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POTENTIAL FOR PRODUCTION AND MARKETING HIGH VALUE SOUTH PACIFIC COCONUT PRODUCTS

BY

APPROPRIATE TECHNOLOGY INTERNATIONAL
1331 H STREET N.W.
WASHINGTON, D. C.
20005

APRIL, 1989

*ATI is a private, not-for-profit development assistance organization based in Washington, D.C. and operating in Asia, Africa, Latin America and the Carribean. ATI's program is concerned with the identification, assessment and adaptation of technology. In collaboration with local organizations in developing countries, ATI develops and tests commercial applications of appropriate technologies in the fields of minerals utilization, agricultural products processing, and small farm equipment.

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PREFACE

On August 27-28, 1987, U.S.A.I.D.'s Regional Development Office for the South Pacific sponsored the South Pacific Regional Coconut Products Manufacturing Conference in Rarotonga, Cook Islands. The purpose of that conference was to explore the possibility of establishing a privately financed, integrated regional facility for manufacturing high-quality coconut products such as edible creams, desiccated coconut, cheese analogues, cosmetic oils, food and industrial additives, and activated carbon. The objectives of this facility would be to (1) create a significant, new and more stable market for South Pacific coconut growers, including small landholders; (2) foster new employment opportunities; (3) increase foreign exchange earnings; and (4) compete with high-volume producers from other countries. The successful establishment of an integrated regional, facility could also lead to the development of a wide range of related small industries and pre-processing facilities in participating countries.

The conference participants felt that a study was needed to determine the feasibility of a central coconut manufacturing facility that could be served by satellite facilities in multiple countries of the region.

The U.S.A.I.D. office in Suva agreed to fund the study and contracted Appropriate Technology International (ATI) to conduct it. ATI is a private, not-for-profit development assistance corporation based in Washington, D.C.

The objective of this study was to determine the feasibility of establishing a coconut processing venture in the South Pacific to produce high-quality products for the export market. The study was designed to address issues of markets, raw materials, logistics; transportation; social, cultural, and political factors, and financial and economic prospects. From September 1988 to March 30, 1989, ATI provided a total of 14 person months of services from the following professionals: Agro-Industrial Planner (Glenn Patterson), South Pacific Coconut Industry Specialist (Garry Cooper), a South Pacific Agro-Industry Technical Specialist (Owen Drew), a Coconut Product/Processing Specialist (Ernesto Lozada), Agro-Product Market Research and Strategy Specialists (Frank Roman and Mike Grossman of James Austin Associates), an Economic and Financial Analyst (Eric Hyman), and a South Pacific Social/Cultural Specialist (Fred Fisk). In addition, the Government of American Samoa provided Pete Galea'i and John Faumina of the American Samoa Development Planning Office and French Polynesia provided Dexter Cave to assist in planning the study and provide country specific information. An Agro-Forest Industry Specialist (Dennis Johnson) was also made available by the U.S. Department of Agriculture's, Forestry Support Program to assist in coconut byproduct utilization.

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The final report was compiled and edited by Glenn Patterson, Eric Hyman, and Nancy Tresp. Administrative support services were provided by Toni Wright.

The thirteen surveyed South Pacific governments, the coconut industry boards and members of the private sector in those countries were instrumental in providing information for this report. ATI and the study team members wish to thank all those who have provided assistance to this effort. Special acknowledgment is also given to the Government of American Samoa for arranging meeting facilities and providing administrative support to the team in American Samoa.

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EXECUTIVE SUMMARY

In August of 1987, the South Pacific Regional Coconut Products Manufacturing Conference was held in Rarotonga, Cook Islands. The objective of this conference was to provide a forum for representatives of the various island groups, including growers, producers and marketers to come together to find a solution to the problem of insufficient returns from the coconut.

> One of the main recommendations of this conference was that A.I.D. fund a study "to determine the feasibility, based on a market, raw materials, logistics/transportation, social, cultural, political, financial and economic analysis; of establishing a coconut processing venture to primarily produce high quality products for the export market."

This study was funded by U.S.A.I.D. under Indefinite Quantity Contract: DHR 5428-I-00-7016-00, and was conducted by Appropriate Technology International (ATI). ATI is a private, not-for-profit development assistance organization based in Washington, D.C. and operating in Asia, Africa, Latin America and the Carribean. ATI's program is concerned with the identification, assessment and adaptation of technology. In collaboration with local organizations in developing countries, ATI develops and tests commercial applications of appropriate technologies in the fields of minerals utilization, agricultural products processing, and small farm equipment.

This study is presented in three sections: (1) A market analysis and proposal for a private-sector marketing services firm; (2) an examination of processing options for countries in the region, including a financial and economic analysis of selected product mixes and processing locations; and (3) an implementation plan. The annexes contain additional information on marketing, country profiles of the region, and other supporting documents. Each section should be considered as an important part of an integrated venture to be implemented by the South Pacific coconut industry and associated agencies.

I. NEED FOR A OF PRIVATE-SECTOR MARKETING SERVICES FIRM FOR THE COCONUT INDUSTRY IN THE SOUTH PACIFIC

A. Market Analysis

This study has clearly identified the importance of a coconut industry profile. The team has found that institutional problems and lack of information on market opportunities and technological options have prevented the South Pacific coconut industry from making better use of its resources. Present operations producing low-value commodities such as copra and edible coconut oil are not currently sufficiently profitable in the region and are subject to major fluctuations in market conditions. An examination of reasonably accessible export

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markets showed some market opportunities for selected alternative products. However, there is competition from other producers of coconut products as well as other vegetable oils.

Therefore, an objective of this market research was to locate "niche" markets that (1) present suppliers have not tapped because of different quality expectations between producers and buyers, (2) do not compete with major suppliers of coconut oil from other regions or other vegetable oils less subject to consumer concerns about saturated fat content, and (3) represent new markets that have not yet been tapped, but which exhibit interest by potential buyers.

At present, there are some high-value products with encouraging prospects for small-to-medium scale firms capable of meeting high quality standards for export. Because the size of these unserved markets is relatively limited, they offer a niche for industry in the South Pacific that may be overlooked by potential large-scale competitors in Southeast Asia. Examples of products that meet these criteria and deserve primary attention in initial marketing efforts include premium-grade, aseptically packaged coconut cream; low-fat dessicated coconut flakes; frozen coconut flakes or chunks; coconut skim milk; and "virgin" (first pressing) oil. Target markets for initial focus will be retail ethnic and health food markets and industrial users in North America, particularly the West Coast.

B. Marketing Firm Functions and Operations

The team recommends establishing a marketing support firm as a permanent private service firm to link coconut processors in the South Pacific to export buyers. This marketing service firm, here called Coconut Products of the South Pacific, Inc. (CPSP) would assist processors by coordinated and orderly marketing of products, locating and developing new market opportunities, and helping to ensure that processors meet product specifications and quality control standards demanded by the market. The costs of establishing a small marketing firm and meeting operating expenses for the first year would be approximately $290,000. It is expected that the initial year's funding could come from grant or loan funds.

Initially, CPSP would collaborate with one or two processors to help them locate specific sales opportunities. As the market grows with existing or new products, it will assist additional processors. Beginning in the first year, the firm would charge participating processors fees based on their gross revenues. A small profit margin is planned to to ensure sustainability and allow expansion of services to processors.

Two locations have a comparative advantage for location of the CPSP marketing service firm. American Samoa offers excellent access to the U.S. market, as Fiji does for the EEC market. The costs and frequency of shipping and air travel are relatively

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good in these two countries. Skilled technical and managerial labor are available in American Samoa and Fiji. Both countries provide favorable investment incentives.

II. COUNTRIES IN THE REGION

A. Product Choice and Locations

Processing technologies that can consistently meet the high quality specifications for high-valued, export products will need to be chosen. In some cases, it will be possible to modify existing coconut cream or other canning facilities. However, the market research has indicated an unfilled demand for a better quality product in more convenient and possibly less costly packaging materials such as aseptically processed and packaged retail laminated boxes or bulk bag-in-box packaged products for the industrial market. At present, no specialty coconut processors are supplying the North American market with coconut cream, coconut skim milk, or virgin oil in these new types of packaging.

Of the thirteen South Pacific countries covered in this study, the Cook Islands, Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu, and Western Samoa were found to have sufficient raw material, other resources, and infrastructure to support an operation producing 1,000 liters or coconut cream or equivalent in other coconut products per hour. Papua New Guinea and the Solomon Islands could each support a 2,500 liter/hour operation.

To include countries with less market access and technical capability, an alternative to complete processing at a single location was explored. This alternative involves using satellite plants to produce an intermediate product (frozen coconut cream) for final processing at a central location in another country. Five central/satellite combinations were analyzed: a central plant in Fiji purchasing frozen cream from Vanuatu or Kiribati and a central plant in American Samoa linked to satellites in Tonga, the Cook Islands or Western Samoa.

B. Findings

The financial/economic analysis showed that none of these central/satellite combinations were feasible because this option requires a higher total capital investment and incurs extra transport costs between central and satellite countries. Complete processing of coconut cream at one location could be quite profitable in locations with an adequate domestic supply of raw materials and sufficiently low costs for unskilled labor. The coconut cream facility would also produce dried low-fat coconut flakes and parings as byproducts. Initially, the flakes and parings would be sold to copra processing mills. There is a potential, higher-value, export market for the low-fat flakes as a replacement for dessicated coconut.

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The form of packaging is also an important decision in coconut cream production. Production costs are much lower for this product in bulk aseptic bags for the industrial market. For the retail market, it is cheaper to produce the product in aseptic boxes than in cans, unless the capital equipment for canning is already available. Also, there are significant economies of scale for a facility that can process 2,500 liters of coconut cream per hour on double shifts over a similar operation with a capacity of 1,000 liters per hour.

Frozen coconut flakes could be produced in a smaller plant than the minimum economic size for coconut cream processing. Operating on two shifts per day would substantially lower the minimum product price needed for commercial viability. Coconut skim milk as a beverage and virgin coconut oil for the cosmetics industry are potential new products that are alternatives to coconut cream production. Since these two products are jointly produced, the break-even price for virgin coconut oil is strongly affected by the expected sales price of the skim milk. The study team has identified preliminary immediate interest in plain or flavored coconut skim milk as well as the virgin oil. However, there is still considerable uncertainty about the prices for these products as potential buyers are reluctant to make price quotations in the absence of samples and/or test marketing.

The capital costs of a new complete processing plant producing coconut cream in bulk aseptic packaging are U.S. $3.7 million for a 1,000 liter per hour operation and $5.7 million for an operation producing 2,500 liters/hour. Frozen coconut flakes could be produced with a capital investment of only U.S. $2.4 million. An operation producing virgin coconut oil and coconut skim milk would require U.S. $7.1 million to establish. If existing operations are used, these costs would be reduced because some of the plant and equipment could be used. However, modifications would still be needed to meet new buyer needs such as aseptic packaging and importing country regulations.

The financial and economic analysis showed that only complete processing operations rather than satellite/central combinations should be considered given present market conditions and the assumptions used. The following locations were identified as potentially profitable for double shift operations with the listed products:

Fiji	--	coconut cream production, 1,000 l/h, in bulk aseptic or retail aseptic packaging
Kiribati	--	coconut toddy production, small scale
Niue	--	coconut toddy production, small scale

Papua New Guinea -- coconut cream production, 2,500 l/h, in bulk UHT aseptic or retail aseptic packs, or canned packaging

Solomon Islands -- coconut cream production, 1,000 l/h in bulk UHT processed aseptic or retail aseptic packaging; coconut cream production, 2,500 l/h in bulk aseptic, retail aseptic, or canned packaging; coconut skim milk and virgin oil on a scale with 30% larger throughput than the 2,500 l/h cream factory

Vanuatu -- coconut cream production, 1,000 l/h in bulk UHT processed aseptic or retail aseptic packaging; frozen coconut flakes

Western Samoa -- coconut cream production, 1,000 l/h in bulk aseptic or retail aseptic packaging

Due to the size of the market in the short-term, it would not be possible to establish all of the above facilities without leading to excessive competition.

The financial and economic analysis of processing locations is most sensitive to the cost of unskilled labor and the purchase price of dehusked coconuts. If operated at a 100% capacity use rate on double shifts, complete processing of coconut cream would provide full-time employment for 220 unskilled workers at a 1,000 l/hour operation or 509 unskilled workers at a 2,500 l/hour operation. Production of virgin oil and coconut skim milk would require 652 unskilled laborers. A frozen coconut flakes factory running on a single shift would need 118 unskilled workers. Across the South Pacific region, there is a large amount of variation in wage rates for unskilled labor, which has a strong effect on the competitiveness of the location. The salaries of managerial and technical staff are a much smaller portion of annual production costs. Product transport costs are also important, but there is less variation in these costs across countries than in unskilled labor costs.

The analysis is based on a delivered unit price of $0.10 per dehusked coconut of average weight, 710 grams. This allows for a conservative assessment of the viability of processing plants because current prices are closer to $0.07 each for coconuts of this size, leaving a reasonable margin for price increases. Nevertheless, a sensitivity analysis was done to examine the effects of an increase in the cost of coconuts to $0.13 per unit without any increase in product prices. Most of the facilities analyzed could not withstand this increase for the full ten-year period of analysis, but could absorb it for a shorter period.

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There are possible risks that should be weighted before investment decisions are made for a particular location. One of the largest risks is a major shortfall in coconut supplies due to adverse weather or pests and diseases. Unless this problem is country-wide, it would be possible to obtain coconuts from another domestic source. Within some South Pacific countries, inter-island shipping is costly. In some cases, shipping raw materials between countries may be limited by quarantine restrictions.

III. IMPLEMENTATION PLAN

The coconut industry has been the subject of many deliberations and discussions in the South Pacific region. Producers and investors have expressed frustration with the current state of the industry and are looking for profitable opportunities in alternative products and new markets. Potential buyers are also interested in obtaining reliable supplies of high-quality products. Unless timely action is taken, these opportunities may be lost to the region.

Consequently, it is essential that a cohesive organization be in place to implement the recommendations of this study. To take full advantage of the market opportunities for value-added products. As a next step, an implementation plan is important in following up on the study so that the region can take best advantage of the benefits that could be provided by a marketing service company. At present, market interest has been generated through delivery of product samples to potential buyers. Also, the expectations of the South Pacific coconut industry for more profitable market, product, and technology alternatives are high.

An initial step is to promptly create an Investment Promotion Team (IPT) to prepare the implementation plan. It is important to maintain the momentum that has been generated through this study with potential investors, processors, and buyers. The IPT can help entrepreneurs in existing and new operations find other investors to enhance the South Pacific coconut processing industry's capability to meet market opportunities. It could provide assistance in preparation of specific business plans. Providing that the reception to the IPT's early activities is positive, it would help organize and locate funds for the marketing firm, CPSP.

I. Proposed Regionally Oriented Marketing Firm

A. Marketing Problems Facing the Coconut Industry

Improving and stabilizing earnings from coconut product exports is critical to the economic and social well being of South Pacific countries.

Many problems faced by the industry are institutional and political. There is a stagnation, in many cases caused by a lack of vision beyond copra, coconut crude oil, and coconut meal production and associated technologies and exploring markets for other coconut products is also lacking. As a result, many potential benefits that could occur from a broader or more diversified vision are not realized. Without real economic alternatives the South Pacific economies will not grow and keep pace with the rest of the world.

The majority of edible coconut product manufacturers in the region are owner-operated, under-capitalized, and have too small a production capacity to reap adequate economies of scale to expand into new markets. Similarly, most of these small operations do not have sufficient resources or manpower to devote to adequate marketing and product development; they also lack capital reserves and have difficulty obtaining financing.

A deficiency in technology development puts the South Pacific region at a disadvantage in the areas of product development and economies of scale such that they cannot react to market demands or new business opportunities. In competitive terms, the major players in the world coconut market, the Philippines, Indonesia and Thailand, have left the South Pacific behind.

Most processors lack the financial capacity and manpower to tap larger markets themselves and there are no marketing organizations existing at this time who can offer needed marketing services. Yet the major component of any successful manufacturing investment is effective marketing, product development, and technical support programs. In addition, limited resources and size necessitate their concentrating on production rather than marketing. Thus processors are more product/process driven and less market driven.

Existing markets for South Pacific coconut products are limited, mostly to expatriate South Pacific Islanders and are relatively stable. Intra-regional competition for some markets discourage industry cooperation including areas where there may be real mutual advantages for collaboration. This

competition often results in further competition among producers in the region which erodes potential markets through marginal price competition and relaxation of quality standards. The prevailing "every man for himself" attitude may be appropriate for the existing limited market opportunities. It precludes, however, the opportunity for expanded and new markets that cooperative professional marketing, coupled with access to improved technical and logistical support, could provide at a lower cost if shared by processors.

The major problem facing South Pacific countries is therefore lack of market development and access to new markets using new technology for new or improved products.

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B. Market Analysis and Strategy

1. Key Findings

o Characteristics of the Market

There are many coconut products already in the market. Therefore, the coconut industry in the South Pacific must market distinctive products to set it apart from the existing products. For many final products, such as a coconut ice cream or mixers for drinks, the coconut is an ingredient that only constitutes a small proportion of the final product. There are a few products, such as coconut cream and low-fat flakes, where the coconut is the principal ingredient. To make full use of the raw material supplies available in the South Pacific, the products in which coconuts are a principal ingredient should receive initial attention in feasibility studies for the industry.

The mass market (non-Hispanic Caucasians) is unaccustomed to much use of coconut products. Therefore, educating the consumer is the key marketing task for increasing product awareness and usage. In addition, it may also be necessary to overcome some negative publicity recently associated with coconut oil. Mass education campaigns are both costly and complex. Therefore, cooperative tie-ups with market-oriented equity investors or speciality market brokers are recommended. Some final products, such as coconut water or skim-milk, are relatively inexpensive on a per unit basis. These products could eventually reach a mass market, but the ethnic market on the West Coast of the U.S. should be emphasized in the short term.

There are two key decision makers -- the intermediate user and the final user. Consequently, the marketing strategy will necessarily involve both a dealer-push and a consumer-pull campaign. The industry manufacturer (for coconut products as an ingredient) and the distributor (for the final product) are the intermediate decision makers. Intermediate decision makers can also be influenced by providing such services as warehousing, reliable supplies, and consistency in meeting specifications.

The market is segmented by industry buyers, product usage, consumer type, and distribution channels. To capture specific niches, it may be

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possible to enter the market in phases. Marketing margins make up a greater proportion of the final product price than producer margins. Thus, forward integration by a marketing service firm or producers will allow them to capture a greater share of these margins.

- Key Marketing Opportunities and Tasks

The market for the low-value commodity products, (desiccated coconut and oil) that have constituted the bulk of coconut consumption faces two problems. First, there has been a steady decline in per capita consumption of desiccated coconuts due to changing tastes and preferences. Second, a recent media campaign has given consumers a negative association of coconut oil with saturated fat and heart disease due to its saturated fat content.

It is recommended that initial marketing attention focus on southern California, from San Diego to Los Angeles. This area can serve as a convenient test market because its ethnic population (1) is already familiar with coconut products, (2) has experienced rising household incomes, and (3) is a large enough market group that its tastes and preferences already have substantial influence on the mass market.

Another marketing task is to establish positive attributes for the coconut both as a final product and as an ingredient. These attributes include taste, flavor, aroma, chemical properties, and nutritional value. It may be possible to take advantage of the trend in the "New American Diet," toward "natural" and "fresh" foods in marketing low-fat coconut products. Marketing efforts for South Pacific speciality coconut products could build on the romantic and healthy images of the South Pacific.

- Entry Strategies

There are two potential entry strategies for the South Pacific coconut industry which are not mutually exclusive. First, the industry can sell intermediate goods, like frozen flakes and coconut cream to manufacturers, such as the confectionary, ice cream, baked goods and other processed food industries. The advantages of this industry-based marketing strategy are its low cost, lower risks through diversification, connections to multiple industries, and emphasis on demand-pull rather than promotional-push. This strategy has some

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disadvantages. Since more of the value added in processing and distribution takes place outside the region, potential profits may be lower for suppliers of intermediate goods than for retail producers. Also, this strategy provides limited opportunities for expanding the demand for the product by influencing end consumers or creating a regional brand loyalty.

If producers could identify a small number of large buyers, they could market their products directly to them. However, in the more likely case of many small buyers, it may be necessary to contract with another firm for marketing services. Industrial buyers might also prefer to work through a marketing firm that could assure reliable deliveries meeting quality standards.

A second possible strategy would be for producers to manufacture selected coconut products and market them through food brokers and specialty distributors. This has the advantage of moving producers forward into the value-chain, and giving their products more identity in the mass market. The main disadvantage is the increased cost of marketing to maintain a sales force, larger commitments to distributors, and the need to share expenses for point-of-purchase promotions and consumer advertising. It would be more difficult for small producers to follow this strategy themselves without the assistance of a marketing service company. It may also be desirable to establish a common brand name in marketing the products of various manufacturers based in the South Pacific.

2. Objectives, Methods, Limitations and Coverage

The market study had the following objectives: (1) identification of attractive market niches for specialty coconut products primarily in North America, (2) preliminary estimation of the market feasibility of establishing multi-product coconut processing ventures in the South Pacific; and (3) development of an initial market strategy for entry into the North American market.

The methods used in the study consisted of a telephone survey to 250 firms in different food and non-food industries and markets; four computer searches of data-bases on coconut imports, commercial listings; market outlet visits to 24 ethnic and mass market supermarkets on the West Coast; and a follow-up survey with 20 respondents representing coconut product users such as

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beverage and ice cream manufacturers, and imported food brokers.

This market study has limitations due to its preliminary nature and the gaps in the available information. There is a scarcity of published data on specialty coconut products and there is no industry producing "coconut water", virgin coconut oil, or low-fat coconut flakes at present. The size of the market for high-value coconut products is uncertain because many of these products comprise only small parts of larger industries or product groupings. For example, piña colada mixes and coconut milk/pineapple juice blends are only a small part of the beverage industry. Estimates of market size and growth are only available for the low-value commodity coconut products. Another characteristic of specialty products is the lack of standards or specifications. As a result, prospective buyers and distributors generally want actual samples of the product before making price or volume commitments.

The study covered the following products and markets:

INTERMEDIATE (COCONUT) PRODUCTS	INDUSTRIES/END USERS PRODUCTS
*Desiccated coconuts	*Juices and soft drinks
*Coir fiber and spun rope	*Liquor
*Specialty oils	*Ice cream
*Fresh coconuts	*Chocolate and confectionary
*Carbonized coconut shells	*Baking
*Coconut water	*Cooking oils
*Coconut cream	*Spices
	*Essences
	*Handicrafts
	*Cosmetics
	*Pharmaceuticals

3. Recent Trends in U.S. Trade in Coconut Products

Information on U.S. trade in coconut products can be found in two reports issued annually: the USDA's FATUS report (Foreign Agricultural Trade of the United States) and the Customs Bureau's TSUSA report (Tariff Schedule of the United States of America). The US International Trade Commission classifies coconut products other than oil and copra into four categories:

1. Coconuts in the shell
2. Coconut meat, except copra, fresh or frozen with less

than ten percent sugar by weight
3. Coconut meat, shredded and desiccated, or similarly prepared
4. Coconut meat, prepared and preserved or not otherwise specified (P&P/N.E.S.)

The most recent figures available in early 1989 pertain to 1987. In 1987, the total value of U.S. imports of edible coconut products, excluding oil and copra, was $46,672,614.

Coconuts in the Shell

In 1987, the U.S. imported 29,361,198 coconuts with a total value of $4,071,667. U.S. imports of coconuts in the shell are dominated by sources in three countries that control 89% of the market. Moreover, the largest supplying country, the Dominican Republic, accounts for 52% of the market, more than twice its nearest competitor, Honduras. The third major source is Mexico. One South Pacific country, Fiji, has less than a 1% share of this market, with most of its exports destined for Hawaii.

Transport costs are an important determinant of the feasibility of shipping fresh coconuts because of the bulkiness of this product. Although the Philippines is a market leader in all other segments of the coconut product trade, it has been unable to make headway in the fresh coconuts market due to the costs of shipping heavy items long distances. The average delivered cost of U.S. imports of coconuts in the shell was $0.14 per unit in 1987, but this varied by country from $0.12 for supplies from the Dominican Republic to $0.26 for the Fiji product. However, it is difficult to compare these costs across countries because of differences in the sizes of the coconuts. The South Pacific does not have a comparative advantage in supplying coconuts in the shell to the U.S. market because of its distance and shipping routes.

Fresh or Frozen Coconut Meat

U.S. imports of fresh and frozen coconut meat containing less than 10% sugar reached 5,548,942 pounds in 1987, with a total value of $2,005,130. This market is also characterized by a high degree of concentration. In volume terms, the Dominican Republic has a 50% market share, compared to 41% for the Philippines, and 3% for Thailand. The average price of imports in this category is $0.36 per pound. Since this category includes a wide variety of products that may vary with the location of origin, aggregated trade data cannot be used to compare prices by country.

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Shredded and Desiccated Coconut Meat

Shredded and desiccated or similarly prepared coconut meat is the largest of the four categories. The U.S. imported 101,427,886 pounds of these products, with a total value of $36,920,695. Thus, the average price of these products is $0.36 per pound. This market is also by far the most concentrated of the four categories.

The Philippines, a consistent market leader in other segments of the market, totally dominates this category with 89% of U.S. imports. Sri Lanka, the next largest supplier, only has a 5% market share. By competing on the basis of price, Sri Lanka has captured some of the market that is not tied to integrated supply sources or foreign investment. Respondents indicated that a new seller would have to supply shredded and desiccated coconut meat at a discount of at least 5% below the market price to overcome questions about the reliability of supply.

Preserved and Prepared Coconut Meat

Preserved and prepared coconut meat includes other forms not specified in the other categories. Many of the products in this category serve niche markets with a relatively small total volume or value by the standards of U.S. trade statistics. The total volume of these products imported by the U.S. was 7,226,815 pounds in 1987 and their value amounted to $3,675,072. The average price of these diverse products was $0.50 a pound.

Approximately 47% of the volume of U.S. imports of preserved and prepared coconut meat products came from the Dominican Republic. The market shares of the next three largest exporting countries were 47% for the Dominican Republic, 22% for Thailand, 12% for Philippines, and less than 1% for the Western Samoa. A key issue in this category of products is achieving economies of scale through joint production or marketing of multiple types of items.

Coconut Oil

In 1987, the U.S. imported approximately 300,000 t of crude coconut oil 10,000 t of and refined coconut oil. Some of this oil undergoes further processing before domestic use or export to other countries. The crude coconut oil had a value of $150 million and the refined coconut oil were worth over $7.5 million.

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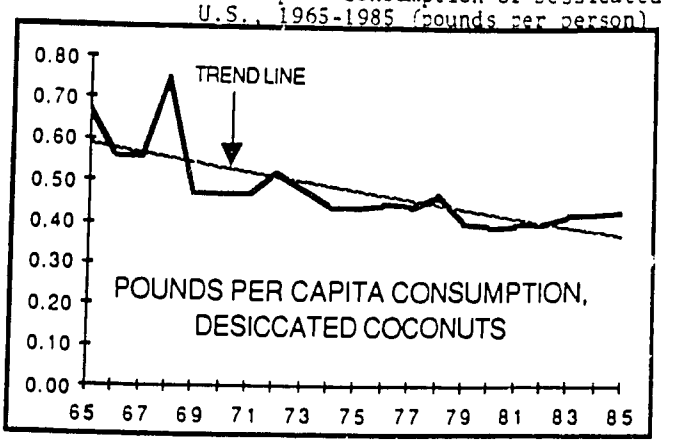
Per Capita Consumption of Major Coconut Products in the U.S.

Estimates of per capita consumption of major coconut products in the U.S. can be found in the USDA Economic Research Service's study, Food Consumption, Prices, and Expenditures. Time-series data are available for the past two decades.

Direct consumption of coconuts by the American population is relatively low. The bulk of desiccated coconut imports are consumed indirectly as ingredients in other food products. Figure I-1 shows the declining trend in per capita consumption of desiccated coconut over the period 1965 to 1985. Reduced use by food processing firms reflects changing consumer tastes toward coconut as a food ingredient.

Given this declining trend for desiccated coconut, a key marketing task is to identify other coconut products that might be of greater interest to consumers and food processors. Research may be needed to determine what product attributes are desired by the two groups of decision makers. Then, a marketing strategy can be developed to determine ways of influencing these decision makers. In general, consumers are more susceptible to media promotions (advertising and print) than manufacturers. The food processing industry supply is often most concerned with cost, quality specifications consistency, and the reliability of supply.

FIGURE I-1. Per Capita Consumption of Dessicated Coconut in the U.S., 1965-1985 (pounds per person)



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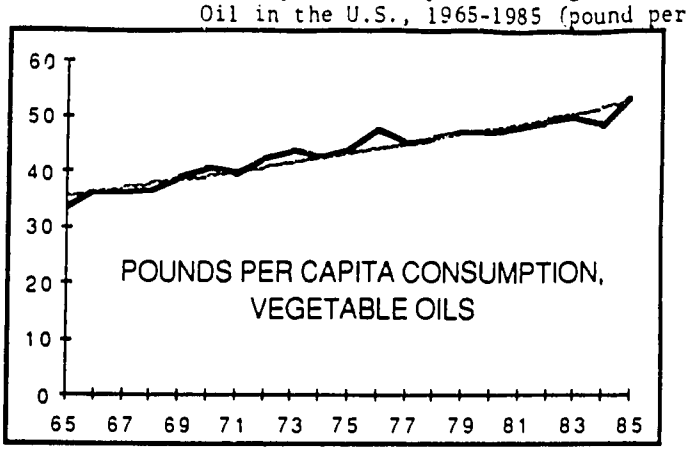
Per capita consumption of vegetable oils has increased at a two percent per annum rate due to greater demand for processed foods and fried fast food restaurant items. Moreover, the year-to-year fluctuation in this consumption has been relatively low (figure I-2). However, the prospects for coconut oil in this market are unfavorable in the United States.

Figure I-2. Per Capita Consumption of Vegetable Oil in the U.S., 1965-1985 (pound per person)



Since coconuts are primarily utilized as ingredients in other food products it may be useful to explore market trends for some of these other products such as juices and processed dairy products. Per capita consumption of fruit juices in the U.S. has grown approximately two percent over the past two decades (figure I-3). The consumption of speciality fruit juices may have grown an even higher rate, but time-series data are not available for this category. There may be good market opportunities in production of specialty juices that combine coconut with other fruits.

