified on the Job Description. Incidentally, at the time, the EDF-financed study has not yet been started due to unavoidable delays. Faced with the situation, the Secretariat requested that the expert shall, instead, visit the coconut-producing CARICOM countries and conduct investigation on the status of the coconut processing industries, to provide ready assistance, if needed, and/or identify areas on which recommendations for further technical or other assistance could be made. Specific areas of study during the visits are as follows:

Farm level: nut recovery systems, copra making operations and areas for cost reduction:

Factory level: operational problems, opportunities for expansion and areas for cost reduction.

The coverage of the field trips are shown on page

I. OBJECTIVES AND METHODOLOGY

The final objectives of the mission may be re-stated as follows:

1. To identify the problems of the coconut industry and the causes of low production of coconut oil:
2. To find solutions to the problems and to propose remedial measures to increase oil production:
3. To identify projects and activities to be undertaken to enable the region to achieve self-sufficiency in edible oils and which would lead to the development of the coconut industry.

To achieve the objectives of the mission, the following methodology was considered appropriate for the situation:

1. Review previous studies made on the coconut and oil industry in the CARICOM region;
2. Visit the coconut producing countries to up-date the informations in the studies and to gather new information;
3. Integrate and synthesize informations from previous studies and new information into an industry evaluation;
4. Draw-up conclusions and recommendations based on the situation evaluation.

II. REVIEW OF PREVIOUS COCONUT INDUSTRY STUDY REPORTS[1/]

A. Status of the Coconut Industry in 1981

Production

Coconut production in the region has been adversely affected by several problems, each having different impacts in different countries. Most common are: pests and diseases, tree age, poor management. praedial larceny and residual effects of hurricanes.

Copra production has also been affected in large measure due to the diversion of nuts from copra to green and dry nuts trade. It is estimated that about 56 per cent of nuts produced go to markets other than copra.

Except for oil palm and rice bran in Guyana, the potential for other oilseed production in the region appears to be of longer term. The following table shows the copra production in the Region.

1/ CARICOM Secretariat: The Oils and Fats Subsecotr MA/81/5/4.

Table 1 - Regional Copra Production

(metric tons)

COUNTRY	1974	1975	1976	1977	1978	1979
Belize	Neg.	Neg.	Neg.	Neg.	neg.	Neg.
Dominica	2,088	2,454	2,420	2,622	2,666	1,733
Grenada	135	203	215	275	386	200
Guyana	5,000	10,700	11,300	5,900	4,800	2,000
Jamaica	2,947	5,632	5,066	3,041	1,896	2,000
St. Kitts-Nevis	75	104	89	126	200	140
Saint Lucia	5,441	6,102	4,694	5,299	5,818	5,665
St. Vincent	2,660	2,100	1,032	1,586	2,981	2,981
Trinidad and Tobago	6,398	8,233	8,579	8,747	6,684	5,000
TOTALS	24,744	35,528	33,359	27,596	25,431	19,719

Processing

Two major conditions characterize the processing segment of the industry:

1. Existing facilities range from modern and efficient to old and inefficient:
2. Plant inefficiency is due in part to a shortage of suitable raw materials: conversely, many of the plants are only suitable for processing copra and were not designed to process other oilseeds. Both technology and under-utilization adversely affect the economic of processing.

The status of processing plants are shown in Table 2.

Table 2 - Status of Coconut Processing Plants

Country	Plant	Oil Milling		Oil Refinig	
		Capacity TPY	Utilization %	Capacity TPY	Utiliza %
Antigua	Edible Oil Factory	250	36	-	-
Dominica	Dominica Coconut Products, Ltd.	6,000	67	3,347	16
Grenada	Tempe Manufacturing	5,000	9	876	30
Guyana	Demerara Oil and Cake Mills	5,000	19	3,740	16
	Majarajah Oil Mills	15,000	8	-	-
Jamaica	SEPROD Company, Ltd.	14,760	54	14,126	96
Saint Lucia	Copra Manufacturers	12,000	50	5,217	33
St. Vincent	Armos Vale (1979) Ltd.	1,800	100	1,970	28
Trinidad and Tobago	Lever Bros. W.I. Ltd	15,000	22	17,325	55
	Coconut Growers Association	9,000	40	10,000	41
TOTALS (Averages)		83,810	(37.2)	56,600	(54.5)

Supply-demand Forecasts

Three major conclusions were drawn in assessing the supply potential of the region:

1. In the medium term, assuming appropriate corrective measures, it is projected that the decline of production can be arrested and returned by 1985 to a level approaching that of 1970. The projected levels of production are shown in Table 3.

Table 3 - Projection of Coconut Production

(thousands of nuts)

Country	1970	1978	1985
Belize	8,800	23,457	23,457
Dominica	15,100	20,872	20,872
Grenada	7,800	8,209	4,000
Guyana	70,000	25,000	25,000
Jamaica	140,000	128,400	158,000
St. Kitts-Nevis	800	6,850	6,850
Saint Lucia	46,600	25,481	25,000
St. Vincent	16,400	14,550	24,844
Trinidad and Tobago	69,700	39,420	39,420
TOTALS	395,200	292,239	353,405

Table 4 - Production Forecasts - Coconuts and Oil

Country	1978			1985	
	No. of Nuts (000's)	Oil Production (T) Potential	Actual	No. of Nuts (000's)	Potential Oil Production (T)
Belize	23,457	2,962	0	23,457	0
Dominica	20,872	2,635	1,094	20,875	2,635
Grenada	8,209	648	126	4,000	50
Guyana	25,000	3,156	1,263	25,000	1,263
Jamaica	128,400	22,140	1,263	258,400	27,313
St. Kitts-Nevis	6,850	865	88	6,850	200
Saint Lucia	25,481	3,576	3,576	50,962	7,152
St. Vincent	14,550	1,837	1,837	24,444	3,086
Trinidad and Tobago	39,420	4,977	3,156	39,420	3,156
TOTALS	292,239	42,796	12,403	353,405	44,855

Table 5 - Demand Forecasts for Various Oil Products (tons)

Country	Edible Oil		Margarine/Shortening		Soaps		Totals	
	1978	1985	1978	1985	1978	1985	1978	1985
Antigua	288	308	45	48	21	32	354	388
Barbados	1,614	1,713	192	242	76	126	1,822	2,081
Belize	140	168	23	32	38	69	201	269
Dominica	468	509	28	35	35	44	531	588
Grenada	411	411	45	54	44	55	500	520
Guyana	6,205	7,196	255	304	299	405	6,579	7,905
Jamaica	12,765	13,693	1,207	1,457	729	1,249	14,519	16,399
Montserrat	49	49	7	9	8	10	64	68
St. Kitts-Nevis	197	210	34	36	18	25	249	271
Saint Lucia	665	686	52	71	47	55	764	812
St. Vincent	850	899	35	48	36	47	921	994
Trinidad and Tobago	10,251	11,751	644	819	507	824	11,406	13,394
TOTALS	33,723	37,593	2,387	3,155	1,856	2,941	37,966	43,698

2. Production of coconuts is unlikely to exceed the 400 million level unless Jamaica achieves its planned 35,000 acre rehabilitation programme over a ten year period:

3. Non-traditional crops represent, at best, a long-term solution, and should be bolstered by a well focused programme of research and development.

Targets for the industry involved a reduction of the coconut oil deficint from 6.4 million gallons to 5.4 million gallons in 1985 and to 3.9 million gallons in 1990.

III. INFORMATION FROM COUNTRIES VISITED

Antigua

Coconut and Copra Production

There are no coconut production statistics and copra has never been produced commercially in Antigua. Food-nut consumption and whole nut sales are insignificant. A trip to the southern section of the island revealed a large quantity of nuts scattered and abandoned under coconut trees. Although the trees are mostly advanced in age, they can possibly bear about 50 nuts per year. Assuming a productivity of 2,000 nuts per acre per year, the potential nut production is 1 million nuts per year. Assuming further that 80 per cent go to copra making and a conversion of 5,000 nuts per ton of copra, the copra production potential in Antigua is about 140 tons per year.

The neighbouring island, Barbuda, is reported to have more coconuts than Antigua and there has been some copra production in recent years. Based on this information, the potential copra production in Antigua and Barbuda can be about 300 tons per year.

Nevis has been producing copra for the Factory in Antigua. The statistical projection of coconut production in 1985 is 6.8 million nuts per year.[1/] Assuming that 70 per cent of the nuts are made to copra, the copra production potential for Nevis is about 700 tons per year.

Summing up, the total copra production potential for Antigua, Barbuda, St. Kitts and Nevis is about 1,000 tons per year.

Processing

The Edible Oil Factory in Antigua has a copra milling capacity of 5 tons per day and an oil refining capacity of three tons per day. On the basis of 200 days per year, the Plant's capacity is 1,000 tons of copra and 600 tons of oil per year.

The equipment and machinery for both the oil mill and refinery were supplied by Rosedowns and are about 25 years old. Management has complained of low extraction, high refining losses and poor quality.

1/ CARICOM Secretariat: Oils and Fats Sub-sector MA 81/5/4

The plant needs rehabilitation, some physical improvements and better operations techniques. With these, the efficiency of the plant can be improved to viable levels. A pre-feasibility study indicates that the operations of the plant can be viable at 50 per cent capacity utilization.[1/]

Marketing

The estimated refined oil consumption in the area are as follows:

Antigua-Barbuda	370 metric tons per year
St. Kitts-Nevis	250 metric tons per year
Total:	620 metric tons per year

The copra production potential and the plant processing capacity are sufficient to meet the refined oil need of the area.

Needs

1. Establishment of Copra Centrals in Antigua, Barbuda and Nevis.
2. Rehabilitation and improvement of plant equipment.
3. Technical assistance for training of personnel for operations.
4. Rehabilitation and fertilization of existing plantations.
5. Expansion of coconut plantation to provide for future increase in consumption and decline of productivity of the trees due to age and senility.
6. Rationalization of prices of edible oil products to improve the viability of copra making and oil processing.

Belize

Coconut production

The present land area planted to coconuts in Belize is estimated at 8,900 acres, mainly concentrated along the coastal areas and the cayes. According to a recent survey, about 1,700 farmers grow coconuts with a majority having only about 100 trees. There are a few larger plantations. Many farms are neglected and nuts are piling up due to lack of markets or processing facilities. In 1981, the coconut production was estimated to be about 18 million nuts per year. Copra has not been produced in commercial quantities. In recent years, there had been occasional exports of whole dry nuts to the United States.

1/ Refer to Annex I for Pre-feasibility Study.

The Coconut Rehabilitation Project

A Coconut Rehabilitation Project has been launched since 1981 by the Belize Government with a fertilizer supply grant from the U. K. Government. The project is managed by the Belize Marketing Board. The project aims to rehabilitate the existing coconut plantations and to expand coconut production through a replanting programme. With proper farm maintenance and regular fertilization, production was expected to double in three years. The new plantings are expected to start bearing after five years and an increase of some three million nut production is expected after nine years. The programme envisions a production of at least 10 million nuts in 1995.

Processing

With about four million nuts, Belize has a copra production potential of about 600 metric tons per year. This is expected to double in 1985. At present there are a number of small-scale oil producers or "oil boilers" who supply part of the cooking oil needs. There is a plan to put-up a processing plant for the production of refined oil, shortening and margarine which will utilize various oilseed and copra. When this plant will be in operation, Belize will be self-sufficient in edible oils and may have to export its production in excess of its needs. While waiting for the operation of this plant, the Marketing Board is offering to sell copra to other CARICOM countries. Interested parties may send their offers to the General Manager, Belize Marketing Board, P.O.Box 479, Belize City, Belize, Central America.

Needs

1. Technical assistance on copra production;
2. Setting-up of suitable copra making facilities;
3. Market for about 600 metric tons of copra per year;
4. Technical assistance for the control of coconut mites;
5. Increase in copra prices to make copra production viable.

Dominica

Coconut and Copra Production

Dominica had about 10,100 acres of coconut land with about 376,999 bearing trees before hurricane David in 1979. There were 1 647 registered copra growers with 2,303 landholdings. The average farm size was 4,4 acres. Productivity was about 2,100 nuts per acre and a nut production of roughly 21 million nuts was reported in 1978. In the same year, 2.666 tons of copra were produced, equivalent to about 13.3 million nuts which is 63.4 per cent of coconut production estimates. The balance went to whole nut export, local consumption, and as unrecovered nuts.

Dominica is said to be the most mountainous country among the Caribbean islands. Consequently, most of the coconut farms are on steep mountain-sides and deep valleys. This situation makes farm maintenance difficult and farm mechanization impractical. Nut recoveries can be low due to bad terrain and poor visibility due to weeds and thick undergrowths.

About 30 per cent of the coconut trees were damaged by the hurricane. Copra production dropped from 2,666 tons in 1978 to 834 tons in 1980, the year after the hurricane. Copra production dropped further to 692 tons in 1981 or 26 per cent of pre-hurricane production. In 1982 the copra production picked-up to 1.620 tons and during the first seven months copra production averaged about 200 tons per month. With production steadily increasing, a production of more than 3,000 tons is probable for 1983, which is 12.5 per cent higher than pre-hurricane level. The meteoric rise in copra production is evident of the recovery of the trees from the effects of the hurricane and the effects of the Coconut Rehabilitation and Expansion Project which is jointly undertaken by the Canadian International Agency and the Government of Dominica.

The Coconut Rehabilitation and Expansion Project is a nine-year programme which started in 1981 and ends in 1989. The project involves an aid of C$ 4.0 million from the Canadian Government, which will cover the following:

1. Planting material for replanting 3,000 acres of coconut farms destroyed by the hurricane:
2. Planting material for 3,000 acres of expansion area:
3. Fertilizer for two years for bearing trees and for four years for new trees:
4. Medicide and pesticide, on case to case basis:
5. Building materials for the repair of dryers damaged by the hurricane:
6. Construction of five new dryers which will be operated by co-operative:
7. Building of farm roads in the expansion areas:
8. Equipment for land clearing, such as brush-cutters and chain-saws.

A fifty per cent increase in coconut production is expected in 1985. In 1990, when the new plantings will be in full-bearing, fifty million nuts are expected to be produced from some 13,000 acres of coconuts. This will mean a potential of about 10,000 tons of copra which will be about twice the present milling capacity at Dominica Coconut Products plant.

Hampstead Estate

Hampstead Estate has 320 acres of coconut land, mainly on steep mountainsides. An average of 15,000 nuts are collected every week, which is about 750,000 nuts per year. The estate has begun its fertilization programme under the Coconut Rehabilitation Project in 1981 and a substantial increase in fruit-bearing of the trees is evident. An average productivity of 80 nuts per tree is a reasonable estimate despite of the trees being in advanced age. Actual nut recovery is, however, only about 60 nuts per tree or a probable loss of 25 per cent. The low recovery is attributed to the rugged terrain which makes both weeding and gathering difficult and the poor visibility due to weeds and tall undergrowth.

Only fallen nuts are harvested. Since the terrain is rugged and mechanization of farm operations is impractical, all farm work is done by manual labour. Harvesting, husking, covering, gathering and bringing of nuts to the roadside are paid by tasks or contractual basis. From the farm, the nuts are hauled by a tractor-drawn trailer to the copra factory.

The estate operates a copra factory. The factory has a large malayan-type copra dryer with three separate compartments which are operated alternately. Each compartment has a capacity of 3,000 nuts. With 2 charging per week the dryer has a capacity of 18,000 nuts per week.

Processing

All copra in Dominica are processed at the Dominica Coconut Production plant in Roseau. The plant has an oil mill, oil refinery, complete lines for toilet soap and laundry soap, glycerine recovery and evaporation equipment and plastic-bottle making machines. The laboratory is adequately equipped for quality control.

The oil mill consists of a Rosedown Mark II expeller and a Lion Anderson Expeller, hammer mill, cookers, screening tank and standard auxillary equipment. The combined milling capacity is 24 tons of copra per 24-hour operation. Residual oil in cake ranges from six to seven per cent and recoveries vary from 150 to 153 tons of oil per ton of copra. On the basis of 250 days a year, the milling capacity of the plant is 6,000 tons.

The oil refinery is a conventional Rosedown oil refining plant. Basically, it consists of a batch neutralized-bleacher, a batch deodourizer, cooler, a high-vacuum system and filters. Refining losses vary with the quality of the oil but recoveries are relatively high. The refinery has a capacity of about 15 tons of oil per 24-hours operation. Operated 250 days a year, the refinery capacity is 3,750 tons of oil. The capacity of the refinery can be increased by fifty per cent with the addition of a vacuum bleacher.

Needs

1. Development of new products in anticipation of excess nut production;
2. Development of idle estates and farms for copra production;
3. Setting-up of copra centrals for the small farmers;
4. Feasibility studies for by-products utilization;
5. Development of a systems to maximize nut recoveries and improve farm maintenance;
6. Rationalization of prices of edible oil products to improve viability of copra production and oil processing.