Figure I-3. Per Capita Consumption of Fruit Juices in the U.S., 1965-1985 (pounds per person)

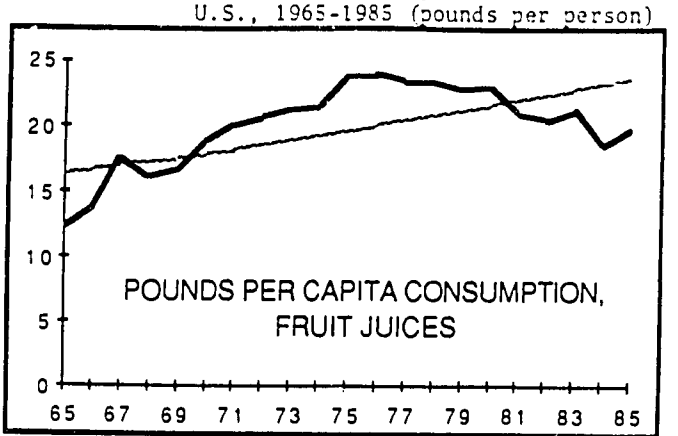


Figure I-4 highlights the differences in market segments that can occur within a product category. There has been a steady decline in whole milk consumption, with per capita consumption in 1985 amounting to less than half of what it was in 1965. On the other hand, per capita consumption of other dairy milk products almost tripled over the same time period, rising at an annualized growth of 5.5 percent. This category of other milk products includes both old and new products such as low-fat milk, skim milk, buttermilk, flavored milk drinks, and yogurt. The growth of other milk products reflects trends in the American diet toward lower fat and lighter foods. In keeping with this change, there may be an opportunity for a coconut-flavored milk drink.

Figure I-4. Per Capita Consumption of whole milk and other milk products, 1965-1985, (pounds per person)

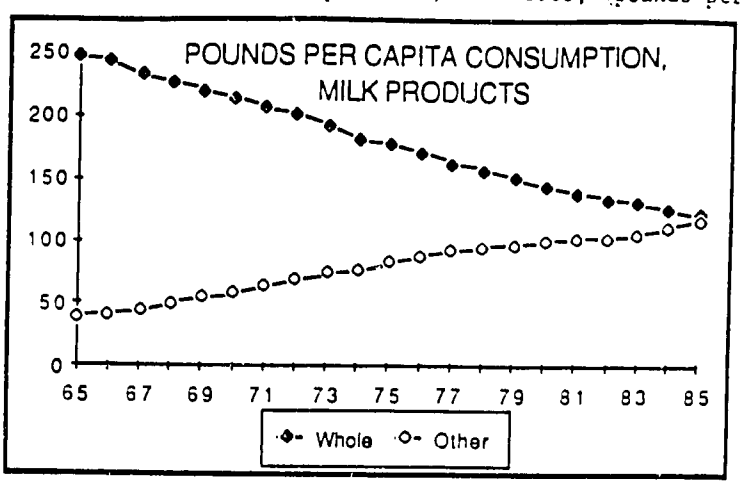


Figure I-5 compares trends for non-alcoholic sodas, and alcoholic distilled spirits. Growth in per capita consumption of non-alcoholic sodas has been steady. Although this market is dominated by a few large, producers, there may be some potential for a small producer to enter the market with a coconut-flavored soda or carbonated cocorut water. In particular, the ethnic market shows a preference for sodas over juices. By contrast, growth of distilled spirits in general has been flat over the period as a whole, declining recently after having grown slightly. Within this category, however, there may have been some growth in coconut milk/liquor mixes due to the trend toward lighter alcoholic drinks.

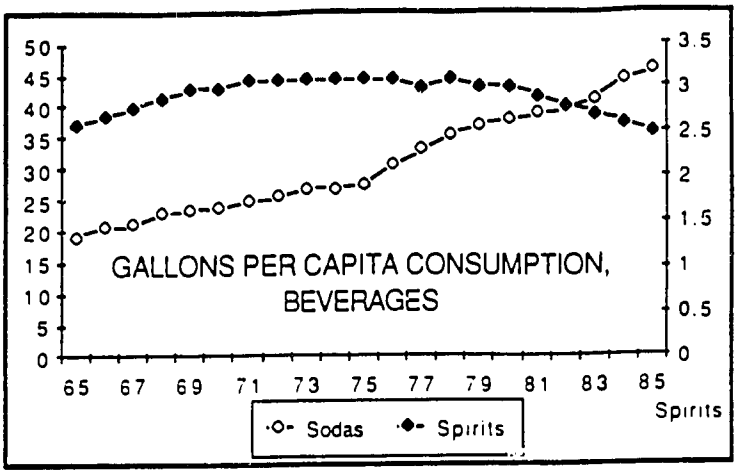


Figure I-5. Per Capita Consumption of Non-alcoholic sodas and distilled spirits in the U.S. 1965-1985 (gallons per person).

Prices

Price data from a single year or a few years can provide indicative information, but a longer time series is needed to draw more definitive conclusions on trends. Agricultural production tends to be cyclical due to weather, and annual demand is affected by stockpiling. There are two main reasons for the annual fluctuation in world prices of commodity coconut products (such as coconut oil, copra, and desiccated coconut). The first reason is changes in the size of the year's harvest in major producing countries, particularly the Philippines. The second reason is related to changes in the supply of competing products.

World production of coconut oil has fluctuated from year to year, but has remained relatively flat over the period 1971 to 1985. Over this same period, production of soybean oil and palm oil have climbed substantially and palm kernel oil production has also risen (figure I-6) The prices for these oils have been much more volatile than the supply. Coconut oil sold at a premium for much of this period, but its relative price began to decline in the mid-1980's (figure I-7).

More recently, a reduction in the demand for coconut oil by the U.S. food processing industry associated with consumer concerns about health effects could depress prices of coconut oil for a long time. The future prospects for coconut oil prices also appear to

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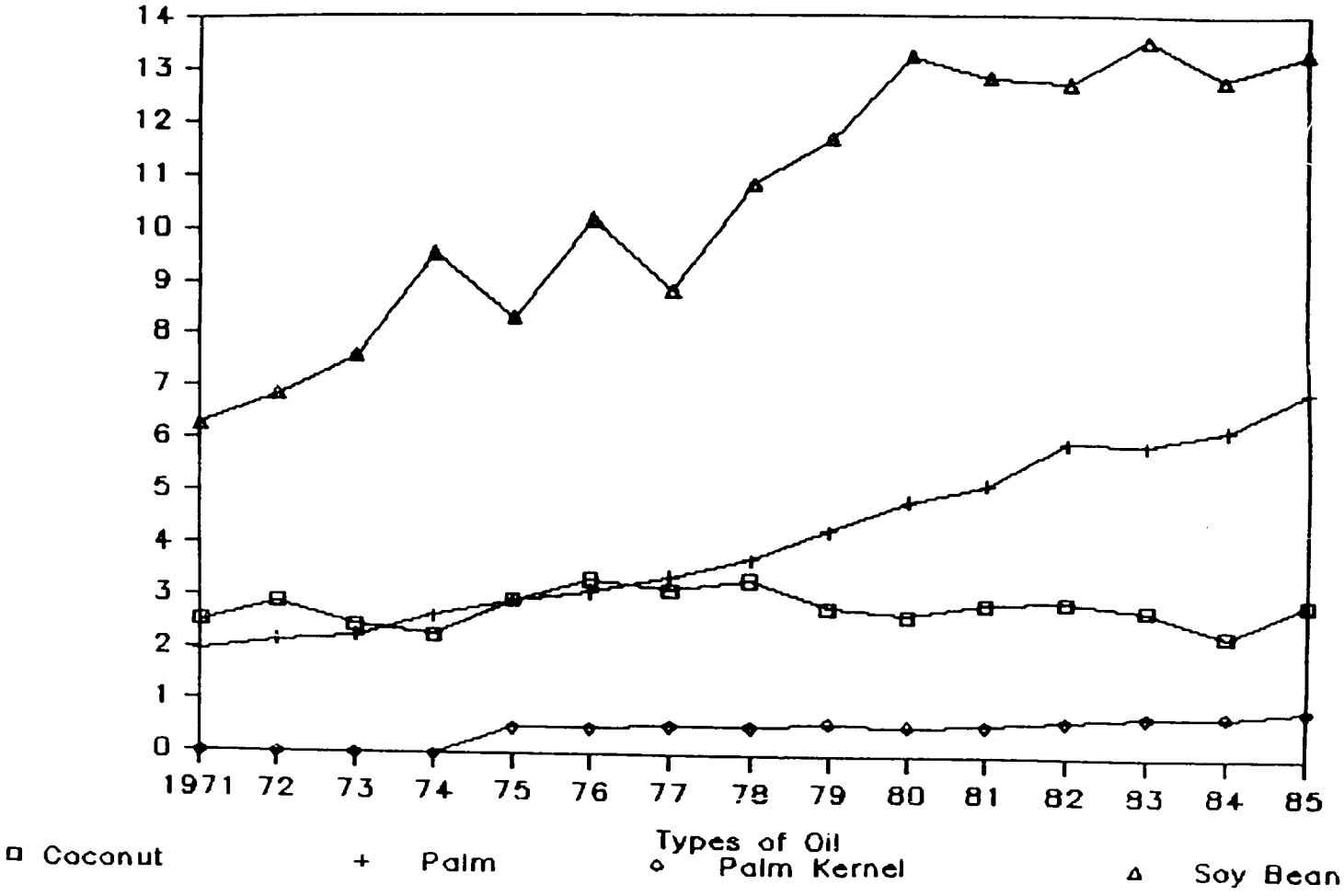


Figure I-6. World Production of Coconut Oil and Its Principal Substitutes.

Source: Hyman, Eric. 1988. Technology, Scale, and the Coconut Industry in the Philippines. Washington, D.C., Appropriate Technology International.

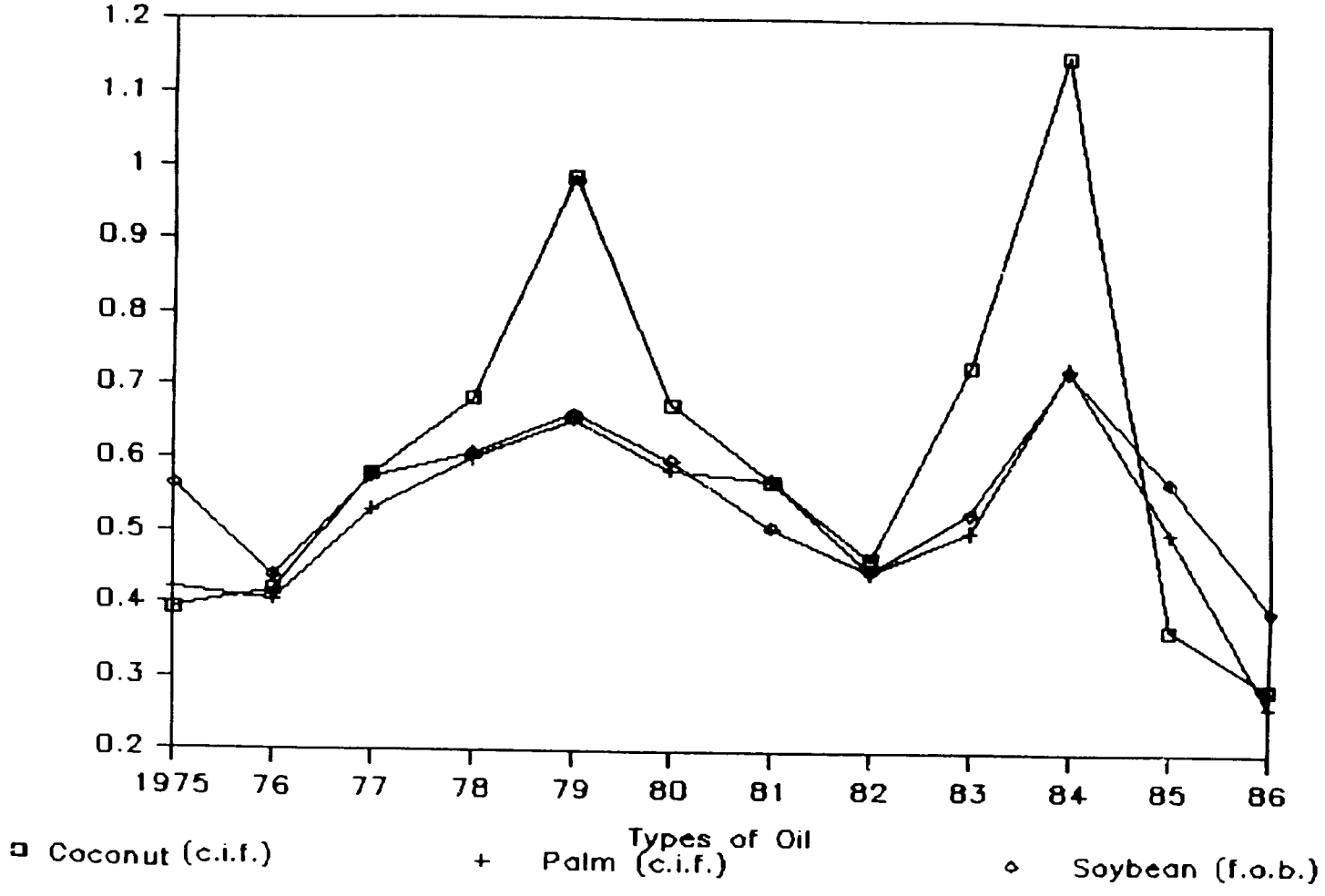


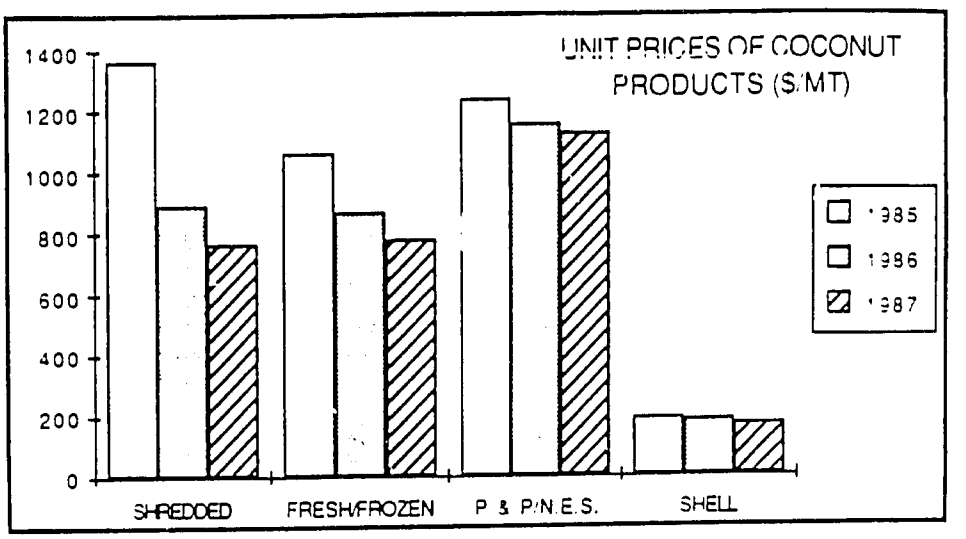
Figure 1-7. Nominal Prices of Coconut, Palm, and Soybean Oils (U.S. $/t at European Ports)

Source: Byman, Eric. 1988. Technology, Scale, and The Coconut Industry in the Philippines. Washington, D.C.

be unfavorable for producers. As a result, there may be some shifting of coconut use from edible oil production to other products.

Between 1985 and 1987, the imputed prices of non-oil coconut products imported into the United States fell in nominal terms (figure I-3). In real terms, the decrease was even greater than this. The main reason for the price decline over that three-year period is an increase in supply. Data are not yet available on the extent of the change in the volume and value of U.S. imports of coconut products resulting from this situation. In the future, cross-impacts that increase the supply of other coconut products as raw materials are shifted from oil production to other uses may also depress prices of these other products.

Figure I-3. Imputed Prices of U.S. Coconut Product Imports



Prospects for High-Value Coconut Products on the U.S. Market

Table I-1 lists types of food and competing products that can be produced by two alternative means, the dry (copra) process and the wet process. The dry process is mainly used for most large-scale, low-value commodity coconut products. The wet process offers greater flexibility in the product mix and the ability to maintain higher quality standards. For these reasons and because most of the large-scale coconut processors in Asia rely on the dry process, the South Pacific could carve out a market niche by selecting wet processing methods.

TABLE I-1. Types of Food and Competing Products That Can Be Produced From Coconuts Through Dry or Wet Processes

DRY (COPRA) PROCESS	WET PROCESS
Coconut Water Mushroom mycelia Yeast Vinegar	Coconut Water (same as dry)
	Coconut Milk
Granulated Coconut Confectioneries and baked goods Ice Cream, peanut butter, cakes and cookies Coconut flour and oil	Meal Animal feed Confectionery Oil Coconut flour
Coconut Flour Noodles Cereals, crunchies/dried crispies Bread	Cream Protein Oil
Oil Cooking oil Industrial intermediates (free fatty acids) Detergent (sulfated monoglycerides)	Oil (Same as with dry process)
	Skim Milk (unstable) Fruit- or chocolate-flavored beverages Low-fat coco-honey Protein isolate Instant drinks Sodium salt from protein
Protein Isolates Infant formulas Meatless spreads Canned vegetable loafs Condensed coconut milk	
Meal Animal feed Coco flour	

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Annex I-a contains profiles of the major products considered in this market study: coconut water, desiccated coconut, coconut cream, fresh coconuts, coconut oil (including virgin oil), edible coconut oil processed to have a reduced saturated fat content, coir, and coconut shells. For each product, information is presented on usage, physical form, category, market users, users comments, size and growth potential in the market, degree of competition, market channels, barriers to entry, and a strategy for entry.

Annex I-b discusses the approach used in the primary survey and also contains the questionnaire used in that survey. Annex I-c lists the organizations contacted. Table I.2 summarizes information on prices and current market orders obtained in interviews. The prices refer to products landed on the West Coast during the first quarter of 1989, including cost of insurance and freight to the port. The quantities in this table represent potential market orders from specific companies; they do not reflect total market demand. The quantities are relatively firm and indicate minimum orders that the contacted companies are interested in placing.

TABLE I-2. PRODUCT PROFILES: PRICES AND QUANTITIES

Coconut Products	C.I.F. Price Range (U.S. $)	Monthly Market Orders[a]
Desiccated coconut	.20 - .25/kg	12,000 t
Coir (fiber)	.03 - .035/kg	250 t
Coir (spun rope)	.055 - .07/kg	140 t
Specialty oil	(samples first)	50 t
Fresh coconuts	.175 - .285/piece	120 t
Carbonized shell	.06 - .08/kg	250 t
Milk and cream	.50 - .80/kg	one 20-foot container load
Water	(samples first)	one 20-foot container load

[a] From Specific companies, not total market demand

The growth prospects shown in table I-3 are also culled from expert opinions, rather than statistical analysis. Thus, they reflect subjective judgments on the products current prospects, as indicated in the telephone questionnaire. Moreover, the growth rates represent short-term forecasts for a period of 3-12 months at the most, and do not reflect long term trends. For the broader categories, such as juices and

alcoholic beverages the growth rates pertain to the overall market, rather than just the component using coconut products. Table I-4 lists some retail prices for products containing coconut in the United States. Particularly for commodities coconut products, price fluctuations can be large.

TABLE I-3. PRODUCT PROFILES: GROWTH PROSPECTS

Industry/Final Product	Overall Market Growth Rate
Fruit juice	H
Carbonated soft drinks	M
Alcoholic beverages/liquor	L
Ice cream	H
Chocolate	M
Confectionary (candy)	M
Baked goods/cakes and pastries	L
Cosmetics	H
Pharmaceuticals	M
Spices	L
Food flavors	L
Essential oils/fragrances	M
Edible cooking oil	L
Handicrafts	L
Home arts and crafts	L

Annual Growth Rates: L= low = 2 - 4%
M= medium = 5 - 8%
H= high = 9 - 10%

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Table I-4. Retail Prices of Selected Foods Containing Coconut in the U.S. (7)

PASTRIES	
Coconut Cookie (8 oz.)	1.79
Coconut Marshmallow Cookies (9 oz.)	1.81
Pepperidge Farm Lemon Coconut Cake (12 oz.)	2.09
Pepperidge Farm Coconut Cake (17 oz.)	2.29
Betty Crocker Coconut Pecan Frosting (16 oz.)	1.89
Coconut Pudding (3.5 oz.)	.49
Coconut Cream Wafers (24.7 oz.)	3.99
Coconut Roll (8 oz.)	1.49
SNACKS	
Cereal Fruit Mix (14 oz.)	1.69
Del Monte Fruit Snacks (5.4 oz.)	1.99
CANDIES	
Coconut Almond Crunch (1.12 oz.)	.15
Peter Paul Almond Joy (1.76 oz.)	.30
Peter Paul Mounds (1.76 oz.)	.30
Coconut Candy (14 oz.)	1.89
BEVERAGES	
Lakewood Coconut Milk (32 oz.)	2.29
Coconut Soda (6-12 oz. pack)	3.49
Coconut Syrup (25.6 oz.)	4.79
Pina Colada (10 oz.)	.79
Pina Colada Mixer (25.4 oz.)	2.09
Natural Coconut Drink (8.5 oz.)	.65
ALCOHOLIC DRINKS	
Pina Colada (200 ml.)	3.50
Coconut Rum (200 ml.)	3.59
INGREDIENTS	
Creamed Coconut (200 g)	3.96
Cream of Coconut (15 oz.)	1.39
Cream of Coconut (16 oz.)	2.19
Grated Coconut in Syrup (18 oz.)	2.29
Desiccated Coconut (6 oz.)	3.19
Fancy Sweetened Coconut Flakes (7 oz.)	.69
Durkee Sweetened Grated Coconut (5 oz.)	1.05
General Foods Baker's Premium Shredded (7 oz.)	.69
Powdered Coconut Milk (2.2 oz.)	.85
Refined Coconut Oil (21.16 oz.)	1.95
SWEETS	
Young Coconut Meat in Syrup (15.5 oz.)	1.15
Young Coconut Meat in Coconut Juice (15.5 oz.)	.95
Coconut Milk (14 oz.)	.99
Coconut Extract (14 oz.)	2.19
Sweet Potato in Coconut Milk (14.8 oz.)	.79
Coconut Sport (12 oz.)	1.65

Table I-4. (continued)

COSMETICS	
Coconut Oil (6 oz.)	2.39
Hain Pure Coconut Oil (14 oz.)	3.89
Coconut Hair Oil (16 oz.)	4.95
Hair & Skin Oil (14 oz.)	3.15
Coconut Soap (12 oz.)	2.49
Skin Moisturizer (16 oz.)	4.95
Coconut/Vanilla Skin Care Oil (8oz.)	6.25
Skin Lotion (8 oz.)	4.55
Bee Pollen Shampoo (16 oz.)	2.99

A follow-up market survey was conducted of industrial users and brokers of edible coconut products, with special reference to coconut cream. Over sixty representatives of coconut users, food brokers, ice cream companies, import brokers, and food and beverage producers were contacted and about 20 responded. The general conclusion was that the South Pacific region should avoid competing in the saturated market for commodity coconut products such as coconut oil and desiccated coconut, which are also facing lagging demand. Regarding coconut cream, some buyers expressed interest in new sources of supply, but noted that the product must be competitive with the traditional sources on both price and quality. In addition, the industrial market is concerned about the reliability of deliveries.

The American Heart Association and studies by the National Academy of Sciences have recommended for a long time that people reduce their total consumption of saturated fats. Yet, it took a recent advertising campaign by the American Soybean Growers Association to effectively reach American consumers in targeting tropical oils as a major source of saturated fat. In fact, coconut oil constitutes less than 5% of the saturated fat in a typical American diet.

Nevertheless, as a result of the public's new concern about tropical oils, five major food processing companies (General Mills, Ralston Purina, Borden, Pillsbury and Quaker Oats), announced in January of 1989 that they were eliminating coconut and palm oils from their products. Previously four other major firms (Kellogg, Sunshine Biscuits, Pepperidge Farms and Keebler) had already taken this step. Many of the large food processing companies have their own plantations of coconuts and their withdrawal from use of coconut oil will release these coconuts onto the open market.

The campaign against coconut and palm oils may have some spillover effects on the demand for other coconut products, especially coconut cream. On the other hand, the ethnic populations using coconut cream in cooking and mass market users of certain products appear to be less concerned with this issue. For example, ice cream consumers would not be worried about coconut cream as a flavoring agent when the basic product is so high in butterfat. Also, many consumers who are familiar with the controversy over saturated fat in coconut oil do not associate a high fat content with fresh coconuts, coconut milk, coconut chunks, or desiccated coconut -- only the oil. Most probably do not understand where the oil comes from and what other coconut products contain it.

Many of the traditional and specialty companies using desiccated coconut report that an already overloaded market has been upset by a number of new entrants in recent years. The total land area in coconuts has expanded and some old stands have been replaced by higher yielding hybrids that have now reached bearing age. The resulting oversupply makes it difficult to market additional supplies at a reasonable price to producers.

At present, the world supply of desiccated coconuts is 500,000 tonnes per year -- five times the demand. General Foods is a dominant player in the desiccated coconut market. There have been recent bankruptcies of coconut companies in Mexico and Malaysia, despite significant support from their governments. New entry into the desiccated coconut and coconut oil markets is likely to be limited due to the supply/demand situation and the high capital costs for large-scale production of these commodities.

The general trend toward a lighter American diet and, ironically, the blitz against tropical oils could open up a profitable niche market for the South Pacific in low- or reduced-fat products. Many respondents expressed interest in learning more about low-fat coconut flakes and milks. Promotion of low-fat products might also help the coconut industry overcome the bad publicity it has been facing. A large-scale marketing effort could be effective at this time in moving health-conscious consumers toward low-fat coconut products. If the coconut industry in the South Pacific is able to tap this interest successfully, it could expand its market presence as its reputation for quality and reliability grows.

The U.S. is a major importer of coconut cream because of the success of coconut-based alcoholic beverages and the large ethnic market that uses it in cooking. The market for coconut cream is currently around 5,000 tonnes (t) per year in the United States.

In the follow-up market survey, a delivered price of under $2.20/kg was quoted to potential buyers of premium-grade, aseptically packaged coconut cream with a fat content of 22.5-25.0%. Without seeing samples, some industrial buyers and brokers for the retail market, particularly those on the East Coast, expressed resistance to this price because they are currently paying $0.99-1.10/kg for a low-quality product. East Coast buyers now obtain diluted coconut cream with a fat content of around 12% from closer sources in the Dominican Republic and Puerto Rico.

However, some West Coast users felt the proposed coconut cream price was competitive with the lower-quality Asian products that they are now purchasing. Although the West Coast market may be smaller than the East Coast market, it might offer a profitable niche for South Pacific producers. This niche might not be large enough to attract competition from Southeast Asian producers. It is also unclear whether the East Coast respondents understood the difference in quality between the proposed product and what is now on the market.

Since some large competitors in the coconut processing industry may leave the market within the next 2-3 years, the prospects for smaller scale South Pacific firms might improve if they are able to survive the market readjustment that is underway. By then, the current heightened consumer awareness of possible health concerns may also have abated.

In summary, commodity products such as desiccated coconuts, coir, and carbonized shells sell almost exclusively on a price basis. Those markets are dominated by large buyers who deal with regular suppliers. There is also second tier of independent users who buy at the competitive price set by the larger buyers and sellers. The specialty market for coconut cream and coconut-based drinks has expressed interest in new sources, but is unwilling to quote a price without seeing samples of the product. Buyers are also on the look-out for new products such as low-fat coconut milk and dried low-fat coconut flakes.

Market Structure: Competition and Channels

At present, there are three major producers or sources of edible coconut products: independent firms in Southeast Asia, U.S. food processing firms, and smaller producers. Table I-5 lists the markets and sources for various coconut products.

Thailand is a major exporter of coconut products that enter the U.S. market through ethnic grocery stores. The Philippines is also a major producer of coconut products, but observations from a sample of ethnic stores in the Greater Los Angeles and Boston areas suggest that Thailand is more aggressive in placing its products in these outlets. The dominance of the Philippines as a major supplier of desiccated coconut and oil for the food processing industry may account for its relative lack of interest in developing other coconut products. Another reason for the success of the Thai product in Asian stores in the United States is the strong linkage to Thai nationals of Chinese extraction involved in marketing and distribution.

Table I-5. Markets and Sources for Various Coconut Products

I. Products in ETHNIC Stores for the IMMIGRANT population	
Young Coconut Milk	-/Thailand
Young Coconut Meat	-/Thailand
Coconut Extract	-/Thailand
Sweet Potato in Coconut Milk	-/Thailand
Coconut Milk Powder	-/Thailand
Sweet Coconut Dessert	-/Philippines
Coconut Drink	-/Malaysia
Coconut Candy	China/Asia
Coconut Cream Wafer	Hong Kong/Philippines
Coconut Biscuit Roll	Taiwan/Philippines
II. Edible and Non-Edible Products in SPECIALTY Stores for the UPSCALE consumers	
FOOD	
Grated Coconut in Syrup	US/Dominican Republic
Coconut Syrup	Italy/Africa
Creamed Coconut	UK/India & Sri Lanka
Desiccated Coconut	UK/India & Sri Lanka
Edible Coconut Oil	US/Dominican Republic
Coconut Ice Cream	US/South America & Asia
COSMETICS	
Coconut Oil	US/South America & Asia
Skin Moisturizer	US/Asia
Coconut Soap	US/Mexico
III. SUPERMARKET Products for the MASS Consumer	
SOLID & LIQUID	
Dry Whole Coconut	US/Honduras
Edible Coconut Oil	US/Dominican Republic
Cream of Coconut	US/Dominican Republic
	US/Philippines
Flakes/Shredded Coconut	US/Asia
	US/Philippines
Flakes for Frosting	US/Asia
Coconut Cookie	US/Asia
Coconut Cake	US/Philippines
Coconut-Chocolate Candy Bar	US/Philippines
Cereal mixed with Coconut	US/Asia
Fruit Mix Snack with Coconut	US/Philippines
Coconut Pudding	US/Dominican Republic
BEVERAGES	
Coconut Soda	US/Puerto Rico
Coconut Milk (juice)	US/South America, Caribbean
Pina Colada	US/Puerto Rico
	US/South America
Coconut Liquor	US/Caribbean

Large U.S. food processors such as General Foods usually have integrated sources of supply in Asia, especially in the Philippines. Medium-sized food processors such as Durkees often have their own sources in South America and the Caribbean. Smaller companies rely on diverse sources. Some have their own coconut groves in Puerto Rico. Others pack products from Mexico and the Dominican Republic. A few European importers obtain supplies from Africa and the Indian subcontinent.

A key feature of the coconut market is the segmentation of certain products and markets through different channels of distribution. The ethnic market consumes products from the countries of origin, that the mass market is often unfamiliar with. Health food stores and other specialty outlets, offer higher priced products that are not distributed by supermarket chains. Supermarket chains service the mass market, but on the West Coast, the chains have substantially enlarged their ethnic foods section in response to the consumption patterns of the large Hispanic and Asian populations.

Some products are sold in several of these channels. For example, coconut oil is available in both ethnic and specialty stores under different brand names and retail prices. Coconut cream can be found in both supermarkets and specialty outlets, and coconut "cookies" are sold in both ethnic stores and supermarkets.

Sales in ethnic stores depend on "word-of-mouth" promotion by the consumer. Products in specialty stores are promoted by store employees and product trials by consumers. Supermarkets depend on point-of-purchase promotions through prominent shelf displays (gondolas) and printed fliers.

4. Other Markets

This study concentrated on the North American market because of limited resources and the scarcity of international statistics on specialty coconut products. Published data are only available on low-value commodities like desiccated coconuts, copra, and coconut oil. Aside from the major coconut producing countries, only limited information on coconut cream is available.

An FAO estimate placed coconut cream exports to developed countries in Europe at 5,000 t per year mainly for the ethnic or immigrant Asian populations in those countries. The United

Kingdom's ethnic market supports consumption of 2,000 t per year. Canada has a small ethnic market with annual coconut cream consumption of 1,000 tonnes. Some coconut cream is processed into a semi-solid coconut filling used in chocolates candies. The United Kingdom and Belgium are major users of this product.

Japan

It was difficult to get information on the Japanese market for coconut products for reasons of language and logistics. The Japanese External Trade Organization (JETRO) contacted Japanese firms to determine which companies are importing coconut products and their sources by country. Most coconut products in Japan are exported from the Philippines. In 1987, Japan imported 20,678 t of coconut oil, and 72% of this was from the Philippines. In 1986, Japan imported 1,973 t of desiccated coconut at a cost of $1,081,000. Although the volume imported was only slightly less than the quantities purchased in 1984 and 1985, the cost was cut in half due to the declining price in yen. The Japanese demand for coconut cream is very small at present and no statistics are available on the quantities consumed.

It may be possible to increase the demand for specialty coconut products in Japan through promotion and advertising, but such a campaign would be costly due to consumer unfamiliarity with these products. The increasing disposable income of Japanese consumers and prospects for further strengthening of the yen relative to the U.S. dollar may make this worthwhile, but Japan is only likely to be a secondary market at most.

All of the Japanese respondents expressed an interest in learning more about high-value coconut products from the South Pacific. However, this may be a cultural phenomenon as the Japanese are often reticent to answer questions on the telephone and usually express interest out of politeness. Further contacts should be made with Japanese producers through a Japanese national residing in country. One can be located via the American Chamber of Commerce in Tokyo.

New Zealand

New Zealand had a population of 3.3 million people in 1987. Approximately, 13.7% of the population consists of indigenous Maoris, Pacific Islanders or mixed groups with Polynesian ancestry. Immigration policies in New Zealand were relatively open for Pacific Islanders moving to New Zealand until 1988. On the basis of ethnic affiliation, about 120,000 people in the country

have a traditional dietary preference for coconut products. Intermarriage and social interactions of Pacific islanders or Polynesians with Europeans or Maoris has increased the exposure to coconut foods. Accounting for this factor as well, a conservative estimate would be that 150,000 people regularly use coconut cream or whole coconuts in their diet.

Four major coconut products are imported to New Zealand (Table I-6) The whole coconuts are primarily for retail consumption. Although the coconut sizes vary considerably, the 400,000 kg of whole coconuts would probably amount to 680,000 coconuts, on average. About 70% of the whole coconuts are processed into coconut cream by consumers in the home. With a coconut yielding an average of 140 grams of cream, this home production amounts to 66,600 kg of cream, which may then be diluted to 100,000 kg of end-product. This is in addition to the 900,000 of canned coconut cream purchased by households. About 85% of the coconut cream consumed is used by the ethnic population, as are 70% of the whole coconuts.

Table I-6. New Zealand Imports of Coconut Products in 1988

Product	Value ($ N.Z.)[a]	Volume
Coconut oil	3,500,000	4,100,000 liters
Desiccated coconut	2,500,000	1,700,000 kg
Coconut cream	2,420,000	900,000 kg
Whole coconuts	200,000	400,000 kg
Total	7,660,000	

[a]There were 1.55 New Zealand dollars per U.S. dollar in early 1989.

Coconut oil and desiccated coconut products are consumed directly or indirectly, by most of the population. Coconut cream is used by approximately 15% of the population and 30% consume whole coconuts. table I-7 lists per capita expenditures on coconut products for the population as a whole and the ethnic component of consumption. Purchasers of ethnic origin spend roughly five times as much on coconut products as does the overall population. While the per capita purchases by the ethnic population are high, total sales are low since the ethnic groups comprise a small proportion of the total population.

Table I-7. Per Capita Expenditures on Coconut Products In New Zealand ($ N. Z.)

	Population As a Whole	Ethnic Population
Coconut oil	1.07	1.07
Dessicated Coconut	0.70	0.70
Coconut cream	1.26	13.60
Whole coconuts	0.11	0.47
TOTAL	$3.14	$15.84

Thus, the New Zealand market for coconut products is very small, and reduced in migration and a weak economy will affect growth in the short term. The market for ethnic products is fragile and manufacturers often have to offer discounts to importers to arrange a deal. An oversupply appears to exist already. The traditional suppliers, particularly those in Western Samoa, have the capacity to expand production of canned coconut cream. The only readily available niche market is in aseptic containers, which have advantages over cans in the costs of packaging materials and freight. However, a shift in product packaging will seriously affect sales of canned products by traditional suppliers. The specialty market for new dairy analogue products such as coconut cheese or yogurt is wide open, but the extent of the demand is uncertain.

Most of the coconut oil is shipped in by tanker. Desiccated coconut arrives on container pallets in multi-walled bags that contain 20-50 kg of product. Contract packers repack it into 1 kg and 0.5 kg units. Tonga is trying to sell pre-packaged desiccated coconut in packages in New Zealand, but so far the results have been mixed.

Most of the coconut oil imported by New Zealand is for industrial use. About 80% is used in processed foods and margarine. The balance is used in soaps, shampoos, body oils and cosmetics. There is a strong demand for desiccated coconut in the baking and confectionary industries, comprising 60% of the imports. The balance is used for home consumption mainly in baking. Most of the coconut cream is imported in 400-gram cans that are packed 24 to the carton for eventual sale to retail consumers.

At present, canned coconut cream sales in New Zealand are dominated by two brands from Western Samoa--Meredith's and Samoan Tropical Products. These two firms control a total of 90% of the retail sales. Other suppliers are Rarotonga Coconut Cream from the Cook Islands and Pacific Crown Coconut Cream out of Fiji. In addition, a small amount of coconut cream from Asian manufacturers is available, but it does not meet the taste requirements for the bulk of the market. Coconut cream from the Pacific Islands generally has a fat content between 17% and 25% by volume, while the diluted Asian product has a fat content of 12%.

5. Strategies, Conditions for Success, and Next Steps

Commodity products sell strictly on price terms and have limited long-term growth prospects due to declining demand and increased supply. Opportunities are available in high-value specialty products, which are less subject to price fluctuations. Prospects may be good for specialty products on both the mass market and the ethnic channels of distribution, especially on the West Coast of the United States. Food processing firms are interested in high-quality substitutes for existing uses of some coconut products.

Often, there is a wide range of purchase prices for selected high-value products because of quality differentiation and limited or fragmented sources of supply. South Pacific coconut processors must develop a high-quality product to obtain the best possible prices. For the industrial market, the region could offer services such as made-to-order specifications. In reaching the retail market, the South Pacific could take advantage of the market's image of the product based on the exotic location. Through the market has a good potential, promotion through word-of-mouth is slow. Ultimately, market feasibility will depend on actively promoting the product.

A viable market strategy might begin by tapping the manufacturers and intermediate buyers brokers first and then the end-users. Retail brokers could be used to reach the mass-market, minimizing initial marketing costs. It is recommended that the South Pacific

1. Compete in terms of quality and service for specialty products

2. Sell on the basis of shelf distribution and direct promotion at first, rather than through advertising

3. Promote a reputation for quality via a known lead product such as coconut cream and then expand into other products

4. Offer a high degree of quality control and reliability of supply, possibly in made-to-order products

5. Establish a clear product identity and rationale for purchase

The markets for specialty products must be developed, and this will require both time and money. Market segments or niches exist, but South Pacific products must be distinctive from existing items already available on the industrial and retail markets. One example of a niche market might be coconut skim milk in aseptic packaging, possibly with added sugar and flavors such as vanilla for the American market. There is a promising niche market for low-fat dried coconut flakes. Another possibility is the promotion of a premium line of branded coconut cream, coconut liqueur, and drink mixers. Higher risk products that would require more marketing efforts include coconut water, and virgin (first-pressing) oil.

A lower risk strategy than competing on the retail market is to produce coconut cream to order for industrial users. Key specifications may need to be investigated to meet the needs of particular firms. The convenience of bulk packages that do not require refrigeration or a large amount of warehouse may also be a selling point. However, production constraints, especially the minimum economic plant size, may create a marketing dilemma for aseptically packaged products.

An aggressive approach would involve investing heavily in market advertising and distribution. This could capture a substantial share of the existing market within a short time period to maximize plant capacity use. However, the costs and risks of this strategy may be high and firms would have to defend the market share they gain against possible competition by established companies.

A more conservative strategy would be to start at a modest level and develop other uses for the product or new products slowly, or to gradually expand from an industrial clientele to retail markets. This strategy would leave most of the heavy initial burden for advertising and promotion on industrial firms buying coconut products as an intermediate good. Later on, advertising costs could be lower as consumers become more familiar with these products in question. Although the risks to producers in the South Pacific

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would be reduced with this strategy, the producers would also be foregoing some of the value added in further processing. Producers might be able to avoid a rapid defensive reaction from other coconut processors through this strategy, but it could result in a lower capacity use rate for the industry in the South Pacific. With either strategy, potential investors in the venture must have financial staying power and a commitment to invest in market development.

In summary, distinctive products must be created to fit the market, subject to constraints of technology and economics. Potential opportunities for profitable processing of selected coconut products in the South Pacific are available for both new and existing products, exploiting different marketing trends. The industry could explore the following opportunities in the near term:

1. Take advantage of the concern for health by launching a branded coconut low-fat milk, or low-fat coconut flakes to substitute for baking and confectionary, beverage or other uses

2. Build on the ethnic and health food markets for soft drinks by launching a carbonated or non-carbonated coconut water drink or a blend with pineapple or other fruit juice. These could sold to a West Coast franchise that specializes in distributing exotic/tropical drinks through mass market channels such as supermarkets with ethnic sections

3. Resolve problems in the trade with poor-quality coconut cream by offering a consistent, high-quality coconut cream for ice cream, chocolate, and confectionary manufacturers. This product would be sold on the basis of customer specifications backed by an excellent quality assurance program

4. Play up the natural aspect of coconuts by manufacturing a coconut based flavor essence for shampoos, cosmetics and foods. These products might appeal to the ethnic market segments as well as the mass market

5. Take advantage of the exotic image of the South Pacific and the tropical image of the coconut by developing an advertising campaign to break into the alcoholic beverage market with a branded South Pacific coconut liquor

Some of the next steps that could be taken to follow up on the preliminary market study are listed below:

1. Contact specialty food brokers and institutional or industrial users to gain access to distribution channels

2. Concentrate on the West Coast of the United States at first because of lower transport costs from the South Pacific, and an ethnic population base as a point of entry

3. Provide export services to existing South Pacific processors to help expand their markets

4. Conduct a "selling survey" to generate interest and obtain information by selling through samples. On the "production" side, standardize the initial offering of samples and prepare specifications based on specific market requirements

5. Prepare the basic marketing logistics and advertising package. A small temporary warehouse and sales office could be set up on the West Coast and an ad agency retained to develop the company logo, advertising theme, and layout

6. Set aside marketing funds to invest in a limited sales effort (distribution and promotion) to test the feasibility of each potential product

C. General Description of the Marketing Service Firm

The South Pacific region lacks a marketing organization capable of bringing together the goals of the industry and of buyers. The study recommends establishing a marketing service company to fill this gap. This company, Coconut Products of the South Pacific (CPSP), would be a permanent marketing service firm dedicated to linking South Pacific coconut processors who wish to utilize CPSP services to buyers in the North American, Japanese, EEC, Australian and New Zealand markets.

CPSP's key functions will include:

- Finding buyers for existing coconut products and identifying good markets for processors

- Providing for the orderly marketing of products so that prices, transportation, freight forwarding and bills of lading, are well coordinated

- Developing new and expanded markets and product use opportunities

- Developing acceptable product specifications through collaboration with buyers and processors

- Providing training, monitoring and technical support

- Managing or contracting out research, development, technical support and possibly pilot plant facilities

- Conducting market research, promotion, and advertising

- Assisting processors in meeting U.S. Food & Drug Administration requirements as well as regulations in other importing countries

- Promoting investments aimed at upgrading existing operations or establishing new operations

D. Objectives

<u>Short Term</u> (1 - 1 1/2 years)

- To establish initial markets and market confidence in the South Pacific processors to produce consistently high quality products which meet market needs

- To develop a long term marketing strategy which will enable higher value trading activities to be available to the South Pacific coconut industry

- To secure the participation of at least one coconut processor capable of meeting buyer specifications

- To assist additional processors as market demand grows and diversifies and processor capabilities increase or improve through balancing, modernizing, diversifying, or expanding operations, where needed

- To position itself as a dynamic company with high quality standards for raw materials, processing, final products and services to customers and processors

- To introduce CPSP as an "efficient" private company committed to making the South Pacific coconut industry more viable

Long Term

- Identify all South Pacific countries and processors capable of producing high quality, marketable, coconut products

- Assist in developing new products and processes to meet market needs and demand;

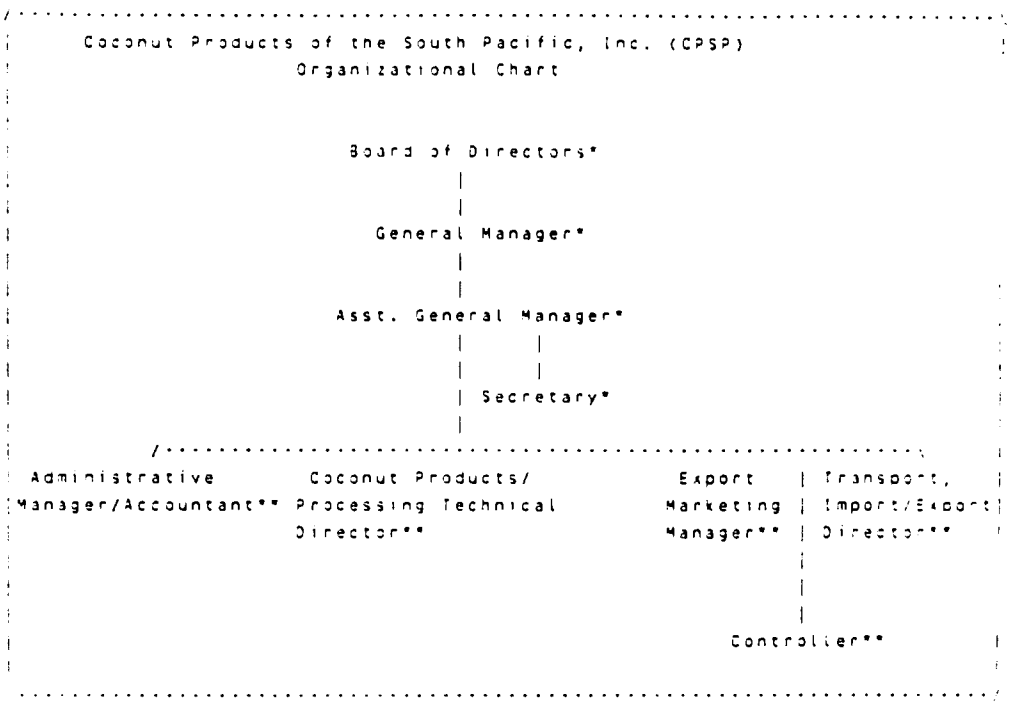
- Foster a very dynamic and high-quality image for CPSP itself and the South Pacific products it promotes

- Build and expand, collaborative efforts between CPSP and processors, in a specialty South Pacific coconut products industry dedicated to providing high-quality products and services and thereby becoming a world coconut product quality standard setter

E. Organizational Structure

The organizational structure suggested for CPSP for the first 1 - 1 1/2 years of operation would include a Board of Directors and a lean management team as shown in Figure I-2.

Figure I-9



*Planned positions for initial CPSP startup operations expected to last 1 - 1 1/2 years

**New positions to be added as market demand and processing, supply/capabilities permit

F. Management Team

1. Board of Directors

CPSP would be headed by a 3-5 member Board of Directors, consisting of individuals with private sector backgrounds in the export food industry, as well as marketing, accounting and finance. Government representation on the Board is discouraged to assure a regional coconut industry and private sector business orientation for CPSP. It is strongly recommended that the chairperson of the Board be someone with a strong marketing and food industry background having demonstrated leadership capability in all facets of the food industry profession. Suggested terms of services for Board members would be up to 2 years, either staggered or revolving to ensure continuity. To assure close and continued communication with the Board, it is strongly suggested that the General Manager be a non-voting member of the Board.

2. Operations Management Team

The CPSP management team, for the first 1 to 1 1/2 years, would consist of a general manager, assistant general manager and secretary.

The <u>general manager</u> should have a strong marketing and promotions background, be highly familiar with the South Pacific and the world coconut industry, have good knowledge of the markets and prospective buyers, and have a strong management capability in a multi-cultural setting. This, person while being technically capable must also be a person whose personality is acceptable to leaders of the coconut industry throughout the region; particularly taking into account the socio-economic and political importance of the industry in most countries. Someone of South Pacific origin is preferred This person would be required to travel extensively to identify and meet with prospective buyers, processors, investors, etc.

The <u>assistant general manager</u> should have a solid administrative/accounting background with sufficient technical knowledge to facilitate research, development and delivery of technical support. The assistant general manager would be responsible for responding to buyer and producer inquiries and providing necessary services while the general manager is away.

The <u>secretary</u> must possess excellent secretarial capabilities including competency in the use of

suitable computers, software and communications equipment.

G. Initial Processing Volume and Locations

At present it is estimated that 1,900 tons per year of canned coconut cream from six existing plants would be available to CPSP for possible marketing to new buyers. These processing facilities are discussed more fully in the sections on "Existing Coconut Processing Operations" in the Regional/Country/Processing/Location Analysis and in the individual country profiles (Western Samoa, Fiji, Niue, Cook Islands). An additional 1,000 tonnes of coconut cream in aseptic packaging may be available from a proposed new plant in Western Samoa.

Some or all producers could modify their operations to formulate products that meet niche market specifications with buyers. However, this may require working closely with potential buyers and obtaining technical assistance and additional financing. For economic reasons consideration should first be given to upgrading existing facilities to expand production or meet new product specifications.

If existing processors prove to be unable or unwilling to meet market needs, new facilities could be established in favorable locations in the region. The Financial and Economic Analysis section of the Regional/Country/Processing Location Analysis Study contains a pre-feasibility analysis for new investment opportunities appropriate to individual countries and possible processors within those countries.

H. Relationships between CPSP, Processors, Buyers and Technical Support Services

CPSP is designed to maximize the coordination of participating South Pacific processors with markets and provide ready access to appropriate technical support services.

Below is a list of the type of linkages CPSP, coconut processors, the market/buyers and technical support services could have with each other.

1. CPSP Market Services with Coconut Processors.

   a. Promote existing and new products to export markets under its own brand name or a processor's brand name (if advantageous to marketing)

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b. Help establish, with processors, product/process specifications acceptable to both processors and buyers

c. Keep processors up to date on importing country regulations

d. Assist processors in meeting import regulations and to obtain brand name registrations and other approvals for export to buyer countries

e. Assist and/or facilitate processor quality assurance programs through training, product monitoring and upgrading, and product/process development

f. Assist in locating equipment, packaging, labels, and other supplies

g. Inform processors of new technologies/ products/services which may be of interest to processors

h. Coordinate, if requested, transport, freight forwarding and, bills of lading

i. Assist in finding qualified managerial and technical staff

j. Assist processors develop brand names

k. Assist in locating investors to expand existing operations or start new ones

l. Processors will pay a small percentage of gross sales to CPSP for marketing services provided

2. CPSP Market Services with Buyers

a. Represent processors and market their products to buyers by showing products and describing processor operations and quality assurance programs

b. Assist buyers in developing product specifications which are compatible with processor capabilities

c. Help buyers develop other coconut product uses or forms

d. Conduct negotiations on sales terms in consultation with processor upon request

3. Regional and In-Country Support Services (TSS) with CPSP

   a. Locate, evaluate, certify and monitor qualified in-country technical support and jointly develop a list of services for providing technical support to processors

   b. Locate and contract with a South Pacific based research and development (R&D) organization (IRHO for example) having applied research and development facilities, including access to a pilot plant, to provide technical services to processors, buyers and in-country technical support

   c. Establish and monitor minimum raw material, operations and finished product standards and procedures for the processors it represents. Promote the benefits of these standards to buyers

   d. Work with a South Pacific based R&D organization, to provide special technical support and problem solving inputs not available in the South Pacific

   e. Develop, in collaboration with the regional-based organization, a list of technical support services, and associated suggested costs, to be offered to processors

4. Technical Support Services with Processors

   a. Train processor quality assurance (QA) staff and advise on upgrading QA facilities and procedures

   b. Provide advice on facilities, processing procedures and product changes needed to meet importing country and buyer regulations/specifications

   c. Assist in solving product, production, QA and capacity utilization problems

   d. Facilitate funding of specific expertise for problem solving

5. Processors with Buyers

   a. Processor will ship directly to buyers or through CPSP

b. Processors and buyers will suggest improvements in CPSP services and/or need for new, additional services

I. Benefits to Processors

Potential benefits to processors collaborating with CPSP include

1. Potential to expand into additional and more diversified markets made possible by CPSP's collective sources of products from more than one capable South Pacific processor and more immediate access to the market

2. Potential to improve product marketability and expand into additional or new products through access to CPSP's technical support services

3. Availability of efficient and ongoing information on relevant market trends and forecasts so processors can anticipate market needs and make necessary adjustments in production

4. Adding marketing flexibility at less cost by increasing sales volume outside present marketing territory.

5. Allowing limited processor resources and manpower to concentrate on production and supply rather than marketing activities

6. Providing more predictable and lower sales and administrative overhead costs

7. Eliminating training costs and turnover of sales personnel

8. Obtaining the ongoing services of professional, experienced, marketing and technical support organizations to improve processor products and operations

9. Processors only paying for outside technical support services as needed

10. Identifying and bringing together potential investors to upgrade existing operations or build new plants as market needs warrant

J. Benefits to Buyers

Buyers would benefit from purchasing South Pacific coconut products through CPSP because it would:

1. Have good international communications

2. Represent a number of South Pacific processors who can provide a wide variety of coconut products

3. Understand the South Pacific and its coconut industry and ability to meet market needs

4. Closely monitor and certify product quality and only sell products meeting agreed upon high-quality standards and well defined specifications

5. Stand behind its products and services

K. Financing

It is very important that the financing for start up and ongoing operations of CPSP permit it to execute its appropriate role and function as a regional, industry service organization. It is therefore recommended that CPSP be financed by a suitable regional and/or international development aid or loan program for the first to one and one-half years of operation. Minority shareholding investments from suitable buyers of products would also be encouraged to enhance favorable long-term market commitments.

It is envisaged that the ongoing operati[illegible] of CPSP would be funded from revenues collected from a percentage of sales of product charged to processors. This would meet CPSP operating costs and permit it to expand operations as processor and market needs dictate.

CPSP's net profit margin will only be high enough to permit sufficient services and staff to be added to meet market demand and processor supply capabilities, thus making its return on investment low. Outside funding for costs would be sought from regional and international organizations and regional governments to cover initial operations. This financing would only be needed for the first 1 to 1 1/2 years, after which commissions from sales of processor products will provide the operation and expansion funding for future years. A continual source of revenue from specific sources in addition to commissions may be needed to cover costs of market and product research and development.

L. Financial Analysis and Plan

Table I-8 shows the first year's equipment and operations budget for CPSP if set up in American Samoa. Costs could be slightly lower if CPSP were headquartered in another South Pacific country.

TABLE I-8

Coconut Products of the South Pacific Corporation
First-year budget (U.S. dollars)

EQUIPMENT	
Furniture	$3,200
FAX	1,800
Air Conditioning	1,100
Computers	5,500
Xerox	1,000
Typewriters	1,000
Vehicle	10,000
Subtotal	23,600
START-UP COSTS	20,000
Total capital costs	43,600
OPERATING COSTS	
Rent (1200 sq. ft.)	14,400
Housing for mgr. & asst.	13,200
Salary, Manager	40,000
Salary, Asst. Manager	32,000
Salary, Secretary	12,000
Fringe benefits (35%)	29,400
Maintenance (5% of equipment)	1,800
Electricity	2,400
Water, sewer, garbage	100
Supplies	3,500
Telephone, fax, modems	7,500
Cables, postage	3,000
Fuel for vehicle	600
Regional air travel (20 trips)	11,000
Regional land travel	1,500
Intl air travel	7,500
Intl land travel (5 trips)	3,000
Per diem	16,320
Contractual services	10,000
Lab testing	4,500
Consultants	7,440
Legal	4,000
Security	1,200
Market testing	2,500
Printing	5,000
Insurance (1% of equipment & vehicles)	236
Representation	3,000
Ext. audits	2,000
Subtotal	$238,476
Contingency (5% of oper. expenses	11,924
TAXES	
Corporate income tax	0
Payroll tax	17,800
Social SEcurity tax	6,300
License fees	500
Subtotal	$24,600
FINANCING	
Repayment of principal	8,720
Interest (14%)	6,104
Subtotal	$14,824
Total annual cost	$289,824

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However marketing products through a company with an American Samoan address will make it easier to market to North America. Other countries in the region have fewer direct political and regulatory ties with the U.S. than American Samoa. The location choice for CPSP will also depend on the source of funds for the first 1 - 1 1/2 year's operations and other regional political factors which will be researched by the Investment Promotion Team as described in the Implementation Plan of this report.

As market needs become more defined and South Pacific investors, including existing coconut operations, express interest in collaborating with CPSP to meet those needs, a clearer projection of CPSP's financial needs can be developed. It is anticipated that sufficient sales and subsequent fee revenues from those sales could be generated by the second year to cover operating costs.

CPSP's fees will be adjusted to meet its costs and allow for expansion of services, as needed. CPSP's net profit will, however, be kept low with fee revenues covering costs plus reserves for expansion the following year. Initially, the fees will be negotiated with the specific processor(s) it represents.

Governments of countries in the South Pacific region as well as regional and international development agencies will also be approached to determine if additional grant funding would be available to cover part of CPSP costs and thus allow a lower fee to be charged to processors in the early stages of CPSP operation.

The amount of the fees that CPSP will have to charge to be self-sustaining and repay a loan covering the first year's costs will depend on the number and type of processing facilities it serves. For administrative convenience and equity the fees should be based on the gross revenues from products sold by CPSP for the assisted facilities. Table I-9 shows the estimated gross revenues from products sold by CPSP for a variety of coconut processing operations. Table I-10 contains a suggested fee schedule that CPSP would have to implement to break even on its costs when it provides assistance to the stated number and types of facilities.

TABLE I-9

Estimated Gross Revenues from Different Type Coconut Processing Operations

Aseptic Bulk Coconut Cream Production		Gross Revenues
Type		
A	1 shift, 1,000 l/h plant, 60% capac. use	1,829,520
B	2 shifts, 1,000 l/h plant, 60% capac. use	3,659,040
C	1 shift, 2,500 l/h plant, 60% capac. use	4,573,800
D	2 shifts, 2,500 l/h plant, 60% capac. use	9,147,600
	Type of frozen flakes production	
E	1 shift, 1,000 kg/day, 60% capac. use	1,648,350
F	2 shifts, 1,000 kg/day, 60% capac. use	3,296,700

TABLE I-10

Suggested Fee Schedules Needed to Cover CPSP Costs

	% of gross revenues
1 plant, type A	0.16
1 plant, type B	0.08
1 plant, type C	0.06
1 plant, type D	0.03
1 type A plant & 1 type E plant	0.08
1 type B plant & 1 type F plant	0.04
1 type C plant & 1 type E plant	0.05
1 type D plant & 1 type F plant	0.02
1 type A plant & 1 type C plant	0.05
1 type B plant & 1 type D plant	0.02
1 type A, 1 type C, & 1 type E plant	0.04
1 type B, 1 type D, & 1 type F plant	0.02

II. REGIONAL/COUNTRY/PROCESSING LOCATION ANALYSIS

A. Introduction and Objective

The purpose of the regionally oriented marketing firm, CPSP, described in Section I is to improve the ability of the South Pacific countries' coconut industry to gain access to major export markets and compete against other producers elsewhere. Coupled with this however is the need to ensure that adequate raw materials, processing facilities and, support infrastructure are present to support this industry. Several South Pacific countries were surveyed to get up-to-date information on the type, quantity, quality, cost, and reliability, of available resources, and the influence the public sector and coconut related institutions have on the use of these resources.

Factors believed to influence the profitable operation of high value edible coconut product operations were surveyed. For this report edible coconut products included cream, milk, skim milk, water, and low fat desiccated coconut; but not copra, coconut oil and commodity grade desiccated coconut.