Grenada

Coconut and Copra Production

There are roughly, 4,000 acres of coconuts in Grenada, most of which are located in the eastern, north-western and southern coastal areas. Like the other islands, Grenada is a mountainous country and the coconut plantations are, largely, on mountain sides and hilly land. Farm sizes vary from a few acres to large estates. Hope Estate, the largest coconut plantation has 250 acres; Paradise Farms of Grenada Farms Corporation has 150 acres in coconuts. Some of the farms are of pure stands and many intercropped with bananas and other food crops. Most of the copra produced come from large farms and estates while the small producers tend to sell their produce as green nuts or dry nuts. It is estimated that productivity in the island averages about 40 nuts per tree or roughly 2,000 nuts per acre per year. Based on this assumption, the potential nut production is about 8 million nuts per year. Copra production in 1982 was 973,500 pounds or 440 tons. Based on 6,000 nuts per ton copra, 2,640,000 nuts were made to copra. Dry nuts sales was recorded to be about 120,000 nuts. Assuming that 1 million nuts go to local consumption as green nuts and dry nuts, some 4 million nuts remained uncollected or 50 per cent of production. There is a general neglect of coconut plantations, some farms overrun with weeds and grasses. With this condition, nut collection and gathering are difficult tasks. This partially explains low nut recovery.

It is reported that copra-making in Grenada is largely by sun-drying. There is an acute lack of drying facilities. This accounts for the preference of small farmers to sell their nuts instead of making copra. Since the market for nuts is limited, some nuts would remain uncollected. During the first six months of 1983, 512,000 lbs of copra were produced. If the trend continues, production in 1983 will probably be close to 500 tons, roughly equal to the production in 1982. (Note that there has been a significant increase in copra production in the other islands between 1982 and 1983). With a probable production of eight million nuts, Grenada's potential copra production is about 1,300 tons per year. The actual production is only 36 per cent of potential.

Grenada's edible oil requirement is about 500 tons per year. Deficit in oil production is supplied from imported oils. If the coconut production estimates are about right, the potential oil production is 700 tons per year. This indicates that Grenada has possibilities for self-sufficiency in edible oils.

Processing

The Tempe Manufacturing plant in St. George processes all copra in Grenada. The plant is, basically, a Rosedowns plant consisting of an oil mill, refinery and laundry soap plant.

The oil mill has a Mark II expeller, with cookers, hammer mill, gravity oil screen, filter press and a cake mill. The expeller has a capacity of 17 tons of copra per 24 hours operation. With 500 tons of copra, the mill need operate only 30 days to process the copra production. Basing on 200 days operation, the mill capacity is 3,400 tons per year and the capacity utilization is about 15 per cent. In 1982, out of 972,648 lbs of copra milled, 1,268 drums or 57,060 gallons of refined oil were produced. Allowing for reasonable refining losses, the extraction rate is only 140 gallons per ton copra. Part of the inefficiency is due to the quality of copra milled.

The refinery consists, basically, of a batch neutralizer, vacuum bleacher, deodourizer, cooler and filters. Steam is produced by a locomotive-type oil-fired steam boiler which operates at 100 psig. A superheater heats the stripping steam for the deodourizer. The vacuum system is a barometric condenser-vacuum pump series capable of effecting a relatively low vacuum. Refinery capacity is about four tons oil per day.

The soap plant consists, basically, of a soap kettle, crutcher, slabber, cutter and stamping machines. Soap stock is made into coloured laundry soap.

Needs

1. An intensive copra production programme;
2. General rehabilitation of coconut farms and pest control;
3. For the Tempe plant: a high pressure boiler, more efficient vacuum pump and more equipment for the laboratory;
4. Rationalization of prices of edible oil to improve the viability of copra production and oil processing.

Guyana

Coconut and Copra Production

According to a government survey in 1978, there were 16,450 farms with coconuts, 2,862 of which are of pure stands and 14,622 were with scattered plantings. The area with pure stands was 21,433 acres while there were 367,646 trees in scattered plantings. The main coconut producing areas in Guyana are shown in Table 6.

Table 6 - Main Coconut Producing Areas

Area	Total No. of farms with coconuts	Pure Stands		Scattered Plantings	
		Farms	Acres	Farms	Palms
Esquibo Coast and Islands	3,547	552	2,153	3,230	98,905
East Demerara	3,610	671	12,143	3,022	41,270
East Berbice	4,886	771	1,707	4,518	90,419
North West and Pomercon	1,555	381	3,495	1,159	105,185
Totals:	13,407	2,375	19,498	11,929	344,788

Source: Guyana Rural Household Survey, 1978 - Min. of Agriculture

Two significant changes had happened since 1978:

1. Some of the coconut plantations had been converted to rice production and housing lots:
2. Ownership of land and sizes of farms could have changed.

The reduction of acreage is assumed to be about ten per cent. The change in ownership could not have changed productivity significantly. With these assumptions, the present area under coconuts could be about 19,000 acres. At an average of 2,000 nuts per acre from pure stands, and fifty nuts per tree from scattered plantings, the total nut production is about 55 million nuts per year. This is about twice the recorded nut production in 1978. Table 7 shows the production of nuts, copra, and refined oil from 1970 to 1979 and copra and oil production from 1980 to 1982.

Table 7 - Production of Nuts, Copra and Refined Oil in Guyana

Year	Nuts ('000)	Copra ('000 lbs)	Refined Oil ('000 lbs.)
1970	50,000	11,365.8	7,910
1971	55,000	14,609.3	8,900
1972	28,500	17,295.0	10,690
1973	27,400	9,950.9	7,180
1974	26,400	5,004.2	2,900
1975	31,300	10,687.3	7,010
1976	32,400	11,258.4	6,454
1977	25,200	5,927.9	3,358
1978	27,587	4,792.1	2,9755
1979	33,200	4,736	1,918
1980		4,050	2,349*
1981		2,365	1,372*
1982		1,345	780*

*Refined oil calculated as 58 per cetn of copra.

Source: Ministry of Agriculture statistics.

It can be noted that in 1976, the ratio between nut production and copra production is 2.87 which is about the number of nuts required to produce a pound of copra. It is possible, then, that domestic nut consumption and nut sales were not included in the production figure. If we assume that six million nuts went to consumption and nut sales and a seventy per cent nut recovery, the actual nut production in 1976 was 55 million nuts - a figure which tallies with previous calculations based on acreage. If we now assume a decrease in nut production of ten per cent from 1976 to 1983, for various reasons, the present nut production in Guyana is about 50 million nuts a year. On the basis of 5,000 nuts per ton of copra, 10,000 tons of copra can be produced from 50 million nuts. Based on a recovery of 59 per cent from milling and refining, the potential refined oil production is 5,900 tons or 82 per cent of estimated annual consumption of 7,200 tons in 1985.

It would be interesting to note that in Trinidad, they were able to produce 5,000 nuts per acre by clearing under the trees and providing facilities for maintenance, gathering and copra making, even without fertilization. It would be safe to assume that by doing the same to the coconut plantations in Guyana, the productivity can also be increased to 3,000 nuts per acre or 50 per cent more than the assumed value of 2,000 nuts. Even without fertilization or replanting, Guyana has, therefore, the possibilities of achieving self-sufficiency in refined oils.

Rebuilding the Copra Industry

The greatest need of the coconut industry in Guyana is to rebuild its copra industry. As shown earlier, the country has the potential for self-sufficiency in edible oils. In order to achieve this goal, at the least cost and in the shortest time, it is recommended that a coconut industry enterprise, such as a Coconut Development Company, be created and which shall undertake the following programme and functions.

1. To lease or rent all abandoned and under-exploited coconut estates and farms and to exploit and develop these lands for viable copra production operations;
2. To acquire funds and manage the operations of the enterprise;
3. To undertake such other activities that will be required for the development and viability of the coconut industry.

Guyana should not stop at self-sufficiency. It has the land and the climate suitable for coconuts. It should aim at being able to export not only oil but also other coconut products. The coconut industry is still the most reliable and stable agro-industrial industry. A coconut replanting programme should then be launched in the earliest opportunity and time.

Processing

The three oil processing plants in Guyana are shown in Table 8.

Table 8 - Capacities of Oil Mills and Refining Plants in Guyana

Name of Company	Capacities based on 300 Days	
	Oil Mill (tons copra)	Refinery (tons Oil)
Demerara Oil and Cake Mill	5,000	3,600
Maharaja Oil Mill	9,000	4,500
National Edible Oil Company (GPC)	13,500	7,600
TOTAL	27,500	18,200

The Demerara Plant consists of an oil mill, an oil refinery and a small shortening plant. Milling equipment consist of a Maxoil Duplex and two small Maxoil expellers from Rosedowns, hammer mills, rollers, cookers, oil screeners and filter press. The mill has a capacity of seventeen tons per 24 hours operation. The refinery is a conventional batch-plant consisting of neutralizers, bleacher, deodourizer, cooler, filter press and cooling tower. Vacuum system is a barometric condenser-vacuum pump series. The shortening plant consists of blending tanks and a drum-type chiller. Steam is supplied from oil-fired vertical boilers and passed through a separate super-heater. The refinery capacity is about 12 tons per 24 hours.

The Maharaja Plant consists of a full-press Anderson Oil Mill plant and a Rosedowns batch oil refinery. The mill consist of two Anderson-Duo expellers with a hammer mill, vibrating screen, filter press, and copra cookers. Milling capacity is 30 tons copra per day. The refinery is a Rosedowns batch-type design with a combined neutralizer-bleacher, bleaching filter, deodourizer-cooler and a 3-stage jet-ejector vacuum system. Steam is supplied from a high-pressure oil-fired steam boiler. The refining capacity is about 15 tons of oil per day.

The NEOCOL plant consists of a mechanical pressing plant, a solvent extraction plant and a refinery, supplied turn-key by SKET of Germany. The mechanical press can be operated as a pre-pressing plant for the solvent extraction plant or as a full-press plant. The pre-pressing capacity is about 45 tons of copra per 24 hours operation and 24 tons of copra as a full-press plant. Oil in cake after pre-pressing is about twenty per cent and about ten per cent after full-pressing. The mill consists, basically, of a copra breakers, expellers with cookers, vibrating oil screen, filter press and cake cooler. The solvent-extraction plant is a batch design, basically consisting of a batch-type rotary extractors, solvent tanks, miscella tanks, miscella filer, miscella evaporator and solvent recovery system. The plant has a capacity of about 24 tons of feed (pre-press cake) per 24 hours operation. Residual oil in cake, after solvent extration ranges from one per cent to three per cent and the solvent loss ranges from four to eight kilogrammes per ton of feed material. The solvent-extraction plant can process rice bran or corn germ. Refinery equipment consist, basically, of open-type neutralizers, vacuum-bleacher, deodourizer-coolers and a bleaching filter. The vacuum system is a booster-vacuum pump series (without inter-condensers). Steam is supplied from high-pressure oil-fired boilers. A cooling tower is used for re-cycling cooling water for the whole plant.

Hope Estate

Hope Estate has a land area of about 4,000 acres planted with various crops and has about 1,600 acres of fruit-bearing coconut trees. In 1982 2,260,900 nuts were harvested and 544,800 lbs (248 metric tons) of copra were produced. Nut recovery is estimated at about 70 per cent and there is a high percentage of immature nuts in the nuts harvested due to the harvesting system. Nuts are harvested by hooking or climbing.

The nuts are transported from the farm to the drying station along water canals in boats and by tractor-drawn trailers. The nuts transported on land are usually dehusked at the farm, while nuts transported by boats are dehusked at the drying station to provide more fuel for the copra dryer.

At the drying station, the nuts are cracked over a container which catches the water. The water is boiled and concentrated to make a kind of local food seasoning. The kernels are "digged" and placed in shallow wire-screen trays. The trays are placed on tray racks inside the dryer where the kernels are dried by hot air. Hot air is produced by a large cylindrical steel duct under the trays. The duct is heated by burning coconut shells and husks in a furnace at the front-end of the duct. Drying time varies from 12 to 16 hours and the dryer has a capacity for 6,000 nuts.

Excess coconut shells are made into charcoal by an improvised steel charcoal retort. Unused coconut husks are made into fibers and handicraft fiber products. Handicrafts are also made from coconut leaf midribs.

Operations of the estate are highly labour intensive. In some of the jobs, cost is controlled by piece-work or contract work. The presence of many immature nuts in the nuts used for copra making indicate that the trees are over-harvested or "forced" harvested. Immature nuts produce less copra and poor quality copra. Some system should be applied to reduce the harvest of immature nuts.

Needs

1. A crash-programme for copra production;
2. Rehabilitation of the Demerara Oil Mills;
3. Wet-processing plant to produce skim milk, edible coconut flour and cooking oil;
4. Feasibility study of a large-scale fiber processing plant for establishment sometime in 1986;
5. Rationalization of prices of edible oil products to improve the viability of copra production and oil processing.

Jamaica

Coconut and Copra Production

Between 1966 to 1979 about 7 million coconut trees had been planted and since then replanting has continued at the rate of about 500,000 trees per year. As of 1982, 43,000 acres have been planted to coconuts, 26,000 of which are full fruit-bearing. A target of 58,000 acres has been set for 1991 with 5.8 million trees. New plantings are mostly "malayan dwarfs". The variety has been chosen over the old caribbean tall due to its apparent resistance to lethal yellowing disease and its early bearage. However, it has a disadvantage as a nut source for copra making due to its thin kernel, small nuts and short shelf-life. It takes about 7000 nuts to make a ton of copra. A new variety called "mapan" a cross between the malayan dwarf and the panama tall is under development. The mapan is claimed to inherit the disease resistance of the dwarf and the nut qualities of the tall parents.

In 1982, the nut production was estimated at 106 million, while in 1983 some 116 million nuts are expected. The equivalent copra production are 15,800 and 17,300 tons of copra in 1982 and 1983 respectively. The actual copra production in 1982 was 1,617 tons and the projected production for 1983 is 2,500 tons. Actual copra productions are only about fifteen per cent of potential. It is estimated that about 40 per cent of nut production goes to jelly-nut consumption, "oil boiling", and to dry-nut sales and consumption. It is apparent that a considerable quantity of nuts are uncollected.

Most of the copra produced come from large coconut estates. Most of the coconut farms belong to farmers with small land-holdings. Copra price averages at about J$1,500 per ton (about EC$2,000) from the farm. It is apparent that increasing the price alone was not sufficient to boost copra production as expected. It is worthwhile to note that the oil production equivalent to the 1983 nut production is about 10,000 tons which is, incidentally, the projected refined oil consumption for Jamaica.

Lethal yellowing disease still exists but has been reduced to controlable levels. The coconut mites are becoming a pest problem. Larceny, which apparently has some relation to "oil boiling", has compelled estate owners to harvest even pre-mature nuts. This down-grades the quality of copra.

The Copra Programme of the Coconut Development Board

To hasten recovery of the coconut industry, the Coconut Development Board started a Copra Programme in 1980. Under the programme, coconut farmers are entitled to free seedlings, weed grant of 32 cents per tree per year, and free fertilizer for a period of five years. In return, the farmers commit fifty per cent of their production to be sold to the Board. The Coconut Development Board is the exclusive copra buyer and copra supplier to SEPROD.

The Bowden Estate, St. Thomas, Jamaica

Bowden Estate has about 1,800 acres in coconuts with about 120,000 trees over six years and full-bearing. In 1982, the production was 2.2 million nuts. As of July 1983 production hit 2.55 million and about 3.8 million nuts are expected for 1983. The trees are mainly malayan dwarfs and the nut to copra conversion is about 7,600 nuts to a ton of copra. Productivity is only about 35 nuts per tree per year, which is very low compared to the normal productivity of the malayan dwarf of 150 nuts.

The Estate operates a copra factory which has three malayan-type copra dryers and Chula copra dryer. Each of the malayan dryers has a capacity of 10,000 nuts capable of two chargings per week. The diesel-fired Chula dryer has a capacity of 30,000 nuts with a drying time of 30 hours. High nut spoilage is noted due to the short shelf-life of malayan nuts and the long storage period due to the size of the dryers. Low copra grade is a result of spoiled nuts, pre-mature nuts and long drying time using the malayan dryers.

The Soap and Edible Products Co., Ltd. (SEPROD)

The SEPROD Plant is an integrated processing plant. The Oil Department operates an oil mill and an oil refinery. The oil mill is an Anderson full-press plant with three Super-duo expellers. The mill has a capacity of about 72 tons of copra per 24 hours operation. The refinery is a continuous plant supplied by Cambrian of Canada, and has a capacity of 90 tons per 24 hours. The refinery was designed to process various edible oils including copra oil and soyabean oil. At present, all copra oil production are used in soap manufacture. Edible refined oil production comes from soybean oil extracted at the Jamaica Soya Products plant.

Needs

1. Setting-up of copra centrals to process nuts from small farms;
2. A more aggressive copra production programme to minimize jelly nut consumption and "oil boiling";
3. Dryer designs with shorter drying time and low operating costs;
4. A programme to control the spread of the coconut mites;
5. A system for lower farm maintenance cost;
6. A project study for the setting-up of by-products utilization facilities and the subsequent establishment of viable plants.

Saint Lucia

Coconut and Copra Production

Before the hurricane "Allen" in 1980, the land area planted with coconuts in Saint Lucia was estimated at about 30,000 acres. Since the country is largely mountainous, a large portion of the coconut farms are located on steep mountain sides. The hurricane damage was estimated at about 25 per cent of the coconuts. Since there has not been significant replantings after the hurricane, the "net" coconut land area at present is about 23,000 acres.

The plantations are scattered widely throughout the island. About 60 per cent of the farms are interplanted with bananas and other food crops. In 1981, there were 2,296 coconut producers registered with the Saint Lucia Coconut Growers' Association producing some 3,700 tons of copra during the year. The farm sizes vary from less than an acre to over 500 acres, with annual productions ranging from about a ton to over 250 tons of copra. Copra yields also vary widely from about 0.1 ton to about 1 ton of copra per acre per year. Records show that smaller farms have generally higher copra yields than the larger estates. This is explained by the fact that many of the small farms are interplanted with bananas which are regularly fertilized and cleaned, while many of the estates are neglected or even abandoned.