B. Methodology

Figure II-1 contains a map of the region. Thirteen countries listed in Table II-1 were surveyed through personal visits to the countries. Discussions with public, institutional and private sector persons were conducted to collect information on the following topics:

1. Current end use of coconuts in country and for export

2. Extent of the resource, the varieties of coconut palm and pest and disease controls

3. Support infrastructure including roads, wharves, storage facilities, domestic, and external shipping

4. Utility costs, human resources and their geographic availability relative to crop access

5. Current and future roles of the producer boards, and other government or quasi-governmental institutions

6. Food manufacturing sector's, scope and technology application

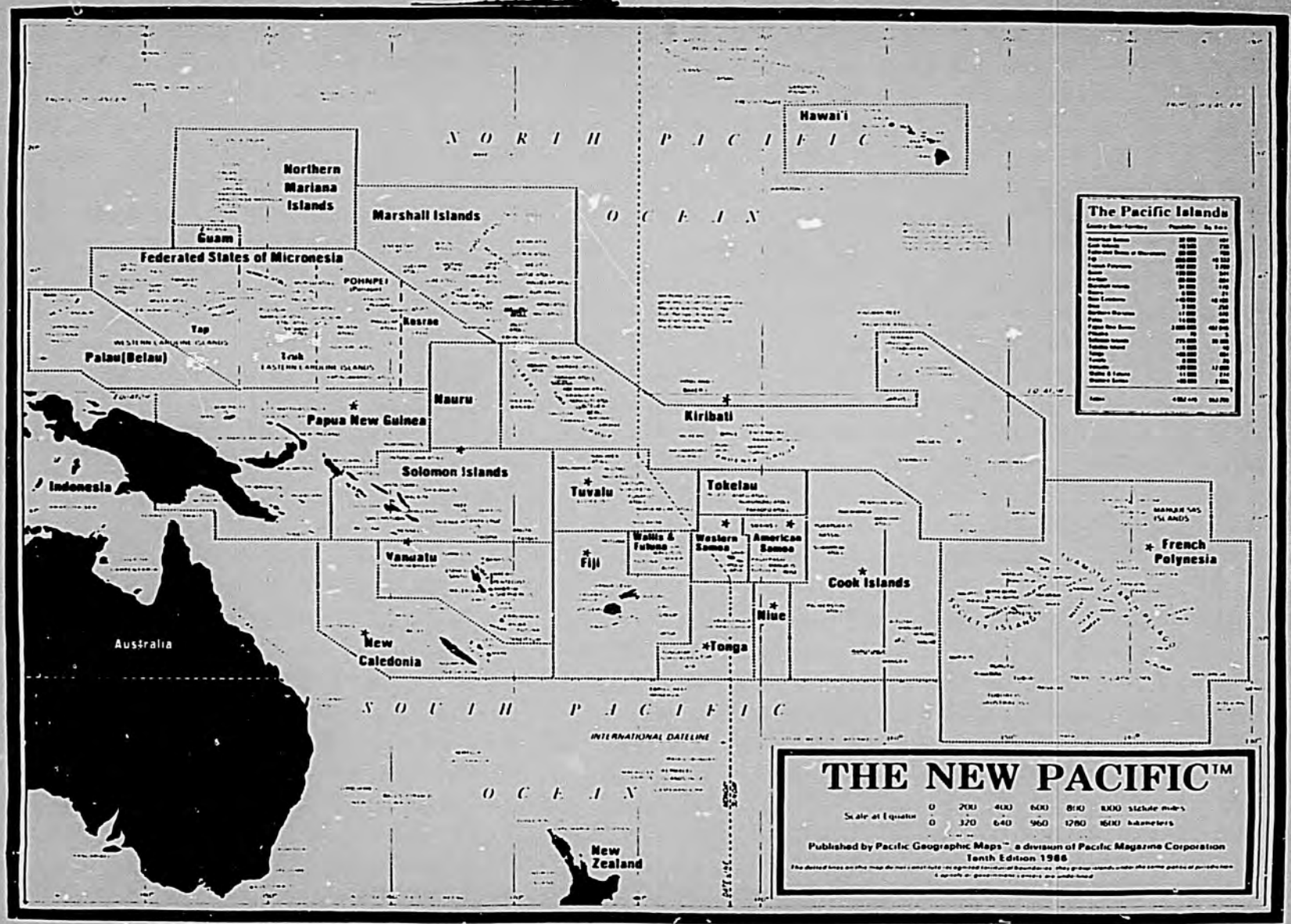

FIGURE II-1 MAP OF SOUTH PACIFIC

Table I-1

SOUTH PACIFIC COUNTRIES SURVEYED

Country	Population	Area in Sq. Miles	Currency	Exchange Rate (Local Currency per U.S. $)
American Samoa	38,500	197	US Dollar	1.00 = PAR
Cook Islands	18,000	240	NZ Dollar	x 1.55
Fiji	700,500	18,272	Fiji Dollar	x 1.40
French Polynesia	172,800	3,265	Pacific Franc	x 1.13
Kiribati	64,000	690	Aust. Dollar	x 1.15
New Caledonia	151,300	19,103	Pacific Franc	x 1.13
Niue Island	2,000	260	NZ Dollar	x 1.55
Papua New Guinea	3,320,700	462,243	Kina	x 1.25
Solomon Islands	272,500	27,556	S.I. Dollar	x 1.82
Tonga	94,400	699	Pa'anga	x 1.23
Tuvalu	8,600	26	Aust. Dollar	x 1.15
Vanuatu	135,600	11,880	Vatu	x 1.07
Western Samoa	160,000	2,935	Tala	x 2.02

Country Profiles were compiled with supporting resource documents, collected from each country. (Annexes II-a thru m) Some country profile information was not obtainable due to its proprietary nature. The collected information was felt to be correct and accurate at the time collected, September 1988 to January 15, 1989. Investors and others interested in using the country profiles for business planning purposes should verify or otherwise update them before any financial/economic analysis or investment decisions are made.

The country profiles and some additional data in the supplementary resource documents provided location-specific data for financial/economic analysis. The country profile data were collected and analyzed by team members having extensive knowledge about the South Pacific coconut industry, and relevant public and

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private sector institutions and other issues which could directly or indirectly influence coconut processing profitably.

C. RESULTS

1. Coconut Supply

While nearly every South Pacific country surveyed has some coconuts, the quantity, quality, cost, location in-country and competition from existing industrial purchases limit what is available for new coconut processing operations. Table II-2 summarizes, by country, the estimated quantity of nuts available for edible coconut product processing. Since the quality of available coconuts will vary from country to country these factors are considered in the individual country/processing location analysis in section II-E below.

2. Existing Coconut Processing Operations

Table II-3 summarizes data from existing coconut food processors having facilities available to produce exportable edible coconut products. At present, the annual available capacity is about 1,860=t of canned cream, 550=t of frozen cream and 2,000=t of desiccated coconut assuming operation on a single shift. Capacity utilization ranges from 0 to 60% or more.

Balancing, modernizing, diversifying, and expanding these operations to ensure production of export quality products could increase coconut cream or its output to over 4,000 tonnes/year. This output would only require nuts that are readily available for edible product production and not those presently used for copra or dessicated coconut production. If higher prices than those for copra were offered the coconuts supply for edible production could be increased considerably in some locations.

3. Countries Surveyed

The major factors affecting coconut processing and marketing in each specific country are addressed below. However, the country profiles should be consulted for more in-depth information.

Table II-2

Estimated Copra Equivalent of Coconuts Available for Edible Cocnut Processing

Country	Total Nuts -CE (a)	Used In Copra	Locally Consumed	Available for Specialty Processing (b)
American Samoa	150	0	150	[illegible]
Cook Islands	1200-1600	500-1200	120-200	[illegible]
Fiji	22475	13485	12000-15000	[illegible]
French Polynesia	15264	14000	3920	
Kiribati	9000-1200	10000	3000-4000	[illegible]
New Caledonia	2385		500	[illegible]
Niue	150	NIL	10-15	[illegible]
Papua New Guinea	250,000	200,000	50,000	50,000
Solomon Islands	42,000-48,000	31,000-38,000		[illegible]000-8000 (c)
Tonga	13,738	9,738	3,000	[illegible]
Tuvalu		NIL		[illegible]
Vanuatu	59,000	40,612	18,000	5,000
Western Samoa	50,000*	24,000		2,000

(a) CE = Copra Equivalent in TONNES

(b) Nuts used for copra, local consumption and available for possible specialty products may not add up to Total Nuts - CE because it is felt some nuts now used for copra would be easily available for specialty products processing if financially/economically feasible.

(c) Depends on processing location (Yandina or Guadal Canal) selected.

*1985 statistics

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Table II-3

Existing Regional Coconut Food Processors*

Country	Location	Product Type and use	Estimated Production Capacity Tonnes/yr.	Capacity Utilization %
COOK ISLANDS	Cook Islands Coconut Products, Ltd. Matavera, Rarotonga	Canned Cream (Consumer)	120	25-50
FIJI	Food Processors of Fiji, Ltd. Vatunaga, Suva	Canned Cream (Consumer)	400	25-50
	Chappallia Properties, Ltd. Taveuni Island Northern Province	Frozen bulk Reprocessing	500	5.0
NIUE ISLAND	Government Food Factory Alofi	Canned Cream (Consumer)	180	0
		Frozen Bulk	50	
TONGA	Tonga Commodities Board Nuku Alofa	Desiccated (Bulk/Consumer)	2,000	15-40
WESTERN SAMOA	R. Cook Enterprises Apia	Canned cream	100	30-40
	R.V.Meredith Ltd. Apia	Canned cream	460	40-50
	Samoa Tropical Products Apia	Canned cream Syrup	600	60+

Note: Estimated Production On Single Shift Basis.
*Does not include copra and coconut oil processors.

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American Samoa

American Samoa has the highest regional shipping frequency to North America. It also enjoys special access to United States markets, and has relatively low utility costs. In addition, the territory encourages private investment through generous incentives and has an established fish canning industry. If obtaining coconut cream supplies from other countries for packaging in asceptic form and marketing centrally is feasible, American Samoa offers some advantages. However it has relatively high labor costs and lacks an adequate supply of domestic coconuts for processing.

Cook Islands

Cook Islands has an existing coconut cream cannery in Rarotonga with good expansion capability and experienced labor resources. Wage rates are moderately high compared to the regional average. The internal shipping service provides special rates for freighting coconuts from the outer islands of the group and the government is fully supportive of the industry.

Fiji

Fiji has two existing coconut cream factories:

1) Food Processors of Fiji has a cannery in the Vatuwaga industrial area close to Suva, the main port.

2) Choppalia Properties Ltd. on Taveuni Island is dedicated to frozen bulk coconut cream processing.

Fiji is a transport hub for the Pacific and enjoys frequent shipping links with Australia, New Zealand, and the EEC block as well as good service to North America. It has an excellent labor force, good utility prices, and relatively well developed infrastructure plus generous incentives for business establishment in the region. Raw material supplies are readily available in key areas.

French Polynesia

French Polynesia has a large resource of coconuts and strong government support for greater development in the industry.

Transport cost to the U.S. market would be relatively high as are coconut costs.

Kiribati

Kiribati has a sufficient supply of raw material and labor for small-scale operations on South Tarawa and at Kirimati Island. The best opportunity for added value there is considered to be in the commercial production of traditional products such as toddy and processed toddy products such as syrups and spirits. An industrial complex is planned and the investment incentives are good.

New Caledonia

The available coconut supply could support a processing plant if price incentives for harvesting are improved. The country has adequate freezer storage and canning facilities, excellent infrastructure and strong association with EEC markets linked with excellent shipping. The administration is supportive of further coconut industry development. It has a strong local market for specialty coconut products currently served by imports.

Niue

Niue has a processing facility capable of processing canned and frozen coconut cream. The supply of raw materials is very limited and labor availability is low. The government places a high priority on export income and offers generous industry incentives.

Papua New Guinea

Papua New Guinea has the largest raw material supply in the region and as yet has not ventured into export of processed coconut food products. Canning operations exist for noncoconut products. A modern meat canning plant situated at Madang has excess capacity, and could offer its facilities for coconut processing. Some locations near Madang, Lae and Kieta enjoy good port facilities, infrastructure and utility advantages. The Government is supportive of the coconut industry and strong investment concessions are available.

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Solomon Islands

The Solomon Islands have two areas of concentrated stands of coconuts:

1. Yandina in the Russell Islands has some 4,000t of copra production on a good road network.

2. Guadalcanal has a large raw material supply, good infrastructure and a full range of utilities at the Honiara Industrial Estate.

   The investment packages being prepared by the government are very attractive. Wage rates are relatively low and this offers a major advantage for labor intensive coconut processing operations.

Tonga

Tonga has a new desiccated coconut plant capable of sustaining major production, an oil mill which produces copra cake as a byproduct, and a soap making operation. Moving into coconut cream preparation is an option but existing coconut processing firms consume much of the raw material supply. Thus, an investment in a new activity may have to compete with other operations for raw materials.

Tonga's Incentive Act has proven a good model in the Pacific. The infrastructure and utilities in the industrial estate at Nuku Alofa are good.

Tuvalu

Tuvalu has a soap-making plant which uses coconut oil. Specialty products derived from toddy are also being produced. Although the volume of raw material is limited, the coconuts are of high quality. The distance from harvest locations to processing points and the shipping frequencies are limited.

Vanuatu

Vanuatu has concentrated stands of coconuts on the island of Espirito Santo which has good infrastructure and utilities as well as a freezer storage capacity of approximately

3000 cubic meters. The country could easily sustain coconut cream operations. The government offers attractive incentives, including free exemptions.

Western Samoa

There are two major producers of canned coconut cream in Western Samoa as well as several smaller operations utilizing cream in their products. In addition, there is a major copra mill, and a UHT plant being considered.

At Apia, the capital, infrastructure and utilities are good. Since raw material supplies are heavily utilized, strong competition from copra and oil processing could occur if existing cream operations or new ventures expand the market for coconuts. Wage rates for unskilled labor are relatively low and good investment incentives are available.

4. Public/Institutional Sector Activity

There are two South Pacific regional institutions which play a significant role in coordinating the various countries' endeavors in the area of political cooperation, trade, and culture.

a. The South Pacific Bureau for Economic Cooperation and Development (SPEC), headquartered in Fiji;

b. The South Pacific Commission (SPC), headquartered in New Caledonia.

Of these two organizations, SPEC has a mandate to further the development of the coconut industry.

Within the countries surveyed various organizations or boards are empowered to coordinate the activities of the coconut industry. These institutions often have wide powers, which can include

- Licensing buyers and/or sellers and processors of copra
- Setting country prices to producers
- Negotiating export pricing, shipping, etc.
- Operating and promoting stabilization schemes
- and Providing other services related to

coconut production, processing and trade.

Producer boards in many of the countries accept the need to encourage growth and diversification in the coconut industry. However, lack of opportunity precludes reinvestment in sectors of coconut production other than copra or oil milling. In some cases legislation covering the operation of these boards is too restrictive thus not allowing investment in alternative possibilities. Shifts to processing high value edible product may be advantageous but the question of markets needs to be answered before further investment is justified.

Considerable differences exist between the producer boards and the processing industry in some countries. In some cases personality clashes occurred as a result of a misunderstanding of mutual roles.

The producer boards have a clear mandate from their central governments to protect the interest of the coconut farmers who usually are geared to copra production. As copra prices fluctuate a great deal, the boards implement a variety of measures to stabilize pricing structure. Since the main export product is generally copra, some boards intervene in the pricing for raw coconuts sold for edible product production. The processing sector sometimes considers this levy unfair and it increases the cost to its products. Nevertheless, there are many areas of common interest among producer boards, processors and farmers and many differences are considered to be of a short term nature which must be bridged for the expansion of the industry.

5. Social/Political Analysis

Most of the countries considered in this study belong to the Pacific Forum. There are now thirteen Forum Island Countries. All of these countries are self-governing, although some have a special relationship with a metropolitan country. The main Forum Island countries in Melanesia are Papua New Guinea, Solomon Islands, and Vanuatu.

These countries have a Melanesian population, with a small admixture of other races. In Papua New Guinea some authorities distinguish the inland Papuan peoples from the coastal Melanesians. In

all three countries there are large numbers of racial and linguistic subdivisions.

The indigenous Fijian people are Melanesian with a Polynesian admixture of long standing. They comprise about 45% of the 715,000 population. They are slightly outnumbered by people of Indian origin. There are also influential small minorities of Chinese, European and mixed race.

The Polynesian islands extend over a wide area of the South Pacific. The Pacific Forum countries that are now mainly inhabited by Polynesians include: Tonga, The Cook Islands, Niue, Western Samoa, and Tuvalu.

Of these countries, Niue and the Cook Islands are self governing countries in free association with New Zealand. Their people have New Zealand citizenship.

Micronesia comprises most of the island groups in the Central Pacific East of the Philippines, mainly North of the Equator. The Forum island countries of Micronesia include The Federated States of Micronesia, The Marshall Islands, Nauru, and Kiribati.

Of these only Kiribati is included in this study.

Non-Forum Countries

For purposes of this project, three Non-Forum countries are also considered. These include New Caledonia, French Polynesia, and American Samoa.

New Caledonia and French Polynesia are overseas territories of France and the indigenous people, Melanesian and French in New Caledonia and Polynesian and French in French Polynesia, are French nationals. American Samoa is a self-governing territory of the United States of America and the indigenous people have U.S. nationality.

a. Smallness and Fragmentation

A common feature of South Pacific countries is their relatively small populations by world standards, ranging from about 3,500,000 in Papua New Guinea to 2,000 in Niue. They also share, in different degrees, a remoteness from world markets,and many are fragmented by land and sea barriers that make internal communications and transport

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difficult.

In Melanesia, this physical fragmentation is augmented by political and linguistic fragmentation into literally hundreds of separate tribes with many distinct languages. Pidgin languages form the basis for national unity and politics. In Polynesia, and in Kiribati, the part of Micronesia with which the project is primarily concerned, languages and customs are much more uniform. However, these countries are physically fragmented into small island populations scattered over vast areas of ocean.

b. The Subsistence Sector

Another important feature common throughout the region is the prevalence of smallholder self-subsistent agriculture. This is a cultural feature of the greatest social and economic significance for the project. Most indigenous Pacific Islanders can, and often do, produce their own basic food and shelter. Most also participate in the market by producing a surplus for sale, or working for wages, or receiving remittances from family members working elsewhere. Even small cash sources can greatly increase the standard of living.

Before European contact the Pacific people supported themselves wholly from their self-subsistent family and village production. Moreover, the standard of living achieved was one of primitive affluence, providing simple but adequate diet and shelter, with a work input that left them ample leisure. In those respects they were better off than a large part of the world's population.

This affluent subsistence production still operates, in conjunction with supplementary cash activities, in most of the Pacific Island countries. In smaller island countries and in coastal areas of the larger islands the basis of the coconut industry has grown. There is also an estate component, but the smallholders are by far the greatest source of coconuts and copra for the market.

Subsistence sharing of the essentials of living is the foundation of the social system in the rural areas of the South Pacific. It

provides for all members of the social unit, whether it be the household, the extended family (e.g. the AIGA of Samoa), the clan, other kin group, or even the village. It provides a significant degree of political, social, and economic stability at the micro level and a stabilizing influence on national politics and economic situation as well. The flexibility of the system protects against the worst effects of external shocks such as sharp variations in the price of copra or the availability of wage employment, and adverse weather.

c. Melanesia Analysis

The physical and social conditions of the various countries and their historical heritage affect their political conditions. In Melanesia, tribal and linguistic fragmentation, as well as the physical isolation of many rural groups, inhibits effective communication between large parts of the population and the centers of government. Education in isolated rural communities is also restricted in scope and quality. Every adult has the right to vote, but most have very limited knowledge of national problems and this lack of knowledge influences the type of person elected to the legislature.

Papua New Guinea, which is so much larger in population and area than the other countries of Melanesia, has responded to this problem by setting up regional governments that are delegated many local responsibilities. The quality of the regional administrations varies considerably and, in some cases, the local bureaucracies are difficult to deal with.

At the national level, the Melanesian countries have some able politicians and administrators. This is particularly so in Papua New Guinea where a reservoir of very able and experienced personnel have evolved from the elite who have enjoyed good tertiary education. In the Solomon Islands and Vanuatu this resource has been somewhat slower to develop, but is following a similar path. At the lower levels of parliament and public service, in these two countries, there are fewer people who have broad experience.

In Vanuatu, the political situation is further complicated by the divisive after-effects of competing French and British interests during the Condominium. There has been no change in government since independence, nine years ago. Serious splits have occurred in the ruling party which have reduced stability.

d. Fiji Analysis

In Fiji the key political issues are related to the economic situation, but are based on race. The two main components of the population are the Fijians and the Indians. At village level, and in normal civil and economic relations, individual Indians and Fijians generally work well together.

The problems arise mainly on the macro-economic level. Fijians have been concerned to see their country's slow economic progress since independence, and the European expatriates moving out of many commercial and industrial enterprises, with great benefit to the Indians but little to the majority of Fijians.

The native Fijians have some justification for their concern. As a race they have had little experience or training in the complexities of commerce and industry, and apart from a relatively small sector of the Fijian population, are generally less qualified than the Indians to take full part in the expansion of the advanced sectors of the economy. This fact is recognized even by many Fijians, but that does not make the situation more acceptable. This is the basic reason for the political upsets of the last few years including two non-violent military coups. It will take considerable time to restructure the country properly to satisfy Fijian aspirations.

This imbalance is not due simply to a Fijian lack of inherent ability or even capital, but rather to lack of experience in commercial and industrial activities. This in turn results in a lack of capacity to seize even those opportunities that come their way. The casualty rate for Fijians who have tried has been high.

The remedy for this problem requires a much

greater degree of special assistance and encouragement to the Fijians, starting from the basic education they receive in the inferior rural schools most of them must attend, and reaching up through all aspects of economic life. The installation of a few Fijians as directors of large companies does not get at the root of the problem at all. In fact there are no quick and easy solutions to the problem, and attempts to take the easy path have distracted attention from the hard and slow remedies that should have been pursued over the last two decades. Building from the bottom up takes at least a generation to be effective, as the experience of Malaysia has shown. Unfortunately this process has hardly begun.

The coconut industry is important in this situation. Most of the coconut producers are Fijians, and although only about 10% of commercial copra has been produced by Fijian smallholders in recent years, a considerably larger amount is consumed by producers' households. Any move that will help Fijians to increase their money incomes from coconut production will eventually help provide their children with a little better environment for education, with a little more money for institutional materials and nutritious foods.

Fiji has the institutional and research capacity to support improvement in the coconut industry. The Ministry of Agriculture and Fisheries is reasonably strong organizationally and technically. There has, however, been a lack of political will to provide and apply the resources necessary.

e. Polynesia Analysis

Being culturally more homogeneous, the Polynesian peoples way of life incorporates traditional social systems readily with politics at the national level and, generally speaking, the national government and the rural people communicate reasonably well.

Each of the Polynesian states has a legislature, but there are considerable differences in their modes of election. Niue comprises 14 villages and its legislature is made up of 20 members, 14 elected by the individual villages, and 6 by universal

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suffrage. The Cook Islands' legislature comprises 22 members elected on a system that gives each island at least one seat, with more to the more populous islands. Rarotonga, with more than half the total population, has nine seats. In Western Samoa the "aiga" or extended family is the basic political, social and economic unit, and is headed by a minor chief or "matai". The legislature comprises 47 members of which 45 are elected by the "matai", and only 2 by universal suffrage.

In Niue and in the Cook Islands, the difference between the policies of the government and the opposition tend to center more around personalities than around major issues of national development or general policy. In Niue the government has been remarkably stable over the last fifteen years. In the Cook Islands, there have been several major changes of government, but the changes have been more in personalities than in the general direction and aims. Somewhat the same tendency is seen in Western Samoa, although there economic policies, in particular the degree of financial restraint necessary have been a major political issue during the last two decades. From the point of view of the project, however, there is little cause for concern, as Samoa has a strong and reasonably competent Department of Agriculture.

There is, however, an exception. In Western Samoa the coconut industry has two points of political sensitivity. One is WSTEC, the government owned corporation that runs the public estates taken over from the Germans after World War I. The other is export marketing, which has been unsatisfactory in the past due to excessive operating costs and inappropriate incentive policies. Changes have been recommended in this field, but many vested interests have been involved and it is not known how effectively the changes have been implemented.

In Tonga the system of government is rather different. The King is the ruling head of state of the Tongan monarchy. There is a legislature which consists of a cabinet of 7 ministers appointed by the King plus the governors of Ha'apai and Vava'u (also appointed by the King), seven members elected

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by the 33 nobles of Tonga, and seven members elected by universal suffrage. There is a strong Department of Agriculture, but for policy matters involving major innovations, the support of the King is of great importance.

In Tuvalu, there is a legislature of twelve members elected by island communities. Tuvalu is too small to operate a major department of agriculture, but it has had some competent advisors. The major institution in the coconut industry is the Tuvalu Copra Cooperative Society which organizes the collection of the copra from the individual islands, markets it, and maintains a reserve fund to even out the effects of fluctuations in the international price of copra. It has been reasonably well managed and successful and has been important to Tuvalu, as copra is its only significant export.

f. Micronesia Analysis

Kiribati is the only Micronesian country specified in the project guidelines. Kiribati is a Republic. There is a legislature of thirty-six members, one of whom is elected nationally as President from three or four candidates nominated by the elected members. The President appoints his own cabinet from among the elected members. The President is the head of the government in a real sense so long as he retains the confidence of the legislature.

The inhabited islands of Kiribati are very widely scattered over vast areas of the Pacific Ocean. Island councils with considerable local authority are established on all inhabited islands. The copra industry is long established, and most palms are in small stands scattered among the small islets of the atolls, some of which are difficult to access from centers of population. The industry consists for the most part of very small holdings scattered throughout the country, and is served by a copra society which markets the product and maintains a price-equalizing reserve. The government actively pursues a coconut replanting program, and manages the large plantations in Fanning and Washington Islands, but a resettlement program from the Gilbert group to these

islands is now in progress and subdivision is likely to proceed.

g. Non-Forum Countries Analysis

New Caledonia is prosperous, though income is distributed very unevenly. It is beset with some serious political problems which led to considerable disorder in recent years. These problems may recur, and external pressures in support of self-government continue. The current French government has introduced measures leading to possible independence in ten years. The economy is no longer based on agriculture, but on French operated mining and French government subsidies. The coconut industry is mainly based on production in the indigenous areas of the country, particularly the islands to the East of the mainland. It has been declining for many years due to the relatively lower returns compared with other parts of the economy -- despite subsidization of copra prices to as much as twice world levels.

French Polynesia is presently very prosperous, but this prosperity depends almost entirely upon financial inflows connected with French nuclear testing, and on French government subsidies.

While there are strong demands for political autonomy, which have been resisted by the French government, the situation is rather different from that in New Caledonia. In New Caledonia the indigenous Kanaks are a minority in their own country where as in French Polynesia 75% of the population are Polynesians. Removal of French nuclear operations would leave the French with very little material interest in the territory and their incentive for heavy financial support would be greatly diminished. Discontinuation of that support would be catastrophic for the economy, leaving it with little besides a small tourist industry and the export of coconut products as a source of foreign income. It appears that most of the population appreciate this fact and is reluctant to endanger their prosperity.

American Samoa is also relatively prosperous as a result of significant U.S. Government assistance. It has the largest tuna canneries in the South Pacific. American

Samoa's favorable relations with the U.S. permits it to be substantially self-governed. This helps assure a stable political base for the foreseeable future. The vast majority of American Samoans strongly desire to maintain U.S. Terrritorial status.

h. The Pacific Coconut Industry

The coconut industry of the South Pacific operates in two main modes. The Traditional Mode has a primary aim of directly meeting the consumption needs of the producer's family. The Estate Mode, has a primarily commercial aim. In the Pacific, the production of coconut products in the Traditional mode is of vital importance because of its contribution to the subsistence requirements of the majority of the population, and also because it has been the greatest source of raw materials for coconut product exports. It is therefore of exceptional importance politically, socially, and economically.

The coconut palm provides the nonmonetary economy, and thus the majority of the Pacific population, with a large part of its basic requirements. The coconut meat is a staple food, and a source of vitamin E. The milk provides drink. The fresh toddy is an source of vitamin C. The shell provides utensils and fuel and the husk fuel and twine. The leaves provide baskets and the sides and roofing of dwellings. The tree trunk provides hard and durable wood for many purposes. The coconut palm makes a very large and relatively non-seasonal contribution to the livelihood of the coastal and island villages where the majority of the indigenous people live.

Even in the atoll countries, where land tends to be scarce and of low fertility, and where root crops are difficult to grow, the coconut palm, together with ocean products, makes possible a reasonably adequate level of living, considerably above that found in many parts of Asia and Africa. As a main staple food, and a main source of cash income the coconut palm is of immense importance and in the South Pacific.

However, although nutritionally adequate, subsistence diet tends to be monotonous,

because the range of products they can produce is very limited. For people so supplied with the essentials of life, quite modest supplementation from the cash economy can greatly enhance their standard of living and diversify the diets.

For nearly 100 years after a market for copra developed in the Pacific, a combination of subsistence and cash economies worked quite well. However, since World War II, the incentive for traditional producers to prove copra on this basis has been eroded by a number of factors.

First, there has been a long term decline in the price of copra relative to other goods, thus reducing the earnings of traditional producers for a given level of effort.

Second, a market for labor has developed away from the traditional subsistence areas, drawing off labor from the subsistence producing units into wage labor on mines, estates, urban employment or through emigration. As the people so drawn off were mainly active young adults, the reduction in the effective labor force of the subsistence units was greater than the reduction in the consumption requirements. This increased the opportunity cost of the labor available for copra making.

Third, in many Pacific countries, large inflows of international aid offered employment at prices above the natural market.

Fourth, wage earners who have left the subsistence sector have sent remittances back to their families. This alternative source of cash income has reduced the incentive offered by the low returns from copra making.

Copra production by the traditional subsistence sector is also affected by a number of short-term variables, especially weather and fluctuations in world demand.

Drought in particular, and to a lesser extent, cyclonic winds, can greatly reduce the yield of the coconut palm. This reduction in yield may severely cut the surplus of nuts available after basic consumption needs have been met. In many

Pacific societies, and particularly in the outer islands of atoll countries such as Tuvalu, consumption needs are given priority, and copra production will diminish, or even cease.

The price of copra on the international market is subject to wide fluctuations. In periods of low prices, the return to copra producers after deducting freight charges may be unacceptably low. Since freight and handling costs tend to vary less than the international price, so that the returns to the producer, especially in remote areas, are adversely affected. The effects of a fall in price are therefore exaggerated, and even when there is a substantial surplus of available coconuts, a low price can make it not worthwhile to collect coconuts from the more distant islets. At even lower prices the effort of processing nuts into copra is no longer justified, and production will cease.

These factors cause the output of copra from the traditional subsistence producers to vary greatly. As an example, Tuvalu is heavily dependent on copra as a major export, especially as a source of cash income for its outer island population. Between 1982 and 1984, Tuvalu's total foreign earnings from copra varied from $A 17,000 to $A 343,000. This occurred despite the fact that all Tuvalu copra is marketed by the Tuvalu Copra Cooperative Society. This society has built up reserves which are used to subsidize to some extent the price received by outer island producers in periods of low prices.

In summary, a large share of coconut products coming onto the market in the Pacific originates in the mixed subsistence/cash or traditional mode of production, where household subsistence needs are of special importance. The production of a surplus for sale depends heavily on the return per unit of effort, and thus on price. However, alternative sources of cash with a higher return per unit of effort, or with other advantages such as access to easier urban living, can do much to undermine the price effect -- as experience in New Caledonia has shown. To the extent that the project can increase the farm gate price of coconut products per unit of effort, it will benefit the indigenous people in the low income

group. The long term trends in supply may be affected significantly nevertheless by the socio-economic changes taking place.

6. Environmental Impact

If higher coconut prices resulting from greater domestic processing stimulate an expansion of the area of coconut trees or a replanting of senescent stands there could be positive environmental impact on watershed management, prevention of soil erosion and carbon fixation. The processing of coconut products, like many other food processing operations can have both positive and negative influences on the environment. The following measures are proposed to maintain or improve the environment at the processing site as well as at the farm site.

a. Husks - In most cases coconuts will be husked at the harvesting site to reduce transport cost and effort before moving them to collection and processing sites. The husks will be left behind to provide compost, hold soil water, reduce erosion and return plant nutrients such as potassium to the soil. Some husks may also be used as a fuel for domestic cooking and other uses.

b. Shells - These will be used as fueled in the processing plants to provide steam, hot water and possibly electricity through cogeneration plants. Surplus shells will be sold to charcoal producers or directly to households for fuel. The ash will be returned to the soil to replenish minerals usable by plants, thus reducing needs for imported fertilizers.

c. Coconut Water - An estimated 200 liters of coconut water will be produced from every 1000 nuts processed. Usually this is discharged into municipal sewer systems or streams/rivers near processing facilities and increases the biochemical oxygen demand by 40 g/liter. An alternative to disposal could be developed for profitable use of this product. Several products for local or export use will be explored by CPSP in an effort to convert this waste from a potential pollutant to a usable, profit contributing resource.

d. Solid Food Processing Wastes - Parings and will initially be sold to copra processors and pressings for animal feed. More profitable uses will be explored by CPSP.

e. Processing Plant Working Environment - A prime objective of CPSP, and the processors it provides marketing services to, is to market high quality products. An important way to accomplish this is to instill in the staff a sense of pride in their work and work environment. Management must provide adequate staff training, equipment, and facilities to keep liquid and solid food and packaging wastes to a minimum. Incentives will be given to staff to encourage low wastage. The housekeeping in and outside the plant must be designed to allow easy cleaning of the entire premises to prevent insects, rodents, and bad odors from developing.

The section on by-product utilization should be consulted for further discussion on uses of husks, shells , water, and solid wastes.

7. By-Product Utilization

To increase financial returns for coconut farmers and processing operations it is important to make use of as many parts of the coconut plant and the nuts as possible. Coconut palm by-products available in large quantities offer good opportunities for reducing costs or generating revenues. Possibilities for local or export include:

a. Husks: Excess husks available at the processing plant site will possibly be used as a fuel. Approximately 420 kilograms of husks will be available for every 1000 nuts processed. This could supply 5840 mJ/or 1323 kg of steam energy assuming 13.9 mJ per kg of husks at 15% moisture or 3.15 kg of steam per kg of husk. A 68,000 nut per day operation estimated to be a minimum financial/economic capacity for the technology chosen, would have available 89,000 kg of steam energy or which could meet 208% of plant heating fuel needs. (See Annex IV).

Processing of coir for export does not appear to be feasible as India and Sri Lanka dominate that industry with a variety of products such as mats, and 2 ropes and have the proprietary technologies and economies of scale which presently preclude many South Pacific opportunities. An operation in Papua New Guinea, has very good facilities for

producing large matting from coir for soil erosion control and landscaping. This product may offer marketing possibilities that will be explored by CPSP. If sufficient markets are located, the technology could be sold or licensed to the private sector in other South Pacific countries if the Papua New Guinea operation cannot meet market demand.

b. Shells: There will be even larger quantities of coconut shells than husks available at processing plants. Shells and husks have about the same heat value if they contain the same percent of moisture. Shells are easier to ignite and burn and produce less ash and corrosive gases than husks. Shells therefore will be considered as a boiler fuel to produce heat energy and possibly power a steam turbine for cogeneration of electricity.

Since the recommended coconut processing facilities will operate 2 shifts per day, electrical power could be sold to the national electrical grid or industrial users. This would help reduce foreign exchange costs for imported fuel to operate electrical power plants.

Excess shells could also be sold as fuel for domestic home use or for charcoal production for domestic use. The exportation of charcoal to activated charcoal manufacturers will be explored by CPSP. Production of activated charcoal requires a large investment (2.5 to 3.2 million U.S.dollars) and a large quantity of shells to justify the operation.

Other uses of coconut shell to produce shell flour, bowls and, souvenirs do not utilize large quantities of shell and face competition from other raw materials and countries having established markets for these products. Thus, there are limited marketing possibilities compared to possible savings in using shells for fuel.

c. Oil: If coconut skim milk is produced a market must be found for the by-product virgin oil. The opposite situation is also true. Some markets, for a premium quality oil with good flavor and aroma have been identified. These markets will be explored

by CPSP to more clearly define the type product needed and its possible selling price and quantities desired. In the meantime the oil will be sold to coconut oil processors for export and/or domestic markets. Coconut skim milk production may not be economical without virgin oil being sold at a price higher than ordinary refined, bleached and deodorized oil from the copra process.

Some applied research has been done on using coconut oil as a partial or complete substitute for diesel fuel. Coconut oil has a combustion value of 3,718 kJ per kg, which is about 15% less than diesel oil. As much as 30% coconut oil has been blended with diesel as a car and truck fuel. Total direct replacement is not feasible as coconut oil solidifies at 22-23°C.

Alternatively production of methylesters by combining coconut oil with methanol and sodium hydroxide and separating out glycerol has shown some pilot scale promise in the Philippines but it has not been shown to be commercially viable yet. Both of these potential vehicle fuel sources will be explored by CPSP.

d. Pressed or Expelled Residue: This by-product consists of slight off white to white fibrous dry material remaining after the cream has been pressed and the material dried. Its fat content depends on the amount of partial reduction done to the fresh meat before extraction, the pressure used to extract the cream and use of water to wash out additional cream. The percent fat can range between 35 to 40% and since it is lower in fat than desiccated coconut, it could be utilized in specialized low fat applications. Initially this product will be sold to copra mills for oil production or as animal feed. CPSP will explore more profitable uses such as a cake topping, meat extender, and as a partial wheat flour replacement in bakery goods. Some markets already utilize this low-fat desiccated meal, but these markets need to be expanded and additional uses found.

e. Trunk Wood: In the South Pacific there are large numbers of unproductive senescent coconut trees. The trunk in some South Pacific countries is cut into timber for building and other domestic construction

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purposes. While local use should still be encouraged, CPSP will explore export markets for flooring and furniture. Marketing may be a major obstacle for trunk wood as it is a relatively new commercial product and not fully accepted by some users.

Only about 20% of a coconut trunk is suitable for sawing into timber leaving the remaining available for fuel, either as a direct fuel or converted to charcoal. Transportation of coconut wood could be a major obstacle for its use as a fuel unless more profitable uses can be found for the usable lumber in the trunk.

f. New Additional Product Concepts: The above planned by-product uses should be a primary focus for by-product utilization. Other products which could be explored from the marketing and technical/production aspects will need more in-depth research and development. These products, listed in Table II-4 and described in Annex V are felt to offer good opportunities for making alternative use of coconut by-products to meet local and/or export market demand.

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TABLE II-4

NEW/ADDITIONAL PRODUCT CONCEPTS

BY-PRODUCT	PRODUCT DERIVED
Coconut Water	Vinegar Nata de coco Beverage - Non Carbonated - Carbonated Single Cell Protein for animal feeds Concentrated - for food or fermentation substitute uses
Expelled or Pressed Residue	Meat extender Partial replacer for wheat flour in bakery goods Processed legume extender
Palm Hearts	Canned or dried
Coconut Sap or Toddy	Alcoholic Beverage - Lambanog - Tuba Syrup
Coconut Milk	Cheese Yogurt Jams/Spreads
Coconut Skim Milk	Coconut Honey
Oil	Coconut flavored oil for cosmetic and suntan block products
Trunk	Strip Flooring Block Flooring (Parquet) Furniture Sliced Veneer Particle Board

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8. Local Markets

Except for Papua New Guinea and Fiji, the population of the countries surveyed does not justify the capital investment required to establish a processing operation solely for the home market. The volume of imports of processed cream in these countries is small, except for Papua New Guinea.

Most of the imported coconut cream is packed in cans of 300 or 400 ml and imported from Thailand, the Philippines, and Malaysia. Generally the products are of a diluted cream nature having a fat content below 14%. Thirty percent of these imported products are labeled cocomilk and the remaining 70%, coconut cream. There is no industry standard at present for coconut cream and milk. In the South Pacific consumer interest is high for a coconut cream with a minimum fat content of at lease 18% and an average of 20-24%.

There was no evidence of intra-regional trade in coconut milk or cream for retail markets. Fiji has ordered some canned coconut cream from Western Samoa during periods of local shortages.

D. Technology/Processing Analysis

Market analysis has indicated demand for three products, coconut cream, low-fat desiccated coconut flakes, and coconut skim milk. This demand reflects inconsistent or low quality of existing, similar coconut products and health concerns related to coconut oil. Virgin oil, a by-product, and frozen coconut meat flakes or chunks are two additional products, which offer opportunities for further market development. Table II-5 shows the typical chemical composition for these proposed products.

TABLE II-5

TYPICAL COMPOSITION FOR PROPOSED COCONUT PRODUCTS

	CREAMED COCONUT	SKIM MILK	VIRGIN OIL	LOW FAT DESICCATED FLAKES (DCN)	FROZE FLAKE
TOTAL SOLIDS(%)	30-35	12	NA		
SUSPENDED SOLIDS (%)	2-3		NA		
FAT (%)	20-25	1-2	99.1	35-40	33-40
MOISTURE(%)	42-50		0.7	2-5	33-38
PROTEIN (%)	2-3	1-2	0.0	4.5-5.5	2.9-4.
ASH (%)	<0.75		0.0		1.0-1.
FREE FATTY ACIDS%	0.7		0.08	<0.1	
MELTING POINT	NA	NA	24.2		
pH	6.0-6.2	6.0-6.2	NA	6.1-6.3	

*NA - not applicable

Coconut cream, considered here as a core product, has a wide range of uses and is currently sold in frozen and canned forms. With some additional pieces of equipment, a coconut cream plant could produce other products such as a coconut skim milk and virgin coconut oil, depending on the market.

Three types of processing-packaging technologies analyzed to produce exportable quality products which market research identified included.

- Canned products are hot filled, sealed and retort heat-processed. This market is the export retail trade, especially ethnic and health food markets. This type processing is presently done by several South Pacific coconut cream processors for export, is well known by the coconut industry and therefore is not discussed in this analysis.

- Ultra High Temperature (UHT) processed product in semi-rigid laminated 200, 250, 500 or 1,000 ml packs is to be targeted for the retail market. (UHT processing is the process where the product and the package are sterilized in separate processes and the sterile products filled into the sterile container.) No South Pacific coconut processors are presently using such a technology on coconut products but some dairy or fruit juice operations presently having UHT processing equipment could be converted if market demand warrants. These retail boxes offer lower packaging and transport costs than canned products. See Annex IV.

- UHT processed product in flexible laminated bags in 5, 25, 200, and 1,000 liter packs is to be marketed to the industrial market. Similar heat processing is used with this technology as with retail UHT processed products, but the heat processed product is aseptically filled in the bags and sealed, shipped and stored in rigid cardboard or plyboard boxes and/or fiber or st drums. No South Pacific food processing operations are using this technology now. It is, however, beginning to be used by several North American, European, Asian and South American food ingredient manufacturers who want to reduce packaging and transport costs and provide more convenience to industrial users of these bulk-packaged products. An example would be aseptically bulk packed pineapple juice imported as an ingredient for pina colada mixes which are blended, bottled, and marketed in North America.

A description of processing methods and facilities and the quality assurance program applicable to all these products follows:

1. Coconut Cream

In the South Pacific region, coconut cream is presently produced commercially in Western Samoa, the Cook Islands and Fiji. The current canning method, however, involves the use of a batch pasteurizing and subsequent retort heating which subjects the delicate coconut cream to high temperatures for an extended period of time. As a result, the product is of uneven quality and has lost some flavor and aroma. In order to expand the market for coconut cream and other high-valued products, the quality will need to be improved. The key to the production of high-quality coconut cream is the use of a continuous pasteurizer followed by continuous sterilizing and aseptic packaging coupled to an aseptic filling unit. With this system, pasteurization is accomplished by subjecting the cream to a temperature of 72°C for not more than 2 minutes inactivating most of the spoilage and food poisoning organisms. Sterilization is done by subjecting the cream to 140°C for four seconds thereby killing all organisms. This method can be highly successful if utmost care is practiced to make the whole plant sanitary.

a. Process Flow: The recommended process flow for the production of coconut cream is shown in figure II-1. This process starts with inspection and grading of incoming coconuts where immature, over-mature, and cracked coconuts are rejected and returned to the supplier. From the inspection and storage area, the coconuts are sent to the opening section where the shells are removed using a hand tool. With practice, the coconut shell could be removed without breaking the meat. Breaking some of the meat is difficult to avoid in shelling, but this makes the subsequent paring step difficult. The testa (the brown layer between the shell and white meat) is then pared off with a paring tool, taking care not to break the meat.

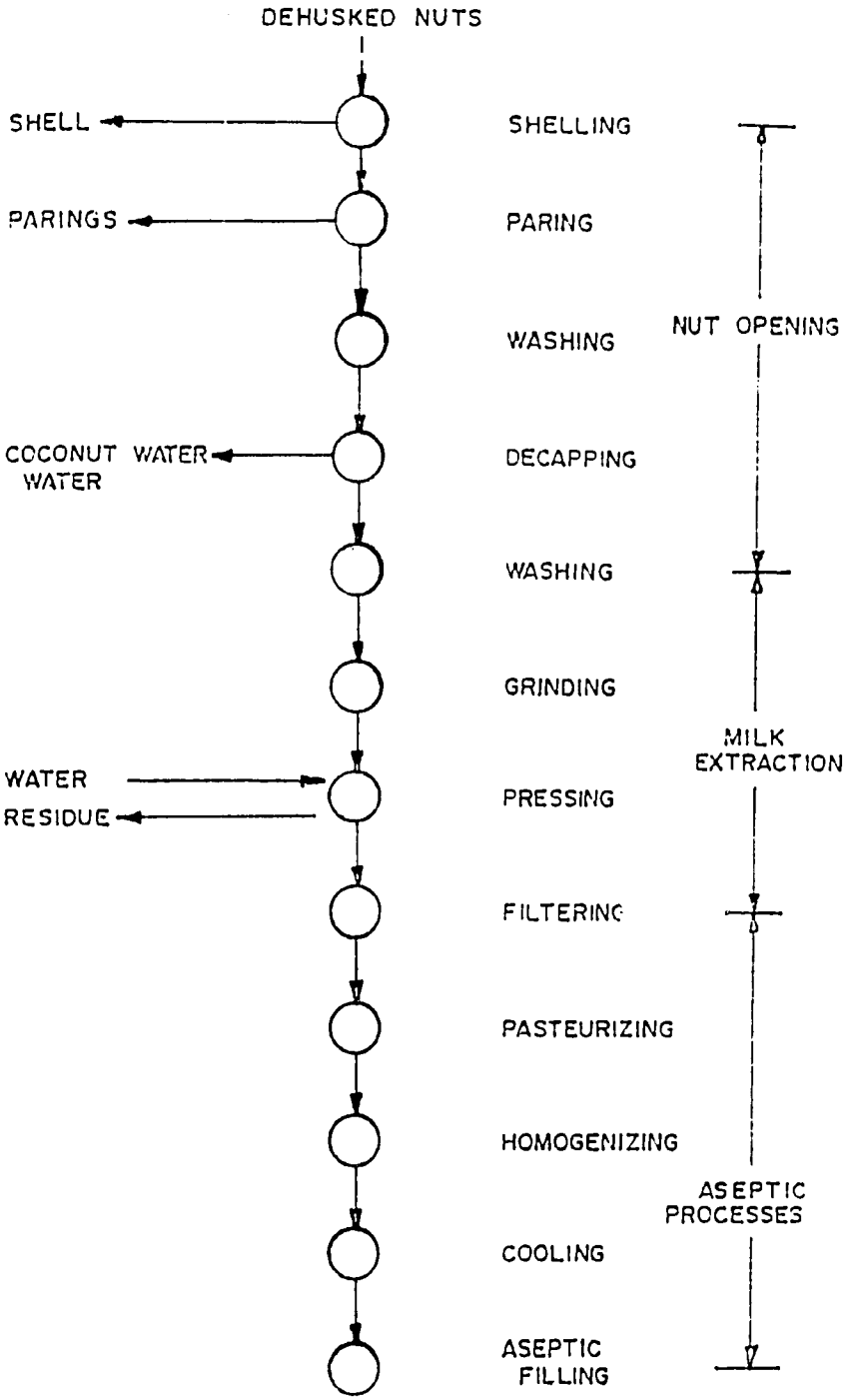

FIGURE II-1. Process flow for coconut cream production.

The pared meat is then moved to a decapping machine where it is cut into smaller pieces and the coconut water is removed.

After the coconut opening stage, the pieces of pared meat are moved to the cream extraction stage. This stage consists of comminuting the pared meat, pressing it to extract the cream and filtering to remove solid particles. The machine used for comminuting is similar to the one used in the desiccated coconut manufacture. The press or extractor is a continuous flow machine such as the Kraus-Maffie or the Rietz S-press. The resulting coconut cream may have a fat content of up to 38%, but is usually diluted with water to meet market specifications.

The extracted cream is then pumped to the pasteurizing stage where it is preheated and the solid particles separated through a centrifugal screen. Pasteurization is done in a plate heat exchanger. Then, the cream is sterilized through steam injection, cooled and pumped to a holding tank. The sterilized cream is then packaged in aseptic boxes for the retail market or aseptic plastic bags for the bulk, industrial market.

The by-products are dried parings and coconut flakes, or low-fat desiccated coconut (DCN) with a fat content of 35-40%. The coconut shells are used to fire boilers for generation of power and process heat.

b. General Functional Layout: The general functional layout of the processing plants proposed for size A plants (2,500 liters of coconut cream per hour) is shown in Figure II-2. The layout for smaller size B plant (1,000 liters/hour) is the same, except for the size of the building and equipment (listed in Table II-6).

The building plan is divided into the following sections: nut storage, nut opening, washing, grinding and blanching, drying, screening/packing,

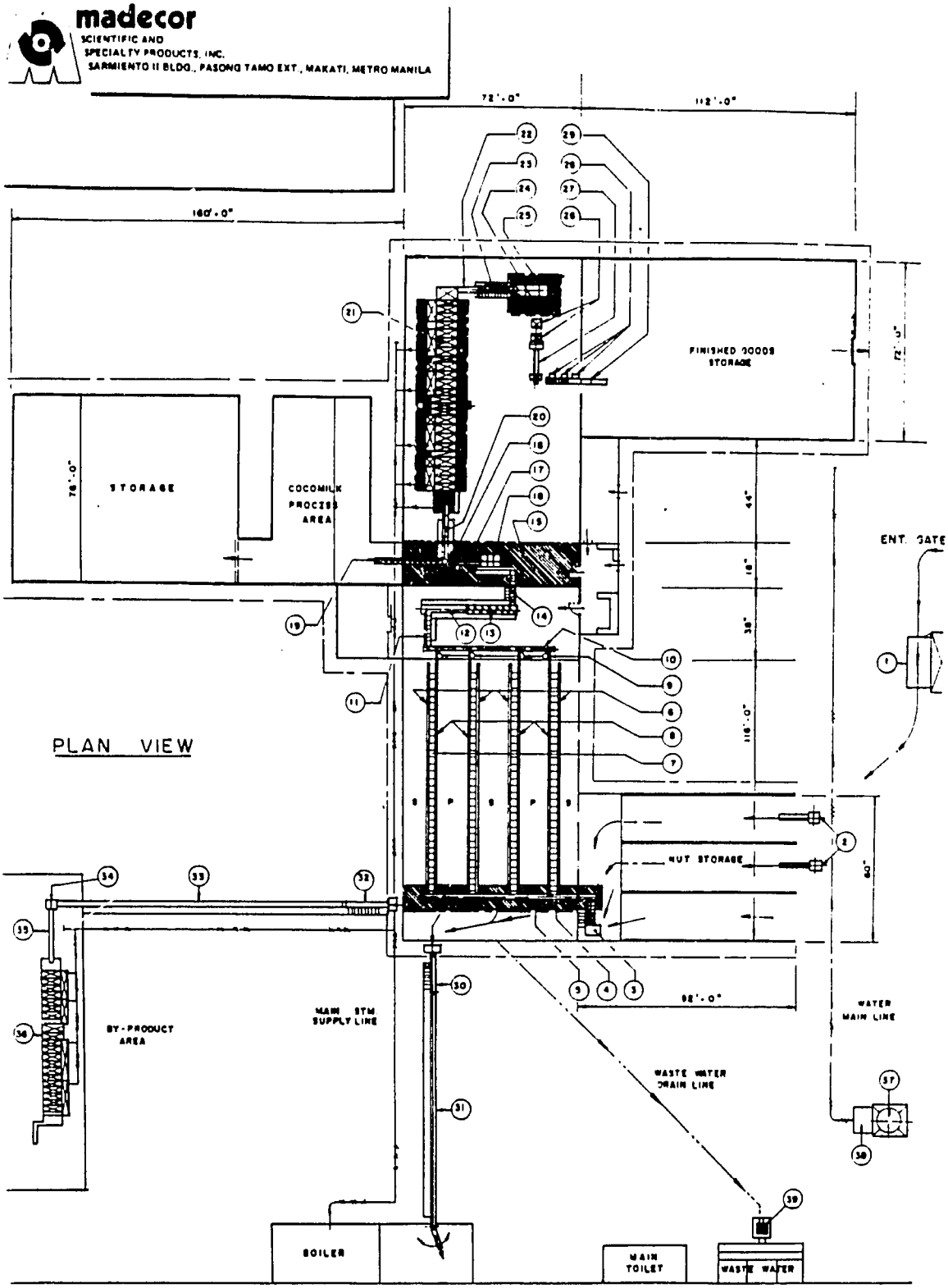

FIGURE II-2. General Functional Layout for a Coconut Cream Operation

Table II-6. Major Equipment Shown in Functional Lay-Out For A Coconut Cream Operation.

1. Toledo Truck Scale, 50-ton
2. Nut unloading cleated belt conv.
3. Nut counting chain-type conveyer
4. Nut cross belt conveyer
5. Checkered ms plate platform
6. Nut distribution belt conveyer
7. Shellers and parers bin-120 boxes-30 boxes/line
8. Pared meat belt conveyer
9. DD decapping machine
10. Pared meat cross collecting conv.
11. SS inclined washing screw conv.
12. Inspection belt conveyer
13. SS surge screw conveyer
14. SS dewatering incline screw conv.
15. Concrete mezzanine floor
16. DCN convertible grinder - 3 units.
17. DCN grinder discharge SS screw conv.
18. SS screw conveyer to screw press
19. SS feedscrew conv. to blancher
20. SS tabular-type screw blancher
21. DCN dryer - 2500 LVS/hr. cap. - output
22. Dryer discharge SS screw conv.
23. SS tubular-type inclined feedscrew conveyer to screener
24. DCN screener, 5 screens
25. Screening platform
26. SS DCN cars
27. Vibrox packing equipment
28. a) Toledo Check Weigher
    b) Sentinel Heat Sealer
    c) Sewing Machine
29. DCN bag flatener
30. Inclined cleated belt conv. (shell)
31. Overhead shell belt conv.
32. Inclined parings belt conv.
33. Overhead parings belt. conv.
34. MS. hammermill
35. Inclined parings belt conv.
36. By-product dryer
37. Water elevated tank
38. Chlorination room
39. SS rotary screen drum for solids recovery

finished goods storage and laboratory. Also shown in the general layout is the location of the powerhouse, parings dryer, water tank and wastewater collection systems.

The general lay-out provides ample space for good ventilation and sunlight to eliminate breeding grounds for rodents, insects and microorganisms. For the larger plant, 3 hectares (ha) is required for the plant site and 2 ha for the waste water treatment lagoons, which should be located about 100 meters away from the plant. For the smaller plant, 2 ha is required for the plant site and 1 ha for the wastewater treatment lagoons.

c. Material Balance

Daily coconut requirement: For a size A plant producing 40,000 kg of coconut cream (22.5% fat) per day in two shifts, about 169,500 coconuts are required daily. A size B plant producing 16,000 kg of this coconut cream would require 67,800 coconuts. Figure II-3 shows the general material balance for cream production per 1,000 coconuts processed. Table II-7 shows the specific material balance for the two sizes of plants analyzed.

Table II-7. Material Balance for Coconut Cream (22.5% fat) Production for 2,500 liters/hr and 1,000 liter/hr (2 shifts).

	Plant A (2,500 liters/hour)	Plant B (1,000 liter/hour)
Nuts	169,500	67,800
Cream, liters	40,000	16,000
Parings (5% MC), kg	4,400	1,700
Low-fat DCN (3% MC), kg	12,500	5,000
Shells, kg	30,500	12,200
Water, kg	33,900	13,600

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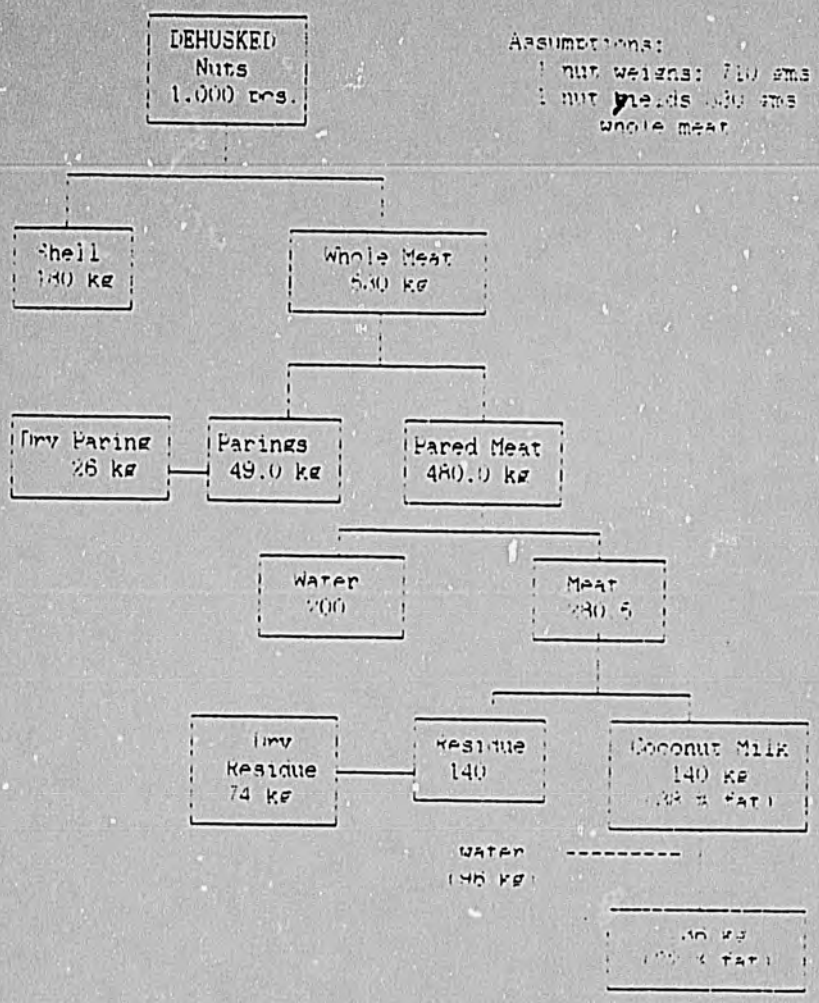

FIGURE II-3. Material balance in coconut cream production

Rejects: It is estimated that 12% of the coconuts will be rejected as unsuitable at the nut receiving area because they are cracked, immature, or over-mature. The Philippine experience shows a 5-10% rate of rejection, but it may be higher in the South Pacific where coconuts are mainly harvested after they fall naturally from the trees. The rejected coconuts are not purchased and are returned to their suppliers.

Shell: Assuming an average coconut had a shell weight of 180 grams (g), size A plants would yield 34,300 kg of coconut shells, compared to 13,700 kg at size B plants. All of the shells will be used to fire the boilers for power and process heat generation.

Parings: The fresh parings, removed from the meat, constitute about 15% of the weight of the whole meat. The Philippine standard is 13%, but because of the inexperience of the South Pacific workers in paring work, a 15% loss is a more conservative estimate. In size A plants, two shifts would produce about 9,300 kg of fresh parings at full capacity. When dried to a 5% moisture content this will yield 4,900 kg of parings. A plant of size B would yield 1,950 kg of dried parings.

Coconut Water: Daily production of coconut water would be around 38,100 l and 15,200 l, respectively for the two sizes of plants operating at full capacity. The coconut water is passed through an oil and sludge separator to remove suspended oil (about 0.2%) and solid particles such as shells and meat. Some of the water will be diverted to neighboring farms as irrigation water and the rest will be pumped to a fermentation lagoon.

Coconut Cream: In a continuous presser, about 140 kg of whole cream (38% fat without added water) can be produced from 280 kg of pared meat. About 96 kg of water is added to 140 kg of whole cream to produce 236 kg of cream with a fat content of 22.5%. Since 1,000 coconuts of average size are needed to

produce 140 kg of whole cream, each nut will yield 0.24 l of cream with 22.5% fat.

Coconut Residue or Low Fat Desiccated Coconut (DCN): The total fresh coconut residue that will be produced in the larger plant is 26,700 kg, which yields 14,000 kg of dried material per day at a 5% moisture content, the smaller plant can produce 5,600 kg of dried residue per day.

d. Equipment List: The equipment needed for a coconut cream plant capable of producing cream and low-fat DCN is summarized in Table II-8. See Annex __ for names of some possible suppliers and other equipment descriptions.

Table II-8. Equipment for the Production of Coconut Cream and Low-Fat Desiccated Coconut.

Nut Opening Area

1 - Nut counting conveyer, 3hp gear motor, 30 rpm
1 - Nut distributions conveyor, 2hp gear motor, 30 rpm
4 - Nut cross belt conveyor, 2hp gear motor, 30 rpm
4 - Shell parings and line, 25 bins per line
4 - Pared meat belt conveyor, 2hp gear motor, 30 rpm

Washing and Inspector Area

1 - Pared meat cross conveyor, 2hp gear motor, 30 rpm
4 - Decapping machines, 1 hp gear motor, 30 rpm
1 - Surge screw conveyor, 5hp variable speed gear motor
1 - Screw washing conveyor, 2hp gear motor, 30 rpm
1 - Dewatering screw conveyor, 2hp gear motor, 30-40 rpm

Grinding Blanching Area Pressing Area

1 - DCN grinder feed belt conv, 2 hp gear motor, 30-40 rpm
6 - DCN grinders, 20 hp AC motor and 1 hp gear motor
2 - Screw pressers, 25 hp and 2 hp
2 - Vibrating screen
2 - DCN grinder discharge screw conveyor, 1 hp gear motor
2 - Tubular-type screw blancher w/ steam locking device, 5 hp gear motor, vari-speed, 0-60 rpm.