In 1981, 85 per cent of copra deliveries to the SLCGA were from small farms with less than 20 tons of copra per year. The following Table shows the copra production in relation to farm sizes before and after the hurricane.

It should be noted that with 23,000 acres, Saint Lucia should produce about 12,000 tons of copra per year. In 1982, the production was 3,755 tons. Production from January to June 1983 was about 3,000 tons during the six months, a production of 6,000 to 7,000 tons copra is anticipated for the year 1983. This is roughly fifty per cent of the potential copra production. If an effective copra production programme is launched, it is probable that 10,000 tons of copra can be produced in Saint Lucia.

Table 9 - Copra Production vs. Farm Size

Category	Number of Producers				Total Copra Delivered (tons)			
Tons Per Year	1978	1979	1980	1981	1978	1979	1980	1981
Below 20	2,418	2,696	2,915	2,282	3,751	4,194	4,626	3,122
20 - 49	20	22	22	9	606	666	608	234
50 - 99	3	4	4	5	187	268	224	346
100- 249	6	6	7	-	780	934	1,027	-
250 and above	1	-	-	-	269	-	-	-
Totals	2,448	2,728	2,948	2,296	5,593	6,062	6,485	3,692

Source: St. Lucia Coconut Growers' Association.

The increase of proudction in 1983 indicates that some of the idle estates have resumed copra production.

Most of the estates and farms require rehabilitation and clearing. Some of the farms and estates have been neglected or abandoned after the hurricane. A loss of about 30 per cent as unrecovered nuts is probable. This is due to bad terrain, poor visibility due to heavy under-growths and abandonment. The coconut mite is a growing pest problem of the coconut industry in Saint Lucia.

Copra Production and Whole Nuts Sales

Copra making is by sun-drying or with the use of the typical malayan copra house. There is an apparent lack of copra dryers, especially for the small farmers who cannot afford to construct a copra house. Since most of the copra come from small producers, the construction of copra drying facilities would significantly increase copra production. All copra are sold to the St. Lucia Coconut Growers' Association, which in turn, sells the copra to the Copra Manufacturers' plant for processing.

In recent years there had been occasional exports of mature nuts to the United Kingdom but the volume has continuously declined from 241 tons in 1978 to 60 tons in 1982. The 1982 nut exportation was less than one-half per cent of copra production. Jelly-nut consumption is estimated at about 2 million nuts per year or about five per cent of nut production.

Processing

The only copra processing plant in Saint Lucia is the Copra Manufacturers' plant located in Soufriere. The plant is owned and operated by the St. Lucia Coconut Growers' Association. The plant has facilities for oil milling, refining and laundry soap production. The Oil Mill has three Rosedown expellers with a total capacity of 50 tons of copra per day. The total refinery capacity is about 24 tons of oil per 24 hours operation. Based on 300 days operation the milling capacity is about 15,000 tons of copra, while the refining capacity is about 7,000 tons. The soapstock from the refineries go to laundry soap production. With the projected production of 6,000 tons in 1983, the mill will have a fourty per cent capacity utilization. Assuming that all crude oil is converted to refined oil, the production will be about 3,500 tons or 840,000 gallons. This will mean a capacity utilization of about 50 per cent.

The Oil Mill is relatively an efficient plant. With only six per cent residual oil in cake, as reported, extraction is about 150 gallons per ton of copra. Reports show, however, that refining losses are on the high side. The refineries are of the conventional batch systems.

The plant has two steam boilers, one of which is in use, in a Bunker-C fired fire-tube boiler, while the other is a water-tube boiler. The water-tube boiler can easily be converted for coconut-shell firing.

Consumption and Market

Refined oil consumption for Saint Lucia was estimated to be about 194,000 gallons or 800 tons in 1983. This is equivalent to, approximately 1,300 tons of copra, roughtly twenty per cent of projected copra production for the year. The 1985 exportable surplus will be about 650,000 gallons.

Areas for diversification

1. Production of fibers and fiber products from coconut husks;
2. Production of charcoal and charcoal briquets from coconut shells;
3. Production of coconut food products.

Needs

1. Rehabilitation and development for copra production of neglected or abandoned coconut estates and farms;
2. Setting-up of copra centrals for the small copra farmers;
3. A feasibility study for the commercial utilization of coconut by-products and a consequent establishment of processing plants, if feasible;
4. A programme for controlling the coconut mite;
5. A replanting programme to increase capacity utilization of existing processing plant and to provide raw materials for other coconut products;
6. A feasibility study for the establishment of electric power plant using coconut shell as fuel for steam-turbine system;
7. Rationalization of prices of edible oil to improve the viability of copra production and oil processing.

St. Vincent

Coconut and Copra Production

St. Vincent has approximately 5,600 acres of coconut land most of which are on the western coast of the island. Like most of the Caribbean islands, the country is largely mountainous. Consequently, most of the coconuts grow on mountainsides and valleys. More than 70 per cent of the coconut land belong to large estates. The two largest estates, the Orange Hill Estate and the Union Estate, occupy about 3600 acres. Based on 2,500 nuts per acre, the norm for the island, the potential nut production is roughly 14 million nuts per year. In 1982, actual nut production was 9,134,000 of which 1,022,000 were exported as dry nuts. Incidentally, the dry nut market has been on a constant decline. In St. Vincent the dry nut exports dropped from 4,130,000 in 1980 to 1,022,000 in 1982. The local nut consumption is placed at five per cent or about 700,000 nuts per year. Adding up, some four million nuts must have been left uncollected or about 28 per cent of potential production. This value is probable and understandable considering the bad terrain and tall undergrowths in many of the farms.

More than 90 per cent of the copra produced come from the estates. The large estates have "industrialized" their copra production. This is the reason for the increase in copra production and the good quality of copra. In 1981, copra production was 1,130 tons. This jumped to 1,673 in 1982. About 2,000 tons of copra are expected in 1983. Potential copra production based on 5,000 nuts per ton is 2,800 tons. The 1982 copra production is about 60 per cent of the potential. The constraints for increased copra production are: 1) limited milling capacity; 2) problem of market for oil; and 3) lack of copra making facilities for the small farmers.

More than 50 per cent of the coconuts are infested with coconut mites. This has reduced the size of the nuts and nut production. Weed growth is another problem since the volcanic soil seems suitable for weeds and grasses but is deficient for coconut growth. The heavy undergrowths provide suitable habitats for rats.

Union Estate

Union Estate is about 400 acres largely planted with coconuts with some parts interplanted with bananas and other crops. The farm yields some one million nuts per year. Calculated at 40 trees per acre, the resultant productivity is about 65 nuts per tree. Some sections of the farm, interplanted with bananas yield more than 90 nuts per tree. This is due to fertilizer-sharing with the bananas, good maintenance and almost complete recovery due to the existence of bananas. The nuts are relatively large and the nut to copra conversion ratio is about 5,000 nuts per ton copra. Mite infestation is still limited but is spreading to a wider area.

The farm is well maintained by regular brush cutting schedules. Due to the rugged terrain, most of the farm jobs, including clearing and weeding, are done by contractual labour. It is claimed that good farm maintenance resulted in about 17 per cent nut production and recovery. Only fallen nuts are harvested. Most of the nuts are dehusked in the farm and are transported to the copra station by tractor-drawn trailers and hired trucking.

Copra making operations are all on contractual work. The nuts are cracked then the kernels are removed from the shell in one station. The kernels are hauled by trucks to the drying station. Forced-draft diesel-fired dryers are used. A drying cycle is about 24 hours. The copra produced is of high quality. The free fatty acid content of oil is reported to be less than 0.5 per cent.

Union Estate has an idle coconut fiber processing plant. Equipment include a defibering machine, baling press, machines for making twines, ropes, brushes and matting information on the fiber plant can be obtained from Mr. Werner Voeth of CDB, Barbados. The plant has a capacity to process husks from 8,000 nuts per eight hours operation.

Orange Hill Estate

Orange Hill Estate is a 3,200 acre coconut plantation. The farm yields about 4.2 million nuts per year or about 1,300 nuts per acre. This is relatively low compared to Union's 2,500 nuts per acre. Based on 2,500 nuts per acre, the estate should produce some eight million nuts per year. Nut recovery is a very difficult problem due to the bad terrain and heavy undergrowths which make nut-picking difficult and expensive. The size of the plantation may also contribute to the low efficiency of nut collection. Orange Hill Estate is in the vicinity of the Soufriere volcano. The rich volcanic soil favours growth of weeds and grasses but is not suitable for coconuts. Weed control and brush cutting, which are mostly done by labour, are both technical and cost problems. Hauling of nuts to the factory and brush-cutting on flat land are by tractor operations. Practically all other jobs are by contractual labour. The estate has five tractors for nut hauling, brush-cutting and other odd jobs. Normally, two brush-cuttings are scheduled per year.

Based on eight million nuts and an average of 6,000 nuts per ton of copra, the copra production potential of the estate is 1,300 tons per year. Most of the nuts are made into copra with some exportation of choice-nuts. The estate operates a copra factory. The plant has three forced-draft diesel-fired dryers, each with a capacity of about 12,000 nuts. Drying cycle is about 30 hours. Drying cost is high due to expensive fuel and long drying time. Actual copra production from 4.2 million nuts is about 700 tons per year.

Processing

The oil mill and refinery plant owned by Arnons Vale (1979) Ltd. processes all copra in St. Vincent. The plant is a conventional Rosedowns plant. The oil consists of 3 Maxoil expellers, hammer mill, copra cookers, gravity screen and an oil settling tank. With the two expellers used for pre-pressing and the third for final pressing, the old mill has a capacity of ten tons of copra per 24 hours operation. The refinery consists of a neutralizer-bleacher, deodourizer-cooler, bleaching filter, and water cooling towers. For deodourizing two types of vacuum systems are installed: a steam jet-ejector system and a vacuum pump system. Two forced-draft cooling towers are used; one for condenser water and one for cooling. The refinery has a capacity of 15 tons of oil per day. Steam is supplied by an oil-fired boiler.

The capacity of the mill and refinery are not balanced. For the size of refinery, the oil mill should have a capacity of about 25 tons of copra per day. The oil mill's capacity should be increased to accommodate the anticipated increase in copra supply and to balance the refinery's capacity. This can be done by adding more Maxoil units or replacing the small expellers with one Anderson Superduo 33 or a Rosedowns Mark III. The plant also needs a filter press to replace the settling tank. The quality control laboratory needs additional equipment for process and quality control.

Needs

1. Feasibility studies to re-activate the coir fiber plant at the Union Estate and the coconut shell button plant at the Orange Hill Estate;
2. Expansion and improvement of the processing plant;
3. A system to reduce cost brush-cutting and weeding at Orange Hill Estate;
4. A programme of fertilization and pest control;
5. Market for refined coconut oil;
6. Copra making facilities for the small farmers;
7. Shell fired hot air generator to replace diesel burner for drying copra;
8. Rationalization of prices of edible oil to improve the viability of copra production and oil processing.

Trininad and Tobago

Coconut and Copra Production

In 1955, the area of coconut land in Trinidad and Tobago was estimated at about 40,000 acres. Due to neglect, deaths of trees owing to disease and old age, conversion of coconut land to housing subdivision and other purposes, the area has diminished through the years. At present, only about 28,000 acres of productive coconut land remain. Most of the lands are in large estates and more than 80 per cent of copra production come from these estates. The major coconut-growing districts in Trinidad are: Cedros-Icacos, Manzilla-Mayaro-Guayaguayare, St. Andrews-St. David, Moruga, Chaguanas and Claxton Bay; and North St. George-Bianchissuse.

Cedros-Icacos district is in the southwestern end of the island of Trinidad. There are nine large coconut estates in the district. Their acreage and productivity are shown in the following Table.

Table 10 - Acreage and Productivities of Coconut Estates in Cedros-Icacos District

Estate	Area Under Coconuts (Acres)	Productivity Nuts per Acre Per Year	Potential Nut Production (000)
1. Singh's Estate	2,660	4,000	10,600
2. Perseverance	950	4,000	3,800
3. St. Quintin	750	5,000	3,750
4. Providence	230	5,000	1,150
5. St. Andrews	700	5,000	3,500
6. Constance	1,200	5,000	6,000
7. L'Enviense	450	5,000	2,250
8. Colombia	1,200	5,000	6,000
9. Carlysle estate	190	2,000	380
TOTAL	8,330		37,430

Source: The Situation of Tree Crops (1981) R. Griffith

Due to the effects of the coconut mites in the area, there was a significant reduction of the sizes of the nuts. Present conversion averages about 6,500 nuts to a ton of copra. With this assumption, the potential copra production from the district's estates is about 5,700 tons of copra per year. The estates have mechanized both their farm and copra making operations. Eight have brush-cutters, copra dryers, seven have cracking machines and six raise livestock (water buffalos and/or cattle) under the coconut trees. Cedros-Icacos district produce about 30 per cent of the copra in Trinidad and Tobago. Red-ring disease is under control, however, Cedros wilt has affected about 500 acres at St. Andrews and Singh's estates. The coconut mite is major pest problem in the Cedros-Icacos area. Because of disease and labour problem, Carylsyle estate has become almost abondend. The trees average about 45 years of age and about 15 per cent of productive areas have to be rehabilitated.

The Manzanilla-Mayaro-Guayaguayare district, which is located along the east cost of Trinidad is the second largest coconut district and copra producer. Fifty per cent of the copra producers are in this district, 98 per cent of which are small farmers producing less than 5,000 lbs. of copra per year. Due to shortage in labour and high wages, the large estates have mechanized their operations and graze cattle to help in controlling weed growth. There are 14 large estates in the district with a total area of about 5,000 acres. Forty per cent of the farms are high producers with productivity of about 5,000 nuts per acre while the rest average about 2,000 nuts per acre. The estimated production from the 14 estates is about 17 million nuts per year. There are occasional cases of Cedros wilt and Red ring diseases in the area, more often in the poorly maintained farms. Thirteen of the 14 estates have brush-cutters, 6 have mechanical dryers, and three have cracking machines.

The St. Andrews-St. David district is on the northeastern end of Trinidad. There are 13 larger estates with a total area of about 2,500 acres. This is the less-developed coconut region and there is hardly any mechanization in copra production or farm work. Copra is generally sun-dried. Four of the estates with a total area of about 700 acres have ceased to produce copra. The rest of the estates have an average productivity of about 2,000 nuts per acre. Total nut production in the district is estimated at about 3.6 million nuts per year.

Moruga, Chaguanas, Claxton Bay and Blanchissuse have a total area of about 3,000 acres in coconuts. However, due to urbanization which have converted many coconut farms into housing subdivisions, the area of coconut land has decreased considerably. Interest in copra production is also low. The production of copra in this district have become minimal. Tobago produces about ten per cent of copra in Trinidad and Tobago.

In 1982, copra production was about 8,000 tons. With the present rate at which copra is delivered to the CGA plant, a production of at least 12,000 tons during 1983 is possible. With 28,000 acres averaging about 3,500 nuts per year, the potential nut production in the country is about 98 million per year and the potential copra production, calculated at 6,500 nuts per ton is in the vicinity of 15,000 tons per year. Assuming a 59 per cent recovery from milling and refining, the refined oil producible will be 8,850 tons per year which is about 74 per cent of the country's consumption.

To be self-sufficient in edible oil, Trinidad and Tobago needs about 140 million nuts per year, requiring about 40,000 acres in coconut plantations.

St. Andrews Estate (Cedros)

St. Andrews Estate has an area of about 800 acres, mainly planted with coconuts. Production is about 150,000 nuts per fortnight or 3.6 million per year. This means an actual productivity of 4,500 nuts per acre per year. Since the plantation is almost clear of tall weeds, nut recovery is high, possibly over 90 per cent. The nuts are relatively small due to shrinkage-effect of the coconut mites. Conversion has reduced from 400 lbs per 1000 nuts, before mite infection, to an average of 321 lbs at present. This is equivalent to 6,850 nuts per ton of copra.

The land is, generally, of flat terrain. Both farms and copra making operations are highly mechanized. The estate has three tractors for brush-cutting and nut-hauling. In addition to mechanical brush-cutting, clearing of the plantation is supplemented by cutlass hand-weeding in areas not accessible to tractor operations. About 300 water buffalos are pastured under the coconut trees to reduce cost of weeding and for additional income from meat and animal sales. Harvesting of fallen nuts is regularly scheduled every 3 months or 4 rounds per year. This ensures that only mature nuts are harvested and a high nut recovery.

The copra factory is probably one of the most highly mechanized copra-making facility in the world. Whole nuts are stored in a bin from which they are conveyed by a drag-conveyor to a motor-driven nut-splitter. The splitter cuts the whole nut (with husk) into three sections at an average of 20,000 nuts per eight hours. The nuts drop into a nut cart. When filled, the cart is pushed on steel rails and piled in heaps of 2,000 nuts along the rail track. A row of women picking the split-nuts from the heaps and remove the kernel with a copra knife. The kernels are placed in another rail cart to be transfered to the dryer section. The dryer is a steel box with a perforated steel plate bottom and a swing-type steel-plate cover. Hot flue-gases from a diesel-burner are drawn by a centrifugal fan and blown upwards through the kernels in the dryer. Part of the exhaust is recycled to the blower to reduce fuel consumption. At a temperature of about 160°F, the drying time is about 16 hours. The dryer has a capacity for 15,000 nuts; one drying cycle is completed in 24 hours. With fully-matured nuts and well-designed drying operations, the copra produced has a high quality. Oil content is at least 68 per cent and the free-fatty acid in the oil is less than 0.5 per cent.