Drying Area

2 - DCN dryer, 1,100 kg/hr, hp
2 - DCN dryer discharge screw conveyor, 0.5 hp gear motor, 30 rpm
2 - Tubular type collapsible bottom feedscrew conveyor

Screening and Packing Area

2 - Grading Machine
2 - Vobrox packing equipment with Automatic weighing system
2 - DCN bag flattener
2 - DCN bag sewing machine
2 - DCN bag poly-heat sealer
2 - DCN bag check weigh

Cream Processing and Packaging

1 - Aseptic processing system
1 - Homogenizer
1 - FDA standard extra (Required for steam injection and required to meet U.S. Food & Drug regulations)
1 - Clean-in-place system
1 - Aseptic tank, 4,000 liters
1 - Aseptic filling systems

Nut Processing/Storage Area

1 - Truck scale
1 - Payloader

Water Supply

1 - Water tank (10,000 gal)
1 - Water treatment system

Power House

1 - Boiler, 500 hp
1 - Generator set, 100 KVA

Waste - Water Treatment

1 - Oil and sludge separator
1 - Fermentation lagoon

Quality Assurance Support Facilities and Laboratory Equipment-

1 - Instrumentation and apparatus for chemical testing (moisture, fat, protein, free fatty acid and pH)

1 - Instrumentation and apparatus for physical testing (color, particle size, viscosity)

1 - Instrumentation, equipment, and media for microbiological testing (standard plate count, yeast, mold, *staphylococcus*, caliform, *salmonella*)

e. Electricity: Utility, water, steam. The total rating of the larger plant is 404 horsepower. With a load factor of 0.8, the total load is 404 x 0.8 x 0.746 kw/hp, or 241 kilowatts. If a steam cogeneration plant is installed electric power can be produced using coconut shells as a fuel.

Water: The daily potable water requirement for size A plants is 150,000 l and it is 75,000 l for size B plants.

Steam: The steam requirements include:

	Plant A	Plant B
Pasteurizer/ Sterilizer:	750 kg/hr	300 kg/hr
Dryers:	10,000 kg/hr	4,000 kg/hr
Blanchers:	2,500 kg/hr	1,000 kg/hr

f. Labor Requirements: Operating on double shifts, plant A requires a total of 534 people and Plant B 242 people (Table II-9).

Table II-9. Labor Requirements for Coconut Cream Plants
(Persons Per Day)

	Plant A (2,500 liter/hr)	Plant B (1,000 liter/hr.)
A. Direct Labor		
Receiving/storage	20	10
Nut opening	452	181
Cream extraction	8	6
Aseptic processing	4	4
Finished product warehouse	6	6
Blanching and drying	10	4
Powerhouse	3	3
Quality Assurance	2	2
Subtotal	505	216
B. Administrative		
General Manager	1	1
Production Manager	1	1
Marketing Manager	1	1
Personnel Officer	1	1
Quality Assurance Officer	1	1
Finance Manager	1	1
Accountant	1	1
Salesmen	1	1
Cashier	1	1
Secretary	2	2
Drivers	2	2
Security Guards	6	6
Subtotal	19	19
C. Indirect Labor (Foremen)	10	7
TOTAL	534	242

2. Low-Fat Desiccated Coconut (DCN)

When the pressing residue is blanched and dried, it may be marketed as low-fat DCN. The fat content of this product would range from 35-40% depending on the efficiency of cream extraction. Figure II-2 shows the plant lay-out for the production of cream and low-fat DCN, including a blancher, DCN dryer, and packaging equipment. For every 1 kg of cream with 22.5% fat about 0.33 kg of low-fat DCN with a 38% fat content may be obtained.

3. Virgin Oil and Skim Milk

a. Process Flow: Virgin oil (sometimes called first pressings or natural oil) is produced from coconut cream by centrifugal separation. Virgin oil retains the pleasant sweet smell of coconut and most of its vitamin E content. The general process flow is shown in Figure II-4.

b. Material Balance: Figure II-5 and shows the general material balance for the production of virgin oil and skim milk. For every 1,000 coconuts of average size, 73 kg of skim milk, 50 kg of virgin oil, 26 kg of dried parings, 74 kg of low-fat residue and 13 kg of sludge is produced.

In sizing the overall virgin oil and skim milk processing plant capacity, the minimum rating of 1,000 l per hour for aseptic filling systems, available commercially was used. At this capacity, 16,000 l of skim milk will be produced daily in 2 shifts. Table II-10 shows the summary of material balance of this plant which would require 220,000 coconuts per day.

Table II-10. Material Balance for Virgin Oil and Coconut Skim Milk Production.

Coconuts Required	220,000 pcs
Shell	39,600 kg
Skim Milk	16,800 kg
Virgin Oil	10,960 kg
Parings	5,700 kg
Low Fat Residue	16,200 kg
Sludge	3,900 kg
Water	44,000 kg

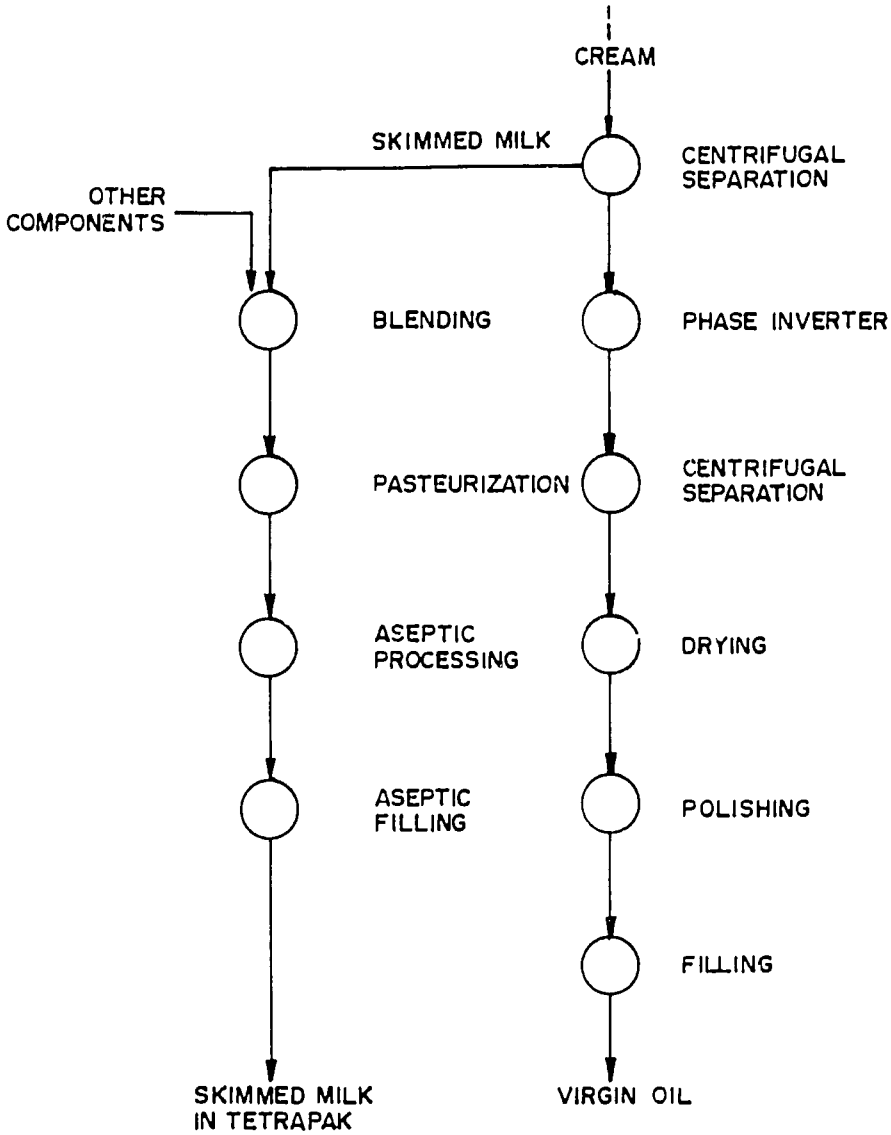

FIGURE II-4. General process flow for the production of virgin oil and skimmed milk.

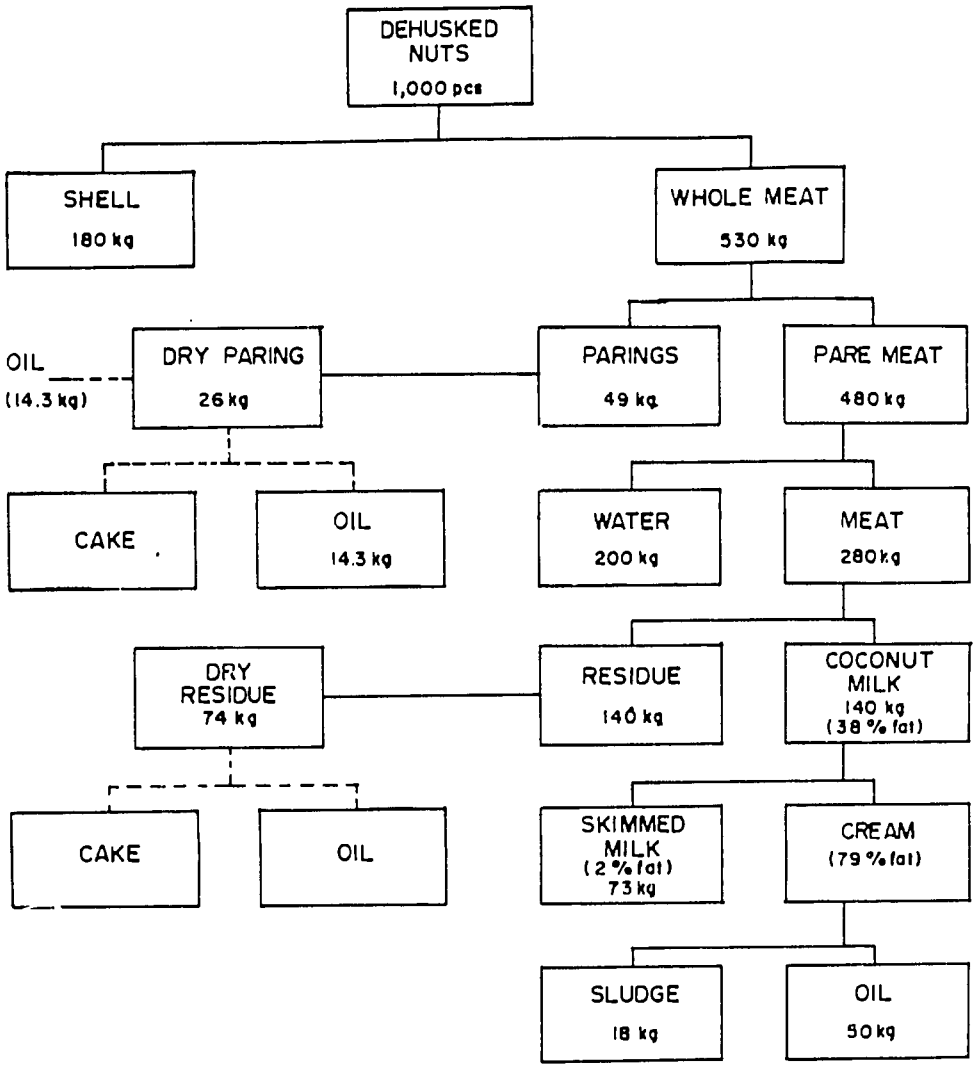

FIGURE II-5. Material balance for the production of virgin oil and skimmed milk.

c. Equipment Required: Some equipment needed for production of virgin oil and coconut skim milk is similar to that of coconut cream production. The production does require a few additional pieces of equipment such as centrifuges, a phase inverter, and an aseptic storage tank. The virgin oil would be packaged in bags using a bulk filling system for aseptic industrial packages, while the coconut skim milk would be packaged in either retail or industrial aseptic packages units.

d. Building Requirement: The plant layout for virgin oil and skim milk production is similar to that of the 2,500 kg/hour cream factory, except that the shelling, and paring area is expanded to 1,700 m^2 and the sanitary skim milk processing area expanded to 580 m^2.

4. Frozen Coconut Flakes (Chunks)

The production of frozen coconut flakes involves the same meat preparation steps used in coconut cream production up to grinding. The finely cut flakes are passed through the rotary or screw blancher and steamed to kill bacteria, that can cause food poisoning or spoilage. The blanched flakes are then packed in sterilized nylon polyethylene laminated film bags and sealed. The recommended packaging weight is 25 kg for quick freezing. The blast freezing temperature should be -40°C and the cold storage is -20°C. The frozen flakes are transported under refrigerated conditions.

The process flow is shown in Figure II-6 and the material balance is summarized in Table II-11.

Table II-11. Material Balance for Frozen Coconut Flakes

	Single Shift	Double Shift
Nuts	35,700	71,400
Flakes	10,000	20,000
Dried parings	9,000	18,000
Shell	6,400	12,800
Water	7,000	14,000

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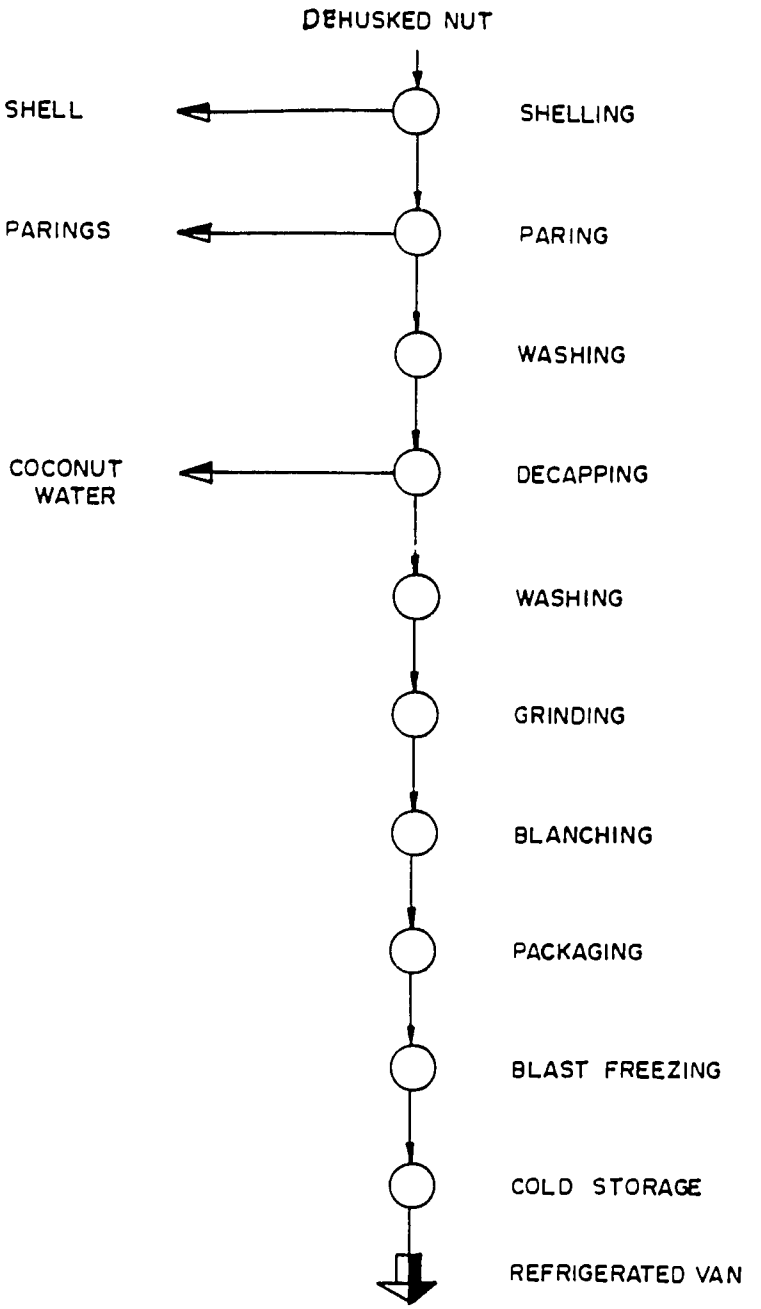

FIGURE II-6. Process flow for frozen coconut flakes.

5. Quality Assurance (QA): The success of any edible coconut product manufacturing enterprise depends to a large extent on the production of consistently high quality products. The market need for these type products was also strongly voiced by market research respondents from several industries. The short space given in this report is not meant to be indicative of the importance of a very good QA program. The program must be an integral part of any coconut processing operation if the operation expects to compete against low quality products and sell to buyers with higher quality expectations. A consistent high quality image can only, therefore, be achieved with an effectively planned and implemented QA program. Quality assurance begins with a sound plant design and site selection. It also requires monitoring day-to-day operations on procurement; in process handling and storage; and final product handling, packaging, labeling and storage. It also includes staff motivation and training to maintain high health and hygiene standards.

An effective QA program must be set up in any coconut processing operation wanting to export to the United States. Regulations for other importing countries such as Australia, Japan, Canada and New Zealand would, in nearly all cases, be met if U.S. Food and Drug Administration regulations are met.

Equally if not more important in meeting these governmental regulations is the commitment and ability to provide high quality products and services to buyers. By developing and maintaining an efficient, effective QA program government regulations, buyer specifications, and market needs will all be achieved.

A complete QA program description needed by a processor is not included as the program is dependent on the specific processor, their operations and products produced. CPSP can assist processors to tailor a QA program to meet the processor government and market needs. See Annex V-T for a description of important features of a model QA program.

The following steps would be followed in setting up the QA program for each processing operation desiring to have CPSP represent their operation.

a. CPSP will make available to the processor a complete set of regulations applicable

to the operations startup or upgrading of facilities, and subsequent operations. A qualified person will be located to offer guidance to the processor on planning, procurement of equipment, setting up facilities and procedures and training staff related specifically to the QA program.

b. Qualified person(s) will also be made available to provide guidance related to processing facility design, location and operations and maintenance and staff training.

c. Qualified South Pacific persons or agencies will be located, by CPSP, to provide QA backup and monitoring services.

d. CPSP will help provide other support to help maintain or upgrade the processor's QA program.

E. Country Analysis of Processing Locations

1. Rationale for Selection of Processing Sites

The country profiles and accompanying resource documents provided information to support the selection of processing locations considered in the financial and economic analysis. These locations have the most feasible combination of factors to meet export market needs and make optimal use of available resources.

Initially, each country surveyed was analyzed independently of existing or potential processing facilities in other South Pacific countries. This allowed each to be judged as a self-sufficient (complete) processing site using its own raw material supply and ability to produce exportable products competitively.

A second analysis helped select countries that could support a feasible satellite operation producing semi-processed products for a central operation elsewhere. This analysis began by examining the feasibility of transport connections between possible satellite locations and certain central operations. Then we investigated whether the operations could generate adequate revenues by themselves without being dependent on subsidies or inflated prices offered by a central operation. The central operations would purchase at a price that includes a margin of 15% over the breakeven price at a 100% capacity use rate, which is reasonable in the food processing industry. Transport costs satellite country to a central operation were assumed to be covered by the central operation. Transport costs and the cost of a satellite's frozen product determined in large part which central satellite combinations were most feasible.

The financial/economic analysis assumed that new plants would be constructed. Due to lack of sufficient information on the cost structure and capability of existing operations, no analysis was done for upgrading these facilities. This does not mean that modernizing or expanding these operations would be an infeasible way of meeting importing country regulations, buyer specifications, and demand. In fact, upgrading existing operations could help increase capacity use rates, reduce investment costs and overall risks, and better utilize the vast amount of experience in coconut and food processing already present in the region.

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Regardless of whether new or existing firms are tapped to produce high-volume coconut products for export, the market position of the industry in the South Pacific could be greatly improved through the creation of a marketing service firm. One function of the marketing service firm, referred to here as Coconut Products of the South Pacific (CPSP), would be to assist existing processors make the necessary changes facilities, operations and procedures with as little investment as practical, while insuring consistent production of a high quality product. Changes in existing operations should only be made after market requirements for product quantity, price, and quality are well defined. It will be CPSP's job to define market demand well enough to build the confidence of existing producers of new investors and entrepreneurs in the region to justify any necessary investment.

Due to limited market demand, unfamiliarity, risk and uncertainty, and CPSP's limited financial and staff resources not all South Pacific countries or even processors will want to use these marketing services initially. Therefore, it is important to select the best combination of market opportunities and processor operations at the beginning so that CPSP activities can meet the expectations of both buyers and processors. As market opportunities open up, demand expands, and processor capabilities grow, additional processors could be assisted by CPSP. CPSP will expand to keep pace with the industry's needs.

It is important that CPSP balance buyer needs with processor capabilities to ensure that production is matched to demand. Buyer expectations will not be met if processors are unable to supply what has been promised. Conversely, processor expectations of higher capacity utilization and better returns on investments will not be met if buyers are unwilling to purchase the products at a reasonable price.

Buyer confidence in coconut products and processors of the South Pacific will also depend on the ability of the processors and CPSP to establish consistently high quality product lines under one or more brand names. CPSP must be willing to stand behind the products and services offered. Without this reliable reputation, South Pacific coconut products and processors will have to compete with many other producers in the market who might have cost advantages. Thus, it will be

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very important to select South Pacific processors who can demonstrate their commitment to meet this challenge.

2. Economic and Financial Analysis

Purpose and Accessibility of the Analysis

An economic and financial analysis was conducted for production of a variety of different coconut products in various locations in the South Pacific. An economic analysis shows the net monetary gains or losses to the country from the investment of domestic resources. It includes tax payments as benefits, excludes subsidies, and is independent of the means of financing. The financial analysis examines the profitability of the enterprise to the investors, which can vary substantially with the financing terms and subsidies available and tax rates. Thus, the economic analysis is the best measure of whether government or donor policy should encourage an investment relative to other alternatives. Yet, the financial analysis is also important because it indicates how attractive the investment will be to entrepreneurs. At this stage of prefeasibility investigation, the data are tentative.

Interested parties in the region can obtain the spreadsheets from this analysis through the Suva, Fiji office of U.S. A.I.D. for rapid updating and revising of the analysis. The analysis is contained on eight 5.25-inch floppy diskettes for an IBM-compatible system using the menu-driven Symphony Version 1.2 software. This software can easily be used by someone familiar with Lotus 123. As the key assumptions listed at the top of the spreadsheets are varied by the users, the changes are linked to the corresponding variables in the subsequent formulas.

Product Choice and Plant Siting

Table II-12 lists the 40 cases analyzed which represent various combinations of products, packaging, location, and scale of production. Three product lines were considered. The first product line is premium-quality coconut cream and its two saleable byproducts: low-fat dessicated coconut (LFDC) for export and dried parings for domestic coconut oil mills as a partial substitute for copra. Coconut cream could be sold in one of three different types of packaging: 340-milliliter (ml) retail-sized cans; 250-ml Tetrapak

TABLE II 1: CASES ANALYZED - LOCATIONS, PRODUCTS, PACKAGING AND SCALE OF PRODUCTION

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE			PACKAGING TYPE				CAPACITY	
			Complete Processing	Satellite	Central Processing (and Satellite Location)	StarAsept	TetraPak	Cans	Plastic	Low	High
a	American Samoa	Coconut Cream			x (Tonga)	x				x	
b	American Samoa	Coconut Cream			x (Cook Is.)	x				x	
c	American Samoa	Coconut Cream			x (W. Samoa)	x				x	
d	Cook Island	Coconut Cream		x					x	x	
e	Cook Island	Coconut Cream	x			x				x	
f	Cook Island	Coconut Cream	x				x			x	
g	Fiji	Coconut Cream			x (Kiribati)	x				x	
h	Fiji	Coconut Cream			x (Vanuatu)	x				x	
i	Fiji	Coconut Cream			x (Vanuatu)		x			x	
j	Fiji	Coconut Cream	x			x				x	
k	Fiji	Coconut Cream	x				x			x	
l	Kiribati	Coconut Cream		x					x	x	
m	New Caledonia	Coconut Cream	x			x				x	
n	New Caledonia	Coconut Cream	x				x			x	

(TABLE II.12 (continued)

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE			PACKAGING TYPE					CAPACITY	
			Complete Processing	Satellite	Central Processing (and Satellite Location)	StarAsept	TetraPak	Cans	Plastic		Low[1]	High[2]
o	Papua N. G.	Coconut Cream	x			x					x	
p	Papua N. G.	Coconut Cream	x				x				x	
q	Papua N. G.	Coconut Cream	x					x			x	
r	Papua N. G.	Coconut Cream	x			x						x
s	Papua N. G.	Coconut Cream	x				x					x
t	Papua N. G.	Coconut Cream	x					x				x
u	Solomon Islands	Coconut Cream	x			x					x	
v	Solomon Islands	Coconut Cream	x				x				x	
w	Solomon Islands	Coconut Cream	x					x			x	
x	Solomon Islands	Coconut Cream	x			x						x
y	Solomon Islands	Coconut Cream	x				x					x
z	Solomon Islands	Coconut Cream	x					x				x
aa	Solomon Islands	Skim/Milk/ Virgin Oil	x (skim milk price of $0.50/l)			x	x					x

TABLE II 12 (continued)

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE: Complete Processing	PROCESSING TYPE: Satellite	PROCESSING TYPE: Central Processing (and Satellite location)	PACKAGING TYPE: StarAsept	PACKAGING TYPE: TetraPak	PACKAGING TYPE: Cans	PACKAGING TYPE: Plastic	CAPACITY: Low	CAPACITY: High
ab	Solomon	Skim Milk/ Virgin Oil	x (skim price b $0.55/l)		x	x	x				x
ac	Solomon	Skim Milk/ Virgin Oil	x (skim price c $0.60/l)			x	x				x
ad	Solomon	Skim Milk/ Virgin Oil	x (skim price d $0.65/l)			x	x				x
ae	Solomon	Skim Milk/ Virgin Oil	x (skim price e $0.70/l)			x	x				x
af	Tonga	Coconut Cream		x					x	x	
ag	Vanuatu	Coconut Cream		x					x	x	
ah	Vanuatu	Coconut Cream	x					x	x	x	
ai	Vanuatu	Coconut Cream	x						x	x	
aj	Vanuatu	Frozen Flakes	x								
ak	Vanuatu	Frozen Flakes	x								
al	Western Samoa	Coconut Cream									
am	Western Samoa	Coconut Cream	x								
an	Western Samoa	Coconut Cream	x								

aseptic boxes for the retail market; and 25-liter (l) StarAsept aseptic bags for industrial use. [Note that Tetrapak and StarAsept are brand names and of aseptic packaging, competing products are available. Use of cost data from the supplier of these two products in the analysis does not constitute an endorsement.]

The second product line consists of frozen coconut meat flakes exported as an intermediate good for industrial food processors, plus parings copra for the local market. The third product mix is coconut skim milk, virgin coconut oil, and parings copra.

In most cases, it was assumed that each plant would use 60% of its capacity on a single shift in the first year, achieve the same level of capacity use on a second shift in the following year, and increase its overall capacity use rate to 70% for both shifts in subsequent years. The only exception was for production of frozen coconut flakes, which was analyzed separately for a single shift and a double shift operation at 60% capacity use in the first two years and 70% thereafter.

The first-cut screening of countries for potential processing sites was based on the presence of an adequate supply of raw materials reliable enough to withstand a localized disruption of coconut supply. The country profile reports address the issues of intra-country siting of processing plants, accounting for such factors as the location of coconut trees, transport infrastructure, utilities, and labor availability.

The following countries were identified as potentially having a sufficient raw materials supply of coconuts to support a plant producing 1,000 liters of coconut cream with a 22.5% fat content per hour: Cook Islands, Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu, and Western Samoa. Kiribati could only support a plant of this size if internal transport problems could be economically resolved. Siting in French Polynesia could be financially but not economically feasible if the government bore the costs of shipping dehusked coconuts, as they currently do for copra. The availability of coconuts is too low in Tuvalu or Niue for this scale of operation. On the other hand, Papua New Guinea and the Solomon Islands could support an even larger processing plant having a capacity of 2,500 liters of coconut cream per hour.

A complete cream processing plant in one location would rely on domestic sources of coconuts. A smaller plant with having a capacity of 10,000 kg of frozen coconut meat flakes per shift/operating one or two shifts per day, was examined for Vanuatu. An alternative to complete cream processing would be a combination of a central processing plant served by satellite plants that send it an intermediate product for final processing. A central plant would purchase frozen cream with a 27% fat content from one or more satellites that could be independently owned and managed. It would convert the frozen cream into a sterile product with 22.5% fat in aseptic packaging.

The satellite plants would be located close to the raw materials supplies. The central plant's location might offer other advantages such as special market access, greater technical or managerial capacity, or infrastructure and lower cost of transporting products to importing nations. This alternative was considered because shipping of raw materials from one country to another is due to infeasible high transport costs for bulky whole or husked coconuts as well as quarantine regulations for plant products.

Potentially, satellite operations could allow more countries in the region to benefit from the value added in coconut processing. Moreover, the central plants could take advantage of economies of scale in packaging technologies, marketing, and distribution. Five central/satellite combinations were analyzed: a central plant in Fiji purchasing frozen cream from Vanuatu or Kiribati, and a central plant in American Samoa linked to a satellite in Tonga, the Cook Islands, or Western Samoa.

Capital Costs and Financing

In this prefeasiblity study, the delivered cost of equipment was assumed to be the same throughout the region, although the analysis does account for higher building costs in American Samoa and New Caledonia. Table II-13 shows the total capital investment for selected alternatives. The minimum capital investment for a small plant producing frozen coconut flakes is $2.4 million. A satellite operation with a capacity of 1,000 l of frozen cream per hour is $3.5 million. A central operation of the same capacity for finishing the product aseptically in StarAsept bags would cost $2.3-2.5 million. Thus, the total

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TABLE II.15 CAPITAL INVESTMENT AND TOTAL LABOR AT 100% REQUIRED CAPACITY USE FOR SELECTED COCONUT PROCESSING ALTERNATIVE (U.S. $)

	A. Satellite for Frozen Coconut Cream (1,000 l/h) Vanuatu or Western Samoa	B. Central for Final Processing of Frozen Coconut Cream, StarAsept (1,000 l/h) American Samoa	B. Central for Final Processing of Frozen Coconut Cream, StarAsept (1,000 l/h) Fiji	C. Central and Satellite Combination, StarAsept, (1,000 l/h) American Samoa w/Western Samoa	C. Central and Satellite Combination, StarAsept, (1,000 l/h) Fiji w/Vanuatu	D. Central for Final of Frozen Coconut Cream, Tetrapak (1,000 l/h) Fiji
Capital Cost	$3,516,615	$2,485,369	$2,234,119	$6,001,984	$5,750,734	$2,843,119
Unskilled Labor	256	18	18	274	274	18
Skilled Labor	21	11	11	32	32	11

	E. Complete Processing of Coconut Cream, StarAsept (1,000 l/h) Western Samoa	F. Complete Processing of Coconut Cream, Tetrapak (1,000 l/h) Western Samoa	G. Complete Processing of Coconut Cream, Canned (1,000 l/h) Solomon Islands	H. Complete Processing of Coconut Cream, StarAsept (2,500 l/h) Solomon Islands
Capital Cost	$3,742,328	$4,380,328	$4,420,661	$5,762,735
Unskilled Labor	220	220	220	509
Skilled Labor	21	21	21	24

	I. Complete Processing of Coconut Cream, TetraPak (2,500 l/h) Solomon Islands	J. Complete Processing of Coconut Cream, Canned (2,500 l/h) Solomon Islands	K. Production of Frozen Coconut Flakes (10,000 kg/day or 20,000 kg/day in two shifts) Vanuatu		L. Production of Virgin Oil (685 kg/h) and Coconut Skim Milk (1,000 l/h) Solomon Islands
			Single Shift	Double Shift	
Capital Costs	$6,400,735	$6,802,235	$2,431,895	$2,431,875	$7,075,675
Unskilled Labor	509	509	118	231	652
Skilled Labor	24	24	15	16	24

capital cost for a satellite/central combination would be $5.8-6.0 million. One of the satellite/central combinations with slightly higher capital cost has lower total production costs due to transport cost savings. A satellite/central combination has 60% higher capital costs than the $3.7 million required for complete processing of the same volume of coconut cream in bulk aseptic packaging at one location.