Processing

There are two copra processing plants in Trinidad: the Lever Brothers (West Indies) Ltd. and the CGA (Coconut Growers Association) plant. Due to copra shortage, the two plants agreed that only CGA mills copra and shares crude oil with Lever Brothers. Both plants produce refined oil, shortening, margarines, soaps and detergents.

CGA has a milling capacity of 50 tons of copra per day. Operated at 300 days a year, the annual capacity will be 15,000 tons of copra or about 10,000 tons of crude oil (53,700 drums). The oil mill has two Anderson Superduos with hammerl mill, cookers, conditioner, screening tank, cake coolers, filter presses and other auxillary equipment. Residual oil in cake ranges from five to eight per cent. Oil recovery should be at least 63 per cent with good copra or a yield of about 152 gallons per ton of copra. The refinery is a conventional batch-type oil refining plant. Basically it consists of open-type neutralizers, closed vacum-type bleachers, deodourizers, cooler, filters for bleaching and finishing, a high-vacuum system and other accessories. The refinery has a capacity of 36 tons of oil per 24 hours operation, just enough to process the mill's oil production. The refining capacity can be increased to 50 tons by reducing processing time.

The Lever Brothers plant had a milling capacity of 15,000 tons of copra per year and a refining capacity of 18,000 tons of oil. With the increasing copra production, the oil mill may have to be reoperated or the CGA mill should have additional milling facility.

The two processing plants have the capacity to produce all the coconut oil needs of Trinidad and Tobago, but can not do so due to the lack of copra production. To be able to utilize valuable investments in the two processing plants and be able to be self-sufficient in edible oils, Trinidad should undertake a coconut replanting programme.

Needs

1. Replanting and rehabilitation programme. Mites control;
2. Systems to reduce cost of producing copra;
3. Up-grading of inefficient copra making facilities to improve the quality of all copra;
4. Feasibility studies for the processing of new products, such as desiccated coconut and wet-processing products;
5. Rationalization of prices of edible oils to improve the viability of copra production and oil processing.

IV. INDUSTRY EVALUATIONS

Table 11 - Coconut and Copra Production Estimates for 1982

Country	Acreage	Nut Yield ('000)	Copra Produced (metric tons)	Remarks
Antigua and Barbuda	1,500*	3,000*	-	*Guess estimate
Belize	8,900	18,000*	-	*Based on 2,000 nuts/acre
Dominica	7,500	15,000*	1,620	*Based on 2,000 nuts/acre
Grenada	4,000	8,000*	440	*Based on 2,000 nuts/acre
Guyana	19,000	38,000*	1,345	*Based on 2,000 nuts/acre
Jamaica	43,000	106,000*	1,617	*Coconut Industry Board info.
St. Kitts-Nevis	1,380	6,800*	-	*CARICOM Secretariat info.
Saint Lucia	23,000	46,000*	3,775	*Based on 2,000 nuts/acre
St. Vincent	5,600	9,100*	1,673	*Min. of Agriculture info.
Trinidad and Tobago	28,000	84,000	8,000	*Based on 3,000 nuts/acre
Totals:	159,300	329,900	18,450	

The productivity of 2,000 nuts per acre is based on 40 nuts per tree and 50 trees per acre. In high-yielding farms in Trinidad, St. Vincent and Dominica, the productivity is from 4,000 to 50,000 nuts per acre per year.

Copra production values were obtained from industry interviews. Acreage were obtained from: Oils and Fats Sub-Sector, CARICOM Secretariat and Ministries of Agriculture information.

Table 12 - Coconut and Copra Production Estimates for 1983

Country	Acreage	Nuts ('000)	Copra (metric tons)	Remarks
Antigua-Barbuda	1,500*	3,000*	-	Guesstimate
Belize	8,900	18,000*	400	*Based on 2,000 nuts per acre
Dominica	8,500	24,000*	3,000	*Based on 3,000 nuts per acre
Grenada	4,000	8,000*	500	*Based on 2,000 nuts per acre
Guyana	19,000	38,000*	300	*Based on 2,000 nuts per acre
Jamaica	48,000	116,000	2,500	Info. from Coconut Industry Bd.
St. Kitts-Nevis	1,380	6,800	-	CARICOM studies
Saint Lucia	23,000	50,000	7,000	Inquiries and CARICOM studies
St. St. Vincent	5,600	12,000*	2,000	*Based on 2,000 nuts per acre
Trinidad and Tobago	28,000	84,000	12,000	Inquiries and CARICOM Studies
TOTALS	160,300	345,800	27,700	

Values in these estimates were obtained from:

1. Studies in the CARICOM Secretariat
2. Field interviews
3. Guesstimates

Table 13 - Theoretical Oil Production from Copra Production in 1983

Country	Nuts (000)	Copra (M tons)	Oil* (M tons)	Remarks
Antigua-Barbuda	3,000	500	300	Assuming 6,000 nuts per ton copra
Belize	8,000	1,300	780	Assuming 6,000 nuts per ton copra
Dominica	24,000	4,300	2,580	Assuming 5,500 nuts per ton copra
Grenada	8,000	1,300	780	Assuming 6,000 nuts per ton copra
Guyana	38,000	6,300	3,780	Assuming 6,000 nuts per ton copra
Jamaica	116,000	16,600	9,960	Assuming 7,000 nuts per ton copra
St. Kitts-Nevis	6,600	1,100	660	Assuming 6,000 nuts per ton copra
Saint Lucia	50,000	9,000	5,400	Assuming 5,500 nuts per ton copra
St. Vincent	12,000	2,200	1,300	Assuming 5,500 nuts per ton copra
Trinidad and Tobago	84,000	12,000	7,200	Assuming 7,000 nuts per ton copra
TOTALS	345,800	54,600	32,740	

* Nut to copra conversion rations were obtained from field interviews. Milling extraction is assumed to be 62.5 per cent of copra weight, while refinery recovery is assumed as 96 per cent, thus the overall oil recovery from copra is 60.0 %*. These values are valid provided that the oil content in copra is not less than 65 per cent (7 per cent moisture) and the free-fatty acid of the oil is not more than 2 per cent (as lauric acid). This means that only mature nuts should be used in copra making and that copra is dried properly.

Table 14 - Oil Supply and Demand Situation Assuming Theoretical Oil Production

Country	Demand (metric tons)	Supply (metric tons)	Surplus (Deficit) (metric tons)
Antigua-Barbuda	390	300	(90)
Belize	270	980	510
Dominica	590	2,580	1,990
Grenada	520	780	260
Guyana	7,910	3,780	(4,130)
Jamaica	16,400	9,960	(6,440)
St. Kitts-Nevis	270	660	390
Saint Lucia	810	5,400	4,590
St. Vincent	990	1,300	310
Trinidad and Tobago	13,400	7,200	(5,600)
Monserrat	70	-	(70)
Barbados	2,100	-	(2,100)
TOTALS	43,720 (100%)	32,740 (74.9%)	(10,980) (25.1%)

The above evaluations are based on the following assumptions:

1. All nuts producible are made into copra (refer to Table 12 - nut productions are based on 1983 estimates).
2. Demand values are based on 1985 projections (Reference: CARICOM Secretariat, Fats and Oils Sub-Sector).

The above evaluation indicates that the CARICOM region has sufficient coconut production to meet at least 70 per cent of its oil consumption. The present large deficit is not due to lack of coconut production, but is primarily due to the poor performance of the copra-making sector of the industry.

Table 15 - Coconut and Copra Production Possibilities in 1986

Country	Acreage	Productivity Nuts per Acre	Nut Production ('000)	Copra Production (metric tons)
Antigua-Barbuda	1,500	3,000	4,500	650
Belize	8,900	3,000	26,700	3,880
Dominica	8,500	3,000	25,500	3,710
Grenada	4,000	3,000	12,000	1,750
Guyana	19,000	3,000	57,000	8,290
Jamaica	48,000	6,000*	288,000	32,910
St. Kitts-Nevis	1,380	5,000**	6,900	1,250
Saint Lucia	23,000	3,500	80,500	14,630
St. Vincent	5,600	3,000	16,800	2,440
Trinidad and Tobago	30,000	4,000	120,000	14,770
TOTALS	149,880		637,900	84,280

The above estimates assume the following conditions:

1. All the countries have a coconut rehabilitation and copra production programme by 1984;
2. Eighty per cent of the nuts produced are converted to copra;
3. Increase in productivity did not include effects of fertilization in new rehabilitation areas.

*Majority of coconuts in Jamaica are "malayan dwarfs".

**Present productivity of coconuts in Nevis according to available statistics.

Table 16 - Possible Supply-Demand Situation in 1986

Country	Copra (metric tons)	Edible Oil Production (metric tons)	Total* Demand (metric tons)	Surplus (Deficit) (metric tons)
Antigua-Barbuda	550	390	390	0
Belize	3,880	2,320	270	2,050
Dominica	3,710	2,220	590	1,630
Grenada	1,750	1,050	520	530
Guyana	8,290	4,970	7,910	(2,940)
Jamaica	32,910	19,740	16,400	3,340
St. Kitts-Nevis	1,250	750	270	480
Saint Lucia	14,630	8,770	810	7,060
St. Vincent	2,440	1,460	990	470
Trinidad and Tobago	14,770	8,860	13,400	(4,540)
Barbados	-	-	2,100	(2,100)
Monserrat	-	-	70	(70)
TOTALS	84,280	50,530	43,720	6,810

The above estimates were based on possible copra production in 1986, which were calculated earlier and shown on Table 15.

Note that a productivity of 3,000 nuts per acre were assumed for Guyana, a value which did not consider the effects of fertilization. If the coconuts were fertilized, it is possible to increase the productivity by at least fifty per cent, this should enable Guyana to be self-sufficient in edible oils.

*Demand includes coconut oil needed for shortening, margarine, toilet soaps and laundry soaps.

V. CONCLUSIONS

1. There is sufficient coconut production in the region to supply at least seventy per cent of the edible oil needs;
2. With a more aggressive and effective copra production programme, the region will narrow-down its edible oils demand and supply gap in three years and possibly achieve self-sufficiency in five years;
3. There are adequate and suitable facilities for processing copra and edible oil needs in the region. Two of the plants need rehabilitation and all require some improvements for production cost reduction and to improve operations. With proper maintenance and correct operation, the plants can be operated efficiently and feasibly, despite of age;
4. There is an urgent need to control the "coconut mites" in practically all the countries in the region;
5. Increasing the price of copra, alone, is not sufficiently effective in increasing copra productions, "industrialization" of copra making is more effective, in the region;
6. Government and/or private enterprise should actively participate in coconut and copra production to enable the region to achieve self-sufficiency in supply of edible oils;
7. There is a region-wide need for a programme of rehabilitation of coconut plantations, replanting and expansion of coconut acreage.

VI. STRATEGY FOR INCREASING COCONUT AND OIL PRODUCTION

1. To structure the coconut and edible oil industry so that copra production will be viable business proposition;
2. To provide opportunity for coconut estate owners and farmers to exploit their lands for copra production;
3. To provide facilities for the processing of coconuts produced by small farmers;
4. To provide suitable financing for the rehabilitation and/or improvements of existing copra and oil processing plants;
5. To devise a feasible programme for solving the problems of coconut pests and diseases;
6. To make idle or under-developed coconut estates and farms available to private enterprise or government for development and exploitation for copra production.

VIII. RECOMMENDATIONS

1. To decontrol or adjust the price of edible oils so that the price of copra can be adjusted to make copra production reasonably attractive to estate owners and farmers;
2. To launch a Coconut Development and Copra Production Programme which shall have the following objectives:

   a) To set-up and operate farm machinery and equipment pool to be available for clearing and replanting existing coconut farms and for the development of new coconut plantations;
   b) To provide no-interest loans, payable in ten years with three years grace period, to estate owners and farmers to be used for purchase of farm machinery and copra making equipment and facilities;
   c) To provide free fertilizers for a period of three years for fertilizing coconut trees, to estate owners and farmers who commit their coconut production for copra production;
   d) To provide management and technical assistance to estate owners and farmers in the acquisition of loans, development of their farms, and the setting-up of their copra-making facilities;
   e) To undertake a nation-wide campaign to eradicate the coconut mites and control other coconut pests and diseases; and
   f) To acquire financial grants and aids to finance the programme.

   It is proposed that the programme shall be administered by the Ministeries of Agriculture.
3. To create a Coconut Development Company[1/] in each coconut-producing country which shall take charge of the development of the coconut industry and immediately undertake a five-year Crash-Programme for copra and oil production as follows:

   a) Set-up Copra Centrals which shall buy coconuts from small farmers who are unable to set-up their own copra-making facilities;
   b) To acquire, by lease or purchase, coconut estates and farms which will remain idle or under-developed, one year after the launching of the Coconut Development and Copra Production Programme;
   c) Assist in acquiring loans for the rehabilitation and/or improvement of existing processing plants;
   d) To acquire soft-loans to finance its operations.

[1/] Proposed organizational chart in Annex III.

4. To create a Regional Coconut Technology Center to be initially funded from grants and whose operations shall be supported from fees paid by the Coconut Development Companies and processing plants for services it will render. The Center shall have the following primary functions:

   a) To design and supervise the establishment of copra-making equipment and facilities;
   b) To design farm mechanization systems and assist in the acquisition of machinery and equipment;
   c) To prepare specific plans and supervise work in the rehabilitation and improvement of plants;
   d) To provide technical assistance in processing, maintenance, and quality control to copra making and oil processing operations;
   e) To undertake studies and co-operate in research and development work with CARIRI, for the utilization of coconut by-products and development of new processes and products from coconuts.

IX. INDUSTRY INFORMATION

A. Industrializing Copra Production

As proven in Guyana and Jamaica, increasing copra prices alone, is not sufficient to boost copra production. Possible reason is that, even at the increased prices which are about twice the CARICOM price, copra making is not attractive enough for small farmers considering the time and effort taken by small-scale copra making, and the cost of setting-up a copra house. The farmers would rather sell whole nuts, jelly or dry, consume as much as he can and whatever is left abandoned. Incidentally, more than sixty per cent of the coconut farms in the region belong to small producers.

Due to shortage of manpower, high labour costs and capital investment in setting-up copra making operations, coconut estate owners are reluctant or unable to engage in copra production. For these reasons, many coconut estates are neglected or abandoned. Whenever possible, nuts are sold in local market or exported, but this volume is insignificant.

The availability of "free nuts" in abandoned plantations provide first opportunity for larceny. The practice has spread even to active plantations because of a "developed" market which started with the sale of abandoned nuts.

Where there is shortage of refined oil in the market as in Guyana, Belize and Jamaica, small-scale coconut oil production or "oil boiling" has become feasible. In many cases, larcency and oil boiling are complementary.

As proven in Trinidad and St. Vincent, the most effective way to increase copra production is by "industrializing" copra making operations. This means copra making "factory-style". Estate owners should be convinced to industrialize their farms by providing easy financing. If this is not acceptable, the estates should be leased for development by a government body such as the Coconut Development Company or by private enterprise. For the small farms, centralized copra making or "copra centrals" should be set-up by similar arrangements. The centrals will buy nuts directly from the farms.

Industrializing copra production will have a chain of effects which will ultimately solve, not only the problem of copra supply, but also some of the existing problems of the industry: jelly nut consumption, larceny, oil boiling and gathering of immature nuts.

To illustrate the feasibility of industrialized copra operations, pre-feasibility evaluations of three concpetual models were prepared.[1/] The systems and technology of the models were derived from existing estates in the region. However, due to the wide variance in labour costs and material prices, the costs and prices in the studies are for illustration purposes only. In any case, the studies should be revised to suit actual capacities, prices and costs.

Model A is designed for estates with relatively flat terrain allowing maximum mechanization of farm operations (Guyana, Trinidad, Belize and Jamaica). Model B is for estates with rugged terrain and steep hills where farm operation have to be done by manual labour, (Grenada, St. Vincent, Dominica, Antigua, Nevis, parts of Jamaica). Model C is a Copra Central designed for processing nuts from small farms.

B. Industrial Utilization of Coconut By-products

Coconut Shell

The products that are commercially produced from coconut shell are: charcoal, activated carbon, shell powder, and handicrafts. It is also used as fuel for steam boilers, steam-turbine power plants, industrial furnace and as domestic fuel. Coconut shell has a heating value of about 7,000 BTU per pound.

[1/] Refer to Annex II for Pre-Feasibility Studies of the Models.

Charcoal is made by burning the shell in limited supply of air. The methods used are: drum method, pit method, kiln method and by retorts. Charcoal making is usually a batch process but there are continuous retorts. About four to six pounds of shells are required to make one pound of charcoal, depending on the method used and the maturity of the shells. Coconut shell charcoal has a heating value of about 10,000 BTU per pound and is almost smokeless. It is sometimes brequited to be used as special domestic fuel. Coconut shell charcoal is one of the best raw materials for the production of activated carbon of various types.

Activated carbon is produced by passing very high temperature superheated steam through a bed of charcoal granules, in continuous or batch systems. The product is a powerful adsorbent. It is used as air or gas filter medium for gas masks, cigarette filters and air conditioners and as bleaching agent for refining oils, sugar and other organic materials.