The capital costs of a 1,000 l/h coconut cream plant would be 17% higher with aseptic retail packs and 18% higher for a new UHT canning facility than one using aseptic bulk packaging. Due to economies of scale, a plant producing coconut cream in aseptic bulk packaging with 150% more capacity would only cost 54% more to establish -- $5.7 million. A similar, large plant for aseptic retail packaged coconut cream would be 11% more costly and a canning plant 18% more than a bulk aseptic facility of the same size. A virgin oil/coconut skim milk plant would cost $7.1 million to establish.

It was assumed that the coconut cream and virgin oil processing plants would operate two shifts per day after the first year. The capacity use rate would be 60% in the first and second years, rising to 70% thereafter. A ten-year time frame was adopted in the analysis.

Financing costs were determined at two different interest rates, 18% and 12%. In both cases, the repayment period was five years with a one year grace period. Because less money has to be put up front when financing is obtained, the financial rate of return on the initial costs to the entrepreneurs can be much higher than the economic Internal Rate of Return (IRR) provided that the interest rate is less than the discount rate. Since the IRR is calculated as a percentage of the capital contribution of the entrepreneur, a small difference in revenues can make a much larger difference in the IRR than in the net present value.

Operating Costs

Table II-14 lists the key cost assumptions that vary across locations. The rest of the assumptions may be found in the spreadsheets in Annex III. All costs are in U.S. dollars. The wage rate and fringe benefits paid to unskilled workers is one of the most important factors in country selection for labor-intensive coconut processing plants. If operated at a 100% capacity use rate, complete processing of coconut cream at one location would require 220 unskilled workers, compared to 256 with combined satellite and central processing. Complete processing of 2,500 l of coconut cream per hour would require 509 unskilled workers. A frozen coconut flakes plant would need 118 unskilled workers on a single shift operation or 231 when there are two shifts per day. Because of the larger quantity of coconuts processed, production of virgin oil and coconut skim milk would require 652 unskilled workers.

The salaries of managerial and technical staff are a much smaller portion of annual production costs. Between 11 and 32 skilled employees would be hired, depending on the type and scale of the plant. Product transport costs are also important, but there is less variation in these costs across countries than in unskilled labor costs.

Another large component of production costs is for purchase of coconuts, the main raw material. The market price for whole coconuts will vary with the price of copra, but should be adjusted to reflect the labor farmers save in not having to shell the coconuts and pare out and dry the meat. On the other hand, an adjustment will have to be made for the higher costs that farmers face in transporting bulkier whole nuts instead of copra. Although raising the prices that farmers receive for coconuts is a desirable goal, a for-profit processing firm would have to base its prices on market values to remain competitive.

The base case analysis is based on a unit price of $0.10 delivered for a dehusked coconut of average size weighing 710 grams. It would take 5,900 coconuts of this size to yield 1 tonne of copra. In some South Pacific countries, the local varieties of coconuts tend to be much smaller than this average. A proportionately lower price would be paid for smaller but mature coconuts,

TABLE II 1. [illegible] IN FIJ ASSUMPTIONS BY LOCATION

Country	Unskilled Wage ($/d)	Management Wage ($/d)	Skilled Technical Wage ($/d)	Semi-Skilled Wage ($/d)	Fringe Benefits & Leave (% of wage)	Transport to U.S. East C. U.S. or Europe ($/full container load)	Building Cost ($/sq m)	Electricity ($/kW h)
American Samoa	20.60	48.00	27.80	27.80	16.20	2,450	400	.125
Cook Islands	9.44	50.00	32.00	11.56	7.50	$,400	250	.240
Fiji	4.60	16.00	11.40	7.40	12.50	$,500	250	.168
Kiribati	4.20	15.00	6.96	6.96	12.50		250	.281
New Caledonia	24.01	53.58	34.92	27.78	32.15	$,000	450	.090
Papua New Guinea	8.67	26.08	12.88	11.04	15.50	$,600	250	.200
Solomon Islands	3.30	15.00	8.28	8.28	14.50	$,600	250	.178
Tonga	4.50	15.00	8.15	7.15	12.50		250	.150
Vanuatu	2.98	13.99	5.41	5.41	11.00	$,600	250	.205
Western Samoa	3.56	15.00	8.00	8.00	12.50	$,200	250	.140

Transport Costs from Satellites to Central Processing Facilities

Kiribati to Fiji = $120/tonne
Vanuatu to Fiji = $1,750/full container load (FCL)
Tonga to American Samoa = $1,060/FCL
Cook Islands to American Samoa = $1,100/FCL
Western Samoa to American Samoa = $755/FCL

Special Taxes

Vanuatu = $150/employee
Cook Islands = 1 % of gross revenues
All = 10 year exemption from corporate income taxes and customs duties assumed.

reflecting the lower amount of meat contained in them. The base unit price is equivalent to $140.80 per tonne of dehusked coconuts.

The purchase price of coconuts will be a critical variable in convincing farmers to sell to the processing plants, especially for the larger scale plants. Nevertheless, the price of $0.10 per average-sized coconut allows for a conservative assessment of the viability of the processing plants. Under anticipated market conditions, this delivered price should be more than adequate for the farmers. At present, delivered prices in Tonga and Western Samoa are closer to $0.07 per unit, leaving a reasonable margin for price increases.

Nevertheless, a sensitivity analysis was done to examine the effects of a 30% increase in the cost of dehusked coconuts in case world market conditions change or it proves necessary to pay a higher price to obtain a reliable supply of a sufficient volume of coconuts to support a large processing facility. This higher cost amounts to an 86% increase over the actual current price.

Revenues

The prices of high-value coconut products are subject to considerable uncertainty because many of them are new to the U.S. market in form, quality, or uses. Based on some preliminary market assessment findings, the c.i.f price for premium-grade coconut cream could be $1.98/l in retail packages (aseptic boxes or cans) and $1.54/l in bulk, aseptic packages for the industrial market. To have a conservative estimate of revenues, this analysis only values the byproduct dried flakes at the reject copra price based on its coconut oil content. However, there is a potential export market for the dried flakes as a low-fat substitute for desiccated coconut. If this market materializes, a coconut cream processing facility could receive a much higher price by exporting the low-fat flakes, boosting profitability substantially.

Since frozen coconut cream for further processing within the region is an intermediate product, it was assumed that it would sell at a 15% margin over the breakeven price at 100% capacity use. This was the lowest margin that provided a minimally acceptable economic rate of return on capital of at least 15% in most of the cases. The same margin was assumed for enterprises producing

frozen coconut meat flakes.

There is still considerable uncertainty over the sales prices of coconut skim milk and even more so for virgin oil. Coconut skim milk is a new beverage for the health food or ethnic markets. Similarly, and virgin oil would be a higher quality raw material for the cosmetics industry which is not currently being used. Therefore, the financial and economic analysis takes a range of prices for the coconut skim milk and set a price for the virgin coconut oil that results in an acceptable economic rate of return at the mid-range of skim milk prices.

Taxes

Since income tax concessions may be negotiated in many of the countries in the region, the analysis assumes a 10-year exemption from income taxes. In some countries, the exemption is only likely to be five years and the effects of having to pay taxes should be examined in subsequent feasibility analyses prior to making an investment. The 1% turnover tax in the Cook Islands and a $150 per employee annual business license fee in Vanuatu were included in the financial analysis. Vanuatu has no personal or corporate income tax. The South Pacific Forum is currently considering establishment of a common policy on investment incentives and taxation in the region.

Results of the Prefeasibility Analysis

In the prefeasiblity analysis, the criterion selected for profitability was a positive economic net present value at a discount rate of 15%. Due to uncertainties in the data, small differences across locations should not be considered significant. Among the satellite installations, Vanuatu and Western Samoa were the lowest cost producers, followed closely by Kiribati and Tonga. With the 15% margin and operation at full capicity, these countries could produce frozen coconut cream in bulk, non-aseptic plastic packaging for between $1.18 and $1.24 per liter at factory gate. The Cook Islands was not competitive as a satellite because its higher wage rates for unskilled labor resulted in a price of $1.36 per liter. None of the satellites could absorb a 30% increase in coconut prices for the whole period of analysis without incurring losses, unless there were an increase in product prices (Table II-15).

TABLE II.15 SATELLITES FOR PARTIAL PROCESSING

	Vanuatu (satell)	Kiribati (satell2)	Tonga (satell3)	Cook Islands (satell4)	Western Samoa (satell5)
Breakeven price ($/liter)[a]	1.03	1.08	1.04	1.18	1.02
With a 15% margin ($/liter)	1.18	1.24	1.20	1.36	1.18
IRR (fin, 18%)	7%	10%	6%	6%	8%
IRR (fin, 12%)	15%	19%	14%	15%	17%
IRR (econ)	15%	15%	13%	15%	15%
NPV (fin, 18%)[b]	(475,878)	(301,561)	(528,418)	(506,945)	(368,950)
NPV (fin, 12%)	(5,456)	(179,773)	(47,083)	(25,609)	(112,384)
NPV (econ)	(37,162)	(3,702)	(223,155)	(49,881)	(63,687)
At a 30% higher nut price					
IRR (fin, 18%)	25%	23%	26%	25%	24%
IRR (fin, 12%)	22%	19%	23%	22%	21%
IRR (econ)	5%	4%	7%	4%	5%
NPV (fin, 18%)	(2,517,975)	(2,343,658)	(2,570,714)	(2,549,040)	(2,411,047)
NPV (fin, 12%)	(2,036,640)	(1,862,323)	(2,089,180)	(2,067,705)	(1,929,712)
NPV (econ)	(2,079,258)	(2,038,395)	(2,265,251)	(2,091,978)	(2,105,784)

[a] At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b] All net present values are at a 15% discount rate.

If the intermediate output of one of the competitive satellites is finished at a central plant, the final product would have a breakeven price ranging from $1.58 to $1.72 per liter in bulk aseptic packaging and around $2.08/l in aseptic retail packs at 100% capacity use. None of these central plants would be profitable because the intermediate product is too expensive even at the relatively low rates of return allocated to the satellites. When the price of frozen cream is increased 20% in the sensitivity analysis, the prospects for central finishing plants become even bleaker (Table II-16).

The concept of a satellite/central combination is inherently inefficient because it requires a higher total capital investment at the two locations and transport costs between islands in the South Pacific are high. Even if product prices were higher so that a profit could be generated despite these costs, such an operation would be unstable because it could be knocked out of the market through entry of a competitor doing complete processing at one location within the Pacific region or in Southeast Asia.

Thus, complete processing at one facility would be a better option. The feasibility of this option in many locations depends on the form of packaging chosen because it constitutes a large portion of total variable costs. The breakeven price of coconut cream in bulk aseptic packaging produced in a 1,000 l/hour plant at a 100% capacity use rate ranges from $1.22/l to $1.68/l in the countries considered in the analysis. At the assumed sales price and more realistic capacity use rates, complete processing could be profitable in Western Samoa, Vanuatu, the Solomon Islands, and Fiji. The profitability of such an operation would be marginal in the Cook Islands or Papua New Guinea, and negative in New Caledonia. Even at the four locations judged most promising, production of coconut cream in bulk aseptic bags would only be marginally profitable following a sustained 30% increase in coconut prices without an increase in product prices (Table II-17).

On the same scale of operation, breakeven prices for complete processing of coconut cream in aseptic retail boxes at the seven locations analyzed range from $1.68 to $2.16 per liter. At the four locations

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TABLE II 16 CENTRAL/SATELLITE COMBINATIONS FOR COCONUT CREAM PROCESSING
(1,000 l/h, double shift)

	Star Aseptic					Tetrapak
	Fiji w/Kiribati (centrals1)	Fiji w/Vanuatu (centrals2)	American Samoa w/Tonga (centrals3)	American Samoa w/Cook (centrals4)	American Samoa w/Western Samoa (centrals5)	Fiji w/Vanuatu (centrals1)
Breakeven price ($/liter)[a]	1.72	1.66	1.61	1.74	1.58	2.08
Sales price ($/liter)	1.54	1.54	1.54	1.54	1.54	1.54
IRR (fin, 18%)	62%	48%	31%	57%	25%	37%
IRR (fin, 12%)	61%	48%	29%	57%	21%	35%
IRR (econ)	60%	42%	16%	56%	7%	20%
NPV (fin, 18%)[b]	(3,454,611)	(2,783,744)	(2,402,891)	(4,131,188)	(1,978,797)	(2,767,893)
NPV (fin, 12%)	(3,148,818)	(2,477,950)	(2,062,708)	(3,791,004)	(1,638,613)	(2,378,248)
NPV (econ)	(3,266,359)	(2,595,492)	(2,193,468)	(3,921,764)	(1,769,374)	(2,528,330)
At a 30% higher frozen cream cost						
IRR (fin, 18%)	83%	79%	66%	78%	62%	75%
IRR (fin, 12%)	83%	79%	66%	78%	61%	75%
IRR (econ)	83%	79%	66%	78%	61%	75%
NPV (fin, 18%)	(6,093,159)	(5,294,620)	(4,956,325)	(7,025,079)	(4,489,673)	(5,278,774)
NPV (fin, 12%)	(5,787,366)	(4,998,827)	(4,616,142)	(6,684,896)	(4,149,490)	(4,889,624)
NPV (econ)	(5,904,907)	(5,106,368)	(4,746,902)	(6,815,656)	(4,280,250)	(5,039,206)

[a] At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b] All net present values are at a 15% discount rate.

TABLE II.17 COMPLETE PROCESSING OF COCONUT CREAM, STANDARDS (1,000 T/Y)

	Solomon Islands (Final[11])	Cook Islands (Final[12])	Vanuatu (Final[13])	Western Samoa (Final[14])	New Caledonia (Final[15])	Fiji (Final[16])	Papua New Guinea (Final[17])
Breakeven price ($/liter)[a]	1.24	1.37	1.24	1.22	1.68	1.26	1.46
Sales price ($/liter)	1.54	1.54	1.54	1.54	1.54	1.54	1.54
IRR (fin, 18%)	37%	4%	37%	45%	33%	31%	6%
IRR (fin, 12%)	54%	11%	55%	65%	31%	47%	0%
IRR (fin, econ)	23%	13%	24%	25%	19%	22%	7%
NPV (fin, 18%)[b]	992,785	(738,520)	993,447	1,292,615	(4,383,558)	796,390	(1,466,300)
NPV (fin, 12%)	1,505,014	(206,718)	1,505,676	1,804,843	(3,807,272)	1,328,192	(934,498)
NPV (econ)	1,308,123	(242,343)	1,405,824	1,607,952	(4,028,785)	1,123,777	(1,138,912)
<u>At a 50% higher nut price</u>							
IRR (fin, 18%)	4%	-18%	4%	9%	50%	1%	28%
IRR (fin, 12%)	12%	-14%	12%	19%	50%	9%	-25%
IRR (econ)	13%	1%	13%	15%	46%	12%	-10%
NPV (fin, 18%)	(634,529)	(2,365,834)	(633,867)	(334,700)	(6,010,872)	(830,924)	(3,187,114)
NPV (fin, 12%)	(122,300)	(1,834,032)	(121,639)	177,529	(5,434,586)	(299,122)	(2,655,312)
NPV (econ)	(319,191)	(1,869,657)	(221,490)	(19,362)	(5,656,099)	(503,537)	(2,859,727)

[a] At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b] All net present values are at a 15% discount rate.

where the aseptic bulk product is feasible, a retail product could also be viable, although less profitable. In other words, the $0.44/l price premium for the retail product, as estimated in the preliminary marketing analysis, does not fully cover the extra costs of this form of packaging. If the retail packs could be sold at a still higher price, which might be possible, they could be as profitable to produce as the bulk product. However, at the assumed product price, an aseptic retail product would not be sufficiently profitable in any of the locations after a sustained 30% increase in coconut prices (Table II-18).

Canned coconut cream using a UHT process would be even more costly to produce than the aseptic retail product. For example, in the Solomon Islands, the breakeven price would be $0.12 per liter higher for canned cream than for the aseptic retail product. It is expensive to import to the South Pacific. At the assumed sales price, a 1,000 l/h plant for canned coconut cream would only be marginally profitable. Due to existing and potential competition from canned coconut cream producers in Southeast Asia, it is doubtful whether a high enough price could be charged to make a canning operation feasible at this scale of production. The prospects would be even less favorable if coconut prices were higher (Table II-19).

There are significant economies of scale in expanding coconut cream production from 1,000 l/hour to 2,500 l/hour in a single plant. For example, in the Solomon Islands, this increase in this scale would reduce the breakeven price by $0.14/l in bulk aseptic bags, $0.19/l in aseptic retail packs, and $0.17/l in cans. At the assumed sales prices, 2,500 l plants in the Solomon Islands or Papua New Guinea could generate very good economic returns by aseptic production of coconut cream packaged for either the industrial or retail markets. On this scale, the profitability of canned coconut cream production in both locations would also be good. Except for canned coconut cream production in Papua New Guinea, these economic returns are high enough to allow a 30% long-term increase in the cost of dehusked coconuts, or alternatively to allow room for price reductions to meet competition (Tables II-19 and II-20).

TABLE II 18. COMPLETE PROCESSING OF COCONUT CREAM, TEIKAKAA (1,000 LTR)

	Solomon Islands (Finalt11)	Cook Island (Finalt12)	Vanuatu (Finalt13)	Western Samoa (Finalt14)	New Caledonia (Finalt15)	Fiji (Finalt16)	Papua New Guinea (Finalt17)
Breakeven price ($/liter)[a]	1.72	1.82	1.70	1.68	2.16	1.71	1.81
Sales price ($/liter)	1.98	1.98	1.98	1.98	1.98	1.98	1.98
IRR (fin, 18%)	17%	2%	20%	25%	35%	20%	3%
IRR (fin, 12%)	29%	5%	33%	40%	33%	32%	10%
IRR (fin, econ)	18%	11%	19%	20%	20%	19%	12%
NPV (fin, 18%)[b]	141,281	(1,289,952)	326,020	614,179	(5,235,539)	291,381	(887,985)
NPV (fin, 12%)	760,409	(690,397)	925,575	1,213,734	(4,552,354)	890,936	(288,430)
NPV (econ)	522,628	(705,252)	781,500	983,276	(4,814,958)	660,478	(518,888)
<u>At a 30% higher nut price</u>							
IRR (fin, 18%)	5%	21%	3%	1%	51%	3%	17%
IRR (fin, 12%)	1%	18%	4%	8%	50%	3%	15%
IRR (econ)	8%	1%	10%	11%	47%	9%	0%
NPV (fin, 18%)	(1,486,033)	(2,917,266)	(1,301,294)	(1,013,155)	(6,862,855)	(1,335,933)	(2,515,299)
NPV (fin, 12%)	(866,905)	(2,327,711)	(701,739)	(413,581)	(6,179,668)	(736,378)	(1,915,745)
NPV (econ)	(1,104,886)	(2,332,566)	(845,814)	(644,038)	(6,442,272)	(966,836)	(2,146,202)

[a] At a 100% capacity use rate and a raw material price of $0.30 per coconut delivered
[b] All net present values are at a 15% discount rate

TABLE II.19 CONCRETE PROCESSING OF COCONUT CREAM, CANNED UHT PRODUCT

	Solomon Islands (1,000 l/h) (cannedl)	Papua New Guinea (1,000 l/h) (cannedl2)	Solomon Islands (2,500 l/h) (cannedh)	Papua New Guinea (2,500 l/h) (cannedh2)
Breakeven price ($/liter)[a]	1.84	1.94	1.67	1.75
Sales price ($/liter)	1.98	1.98	1.98	1.98
IRR (fin, 18%)	0%	13%	68%	29%
IRR (fin, 12%)	7%	9%	83%	39%
IRR (econ)	10%	2%	26%	18%
NPV (fin, 18%)[b]	(1,127,963)	(2,314,066)	3,865,630	1,320,374
NPV (fin, 12%)	(522,888)	(1,708,990)	4,583,821	2,038,565
NPV (econ)	(755,467)	(1,941,570)	3,447,341	902,085
<u>At a 30% higher nut price</u>				
IRR (fin, 18%)	-20%	33%	28%	7%
IRR (fin, 12%)	-16%	31%	37%	12%
IRR (econ)	2%	-15%	18%	10%
NPV (fin, 18%)	(2,755,277)	(3,941,380)	1,459,145	(1,086,111)
NPV (fin, 12%)	(2,150,202)	(3,336,304)	2,177,336	(367,920)
NPV (econ)	(2,382,782)	(3,568,884)	1,040,856	(1,504,400)

[a]At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b]All net present values are at a 15% discount rate

TABLE II.20 COMPLETE PROCESSING OF COCONUT CREAM (2,500 t/h)

	StarAsept		TetraPak	
	Solomon Islands (finalsh)	Papua New Guinea (finalsh2)	Solomon Islands (finalth)	Papua New Guinea (finalth2)
Breakeven price ($/liter)[a]	1.10	1.19	1.53	1.62
Sales price/liter	1.54	1.54	1.98	1.98
IRR (fin, 18%)	191%	125%	158%	99%
IRR (fin 12%)	204%	140%	171%	114%
IRR (econ)	43%	35%	39%	31%
NPV (fin, 18%)[b]	8,184,099	5,642,900	7,754,291	5,213,211
NPV (fin, 12%)	8,798,813	6,257,614	8,432,514	5,891,434
NPV (econ)	8,001,585	5,460,386	7,427,068	4,885,988
At a 30% higher nut price				
IRR (fin, 18%)	113%	57%	90%	45%
IRR (fin, 12%)	127%	70%	104%	57%
IRR (econ)	35%	26%	31%	23%
NPV (fin, 18%)	5,777,614	3,236,415	5,347,805	2,806,726
NPV (fin, 12%)	6,392,328	3,851,129	6,026,029	3,484,949
NPV (econ)	5,595,100	3,053,901	5,020,583	2,479,503

[a] At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b] All net present values are at a 15% discount rate.

Frozen coconut flakes could be produced in a smaller plant than the minimum economic size for aseptic processing of coconut cream. With a 15% profit margin, the c.i.f. price for frozen coconut flakes delivered from Vanuatu would be $1.27 per kilogram (kg) if the plant operated on a single shift or $1.08/kg on a double shift. Since the economic rates of return would be high, the margin could be reduced some to lower the price. However, a manufacturer of frozen flakes could only absorb a 30% increase in coconut raw material prices without an increase in the product price if operating on a double shift (Table II-21).

The analyzed facility for production of coconut skim milk and virgin coconut oil would have a throughput that is nearly 30% greater than the 2,500 l/hour coconut cream plant. Its large raw materials requirement would probably limit the location of the plant to either the Solomon Islands or Papua New Guinea. Coconut skim milk could be packaged in aseptic retail boxes or without added flavorings and sugar. Virgin coconut oil could be packaged in bulk aseptic bags.

To achieve an economic IRR of 15%, the c.i.f. price for virgin oil would have to be at least $1.87/kg when skim milk can be sold at $0.62/liter. The minimum price required for virgin oil is very sensitive to the skim milk price. For example, if an enterprise could sell the skim milk price to $0.70/l, it could earn an economic IRR of 26%. Alternatively, the enterprise could lower its price for virgin oil to meet competition and still earn a 15% economic IRR (Table II-22).

Risks

Table II-23 summarizes the potentially profitable combinations of processing choices discussed above. Due to the limited size of the market in the near term, it would not possible to establish facilities in all of these locations without having an adverse effect on sales prices. Nevertheless, there may be some additional products that could be developed, such as low-fat coconut-based yogurt. Some of these products may offer profitable opportunities, but a financial and economic analysis has not yet been done for them.

TABLE II.21 PRODUCTION OF FROZEN COCONUT FLAKES (10,000 kg/shift/day)

	Vanuatu (Single Shift)	Vanuatu (Double Shift)
Breakeven price ($/kg)[a]	1.11	0.94
Price with a 15% margin	1.27	1.08
IRR (fin, 18%)	14%	20%
IRR (fin, 12%)	28%	30%
IRR (econ)	24%	25%
NPV (fin, 18%)[b]	(43,024)	185,337
NPV (fin, 12%)	289,837	510,199
NPV (econ)	807,740	1,087,703
At a 50% higher nut price		
IRR (fin, 18%)	82%	72%
IRR (fin, 12%)	82%	72%
IRR (econ)	82%	71%
NPV (fin, 18%)	(4,728,938)	(4,385,735)
NPV (fin, 12%)	(4,396,077)	(4,052,874)
NPV (econ)	(3,878,174)	(3,483,369)

[a] At a 100% capacity use rate and a raw material price of $0.10 per coconut, delivered.
[b] All net present values are at a 15% discount rate

TABLE II.22 PRODUCTION OF COCONUT SKIM MILK (1,000 L/h) AND VIRGIN COCONUT OIL (685 kg/h), SOLOMON ISLANDS, DOUBLE SHIFT

	C.I.F. Price of Skim Milk				
	$0.50/l	$0.55/l	$0.60/l	$0.65/l	$0.70/l
Break even price of virgin oil ($/liter)[a]	1.92	1.63	1.34	1.05	0.76
C.I.F. price of virgin oil ($/kg)[b]	1.87	1.87	1.87	1.87	1.87
IRR (fin, 18%)	18%	3%	14%	37%	72%
IRR (fin, 12%)	15%	1%	21%	50%	89%
IRR (econ)	5%	5%	13%	20%	26%	
NPV (fin, 18%)	(4,401,256)	(2,273,595)	(145,533)	1,982,328	4,110,189
NPV (fin, 12%)	(3,653,046)	(1,525,185)	602,677	2,730,538	4,858,399
NPV (econ)	(4,878,766)	(2,750,904)	(623,043)	1,504,818	3,632,679
At a 30% higher nut price					
IRR (fin, 18%)	30%	17%	-5%	9%	26%
IRR (fin, 12%)	29%	15%	1%	15%	34%
IRR (econ)	19%	6%	3%	11%	18%
NPV (fin, 18%)	(7,188,452)	(5,060,571)	(2,932,710)	(804,849)	1,323,013
NPV (fin, 12%)	(6,440,222)	(4,312,361)	(2,184,500)	(56,638)	2,071,223
NPV (econ)	(7,665,942)	(5,538,081)	(3,410,220)	(1,282,358)	845,503

[a] At a 100% capacity use rate and a unit price of $0.10 per coconut, delivered.
[b] All net present values are at a discount rate of 15%.

TABLE II 25. SUMMARY OF POTENTIAL PROFITABLE OPERATIONS ANALYZED[a]

	Complete Coconut Cream Processing						
	1,000 l/h		2,500 l/h			Virgin Oil/ Skim Milk[b]	Frozen Flakes
	Bulk Aseptic	Retail Aseptic	Bulk Aseptic	Retail Aseptic	UHT Canned		
Fiji	x	x					
Papua New Guinea			x	x	x		
Solomon Islands	x	x	x	x	x	x	
Vanuatu	x	x					x
Western Samoa	x	x					

[a]Economic net present value greater than zero at a 15% discount rate.

[b]Depending on the price that can be obtained for skim milk.

Moreover, there are possible risks that should be weighed before investment decisions are made. One of the largest risks is a major shortfall due to adverse weather or pests and diseases, which might result in a lack of sufficient coconuts to process at any price. That location-specific risk could lead to plant shut-downs or bankruptcies. A smaller shortfall might just increase the price of coconuts. Unless the problem is country wide, it may be possible to obtain coconuts from another domestic source. Within some South Pacific countries, inter-island shipping is costly. In some cases, shipment of raw materials between countries may be limited by quarantine restrictions.

One way of handling this risk would be to increase the differential between the base price of husked coconuts and the price in the sensitivity analysis for some part of the ten-year time horizon. the proportion of the time with higher prices could be based on the probability of crop failure or market dislocations. The existing sensitivity analysis already shows that a 30% increase in coconut prices over the base case for 10 years without a proportionate increase in product prices is enough to make most of the processing alternatives marginally profitable or unprofitable. However, a price increase of that magnitude could probably be absorbed for a shorter period without affecting the feasibility of the investment.

F. Potential Investors - Location; Promotion and Selection

Several companies and individuals have expressed interest in considering investments in this venture. These firms are:

a. Existing producers of coconut products who are looking to expand present operations, seeking other sources of coconuts in semi-or completely processed form, interested in wanting to expand markets, and/or want processing operations closer to markets;

b. Food processors, who want to diversify their product line; or make use of unused processing capacity.

c. Users of coconut products who are looking for alternative or new sources of supply to meet their specifications;

d. Investors looking for opportunities in the South Pacific.

Below is a list of possible investors contacted during the course of conducting the study who are interested in talking more with South Pacific representatives about proposed investment opportunities.