Shell powder or flour is made by grinding and pulverizing coconut shell to about 200 mesh. The equipment used consist of hammer mills, grinders, sifters and cyclones. The product is used as a filler for plywood glues and some plastics formulations.

Handicraft articles such as buttons, necklaces, bracelets, trays and decorations are made from coconut shells. Cut into special shapes, coconut shell are inlaid onto table tops and furnitures.

In desiccated coconut plants, coconut shells are used as fuel for steam boilers to supply process steam and to run steam-turbines or steam engines for electric power. With the increase in fuel oil price, many oil mills and refineries have converted their steam boilers to coconut shell fuel in the Philippines. Net savings on fuel is more than fifty per cent by shifting from oil to shell fuel. Coconut shells are generally used as fuel for copra dryers. In actual practice, 30 to 40 pound of shell are equivalent to one gallon of fuel oil or diesel fuel. If diesel fuel is $4 per gallon, the fuel value of shell is about ten cents per pound.

The weight of the shells is almost equal to the weight of copra, thus by using the shells as industrial fuels, the economic returns from the coconut industry can be increased by as much as ten per cent based on copra production.

Coconut Husks

During the last fifty years, industrial utilization of the coconut husks has been an area of interest. Equipment for defibering and utilizing the fibers for various products have been developed. Coconut fiber products include: carpets, door mats, floor mats, brushes, ropes, nets and upholstery materials. Rubberized fibers are used in cushions for car seats and furniture, and bed mattresses. There was a sizable market for unprocessed fibers in Europe but exportation has diminished due to high freight costs.

The husks can also be used as fuels. They have a heating value of about 6,000 BTU per pound. Their bulkiness is a disadvantage due to higher transport costs. With suitably designed dryers, coconut husks can be used for copra drying - to replace coconut shells if the shells are utilized for other purposes.

Coconut Water

Coconut water contain about two per cent sugars and small quantities of other nutrients and organic substances. Researches have been conducted to find feasible commercial uses of the water. It has been used successfully in pilot plant production of food yeast. By adding sugar to it, coconut water has been used as medium for the production of "nata de coco", a jelly-like material. The nata is washed, cooked, sweetened and packed in cans or bottles as a desert or a mix for fruit cocktails. Vinegar can also be made by fermenting a ten per cent sugar solution in coconut water.

C. Production of High-grade Copra

During the refining of oils about three to ten per cent of the oil is lost during neutralization, depending on the free-fatty acid content of the oil. The oil produced from ordinary copra has a high colour, thus requiring bleaching to meet the required colour of the refined oil. The undesirable odour and flavour created by spoilage in copra, requires extensive deodourization. The total cost of refining which includes oil losses during neutralization, caustic soda, bleaching material, steam, labour and other costs ranges from about 20 per cent to 30 per cent of the cost of the finished product.

The refining cost can be reduced considerably by improving the quality of the oil through production of good quality copra. With improved copra drying systems, high-grade copra from which light coloured, almost odour-free coconut oil with free fatty-acid content of about 0.1 per cent can be produced. With this oil, refining loss will not exceed 0.5 per cent, bleaching may not be necessary and deodourizing time will be reduced by about fifty per cent. If coconut-oil flavour is desirable, the crude oil can be marketed as cooking oil. With high-grade copra, the cost of refining will be reduced considerably, assuming a ten per cent savings on cost at a price of $ 10 per gallon, this will mean about $1.5 savings per gallon of oil. If the production of refined oil is placed at 5 million gallons a year, the savings will amount to about $7.5 million per year.

D. Alternative Oil Processing Technologies

Solvent Extraction Plants

Solvent extraction plants are favoured for large capacity operations. As a general rule, the minimum economic-size plant has a capacity of 100 tons of oilseeds per day. Solvent extraction is more commonly applied to low-oil seeds such as soybeans and for other oil-bearing materials with low-oil conents, such as ricebran, and corn germ. When used for high-oil materials such as copra, solvent extraction is preceded by mechanical pre-pressing. The pre-pressing operation reduces the oil content of the material to about 18 per cent, the oil content at which solvent extraction systems are most feasible. Most solvent extraction plants are continuous systems, although some small-scale plants are designed for batch operations.

The main advantage of solvent extraction is higher oil extraction efficiency. While mechanically-pressed cake would contain about 6 per cent residual oil, solvent cake can have residual oil of about 1 per cent. For copra, this means 3 - 4 per cent more oil extracted. The power consumption of a combination pre-pressing and solvent extraction plant is 10 - 20 per cent lower than a full-press plant with the same capacity.

The following are the disadvantages of solvent extraction plants:

1. Higher investment cost. With the same capacities, a mechanical-solvent plant is about twice as expensive as that of the full-press plant;
2. When the price of oil is low, the added recovery of oil can not compensate for solvent losses and cost of investments;

3. Solvent extraction plants are more complex and dangerous, thus they require more skill, maintenance and safety disciplines;
4. In remote areas, solvent hexane procurement can be a problem and may not be available at times.

Continuous Oil Refining Plants

Continuous refining systems are employed for large-scale operations and where soap-stocks cannot be separated effectively by gravity settling, such as soybean oil. For oils which are more difficult to deodourize, such as corn oil and soybeanoil, multi-stage, continuous deodourizer are more effective than batch systems. Heat recovery systems are normally built-in for continuous deodourizers to improve on heat economy. High-speed centrifugal separations are used for separation of soap-stock and washings. Dowtherm or thermal oils are sometimes used for high temperature heating in the deodourizers. Powerful multi-stage jet ejectors are used for creating high vacuums required for multi-stage deodourization.

The main advantage of continuous oil refining plants is their high recoveries or low refining losses. For instance, with crude coconut oil having a free-fatty acid content of 3, a recovery of 96 % can easily be achieved in a continuous neutralizing plant. The recovery with a batch neutralizier will be about 94 per cent. For soybean oil, the difference would be bigger. Continuous plants also occupy less space and therefore lower building costs.

The disadvantages of continuous refining plants are as follows:

1. High investment costs. Continuous refinery will cost 3 to 4 times that of a batch plant with the same capacity;
2. The soap-stock produced is too dilute for soap making;
3. They have higher power consumptions. Where vacuum pumps are used for batch deodourizers, the steam consumption of continuous deodourizers is higher than an equivalent batch plant;
4. Their maintenance requirements are more complex. In remote areas, procurement of parts are often a problem;
5. When the cost of oil is low, the advantage of higher recoveries is offset by high investment cost and power cost.

Wet-Processing

Wet processing of coconuts is relatively a new technology. It is applied to the production of a new line of coconut products. A commercial size wet processing plant in the Philippines produces coconut milk powder and edible coconut flour. Other products such as coconut protein powder or concentrates and coconut milk concentrates are obtained by wet processing. Fresh, mature nuts are delivered to the plant, instead of copra. The process, basically, consists of the following operations:

1. Deshelling- removal of shell from the kernel
2. Paring - peeling out the brown skin of the kernel
3. Grinding of the kernel
4. Pressing out the milk
5. Processing of the milk to various products
6. Drying of the residue
7. Extraction of oil from residue to produce oil
8. Pulverizing the extracted meal to produce flour

The advantage of wet process is its ability to produce food products of higher value than ordinary coconut oil and copra cake produced by conventional (dry) processing.

The disadvantages of the process are:

1. High cost of transporting nuts
2. High investment costs
3. The process is labour intensive. Paring and shelling, alone, will require 2 man-days per 1000 nuts processed
4. The markets for the products have not yet been well developed
5. Processing and quality control are more sophisticated due to food specifications.

Fatty Acids from Soapstock

Fatty acids may be produced from soapstock instead of laundry soap. The process consists of treating the diluted soap stock with sulfuric acid to separate the fatty acid by chemical reaction. The process can be batch, for small-scale operations, or continuous for large capacities. The crude product is black-brown, but can be bleached if a light-coloured product is desired. The price of crude fatty acid is about half the price of coconut

oil, the bleached product can be sold at a price equal to or higher than coconut oil.

The advantages of producing fatty acids instead of laundry soap are:

1. Dilute sopastocks such as those from continuous refining can be processed as feasibly as concentrated soapstocks;
2. There is a foreign market for fatty acids;
3. The value added by production of fatty acid is higher than by soap production.

The disadvantages of producing fatty acids are:

1. The domestic market for fatty acid is limited or sometimes nonexistent;
2. Sulfuric acid is difficult to handle and may not be readily available in remote places;
3. Shipping of small quantities of fatty acids may not be feasible.

Fatty acids are used as starting material for the production of detergents, shampoos, emulsifiers, surfactants, special soaps and other related organic chemicals.

Replacing Old Plants with New Plants

Replacing the existing oil processing equipment with "modern" plants should be studied very carefully. The capacities required in most of the coconut producing countries do not warrant continuous processing. New investments for new plants will require heavy amortization payments and possibly interest payments. This financial burden may offset the advantage of better efficiencies. The shortage of technical manpower and the distance from the source of spare parts are operational problems. The conventional plants existing in the CARICOM region, while of advanced age, are still appropriate for the needs of the next decade. With existing conditions in the region shifting to new technologies for oil extraction and refining have doubtful economic advantages over the continuance of using the old plants.

Wet processing, however, should be considered as a future alternative in countries where nut supply exceeds the processing capacity of existing plants, or in places without existing processing plants.

E. Backyard Oil Production or "Oil Boiling"

Oil Boiling is popular in Guyana, Jamaica and Belize. "Boiled Oil" is produced by boiling the cream of coconut milk. The process starts with shredding the fresh coconut kernel, macerating the shreded kernel in water and then squeezing or pressing out the milk. The milk is allowed to settle overnight to float the cream which contains the oil. The cream is then decanted and cooked in an open pan until all the water is evaporated, leaving the oil and some curd. After filtering out the curd, the oil is placed in bottles, usually second-hand bottles.

The oil has an aromatic coconut flavour. Some people have a traditional preference for this kind of oil and are willing to pay a higher price over the price of commercial refined oil. The residue has a very high oil content (at least 30 per cent). It is usually used as feed for chicken or pigs.

It is reported that considerable quantity of nuts go to oil boiling. The industry has prospered, inspite of very inefficient oil processing, due to the high price the oil is sold and the scarcity of refined oil in the market. The boilers are able to offer higher prices for nuts than copra makers. In many cases, coconut larceny is linked to "oil boiling".

Oil boiling is one of the problems of the coconut industry. It not only deprives the oil industry of much needed copra, but is also wasting unrecovered oil due to inefficient extraction. Many coconut farmers and estate owners harvest immature nuts in order to beat larceny. This practice is also wasteful. Since the industry also breeds crime of larceny, it is a social problem. The industry should either be stopped or commercialized. If only to stop coconut larceny, it should be stopped.

One of the justifications for tolerating the operation of oil boiling is that it is providing jobs and sources of income to many people. An alternative to this is to shift from oil boiling to legitimate copra making. The illegal nut gatherers can be employed in the rehabilitation of coconut plantations, in nut gathering and copra making. These will provide more jobs than the present oil boiling industry.

G. Guidelines for Coconut Processing

Farm Operations

1. Adopt a "Compact Operations" system described as follows:

   Subdivide the whole farm into a number of lots, as many as the number of days you plant to work in order to complete the three-month harvest cycle. Mark each tree with the lot number.

   Example: A farm with an area of 240 acres. Work will be for 60 days in 3 months. Divide the farm into 60 lots of about 4 acres each. Mark each tree with a lot number, as follows: all trees for the first 4 acres (Lot. No. 1) should be marked 1; the next 4 acres (Lot No. 2) are marked 2; and so on.

   Perform all farm jobs (weeding, fertilizing, pest inspection, harvesting; husking and gathering of nuts) for one lot each day. Work on the farm should move from lot to lot in numerical order from lot 1 to lot 60 in 60 working days within 3 calendar months, then the work cycle starts again with Lot No. 1.

   Organize a work-team consisting of the minimum number of workers and equipment to finish all the work in each lot. Inspect the lot being worked on, early in the afternoon to check on work performance. Keep a record of daily nut harevsts- this will serve as a basis for selective fertilization and problem solving. Fertilize only those trees that require fertilizer.

2. Harvest only fully-mature nuts. If possible, harvest only fallen nuts. Fallen nuts should be collected as soon as possible to prevent sprouting. Immature nuts and sprouted nuts yield less copra. Copra from immature nuts have low oil content and are difficult to mill. Nuts harvested from trees (by hooking or climbing) may be kept for two weeks before copra making. This will add to copra yield. Husked nuts should be kept under shade otherwise they will crack and spoil when exposed to hot sunlight.

Copra Making

1. Do not keep kernels long before drying. Molds will grow fast on wet kernels and spoil the copra.
2. Drying should be fast enough to avoid spoilage (about 16 hours). Temperature during drying should be kept between 160° and 180°F.
3. Copra should be dried to less than ten per cent moisture before removing from dryer. The copra will dry farther in storage.
4. Keep copra in dry, well-ventilated shed and should be delivered to the factory as soon as possible.
5. Use the husks and shells as dryer fuel - they are the cheapest fuel for copra making. Systems presently using diesel fuel can be converted to husk and shell firing, using a mult-tube type air heater.
6. If cheap fuel is used and nuts are dehusked, crack the nuts to smaller fragments and feed the kernels with shell into the dryer. Separate the cropa from the shell after drying.
7. The free fatty acid of oil in properly made copra can be kept below 0.1 per cent. It is reasonable to ask for a price premium of at least 5 per cent for this quality.

Transporting of Copra from Farm to Factory

1. A system of bulk transport should be made available to reduce transportation costs.
2. Copra in transport should be protected from the rain and wetting. Wetted copra spoil very fast and should be re-dried as soon as possible, before storage or processing.

Copra Milling

Effective oil milling depends upon several variable such as: quality of the copra, particle size after grinding, moisture content after cooking, cooking and conditioning temperatures, pressure and equipment design and adjustments. The following operating conditions apply to most copra milling operations:

1. Particle size of copra after grinding should be almost uniform with particle sizes between 1/16 and 1/8 inch;
2. The moisture content of the copra after cooking should be about 3 per cent. With high-moisture copra, pre-drying after grinding may be necessary;
3. The temperature of the copra during expelling should be between 220 and 240°F. Shaft water-cooling and cage oil-bath may be necessary to avoid overheating;
4. When using two separate expellers in series, the cake from first pressing should be fed to the second press while still hot and soft. Inter-grinding is not necessary.
5. Adjust discharge choke to produce cake with oil content of about seven per cent, if possible. This is the optimum residual oil in cake. Attempting to reduce residual oil by increasing pressure through reducing choke opening result in lower throughput, high power consumption and excessive wear in the shaft and cage;
6. If oil is to be stored for long periods, the moisture content should be kept below 0.2 per cent to prevent increase in free-fatty acid.

Oil Neutralization (Batch)

Refined oil recovery and quality depend heavily on the neutralization process because it is in this process where the highest loss and maximum free-fatty acid reduction occurs. Several factors affect the effectiveness and efficiency of neutralization; these are concentration of the alkali, design of the equipment, oil temperature, settling time and soap stock formation. The following operating conditions generally apply:

1. The quantity of caustic soda to be used for neutralization should be determined by chemical analysis. Fixed-dosing often results in unnecessary refining losses or under-neutralization.
2. With correct procedures, one neutralization and one hot-water and more washings result in increase in losses. The FFA before bleaching should be less than 0.1 per cent as lauric acid. Refining loss should be between 1.5 and 2 times the free fatty acid content of the oil.
3. With oils having FFA between 1 and 3 per cent, 16° Be' (Sp. gr. = 1.124, 11.) % NaOH) caustic soda solution would give good neutralization results.

4. The temperature of the oil during neutralization should be about 180°F (80°C) and steam supply to the heating coils should be shut-off during the process;
5. Saturated brine equivalent to 0.5 per cent by volume sprayed on the oil after caustic treatment will help in soap-stock separation;
6. After stopping stirring for 10 minutes, spray hot water on the oil (about 1 per cent of volume of oil). This will create a water interphase between the oil and the soap-stock;
7. Settle soap-stock for at least two hours then withdraw slowly but completely from bottom valve. A see-through slight-glass before the discharge valve should be installed for easier interface detection during soap-stock and washings withdrawal.

Washing

1. Analyse neutralized oil for free-fatty acid. If the ffa exceeds 0.1 per cent, a mild caustic wash is necessary. The quantity of caustic soda for caustic wash is about three times the theoretical quantity diluted to about one per cent. If ffa is satisfactory proceed to hot-water washing.
2. Heat oil while sitrring to about 190°F (87°C) then spray hot water at about the same temperature. Continue stirring for 5 minutes then settle for at least 2 hours. Withdraw washings carefully.

Bleaching

1. The most commonly used bleaching agent for coconut oil is Fullers Earth. Use the least amount of Earth necessary to achieve the desired colour. About 0.25 per cent by weight is usually sufficient but the quantity may be reduced if very light-coloured oil is not required.
2. Dry oil before adding the bleaching agent since Fuller Earth is less effective in the presence of water. Since the oil may darken when heated above the boiling point of water in the presence of air, it is preferred that the oil should be dried under vacuum (20 - 25 inches Hg.). Under this condition, the oil can be dried at about 180°F (80°C).

3. Purge the filter press with compressed air before opening.

Deodourizing

1. Coconut oil is relatively easier to deodourize than other oils. With oil depths of 36 to 48 inches, satisfactory deodourization can take place at 350°F under a vacuum of 28 in. Hg. Since multi-stage ejectors have high operating costs, use of vacuum pumps in series with a barometric condenser may give satisfactory results.

2. Cool oil to less than 160°F before releasing vacuum and filter at about 120°F to obtain clear oil. If possible, pump the oil to a storage tank at 160°F after vacuum release and let the oil cool in the tank before filtering. This saves time and water.

3. If condenser water is obtained from the commerical water system, use a natural-draft cooling tower for re-circulation. A tower with a height of 24 feet can effect a 10degree cooling.

G. Alternative Containers for Refined Oil

New bottles are expensive and are sometimes not readily available in some countries. Further, because of foreign exchange limitations, importation of raw material for local manufacture of bottles may be a problem. The following alternative containers may be used for refined oils:

1. Used glass bottles

Bottles used for other products, which are abudant in the locality may be used. Clear bottles are preferred since their cleanliness can easily be checked. The bottles may be purchased from bottle collectors and cleaned in the plant or from bottles contractors who buy the bottles and sell them cleaned to the plant. If cleaned in the plant, cleaning is usually paid by piece-work. The caps, metal or plastic, may be available locally, otherwise they have to be imported. A bottle-capping device or machine will be necessary. For screw-caps or slip-type caps, capping may be done mannually. For small capacities, the bottles may be filled with the use of rubber tubings connected to an overhead tank. It is preferred to use uniform bottles. The bottles can be packed in cartons, which may also be re-cycled. In using used bottles, the property rights of the bottle manufacturer should be checked.

2. 20-liter Containers

For institutional consumers, such as restaurants, hotels and hospitals, 2o-liter containers, either plastic or metal may be used. These containers, returnable or can be re-cycled. Containers with screw-caps are preferred if they are to be refilled. The suitable arrangement is to collect the empties at the time the replacements are delivered. A rebate is paid for returned containers or may be given free to regular customers.

3. 45-gallon Drums

For public markets or corner stores, ordinary 45-gallon drums, fitted with despensing spouts and valves can be used. A stand to hold the drum for easy despensing is required. The drums are usually provided by the supplier with a deposit by the user. The retail buyers bring their own containers or the oil may be despensed in small plastic pouches. This system provides the cheapest oil.

IX. SUGGESTED PROJECTS TO BE FUNDED BY EDF THROUGH THE COCONUT DEVELOPMENT COMPANIES

1.	Antigua-Barbuda	- Rehabilitation of the IDB Edible Oil Factory
		- Copra Central in Antigua
		- Copra Central in Barbuda
2.	Belize	- Copra Centrals
		- Oil Mill and Refinery
3.	Dominica	- Copra Centrals
		- Development of Estates for Copra Production
4.	Grenada	- Copra Centrals
		- Development of Estates for Copra Production
5.	Guyana	- Development of Estates for Copra Production
		- Copra Centrals
		- Production of Edible Copra for Coconut Flour Production
		- Wet Processing Plant to Produce Skim-milk and Coconut Flour
6.	Jamaica	- Development of Estates for Copra Production
		- Copra Centarls for the Small Farmers
		- By-products Processing
		- Wet Processing Plant
7.	St. Kitts-Nevis	- Copra Centrals
8.	Saint Lucia	- Development of Estates for Copra Processing
		- Copra Centrals for the Small Farmers
		- By-products Processing
9.	St. Vincent	- Integration and Operation of Fiber Plant at Union Estate and Shell Processing Plant at Orange Hill Estate
		- Copra Centrals for the Small Farmers
10.	Trinidad and Tobago	- Copra Centrals
		- Wet Processing or Desiccated Coconut Plant
		- By-products Processing
		- Development of Estates for Copra Production

ANNEX I - FINANCIAL PRE-FEASIBILITY STUDY OF THE OPERATION OF ANTIGUA EDIBLE OIL FACTORY

Plant Capacity

Oil Mill	- 5 metric tons copra per 24-hours operation
Refinery	- 3 metric tons of oil per 24-hours operation

Recoveries

Basis	- Oil Content of Copra - 65 % at 7 % moisture content	
	FFA of oil - 2 % maximum as lauric acid	
Milling recovery	- 61.5 %	150 gals oil per ton copra
Refining loss	- 5%	142.5 gals refined oil per ton copra
Cake recovery	- 35 %	770 lbs cake per ton copra

Potential Copra Supply (1985)

Antigua-Barbuda	- 300 metric tons per year
St. Kitts-Nevis	- 700 metric tons per year

Market for Refined Oil (1985)

Antigua-Barbuda	- 90,000 gals per year
St. Kitts-Nevis	- 60,000 gals per year

Production Schedule

First year	100 days operation
Copra requirement	500 metric tons
Refined oil production	71,250 gals
Copra cake production	385,000 lbs
Second year	150 days operation
Copra requirement	750 metric tons
Refined oil production	106,800 gals
Copra cake production	577,000 lbs
Third year	200 days operation
Copra requirement	1,000 metric tons
Refined oil production	142,500 gals
Copra cake production	770,000 lbs

Prices

Copra	$1,606 per metric ton delivered to plant (7 % moisture)
Refined Oil	$16.00 per gal. net, ex-plant
Copra Cake	$ 0.30 per lb, ex-plant
Diesel Fuel	$4.01 per gal. delivered to plant
Caustic Soda	$1.45 per lb delivered
Fullers Earth	$0.80 per lb delivered
Salt	$0.30 per lb delivered
Electric power	$0.16 per kwh
Water	$0.005 per gal

Pre-Operating Expenses (Rehabilitation cost)	$ 100,000
Yearly amortization for 5 years	$ 20,000

Administrative Overhead (including clerical and marketing): $30,000 per year

Repair and Maintenance Costs: $100,000 per year

Salaries and Wages

First Year

Indirect Labour

1 Plant Manager à $1,000 x 12 months	$ 12,000
1 Laboratory Technician à 600 x 12 months	$ 7,200
Total Indirect Labour:	$ 19,000

Direct Labour

1 Foreman à $30 x 100 days	$ 3,000
1 Mechanic à $25 x 100 days	$ 2,500
22 Factory workers à $20 x 100 days	$ 44,000
Total Direct Labour:	$ 49,500

Second Year

Indirect Labour

1 Plant Manager à $1,000 x 12 months	$ 12,000
1 Laboratory Technician à $600 x 12 months	$ 7,200
Total Indirect Labour:	$ 19,200

Direct Labour

1 Foreman à $30 x 150 days	$ 4,500
1 Mechanic à $25 x 150 days	$ 3,750
22 Factory workers à $20 x 150 days	$ 66,000
Total Direct Labour	$ 73,750

Third Year

Indirect Labour

1 Plant Manager à $1,000 x 12 months	$ 12,000
1 Laboratory Technician à $600 x 12 months	$ 7,200
Total Indirect Labour	$ 19,200

Direct Labour

1 Foreman à $30 x 200 days	$ 6,000
1 Mechanic à $25 x 200 days	$ 5,000
Total Direct Labour	$ 97,000

Supplies	First Year	Second Year	Third Year
Diesel Fuel, gals.	20,000	30,000,	40,000
Cost, $	80,200	120,300	160,400
Caustic soda, lbs.	3,200	4,800	6,400
Cost, $	4,640	6,960	9,280
Fullers Earth, lbs.	1,450	2,175	2,900
Cost, $	1,160	1,740	2,320
Salt, lbs.	1,450	2,175	2,900
Cost, $	435	653	870
Miscellaneous Supplies, $	2,000	3,000	4,000
Total Supplies, $	88,435	132,653	176,870
Power, kwh	144,000	216,000	288,000
Cost, $	23,040	34,560	46,080
Water, gallons	600,000	900,000	1,200,000
Cost, $	3,000	4,500	6,000
Copra, metric tons	500	750	1,000
Cost, $	803,000	1,204,500	1,606,000
SALES, $			
Refined Oil, gals	71,250	106,800	142,500
Value, $	1,140,000	1,710,000	2,280,000
Copra Cake, lbs.	385,000	577,000	770,000
Value, $	115,500	173,100	231,000
Total Sales, $	1,255,500	1,883,100	2,511,000

PROJECTED INCOME STATEMENT ($000)

Sales	First Year	Second Year	Third Year
Refined Oil	1,140	1,710	2,280
Copra cake	115	173	231
Total Sales	1,255	1,883	2,511
Variable Costs,			
Copra	803	1,205	1,606
Direct Labor	50	74	97
Supplies	88	133	177
Power	23	35	46
Water	3	5	6
Total Variable Costs	967	1,452	1,932
Fixed Costs			
Indirect Labour	19	19	19
Repair & Maintenance	100	100	100
Administrative Overhead	30	30	30
Amortization of Pre-Operating Expenses	20	20	20
Total Fixed Costs	169	169	169
TOTAL COSTS	1,136	1,621	2,101
PROFIT/ (LOSS)	119	262	410

NOT INCLUDED IN COSTS:

1. Depreciation
2. Interests on capital investment loans (if any)
3. Insurance premiums (if any)

ANNEX II - PREFEASIBILITY STUDY OF COPRA PRODUCTION MODELS

MODEL A - For coconut estates with relatively flat terrain and low rolling hills

Basic Assumptions

1. Plantation area - 252 hectares
2. Productivity: Year 1 - 3,200 nuts per hectare per year
   Year 2 - 4,800
   Year 3 - 6,000
   Year 4 - 8,000
3. Nut to copra conversion ratio - 5,000 nuts per metric ton copra
4. Copra production - 499 metric tons per year
5. Price of copra - (ex-farm price) - $1,300 per ton plus 5 % price premium if the FFA content is less than 0.5 % or an effective price of $1,365 per ton
6. Fertilizer application - 200 kg per ha per year
7. All costs and prices in EC Dollars (August 1983).

Estimate of project cost

Machinery and equipment		$ 180,000	
Farm:	2 Tractors, wheel-type, diesel driven, at least 45 hp.		
	1 Brush-cutter with tractor attachements		
	1 Nut trailers, 3000 to 4000 nuts capacity		
	Hand tools- nut pickers, cutlass, etc.		
Copra plant:	1 Nut-splitting machine, 2000 nuts/hour		
	2 Nut carts		
	1 Copra dryer, forced-draft, with shell-fired air heater, capacity 10,000 nuts/16 hours drying time		
	1 Platform scale, 500 kg capacity		
	1 Bag-closer, portable Hand tools; copra knives, shovels, etc.		
Engineering and instalaltion cost		$ 20,000	
Installed cost of machinery and equipment			$200,000
Buildings:	dryer shed and copra storage, including copra bin.		$180,000
	work-shed for pre-drying operations		
	office, including office equipment		
	fuel shed.		
Total Fixed Capital Investment			$380,000
Working Capital			$ 20,000
Total Project Cost			$400,000

Investment Services

Equity (30 %)	$120,000
Loan (70 %)	280,000
Total:	$400,000

Loan Terms

Interest: 12 per cent per year on unpaid balance. Interests during grace period to be added to loan

Repayment: Ten years period with three years grace on amortization, to be paid in seven equal annual installments starting with year 4.

Financial Plan

Year	Equity	Loan	Total
1 Purchase of equipment and builds.	$108,000	$252,000	$360,000
3 Purchase of additional tractor	12,000	28,000	40,000
Totals:	$120,000	$280,000	$400,000

Interests and Amortizations Schedule ($000)

Year	Drawdown	Amortization	Interest	Principal	Balance
1	252	-	-	-	252
2	-	-	30	-	282
3	28	-	34	-	344
4	-	75	41	34	310
5	-	75	37	38	272
6	-	75	33	42	230
7	-	75	28	47	183
8	-	75	22	53	130
9	-	75	16	59	71
10	-	80	9	71	0

PRODUCTION SCHEDULE	Year 1	Year 2	Year 3	Year 4-10
Nuts Produced 10^6	0.8	1.2	1.6	2.0
Copra Produced MT	160	240	320	400
SALES REVENUES				
Copra Sales, MT	160	240	320	400
Price, $/MT	1,365	1,365	1,365	1,365
VALUE $	218,400	327,600	436,800	546,000
RAW MATERIALS				
Nuts (millions)	0.8	1.2	1.6	2.0
Price, Cents	8	8	8	8
VALUE $	64,000	96,000	128,000	160,000

SUPPLIES				
Diesel Fuel, gal.	800	1,200	1,600	2,000
Price, $/gal	4	4	4	4
VALUE, $	3,200	4,800	6,400	8,000
Fertilizer, MT	50	50	50	50
Price $/MT	800	800	800	800
VALUE, $	40,000	40,000	40,000	40,000
Misc. Supplies	5,000	5,000	5,000	5,000
TOTAL SUPPLIES, $	48,200	49,800	51,400	53,000
POWER, Kw-hrs	24,000	36,000	48,000	60,000
Price, ¢	30	30	30	30
VALUE, $	7,200	10,800	14,400	18,000

SCHEDULE OF SALARIES AND WAGES

Year 1 (½ year) Position	No.	Rate	Months or Days	Annual Salary	Total Annual Salary
Indirect Labor					
Farm Manager	1	1,500	7 mos.	10,500	10,500
Bookkeeper-clerk	1	800	7	5,600	5,600
Utilityman	1	500	7	3,500	3,500
Mechanic	1	24/ day	150	3,600	3,600
Gen. Repairman	1	20	150	3,000	3,000
TOTAL INDIRECT LABOR					26,200
Direct Labor					
Farm					
Tractor Operator	1	24	150	3,600	3,600
Tractor Helper	1	12	150	1,800	1,800
Nut Pickers	2	12	150	1,800	3,600
Weeders	2	12	150	1,800	3,600
Plant					
Nut Splitter Oper	2	12	100	1,200	2,400
Kernel Removers	4	12	100	1,200	4,800
Cartman	1	12	100	1,200	1,200
Dryer Operator	3	12	100	1,200	3,600
Copramen	2	12	100	1,200	1,200
Utilityman	1	12	100	1,200	1,200
TOTAL DIRECT LABOR					28,200

Year 2

Indirect Labor

Farm Manager	1	1,500	12	18,000	18,000
Bookkeepr-Clerk	1	800	12	9,600	9,600
Utilityman	1	500	12	6,000	6,000
Mechanic	1	24	250	6,000	6,000
Gen. Repairman	1	20	250	5,000	5,000
TOTAL INDIRECT LABOR					44,600

Direct Labor

Farm					
Tractor Operator	1	24	250	6,000	6,000
Tractor Helper	1	12	250	3,000	3,000
Nut Pickers	2	12	250	3,000	6,000
Weeders	2	12	250	3,000	6,000
Plant					
Splitter Operator	2	20	150	3,000	6,000
Kernel Removers	4	12	150	1,800	7,200
Cartman	1	12	150	1,800	1,800
Dryer Operator	3	12	150	1,800	5,400
Copramen	2	12	150	1,800	3,600
Utilityman	1	12	150	1,800	1,800
TOTAL DIRECT LABOR					46,800

Year 3

Indirect Labor (same as year 2)

TOTAL INDIRECT LABOR					44,600

Direct Labor

Farm					
Tractor Operator	2	24	250	6,000	12,000
Tractor Helper	2	12	250	3,000	6,000
Nut Pickers	3	12	250	3,000	9,000
Weeders	3	12	250	3,000	9,000
Plant					
Nut Splitter	2	20	200	4,000	8,000
Kernel Removers	4	12	200	2,400	9,600
Cartmen	1	12	200	2,400	2,400
Dryer Operator	3	12	200	2,400	7,200
Copramen	2	12	200	2,400	4,800
Utilityman	1	12	200	2,400	2,400
TOTAL DIRECT LABOR					70,400

Years 4-10

Indirect Labor (Same as year 2)

TOTAL INDIRECT LABOR					44,600
Direct Labor					
Farm					
Tractor Operator	2	24	250	6,000	12,000
Tractor Helper	2	12	250	3,000	6,000
Nut Pickers	4	12	250	3,000	12,000
Weeders	4	12	250	3,000	12,000
Plant					
Nut Splitters	2	20	250	5,000	10,000
Kernel Removers	4	12	250	3,000	12,000
Cartmen	1	12	250	3,000	3,000
Copramen	2	12	250	3,000	6,000
Utilityman	1	12	250	3,000	3,000
TOTAL DIRECT LABOR					85,000
DEPRECIATION - 10% of $380,000, per year					38,000
INSURANCE - 1 % of $380,000, per year					3,800
REPAIR AND MAINTENANCE 5 % of $380,000, per year					19,000
MANAGEMENT OVERHEAD					10,000

COPRA PRODUCTION MODELS - PROJECTED INCOME STATEMENT (EC$000) MODEL - A

SALES REVENUES										
Copra Sales	214.8	327.6	436.8	546.0	546.0	546.0	546.0	546.0	546.0	546.0
VARIABLE COSTS										
Cost of nuts	64.0	96.0	128.0	160.0	160.0	160.0	160.0	160.0	160.0	160.0
Direct labour	28.2	46.9	70.4	85.0	85.0	85.0	85.0	85.0	85.0	85.0
Supplies	48.2	49.8	51.4	53.0	53.0	53.0	53.0	53.0	53.0	53.0
Power	7.2	10.8	14.4	18.0	18.0	18.0	18.0	18.0	18.0	18.0
TOTAL VARIABLE COSTS	147.5	203.4	264.2	316.0	316.0	316.0	316.0	316.0	316.0	316.0
FIXED COSTS										
Indirect labour	26.2	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Depreciation	19.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
Insurance	1.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Repair and maintenance	9.5	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Administrative Overhead	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TOTAL FIXED COSTS	66.6	115.4	115.4	115.4	115.4	115.4	115.4	115.4	115.4	115.4
TOTAL COSTS	214.2	318.8	379.5	431.4	431.4	431.4	431.4	431.4	431.4	431.4
GROSS PROFIT (LOSS)	0.6	8.8	57.3	114.6	114.6	114.6	114.6	114.6	114.6	114.6
INTERESTS	-	30.0	34.0	41.0	37.0	33.0	28.0	22.0	16.0	9.0
PROFIT BEFORE TAXES	0.6	(21.2)	23.3	73.6	77.6	81.6	86.6	92.6	98.6	105.6

COPRA PRODUCTION MODELS - PROJECTED CASH FLOW STATEMENT (EC$000) MODEL - A

SOURCES OF INCOME										
Net Income	0.6	(21.2)	23.3	73.6	77.6	81.6	86.6	92.6	98.6	105.6
Add Back:										
Interests	-	30.0	34.0	41.0	37.0	33.0	28.0	22.0	16.0	9.0
Depreciation	19.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
TOTAL INTERNAL RESOURCES	19.6	46.8	95.3	152.6	152.6	152.6	152.6	152.6	152.6	152.6
BORROWINGS										
Loan	252.0	-	28.0	-	-	-	-	-	-	-
Equity	108.0	-	12.0	-	-	-	-	-	-	-
TOTAL BORROWINGS	360.0	-	40.0	-	-	-	-	-	-	-
TOTAL FUNDS	379.6	46.8	135.3	152.6	152.6	152.6	152.6	152.6	152.6	152.6
APPLICATION OF FUNDS										
Establishment Cost	340.0	-	40.0	-	-	-	-	-	-	-
Working Capital	20.0	-	-	-	-	-	-	-	-	-
Amortization of Loan	-	-	-	75.0	75.0	75.0	75.0	75.0	75.0	75.0
TOTAL DISBURSEMENTS	360.0	-	40.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
NET CASH INFLOW/OUTLFOW	19.6	46.8	95.3	77.6	77.6	77.6	77.6	77.6	77.6	77.6
CASH: BEGINNING	-	19.6	66.4	161.7	239.3	316.9	394.5	472.1	549.7	627.3
ENDING	19.6	66.4	161.7	239.3	316.9	394.5	472.1	549.7	627.3	699.9
DEBT SERVICE RATIO	-	-	-	2.03	2.03	2.03	2.03	2.03	2.03	1.91

MODEL B - For Coconut Estates with Rugged Terrain and Steep Hills

Basic Assumptions

1. Plantation area - 252 hectares
2. Productivity: Year 1 - 3,200 nuts per hectare per year
   Year 2 - 4,800 nuts
   Year 3 - 6,000 nuts
   Year 4 - 8,000 nuts
3. Nuts to copra conversion - 5,000 nuts per metric ton copra
4. Fertilizer application - 200 kg per hectare per year
5. Weedicide application for 50 % of area - 1,000 litres per ha/year
6. Copra production - 400 metric tons per year
7. Price of copra - (Ex-farm price) - $1,300 per ton plus 5 % price premium if FFA content is less than 0.5 % or an effective price of $1,365 per ton
8. All prices and costs in EC dollars (August 1983).

Estimate of project costs

Machinery and equipment	$165,000	
Farm: 2 tractors, wheel type, diesel driven, at least 45 hp		
1 Nut trailer, 3,000 nuts capacity		
1 Multi-purpose trailer		
6 Knapsack sprayers, 3 gallons		
10 Husking points		
Hand tools: nut pickers, cutlasses, etc.		
Copra plant		
1 Copra dryer, forced Draft, with shell-fired air heater, capacity - 10,000 nuts per 16 hours drying time		
1 Mechanical nut cracker for cracking bare nuts, capacity: 2,000 nuts/hour		
1 Bag closer, portable		
1 Platform scale, 500 kg capacity		
Hand tools: copra knives, shovels, etc.		
Engineering and installation cost	$15,000	
Installed Cost of Machinery and Equipment		$ 180,000
Buildings:		$ 160,000
Dryer shed and copra storage, including copra bin		
Work-shed for pre-drying operations		
Office, including office equipment		
Fuel shed		

Total Fixed Capital Investment	$ 340,000
Working Capital	20,000
Total Project Cost	$ 360,000

Investment Services

Equity (30 %)	$108,000
Loan (70 %)	252,000
Total:	$360,000

Loan Terms

Interest - 12 per cent per year on unpaid balance. Interests during grace period to be added to loan.

Repayment - 10 years with 3 years grace period on amortization. To be paid in seven equal annual installments, starting with year 4.

FINANCIAL PLAN

Year		Equity	Loan	Total
1	Purchase of Equipment and buildings	$ 96,000	$224,000	$320,000
3	Purcahse of another Tractor	12,000	28,000	40,000
	TOTALS	$108,000	$252,000	$360,000

INTERESRT AND AMORTIZATIONS SCHEDULE ($ 000)

Year	Drawdown	Amortization	Interest	Principal	Balance
1	224	-	-	-	224
2	-	-	27	-	251
3	28	-	30	-	309
4	-	67	37	30	279
5	-	67	33	34	245
6	-	67	29	38	207
7	-	67	25	42	163
8	-	67	20	47	118
9	-	67	14	53	65
10	-	73	8	65	0

PRODUCTION SCHEDULE	Year 1	Year 2	Year 3	Year 4
Nuts produced, 10^6	0.8	1.2	1.6	2.0
Copra Produced, MT	160	240	320	400
SALES REVENUES				
Copra Sales, MT	160	240	320	400
Price, $/MT	1,365	1,365	1,365	1,365
VALUE, $	218,400	327,600	436,800	546,000
RAW MATERIALS				
Nuts (millions)	0.8	1.2	1.6	2.0
Price, $ per nut	8	8	8	8
VALUE, $	64,000	96,000	128,000	160,000

SUPPLIES				
Diesel Fuel, gal.	1,000	1,500	2,000	2,500
Price, $/gal.	4	4	4	4
VALUE, $	4,000	6,000	8,000	10,000
Fertilizer, MT	50	50	50	50
Price, $/MT	700	700	700	700
VALUE, $	35,000	35,000	35,000	35,000
Weedicide, liters	1,000	1,000	1,000	1,000
Price, $/liter	14	14	14	14
VALUE	14,000	14,000	14,000	14,000
Misc. Supplies, $	5,000	5,000	5,000	5,000
TOTAL SUPPLIES, $	58,000	60,000	62,000	64,000
POWER, kw-hrs	8,160	12,300	16,500	22,700
Price, $ per kw-hr	30	30	30	30
VALUE, $	2,700	4,100	5,500	6,800

SCHEDULE OF SALARIES AND WAGES

Year 1 Position	No.	Rate	Months or Days	Annual Salary	Total Annual Salary
Indirect Labor					
Farm Manager	1	1,500	7 mos.	10,500	10,500
Bookkeeper-Clerk	1	800	7	5,600	5,600
Utilityman	1	500	7	3,500	3,500
Mechanic	1	24/day	150	3,600	3,600
Repairman	1	20	150	3,000	3,000
TOTAL INDIRECT LABOR					26,200
Direct Labor					
Farm					
Tractor Operator	1	24	150	3,600	3,600
Tractor Helper	1	12	150	1,800	1,800
Nut Pickers	2	12	150	1,800	3,600
Huskers	2	12	150	1,800	3,600
Weeders	4	12	150	1,800	7,200
Nut Carriers	2	12	150	1,800	3,600
Copra Plant					
Dryer Operators	3	20	100	2,000	6,000
Copra makers	8	12	100	1,200	9,600
Utilityman	1	12	100	1,200	1,200
TOTAL DIRECT LABOR					40,200

Year 2					
Indirect Labor					
Farm Manager	1	1,500	12	18,000	18,000
Bookkeeper-Clerk	1	800	12	9,600	9,600
Utilityman	1	500	12	6,000	6,000
Mechanic	1	24	250	6,000	6,000
Repairman	1	20	250	5,000	5,000
TOTAL INDIRECT LABOR					44,600
Direct Labor					
Farm					
Tractor Operator	1	24	250	6,000	6,000
Tractor Helper	1	12	250	3,000	3,000
Nut Pickers	2	12	250	3,000	6,000
Huskers	2	12	250	3,000	6,000
Weeders	4	12	250	3,000	12,000
Nut Carriers	2	12	250	3,000	6,000
Copra Plant					
Dryer Operators	3	20	150	2,000	6,000
Copra makers	8	12	150	1,800	14,400
Utilityman	1	12	150	1,800	1,800
TOTAL DIRECT LABOR					64,200
Year 3					
Indirect Labor (Same as Year 2)					
TOTAL INDIRECT LABOR					44,600
Direct Labor					
Farm					
Tractor Operator	2	24	250	6,000	12,000
Tractor Helper	2	12	250	3,000	6,000
Nut Pickers	3	12	250	3,000	9,000
Huskers	3	12	250	3,000	9,000
Weeders	4	12	250	3,000	6,000
Nut carriers	3	12	250	3,000	9,000
Plant					
Dryer Operators	3	20	200	4,000	12,000
Copra makers	8	12	200	2,400	19,200
Utilityman	1	12	200	2,400	2,400
TOTAL DIRECT LABOR					90,600
Years 4-10					
Indirect Labor (Same as year 2)					
TOTAL INDIRECT LABOR					44.600

Direct Labor					
Farm					
Tractor Operator	2	24	250	6,000	12,000
Tractor Helper	2	12	250	3,000	6,000
Nut Pickers	4	12	250	3,000	12,000
Huskers	4	12	250	3,000	12,000
Weeders	4	12	250	3,000	12,000
Nut Carriers	4	12	250	3,000	12,000
Plant					
Dryer Operator	3	20	250	3,000	15,000
Copramakers	8	12	250	3,000	24,000
Utilityman	1	12	250	3,000	3,000
TOTAL DIRECT LABOR					108,000
DEPRECIATION - 10% of $340,000					34,000
INSURANCE - 1 % of $340,000					3,400
REPAIR & MAINTENANCE 5 % of $340,000					
AGEMENT OVERHEAD					10,000

COPRA PRODUCTION MODELS - PROJECTED INCOME STATEMENT (E$000) - MODEL B

SALES REVENUE										
Copra Sales	218.4	327.6	436.8	546.0	546.0	546.0	546.0	546.0	546.0	546.0
VARIABLE COSTS										
Cost of nuts	64.0	96.0	128.0	160.0	160.0	160.0	160.0	160.0	160.0	160.0
Direct labour	40.2	64.2	90.6	108.0	108.0	108.0	108.0	108.0	108.0	108.0
Supplies	58.0	60.0	62.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Power	2.7	4.1	5.5	6.8	6.8	6.8	6.8	6.8	6.8	6.8
TOTAL VARIABLE COSTS	164.9	224.3	286.1	338.8	338.8	338.8	338.8	338.8	338.8	338.8
FIXED COSTS										
Indirect labour	26.2	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Depreciation	17.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
Insurace	1.7	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Repair and maintenance	8.5	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Administrative overhead	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
TOTAL FIXED COSTS	63.4	109.0	109.0	109.0	109.0	109.0	109.0	109.0	109.0	109.0
TOTAL COSTS	228.3	333.3	395.1	447.8	447.8	447.8	447.8	447.8	447.8	447.8
GROSS PROFIT (LOSS)	(8.9)	(5.7)	41.8	98.2	98.2	98.2	98.2	98.2	98.2	98.2
INTERESTS	-	27.0	30.0	37.0	33.0	29.0	25.0	20.0	14.0	8.0
PROFIT BEFORE TAXES	(8.9)	(32.7)	11.7	61.2	65.2	69.2	73.2	78.2	84.2	90.2

COPRA PRODUCTION MODELS - PROJECTED CASH FLOW STATEMENT (EC$000) - MODEL B

SOURCES OF INCOME										
Net Income	(8.9)	(32.7)	11.7	61.2	65.2	69.2	73.2	78.2	84.2	90.2
Add Back:										
Interests	-	27.0	30.0	37.0	33.0	29.0	25.0	20.0	14.0	8.0
Depreciation	17.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
TOTAL INTERNAL RESOURCES	8.1	28.3	75.5	132.2	132.2	132.2	132.2	132.2	132.2	132.2
BORROWINGS										
Loan	224.0	-	28.0							
Equity	96.0	-	12.0							
TOTAL BORROWINGS	320.0	0	40.0							
TOTAL FUNDS	328.1	28.3	115.5	132.2	132.2	132.2	132.2	132.2	132.2	132.2
APPLICATION OF FUNDS										
Establishment cost	300.0	-	40.0							
Working capital	20.0	-	-							
Amortization of loan	-	-	-	67.0	67.0	67.0	67.0	67.0	67.0	73.0
TOTAL DISBURSEMENTS	320.0	-	40.0	67.0	67.0	67.0	67.0	67.0	67.0	73.0
NET CASH INFLOW/OUTFLOW	8.1	28.3	75.5	65.2	65.2	65.2	65.2	65.2	65.2	60.2
CASH: BEGINNING	-	8.1	36.4	111.9	177.1	242.3	307.5	372.7	437.9	503.1
ENDING	8.1	36.4	111.9	171.1	242.3	307.5	372.7	437.9	503.1	563.3
DEBT SERVICE RATIO	-	-	-	1.97	1.97	1.97	1.97	1.97	1.97	1.81

MODEL C - Copra Central for Small Farmers

Basic Assumptions

1. Daily capacity of Central - 8,000 nuts
2. Area to be served - 300 to 400 hectares
3. Nuts to copra conversion - 5,000 nuts per metric ton copra
4. Purchase price of nuts - 16 cents per nut, husked and delivered to roadside
5. Price of copra - $ 1,300 per metric ton plus 3 per cent price premium if FFA content is less than 0.5 % or an effective price of $ 1,365 per ton.
6. All prices and costs in EC dollars (August 1983)

Estimate of Project Cost

Machinery and equipment	$ 130,000	
1 Copra dryer, forced-draft with shell-fired air heater capacity: 10,000 nuts per day		
1 Mechanical nut-cracker with a capacity of 2,000 nuts per hour		
2 Nut carts		
1 Bag closer, portable		
1 Platform scale 500 kg capacity		
1 Nut bin		
2 5-ton truck, stake-back, diesel-driven		
hand tools, copra knives, shovels, etc.		
Installation cost	$ 15,000	
Installed cost of machinery and equipment		$ 145,000
Buildings: (including site development)		
Dryer shed and copra storage		
Work shed for pre-drying operations		
Office, including office equipment		
Total Fixed Capital Investment		$ 280,000
Working Capital		40,000
Total Project Cost		$ 320,000

Investment Services

Equity (30 %)	$ 96,000
Loan (70 %)	224,000
Total:	$320,000

Loan Terms

Interest - 12 per cent per year on unpaid balance. Interests during grace period to be added to loan.

Repayment - 10 years period with 2 years grace on amortization.
To be paid in eight equal annual installments starting with year 3.

FINANCIAL PLAN	EQUITY	LOAN	TOTAL
Year 1	$ 96,000	$224,000	$320,000

INTERESTS AND AMORTIZATIONS SCHEDULE ($000)

Year	Drawdown	Amortization	Interest	Principal	Balance
1	224	-	-	-	224
2	-	-	27	-	251
3	-	50	30	20	231
4	-	50	28	22	209
5	-	50	25	25	184
6	-	50	22	28	156
7	-	50	19	31	125
8	-	50	15	35	90
9	-	50	11	39	51
10	-	57	6	51	0

PRODUCTION SCHEDULE	Year 1	Year 2	Years 3-10
Nuts purchased, 10^6	1.0	2.0	2.0
Copra Produced, MT	200	400	400
SALES REVENUES			
Copra Sales, MT	200	400	400
Price, $/MT	1,365	1,365	1,365
VALUE, $	273	546	546
RAW MATERIALS			
Nuts (millions)	1.0	2.0	2.0
Price, cents	16	16	16
VALUE, $	160,000	320,000	320,000
SUPPLIES			
Diesel Fuel, Gal.	1,000	2,000	2,000
Price, $/gal.	4	4	4
VALUE, $	4,000	8,000	8,000
Misc. Supplies, $	2,500	2,500	2,500
TOTAL SUPPLIES, $	6,500	10,500	10,500
POWER, kw-hrs	8,000	16,000	16,000
Price, ¢ /kw-hr	30	30	30
VALUE, $	2,400	4,800	4,800

SCHEDULE OF SALARIES AND WAGES

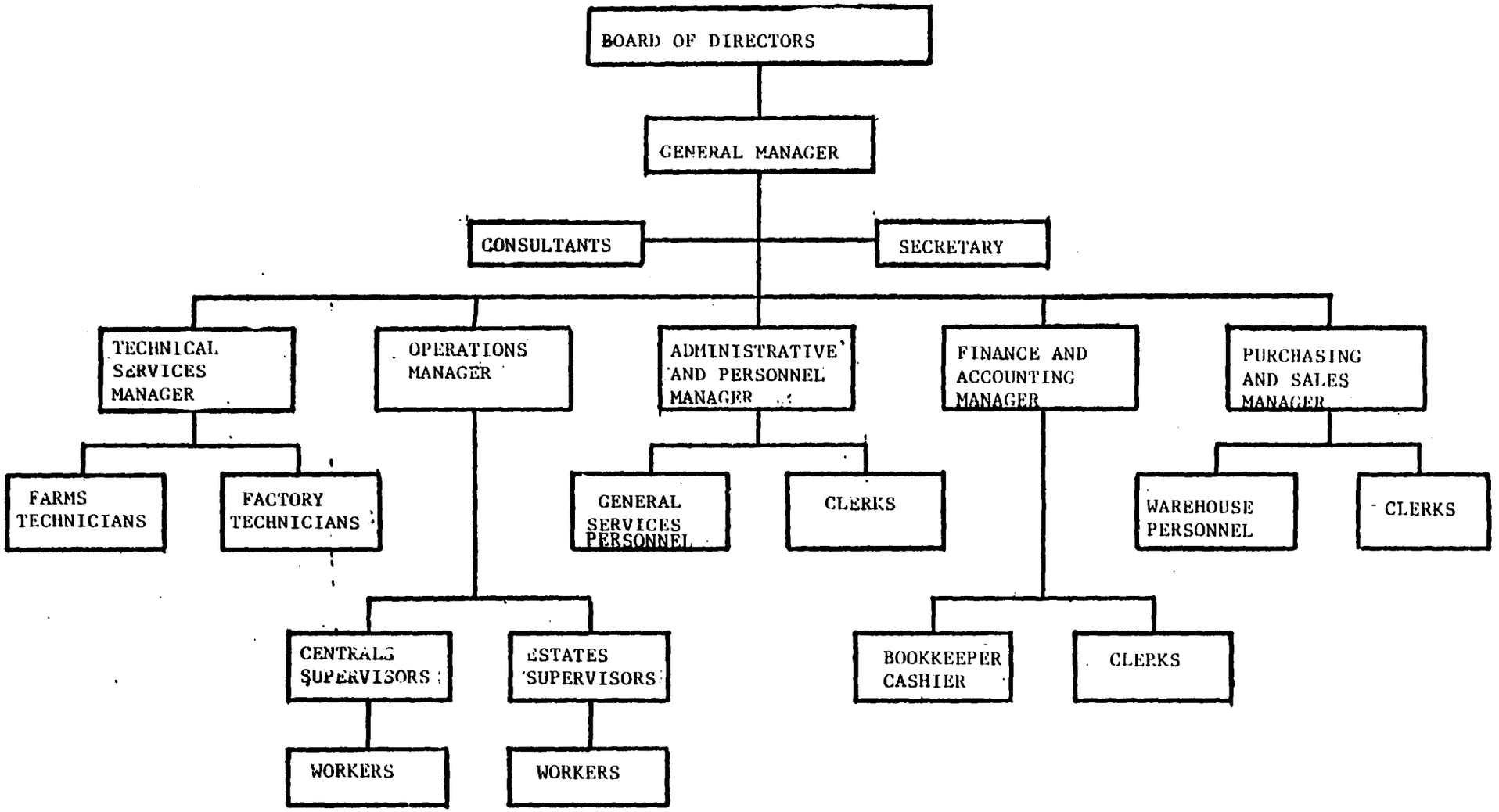
Year 1 (½ year) Position	No.	Rate	Months or days	Annual Salary	Total Annual Salary
Indirect Labor					
Manager	1	1,500	7	10,500	10,500
Bookkeeper-clerk	1	800	7	5,600	5,600
Maintenance man	1	800	7	5,600	5,600
Driver-Mechanic	1	800	7	5,600	5,600
Truck Helper	1	500	7	3,500	3,500
TOTAL INDIRECT LABOR					30,800
Direct Labor					
Dryer Operator	3	14	150	2,100	6,300
Copramakers	4	12	150	1,800	7,200
TOTAL DIRECT LABOR					13,500
Year 2-10					
Indirect Labor					
Manager	1	1,500	12	18,000	18,000
Bookkeeper-clerk	1	800	12	9,600	9,600
Maintenanceman	1	800	12	9,600	9,600
Driver-Mechanic	1	800	12	9,600	9,600
Truck Helper	1	500	12	6,000	6,000
TOTAL INDIRECT LABOR					52,000
Direct Labor					
Dryer Operators	3	14	250	3,500	10,500
Copramakers	4	12	250	3,000	12,000
TOTAL DIRECT LABOR					22,500
DEPRECIATION 10% of $280,000					28,000
INSURANCE 1 % of $280,000					2,800
REPAIR & MAINTENANCE 5 % of $280,000					14,000
ADMINISTRATIVE OVERHEAD					20,000

COPRA PRODUCTION MODELS - PROJECTED INCOME STATEMENT (EC$000) - MODEL C

SALES REVENUES										
Copra Sales	273.0	546.0	546.0	546.0	546.0	546.0	546.0	546.0	546.0	546.0
VARIABLE COSTS										
Cost of nuts	160.0	32.0	320.0	320.0	320.0	320.0	320.0	320.0	320.0	320.0
Direct labour	13.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Supplies	6.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Power	2.4	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
TOTAL VARIABLE COSTS	182.4	357.8	357.8	357.8	357.8	357.8	357.8	357.8	357.8	357.8
FIXED COSTS										
Indirect labour	30.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8
Depreciation	14.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Insurance	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Repair and maintenance	7.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Administrative overhead	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
TOTAL FIXED COSTS	74.6	117.6	117.6	117.6	117.6	117.6	117.6	117.6	117.6	117.6
TOTAL COSTS	257.0	475.4	475.4	475.4	475.4	475.4	475.4	475.4	475.4	475.4
GROSS PROFIT (LOSS)	16.0	70.6	70.6	70.6	70.6	70.6	70.6	70.6	70.6	70.6
INTERESTS	-	27.0	30.0	28.0	25.0	22.0	19.0	15.0	11.0	6.0
PROFIT BEFORE TAXES	16.0	43.6	40.6	42.6	45.6	48.6	51.6	55.6	59.6	64.6

COPRA PRODUCTION MODELS - PROJECTED CASH FLOW STATEMENT (EC$000) - MODEL C

SOURCES OF INCOME										
Net Income	16.0	43.6	40.6	42.6	45.6	48.6	51.6	55.6	59.6	64.6
Add Back: Interest	-	27.0	30.0	28.0	25.0	22.0	19.0	15.0	11.0	6.0
Depreciation	14.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0
TOTAL INTERNAL RESOURCES	30.0	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6
BORROWINGS										
Loan	224.0									
Equity	96.0									
TOTAL BORROWINGS	320.0									
TOTAL FUNDS	350.0	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6
APPLICATION OF FUNDS										
Establishment cost	280.0									
Working capital	40.0									
Amortization of loans		-	50.0	50.0	50.0	50.0	50.0	50.0	50.0	57.0
TOTAL DISBURSEMENTS	320.0		50.0	50.0	50.0	50.0	50.0	50.0	50.0	57.0
NET CASH INFLOW/OUTFLOW	30.0	98.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6
CASH: BEGINNING		30.0	128.6	177.2	225.8	274.4	323.0	371.6	420.2	468.8
ENDING	30.0	128.6	177.2	225.8	274.4	323.0	371.6	420.2	468.8	517.4
DEBT SERVICE RATIO			1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.73



ORGANIZATIONAL CHART
COCONUT DEVELOPMENT COMPANY

COVERAGE OF FIELD TRIPS

Countries Visited

1. Trinidad	14 - 17 August, 29 - 31 August
2. Grenada	18 - 21 August
3. St. Vincent	22 - 25 August
4. Dominica	26 - 29 August
5. Guyana	1 - 10 September
6. Antigua	11 - 15 September
7. Jamaica	16 - 19 September
8. Belize	20 - 23 September
9. Saint Lucia	25 July - 4 August (Previous trip)

Coconut Estates Visited

1. St. Andrews Estate	Trinidad
2. Union Estate	St. Vincent
3. Orange Hill Estate	St. Vincent
4. Hampstead Estate	Dominica
5. Bowden Estate	Jamaica
6. Hope Estate	Guyana

Processing Plants Visited

1. Copra Manufacturers	Saint Lucia
2. Coconut Growers Assn.	Trinidad
3. Tempe Manufacturing	Grenada
4. Arnos Vale (1979) Ltd.	St. Vincent
5. Dominica Coconut Products	Dominica
6. Edible Oil Factory	Antigua
7. SEPROD Co. Ltd.	Jamaica
8. National Edible Oil Co.	Guyana
9. Majarajah Oil and Cake Mills	Guyana
10. Demerara Oil Mills	Guyana
11. Oil Boiling Operation	Belize

Visited several small coconut farms and copra houses

REFERENCES

1. The Oils and Fats Subsector- CARICOM Secretariat
2. A General Economic Study on the Fats and Oils Subsector for the 1980's - P. S. Ross and Partners
3. Extention of Vegetable Oil Processing Facilities in the CARICOM Region - Commonwealth Secretariat
4. Situation of Tree Crops - Reginald Griffith
5. Prospectus for the Coconut Industry - Ministry of Agriculture, Grenada

PERSONS CONTACTED DURING THE MISSION

UNDP, Georgetown

Cecile I. G. Davis	-	Resident Representative
Lancelot Wilkie	-	W F P Project Officer
Hazel Griffith	-	Senior Administrative Assistant
Horace Walks	-	Programme Officer

CARICOM Secretariat

Dr. Winston Phillips	-	Agricultural Planner, UNDP-CCS Institutional Support Project
Winston Smith	-	Commodities Specialist, Caribbean Community (CARICOM) Secretariat

Antigua

Clarence Eduards	-	Permanent Secretary, Min. of Economic Dev.
George Goodwin	-	Executive Secretary, Ind. Dev. Board
Dr. Hayden Thomas	-	Government Chemist, Chemistry and Food Division, Ministry of Agriculture
Frank Henry	-	Senior Agricultural Officer
Cedric Henry	-	Agricultural Officer

Belize

Sandra Bedran	-	General Manager, Belize Marketing Board
Lalo Garcia	-	Head, Extention Dept., Ministry of Agriculture
Dr. B. K. Rai	-	Head of Unit, Caribbean Agricultural Research and Development Institute (CARDI)
Frank Chan	-	Project Officer, Coconut Rehabilitation Project
Nicolas Rivas	-	Senior Field Officer, Coconut Project

Dominica

Wosley P. Louis	-	Permanent Secretary, Ministry of Agriculture
Mona George Dill	-	Assistant Secretary, Ministry of Agriculture
Ronald J. Harvey	-	Project Director, Dominica Coconut Rehabilitation and Expansion Project (Canadian International Development Agency)
Collin Bulley	-	Agricultural Development Adviser. Ministry of Agriculture
Philip Nassief	-	Chairman and Chief Executive Officer, Dominica Coconut Products, ltd.
Jonas Bellot	-	Secretary and Accountant, Dominica Coconut Products Ltd.
Joseph Astaphan	-	Plan Manager, Dominica Coconut Products
Terence Joseth	-	Manager, Hampstead Estate

Grenada

Derrick Ackloo	-	Projects Monitoring Officer, Ministry of Agriculture
Ivan Archer	-	Manager, Tempe Manufacturing Plant

Guyana

Burton Gajadar	-	Economic Adviser to the President
Dr. Patric McKenzie	-	Deputy Chief Agricultural Officer Ministry of Agriculture
Dr. Leslie Chin	-	Technical Director, Guyana Pharmaceutical Products
Dr. Ulric Trotz	-	Director, Institute of Applied Science and Technology
Lionel Sears	-	General Manager, National Edible Oil Co. Ltd. (NEOCOL)
Chico Persaud	-	Manager, Maharaja Oil Mills
Jack Wilkinson	-	Director, Demerara Oil Mills
Jonathan Hopkinson	-	Factory Manager, NEOCOL
Ronald Dan	-	Production Manager (Refinery), NEOCOL
Motilall Sarjoo	-	Production Manager (Extraction), NEOCOL

Jamaica

Roy A. Williams	-	General Manager, Coconut Industry Board
Raymond Sumons	-	Secretary, SEPROD Group of Companies
Winston Chevannes	-	Assistant Operations Manager, Coconut Ind. Board
Richard Jackson	-	Owner and Manager, Bowden Estate

Saint Lucia

Hon.Ira d'Auvergne	-	Minister of Agriculture
Ausbert d'Auvergne	-	Deputy Director, Finance and Planning
John B. Henry	-	Permanent Secretary, Min. of Agriculture
Cosmos Richardson	-	Assistant Permanent Secretary Ministry of Agriculture
David Demarque	-	Chief Agricultural Officer
Clarence Michel	-	Research Officer, Union Agricultural Station
Tjibbe Scheper	-	Managing Director, Copra Manufacturers Ltd.
Cromwell Goodwin	-	Chief Engineer, National Development Corp.

St. Vincent

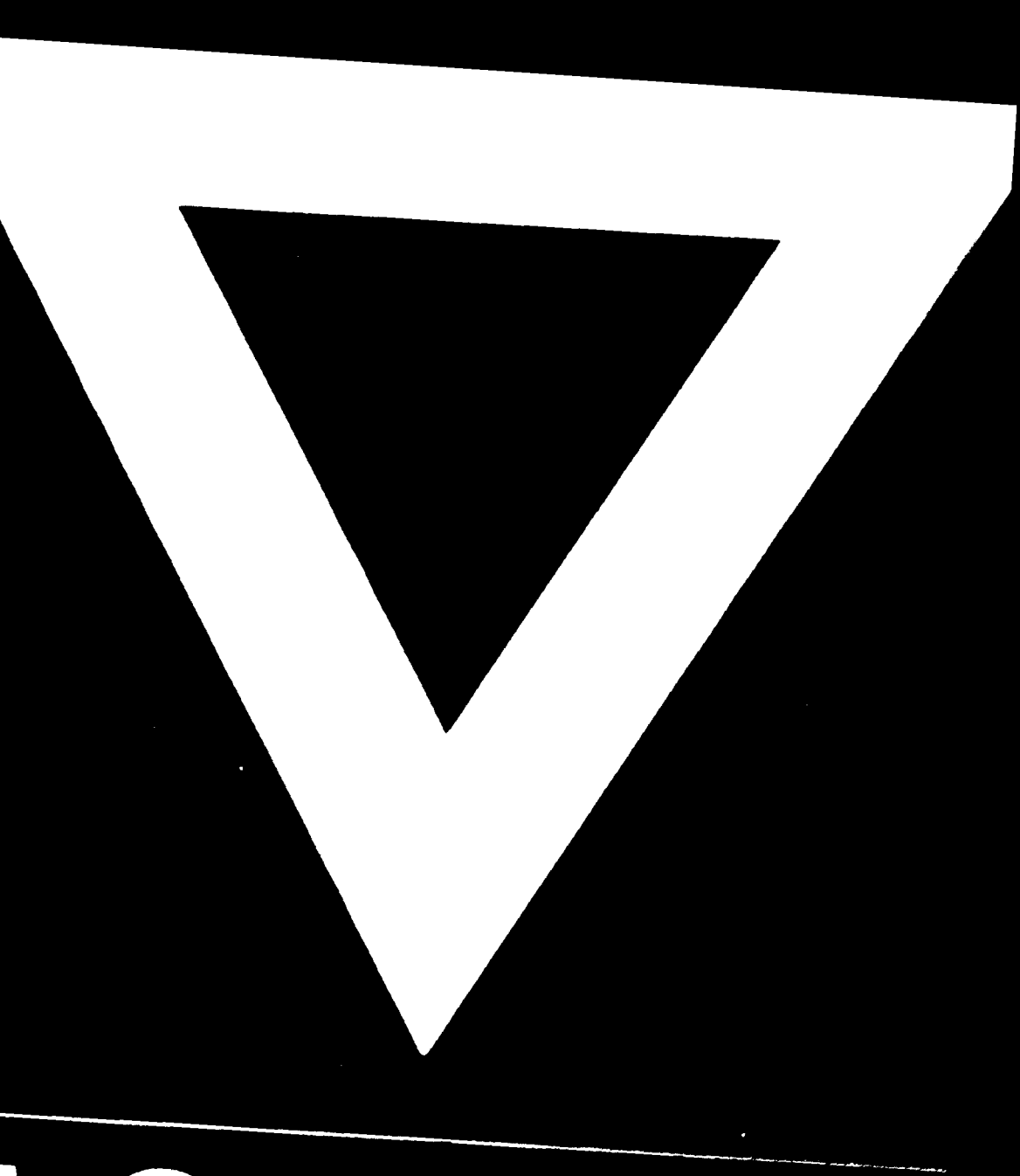
Joslyn Willams	-	Permanent Secretary, Min. of Agriculture
Grafton Vanloo	-	Chief Agricultural Officer
Keneth Bonadie	-	Agricultural Officer, In-charge of Extension
Victor Hadley	-	Managing Director, Orange Hill Estate
Brian Veira	-	Plant Manager, Arnos Vale (1979) Ltd.
Verdin Lewis	-	Production Supervisor, Arnos Vale, Ltd.

Trinidad

Dr. P. Alleyne	-	Permanent Secretary, Min. of Agriculture
Dr. Reginald Griffith	-	Director, Red Ring Research Div, Min. of Agriculture
Desmond Price	-	Technical Director, Coconut Growers Association (CGA) Plant
Richard Potter	-	Plant Engineer, CGA
David Dalbarry	-	Production Supervisor, CGA
Liaquat Shah	-	Head, Engineering Section, Caribbean Ind. Research Institute (CARIRI)
Charles Marvin	-	Manager, St. Andrews Estate

Others

Das Van Helden	-	Agricultural Adviser, Delegation of the Commission of European Communities, Georgetown, Guyana
Richard Constanduros	-	Director, Minster Agriculture Ltd.
Vinay Chand	-	Consultant, Minster Agriculture Ltd.



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