Foreign Investors

1. Fraser & Neave PTE LTD
   475 River Valley Road
   Singapore 1024
   Contact: Lo Kren Sen
   Management Services Manager
   Management Services Unit
   Phone: 463-0222
   FAX: 475-8220
   472-6167

2. Yeo Hiap Seng LTD
   950 Dunean Road
   Singapore 2158
   Contact: Alas Yeo
   Phone: 466-2266
   FAX: 466-4641

3. Standard Tropic Industries PTE LTD
   233 Pandan Loop
   Singapore 0512
   Contact: Sheng Huai Nak, Director
   Phone: 778-7477
   Fax: 779-3314
   Telex: RS 34758

4. Harlen Enterprises PTE LTD
Block 20 No. 143 Pandan Loop,
Pandan Light Industries Park
Singapore 0512
Contact Heng Hua Chin, Managing Director
Phone: 778-7322
Telex: RS 555356 COCOS

South Pacific Investors

1. Director, Economic Development & Planning Office
American Samoa Government, Pago Pago A.S. 96799

2. President, Development Bank of American Samoa
Pago Pago, American Samoa 96799

3. Fiji: National Marketing Authority
Suva

4. Fiji Development Bank/Fiji Investment Board
Suva

5. Solomon Islands: Commodities Marketing Board
Honiara

6. Levers Solomons Ltd.
Yandina, Russell Islands

7. Papua New Guinea: J. Barnes Meats LTD.
Madang

8. Copra Marketing Board of Papua New Guinea

9. Investment Corporation of Papua New Guinea

10. Coconut Products Ltd., Rabaul, Papua New Guinea

11. Western Samoa: Steve Persival Sr.
Natural Foods LTD.
Apia, Western Samoa

12. National Provident Fund
Apia, Western Samoa

13. Samoa Tropical Products Ltd.
Apia, Western Samoa

14. R. V. Meredith Holdings
Apia, Western Samoa

15. Bank - Indo-Suez
Noumea, New Caledonia

16. D.I.D.E.R., Administration
Noumea, New Caledonia

17. Kiribati Copra Society
Batio, Kiribati

There are also potential investor matching services which help to inform investors of proposed projects and project promoters of investors who have interest in such type projects. Among those services contacted who indicated they could be of assistance in locating investors are

A. Investment Promotion Information System
UNIDO Director
Industrial Investment Division
P.O. Box 300
A - 1400 Vienna
Austria
Telephone - (0222) 2631 ext. 4811
Telex - 135612

or UNIDO Investment Promotion Service
Suite 215
1660 L Street N.W.
Washington, D.C. 20036
Telephone - (202) 659-5165
Telex - 9102406649 IPS WSH

B. JETRO (Japan External Trade Organization)
Mitsuo Takii
Executive Director - Research
1221 Avenue of the Americas
New York, New York 10020
Phone: 212-997-0422
Fax: 212-997-0464

In addition to promoting the Japanese export trade, JETRO also provides reports and assistance in defining the market prospects for imports to Japan as well as possible investors. A description of the proposed investment should be sent to Mr. Takii who will route it to public and private sector Japanese groups having knowledge of possible Japanese investors. These investors will contact the project promoters directly.

The above services and possibly other similar services, are not necessarily the best way to promote a new venture in a competitive market. Competitors could also learn of the newly planned venture and take advantage of knowledge on innovative technologies, and services or tap new markets found by the venture. This could reduce greatly any competitive advantage the new venture would have.

III. IMPLEMENTATION PLAN

A. Introduction

Purpose: To provide a clear understanding of those activities that must be planned and implemented to make the South Pacific integrated coconut study available to potential investors, and to locate initial funding for CPSP's first 1-1 1/2 years of operation.

General Description: A large part of the implementation plan could be carried out by an Investment Promotion Team (IPT). The IPT's primary functions will be to identify potential investors and assist them in updating the study to make it more processing location specific. Immediate implementation of this plan is important for three reasons.

First in the process of developing country profiles through field visits, both private and public sectors expressed much interest in participating in this venture. Their expectations for finding more profitable markets for South Pacific coconuts are high as a result of the current situation of the industry. Many countries are already planning to begin production or increase production of high-value edible coconut products for both local and export markets. A common concern, however, is locating markets and production technologies with higher financial returns than existing copra and/or oil operations. By presenting the study as soon as possible, interest in the South Pacific for this venture can be maintained and possibly boosted even higher.

Second, some potential foreign investors are looking at similar ventures in Indonesia, the Philippines and Malaysia. The first firms to gain a foothold in these key markets will have a substantial advantage. Due to the limited size of markets, late entrants may be blocked from participating by economic factors.

Third, some potential buyers have expressed an interest in the proposed South Pacific coconut products. However, they will continue to look for the best quality products at favorable terms from producers in other countries. Too often buyers of coconut products have been disappointed when new products have not met their specifications or have never materialized. It is therefore important that followups to initial sales calls be made to demonstrate that CPSP is ready to establish itself as a reliable supplier.

Table III-1 is a time line of activities that should be carried out to implement the plan in as rapid and well thought fashion as possible.

TABLE III 1 TIME FRAME OF ACTIVITIES
LEADING TO DEVELOPMENT OF A COCONUT MARKET SERVICE FIRM 1989

Activity	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan
AID/Suva receives final draft of reports	XX	XX								
AID distributes study findings to countries		XXXX	XX	XX						
Implementation Plan funding is sought from other agencies/ organizations	X	XXXX								
Investment Promotion Team (IPT) is formed and work plan finalized		XXXX	X							
Implementation Plan funding is located and received			X	XXX						
IPT implements their work plan				X	XXXX	XXXX	XXXX			
Appropriate investors are located, if needed, for existing operations needing upgrading investments or new operations						XXXX	XXXX	XXXX	XXXX	
Funding is located for CPSP's first 1-1 1/2 years of operation				X	XXXX	XXXX				

B. IMPLEMENTATION PROMOTION TEAM (IPT) DEVELOPMENT

Purposes:

1. Locate funding from South Pacific regional and/or international organizations for CPSP's first 1-1 1/2 years of operations.

2. Updating the preliminary feasibility study and transforming it into an appropriate business plan.

3. Locate possible public and private sector investors in the South Pacific and other areas and present the business plan to them, if requested.

4. Facilitate the meetings, between investors and entrepreneurs and advise parties on negotiation terms. If agreements are not reached, IPT will continue the search for other investors.

Structure:

The IPT will be made up of 4 to 5 persons having the experience in:

a. Investment promotion and corporate structure/development

b. Knowledge of the South Pacific and its coconut industry

c. Marketing

d. Speciality coconut products/processing/quality assurance

Members of the team should be available for 6 person weeks spread out over 12 calendar weeks.

Base of operations for IPT will be a South Pacific central location with good international communication and regional and international travel connections. Suggested locations include American Samoa, Fiji, Vanuatu, or Western Samoa.

The Team will report to the public or private group funding IPTs work. A team leader will be appointed by the funding group. Possible funding and other assistance could be from South Pacific Forum (SPEC), the U.S. Department of Interior and members of the regional and international donor community.

TABLE III-2
PROPOSED IPT BUDGET

Consultant Fees		
	6 person weeks, 6 days/week $280/day, 5 persons 180 total days	$50,400
Per Diem		
	$100/day 210 person days	$21,000
Travel		
Air		
	IPT meeting $700/RT, 5 persons	$3,500
	Regional Investor Visits $700/RT, 3 persons	$2,100
	International Travel $1500/RT 3 persons	$4,500
Surface		
	Regional $60/day X 15 days	$900
	$70/day X 20 days	$1,400
Communications		$3,000
Administrative Support		$2,000
Computer Rental		$900
Contingency, Office Rent, etc.		$10,000
		$97,700

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C. Business Plan Development and Investment Promotion

The Investment Promotion Team will have to gather some additional information to update the present study for a specific processing location and prepare a business plan. In addition to its content, the presentation of the business plan is often important in creating an image for the enterprise(s). Some suggestions follow.

1. Appearance

   a. Make it look like a custom document assembled for targeted investors.

   b. Plastic spiral binding.

   c. Prepared on a word-processor for rapid updating and modification. Printed on high quality paper.

   d. Length - about 40 to 50 pages. Use annexes in separate documents to contain information supporting the business plan.

   e. Cover Page - Contents
      Name of promoting group, organization or company
      Address (Location or proposed enterprise if different)
      Phone number
      Month and year business plan was submitted to possible investor

   f. Title Page - Contents
      Same as Cover Page Plus
      1) Name of principle person to contact
      2) In upper or lower corner show
         "Copy Number _____"
      Note: Circulate only a limited number of copies and record who gets which copy.

2. Executive Summary Contents - Length 2 pages

   a. The proposed company's present status and if applicable how it will utilize some existing operations.

   c. Products and services of the company.

   d. A list of potential buyers.

   e. Benefits, in economic and non-economic terms from the company's products or services.

   f. Desired amounts and types of financing.

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g. Company's objectives, short term and long term, and how it proposes to reach those objectives.

h. How and when the investor is likely to benefit from the investment.

3. Table of Contents and List of Tables and Figures

a. Section or chapter numbering.

b. All tables and figures should also have page number relating to text.

c. Include important subsections with the main sections.

4. Structure and Content

a. The company. Initially, entrepreneurs should describe the company--its origins, and expectations, and the management team. This section should summarize the enterprise's overall objectives so that the investor gets a clear indication early on of where the company is going and how it plans to get there.

b. The market. The definition of the market to be served by the company is second in importance only to the definition of the company itself. An important part of that market definition is a description of the benefits derived from the company's products or services. Investors want evidence that founders have a clear idea of who will purchase the company's product or service and why. That is, entrepreneurs must demonstrate that they focus primarily on the market their company will serve rather than on the technicalities of their product or service.

c. Products (or services). This part should describe the company's products or services, including a summarized theory of operation and a statement about performance and present status. The proprietary, patented, or patentable features of the company's products should also be summarized in this section. It is recommended the section on the company's products or services be a page or two shorter than the section on the company's market, as an indication to potential investors that the founders realize the priority of markets over products. Investors

are interested in companies that are market-drive, not product-driven.

4. Sales. After reading descriptions of the markets for products, investors want to know precisely how the company plans to approach its customer prospects and thus capitalize on its potential. This section, should state how the goods or services are to be sold--(e.g. by sales representatives, distributors, in-house salespeople, direct mail, or executive selling). Whichever approach is chosen, it must be clearly outlined and justified. This section should also discuss sales costs and compare them with industry practices.

e. Processing. This section should describe and explain the company's decisions on technology choice and types of raw materials. Investors want to see the processing process be as inexpensive and efficient as possible, geared to maximizing profits. In preparing the business plan, an emphasis on value engineering (designs to minimize costs) will be viewed favorably. Also, entrepreneurs should include plans for quality control since the investors will want to be aware of expected warranty/replacement costs.

Discussion of product development should be quite brief since investors want their money to go into processing and selling rather than developing a new product that is not yet ready to be sold. Consequently, inordinate development expenses and procedures will likely turn off most investors. Engineering in support of manufacturing, on the other hand, is well understood because it should translate into better products and increased profits.

f. Financial Data. The key assumption of the financial analysis should be realistic and well justified. The results of the analysis should be summarized concisely. A senstivity analysis to show effects of changing critical assumptions is desirable. Details and spreadsheets should be confined to an appendix or separate volume.

g. Financial Plan. This last formal section in the business plan should cover the entrepreneur's expectations about the investment itself. This section should

indicate how much money the company is seeking to raise, the form of investment being sought, how the funds will be used, and what portion of the company the investment will purchase.

h. Appendix. This should be confined to resumes of the management team and key personnel. It might also include explanations of financial or other data, but in any case it shouldn't extend the business plan beyond the ideal of forty pages. As we mentioned previously, detailed elaboration of any sections should appear in a second volume.

5. Writing and Editing

a. Legal counsel should review the final draft before presenting it to investors to make sure that Return on Investment forecasts are legally correct and appropriate disclaimers are used.

b. Have a professional editor review for grammar, syntax, consistency, clarity and organization.

ANNEX I

A. PRODUCT PROFILES
B. MARKET SURVEY AND QUESTIONNAIRE
C. LIST OF RESPONDENTS CONTACTED IN INITIAL SURVEY
D. COMPANIES CONTACTED IN THE FOLLOW-UP MARKET SURVEY

ANNEX I-a

PRODUCT PROFILES

PRODUCT PROFILE 1: COCONUT WATER

USAGE: Direct end-use, food consumption.

PHYSICAL PRODUCT: Primarily canned coconut water mostly in non-carbonated form; has not yet appeared in bottles or aseptic packages. A coconut-flavored soda is also available in cans.

CATEGORY: Beverage: juice and soft drinks.

MARKET USERS: The primary market is ethnic, primarily immigrant Asian: (1) Philippine, Thai, and Indonesian; (2) Indian; (3) Vietnamese and Chinese; and (4) very limited usage among Koreans and Japanese. Secondary markets are in Hawaii and the Hispanic and Caribbean communities on the West Coast, Puerto Rico, and Florida. No apparent significant consumption in the mass market; market pockets tend to concentrated.

USER COMMENTS: Too much sugar, too little coconut taste in some products; "canned" flavor disliked, preference for "real" fresh, young, coconut water; an occasional purchase item only.

SIZE AND GROWTH: Indeterminate for this product; the specialty fruit juice market (passion, kiwi, and combinations such as banana-orange) is reportedly the fastest growing segment of the beverage industry--10-20% per year. Note that many of these juice products have graduated from the ethnic market to the mass market.

COMPETITION: Exporters of canned coconut water from the Philippines, Thailand, and Taiwan and Hong Kong; the latter two countries obtain their raw materials from ASEAN countries.

CHANNELS: Direct from exporter to ethnic wholesaler-retailer and to other Asian grocery stores, in U.S. "Chinatowns," and small independent outlets.

BARRIERS: Business ties between retailer and exporter, cultural ties between product and consumer.

ENTRY STRATEGY: A product with a "real" coconut taste.

PRODUCT PROFILE 2: DESICCATED COCONUT

USAGE: Multiple as a food ingredient.

PHYSICAL PRODUCT: The dried kernel is processed into varying sizes, from chunks to extra fine. Finely grated coconut flakes can be steamed into a liquid, milky substance.

CATEGORY: Coconut ice cream and sherbet, juice and pina colada, soft drinks and liquor, chocolate candy, cookies and pies, flavors and spices for cooking.

MARKET USERS: Manufacturers and processors of branded products; primarily a flavor within a multi-product line -- e.g. ice cream, juice, pina colada; occasionally a specialized producer--such as CocoLopez and CocoRibe.

USER COMMENTS: Standard, readily available product. When used for extracting milk, the quality is not as good as it would be with coconut cream, but a good substitute because of lower price and greater product uniformity. A small part of a total product line (less than 1% of sales), provides an exotic flavor, not used by spice companies.

SIZE AND GROWTH: These are large markets in aggregate, at least U.S. $1 billion, but growth is moderate at 3-7% per year since these are mature markets. The U.S. imports approximately 40,000 t of desiccated coconuts, primarily from Asia, with smaller supplies from Mexico and the South Pacific.

COMPETITION: Major coconut-growing and copra-producing countries, ranging in annual volume from the Philippines (2 million t) and Indonesia (1 million) to Mexico (100,000 t) and Fiji, Nauru and the Solomon Islands (20-40,000 t).

CHANNELS: The three main channels in descending order of size (1) large, integrated, general trading companies, which are usually multinational; (2) medium-sized U.S. importers and wholesalers in direct contact for contract with smaller copra producers (many in the Philippines) and Philippine companies with N.Y. sale offices; and (3) wholesale produce markets servicing regional and local manufacturers and retailers.

BARRIERS: High among the large food companies that are backwardly integrated to suppliers and can exercise internal transfer pricing. The large firms also act as purchasing agents for smaller food companies. Smaller importers buy on quoted price and standard specifications. Basically a commodity product, even "extra-fine" desiccated coconut only commands a premium of only U.S. $0.01 per pound. For flavoring, edible synthetic substitutes are available.

ENTRY STRATEGY: Compete on c.i.f. price.

PRODUCT PROFILE 3: COCONUT CREAM (MILK) CREAMED COCONUT

COMPETITION: Coconut cream competes with desiccated coconuts and fresh coconuts. Fresh coconuts are an acceptable substitute because of availability and uniformity, while desiccated coconuts are readily available.

USAGE: Multiple as a food ingredient.

PHYSICAL PRODUCT: The fresh kernel or meat is processed into milk or a semi-liquid nectar. There is no clear distinction between what is sometimes marketed as coconut milk versus cream.

CATEGORY: Coconut ice cream and sherbet, juice and pina colada, soft drinks and liquor, chocolate candy, cookies and pies, flavor and spices for cooking.

MARKET USERS: Small, specialty producers attempt to convey a distinctive image to the end-users -- natural, exotic, high value, and different from the product availabe from the mass market producers and distributors.

USER COMMENTS: A difficult product to work with, some users have tried it, but switched back to desiccated coconut. The consistency often varies from shipment to shipment and each must be tested on arrival. Coconut cream has a superior taste compared to dried coconut, but many consumers cannot tell the difference. Desicated coconut flakes keep better.

CHANNELS: Limited, often by direct purchase from coconut cream producer to ingredient user/producer. Some is purchased from the United Kingdom and Belgium for candy fillings.

BARRIERS: Some large food companies are not very interested in this product because their own production processes are geared to desiccated coconut from their own integrated supply sources. Due to the lack of product standards, coconut cream is sold by sample or on a trial basis

ENERGY STRATEGY: Made-to-order coconut cream meeting buyer specifications.

PRODUCT PROFILE 4: FRESH COCONUTS

COMPETITION: Fresh coconuts also compete directly with desiccated coconuts and coconut cream.

USAGE: Primarily as an ingredient for final food uses in ice cream and juices. Also purchased for direct consumption or as a condiment or flavoring for cooking.

PHYSICAL PRODUCT: Whole coconut, primarily shipped in dehydrated form, with a brown shell and dry but still soft interior. Sometimes as a green, fresh coconut with an interior that is completely soft and contains the coconut water.

CATEGORY: (1) For ingredients -- coconut ice cream and sherbet, juice and pina colada, soft drinks and liquor, chocolate candy, cookies and pies, (2) For cooking -- flavor and spices.

MARKET USERS: Due to the perishable nature of the product, users are almost exclusively manufacturers and consumers located in Puerto Rico, Florida, the Caribbean, Southwest (California and Texas) Central American and Mexico, and Hawaii. Dehusked coconuts in the North arrive harder and drier.

USER COMMENTS: Some industrial users prefer to process fresh coconuts as a food ingredient. The product is cheap, but a large proportion may be for the primary use. The reject coconuts are often desiccated.

SIZE AND GROWTH: The U.S. imports about 17,000-18,000 t of coconuts each year, with a value of U.S. $ 3.0 -3.4 million; but the of the volume may end up as copra. The market has not grown much over the last three to five years.

CHANNELS: Direct orders from plantation to processors; independent middlemen are not significant channels. Also, there are some cross-border purchases and shipments, subject to USDA inspection and approval.

BARRIERS: Proximity is essential due to high transport costs for this bulky product. Standards do not exist and the quality is uneven.

ENTRY STRATEGY: Establish direct ties between plantations and processors.

PRODUCT PROFILE 5: COCONUT OIL

USAGE: Used as an edible cooking oil and a source of fatty acids for soaps, detergents, and cosmetics.

PHYSICAL PRODUCT: Oil and oil-derived chemicals produced by expelling copra (dried coconut meat), which may then be.

CATEGORY: Edible oil, non-dairy creamer for filler; shampoos, soaps essences (flavor and fragrance)

MARKET USERS: Large companies

USER COMMENTS: A commodity product with price as the major selling point. The market is dominated by the Philippines.

SIZE AND GROWTH: U.S. consumption (including both edible and inedible products) of coconut oil decreased from 500,000 t in 1976 to 350,000 t in 1986. The USDA estimates coconut oil imports of 450,000 t in 1988. Prices fluctuate and reached a high of $0.60 per pound in 1984, but have fallen back to the same level of 10-12 years ago. Lauric acid from coconut oil for soaps and detergents accounts for only 45,000 t. Palm kernel oil is a prime substitute for the non-edible uses due to its similar high concentration of lauric acid. For edible uses, the market has declined following the American Heart Association, and the National Academy of Sciences have recommended that highly saturated tropical fats should be avoided. The American Soybean Growers' Association is lobbying for federal regulations to label coconut, palm and palm kernel oil as saturated fats.

COMPETITION: The Philippines is the market leader, but there are a dozen other major exporters and about fifty large coconut producers who have sporadically entered the export market. Since many other vegetable oils are available as substitutes for edible uses, price is an important consideration. Although U.S. soybean oil has a powerful lobby, it is not always price competitive. The soybean industry in Brazil and Argentina are major international competitors, and reportedly are subsidized. Palm kernel exports are a major competitor for the non-edible uses of coconut oil.

CHANNELS: Primarily, large, integrated multinational companies, authorized buying agents and manufacturer representatives.

BARRIERS: Integrated channels, coalitions among Asian producers, unstable coconut prices and a declining U.S. market trend.

ENTRY STRATEGY: It would be difficult to compete on price terms with large existing producers of edible coconut oil and it might be necessary to undertake both a consumer education campaign and a government lobbying effort for the mass market. An alternative would be to produce a virgin (first pressing) oil by using a wet process, resulting in a higher quality product with a fragrant natural aroma for cosmetic uses.

PRODUCT PROFILE 6: "REDUCED SATURATED FAT" COCONUT OIL

A reduced-saturated fat coconut oil is a potential product that is still in the research stages. Work is being done in the Philippines by Proctor and Gamble and Unileven. If this can be done at a low enough cost, companies may attempt a high-volume transformation of their coconut oil output.

USAGE: Direct, end-use food consumption.

PHYSICAL PRODUCT: Ideally, low saturated fats.

CATEGORY: Home cooking oil.

MARKET USERS: Primarily specialty distributors of the minor edible oils, who might supply health-conscious ethnic households with a preferred type of cooking oil.

USER COMMENTS: Samples would be needed for chemical analysis and market testing.

SIZE AND GROWTH: Indeterminate; the total cooking oil market is over U.S. $1 billion, but this includes various vegetable oils.

COMPETITION: Primarily producers of other vegetable oils.

CHANNELS: Direct sales from coconut oil producers to edible oil distributors.

BARRIERS: Health concerns brought to the attention of consumers by lobbying and advertising efforts of the American Soybean Growers Association and other producers of edible temperate oils.

ENTRY STRATEGY: Start with the ethnic market because of familiarity with the product and to reduce perceptions of other edible oil producers that the new product would constitute a threat.

PRODUCT PROFILE 7: COIR AND COCONUT SHELLS

USAGE: Coir and coconut shells are non-food materials for household, industrial fuel, and fiber users.

PHYSICAL PRODUCT: Coir (coconut husk fiber) is available in raw, spun or rubberized forms. Coconut shells are carbonized.

CATEGORY: Coir is used in rope, mattresses, and seats, door mats, handicraft and alternate fuel. Coconut shell charcoal is predominantly used for fuel but may be processed into activated carbon in capital-intensive facilities.

MARKET USERS: Coir is bought by manufacturers and suppliers of general merchandise, gifts, and arts and crafts material, shell charcoal is burned directly in industrial boilers and kilns.

USER COMMENTS: Coir products are low-value, high-volume items. In handicrafts, coir is used as a filler material for containers. Coir competes with abaca and jute fiber and rope and, it has no particular product distinctiveness. Coconut shell makes an excellent charcoal. However, it competes on the basis of the price of alternative sources and face problems of consistent delivery from suppliers.

SIZE AND GROWTH: These are small markets, each less than U.S. $500 million in sales to low-growth, mature industries with limited expansion prospects.

COMPETITION: For coir, most developing countries have similar trade advantages with the United States. Shell charcoal has many alternate sources, locally and internationally.

CHANNELS: Coir is distributed through buying agents for major rope, mattress, and handicraft manufacturers. Shell charcoal may be sold directly to users by a coconut processing plant.

BARRIERS: Price and distance are problems due to the low value and bulk of these products. It is generally an open and competitive market.

ENTRY STRATEGY: Develop a low-cost operation for these byproducts. Obtain equipment to reduce transport costs such as a high-density baling press.

ANNEX I-b

MARKET SURVEY AND QUESTIONNAIRE

An Approach to Conducting the Market Survey on High-Value Coconut Products

Objectives

The purposes of market research include informing users of the products' availability and characteristics, and determining the likelihood and frequency of purchases, as well as the relationship between product prices and the quantity consumed. User perceptions of products are a key element of a market survey. Some coconut products are new from the user's point-of-view because they have not yet been tried and the users are already being served by alternative existing products. For a few products, the marketing task is to encourage product substitution by new users. To do so, one of the main objectives is to determine how the product compares to its substitutes. In marketing jargon, this is described as a product superiority, parity, or inferiority.

Understanding product position is important because an inferior product will have to sell on the basis of a lower price, while a superior product can command a premium. Under product parity, a whole set of marketing concerns have to be addressed including price, quality, reliability of delivery, custom production to meet specifications of each major buyer, and product differentiation through promotion and advertising. A market survey should include technical specifications for products by use when possible. Where these have not been established, the respondent is likely to require product samples for testing so that a more valid indication of interest can be elicited.

The key question of many market studies is "How big is the market for the product?" However, for niche markets, this question might not be relevant because the market size is already known to be small. For example, published data might be available on total sales of ice cream and the shares of coconut-flavored products in that market. Thus, a survey might want to ask other key questions such as, "How can the dollar sales or market share of coconut ice-cream be increased?" or "What are consumer reactions to coconut ice cream?" These questions are appropriate for a neutral survey geared to obtaining general information about the market.

The preliminary market survey conducted for this study was designed to identify opportunities and constraints for the South Pacific coconut industry and directions for further market investigation later. A "snowball" approach was used with telephone surveys of informants leading to identification of other respondents. The survey did not rely on a statistically rigorous, random sampling from the universe of possible respondents. Nor was the market assessment based on a

comprehensive analysis of secondary data.

The pattern of questions asked in the survey varied with the responses. For example, one question was, "Do you want to buy coconut concentrate or flavoring for your ice cream?" If the answer was affirmative, the follow-up question would be, "In what quantity and specifications, and at what price?" If the answer was negative, the surveyor would ask, "Why not?" (Note that artificial flavors already dominate this market.) This type of question is most appropriate for an action-oriented survey that is concerned with purchasing behavior of specific firms or consumers. A neutral survey may yield better responses on long-term attitudes than an action survey which might only reflect the respondents' willingness to try the product out for awhile.

Selection of Respondents

This market survey focused on intermediate users, such as the purchasing manager or the technical director of a manufacturer of ice cream or candy. It also emphasized brokers and wholesalers for retail products. Although the final user ultimately determines a product's viability, consumer survey are expensive and time-consuming. That is especially the case if the consumer is unfamiliar with the product and must be educated in its use.

Existing purchasers of coconut products may represent the most viable market segment for South Pacific producers in the near term. Thus, the market survey focused on existing users and brokers already in this market. Their reactions can be useful in product choice and in reformulating the product or deciding on a strategy to expand the consumer base. A relatively inexpensive way of obtaining these reactions is through a focus group discussion. A focus group could be composed of ethnic consumers to gain some insights on their current or potential use of the products. As a proxy for focus groups of ethnic users, one might interview importers of coconut products who serve the ethnic communities. Unfortunately, it can be difficult to find these importers because of the small and specialized nature of their businesses, which often do not appear in commercial market listings.

The Scope of the Market Study

The choice of what products to include in a market study can be a "chicken-or-egg" dilemma because of the issue of "which comes first, product development or market viability?" Furthermore, the respondent may only be interested in the product if commitments on product quantity, quality and price can be made, but the prospective firm might not be able to secure financing or make production commitments until after prospective users indicate their total requirements.

The situation is even more complicated when multiple products can be generated from the same or a modified manufacturing process.

A market study may have to make assumptions from preliminary data on the process, costs, technical specifications, and quality and quantity of various products. Usually, it is necessary to narrow down the list of possible products before the survey.

QUESTIONNAIRE

REMINDERS TO INTERVIEWER(S):

1. This survey is directed at intermediate users-- probably manufacturing, marketing, and R & D managers, of firms, not at end-users or final consumers.
2. There are really only two basic questions to this survey: (i) Do you use coconut by-product "x"? (ii) If "yes," proceed with the survey; if "no," ask why not.
3. This survey is essentially exploratory, opportunistic, and open-ended. Therefore, the interviewer should allow the respondent leeway in replying. That means: (a) the respondent will probably answer out-of-sequence and introduce new information not covered by the questionnaire; and (b) the interviewer has two difficult tasks-- (i) to encourage the respondent to keep talking, and (ii) to make sure that the responses cover the questions in the survey. Be on the look-out for a genuine expert-- someone who knows the coconut business or who may have buying experience in American Samoa and the Pacific Islands.
4. This is a non-random, survey. We need referrals to continue the survey. (i) Be sure to ask that question (at the end of the interview). (ii) Use the telephone directory and try "blind" or "cold" calls-- for example, to supermarkets, candy manufacturers, ice cream companies. Note that we are interested in several "industries" or types of users; the questionnaire covers "quantitative" information that can be classified, but the qualitative information-- opinions, may be equally important.
5. This is not a "rigorous" questionnaire. The questions are just guidelines. Interviewers may change the form and sequence of the questions, ask long as the basic topics-- Volume , Sources , etc., are covered.
6. The questionairre is preliminary, and we always "pre-test." That means: (i) look over the questionnaire and make your own adjustments, suggestions, etc.; (ii) we should review the results after 5-7 interviewees in order to improve the questionnaire.

QUESTIONNAIRE ELEMENTS

Entry "Story Line"

- Salutation.
- Identity.
- We are conducting an exploratory survey,
- for USAID, on behalf of American Samoa & the Pacific Islands, (this information may or may not be helpful)
- to determine the feasibility of American Samoa's supplying you with coconut by-products (this line needs to be phrased better or restated)

NOTES:

(1) Be prepared to answer questions about the story line; go through the

accompanying materials.

(2) Be patient, as you will probably be "bounced around" to different managers/respondents within the company.

(3) Be sure to list down respondent's name, position, office number, firm address, etc.

(4) In the course of the interview, insert at appropriate stages the following (flattering) remark: "We are interested in your expert opinion on this question..."

Key Question

* Do you/Does your company use any coconut by-products?

==========

* (If no)

(1) Why not? NOTE: A negative response may offer important information on the feasibility of the project. Probe for the reason(s)—cost, unreliable or inconsistent product, high cholesterol, consumer ignorance, taste, etc., and ask the respondent to explain the reason(s).

(2) IMPORTANT:

* Are there substitutes that you use instead of coconut?
* What are they?
* Why are they preferred to coconut by your firm?

(3) Exit. Thank you. Can you suggest another respondent to help us continue the survey?

==========

If Yes

NOTE: (1) A separate sheet may be useful to list down the answers.

(2) The sequence of questions may be rearranged. Some respondents may prefer to "warm up" with general Usage & Attitude questions.

Usage & Attitude

* What particular coconut products (or by-products) does your company import/ purchase/ use? (refer to list if needed)
* How is the particular by-product used in your company? (name each one if more than one)
* What (if any) are the substitutes for the coconut by-product?
* What do you like about the coconut by-product with respect to its substitute(s)?
* What do you dislike about the coconut by-product with respect to its substitute(s)?

Volume

* Over how many years has your company been buying the coconut products? (name each individually if more than one)

* How many pounds or tons of each product (as named by the respondent) did your company buy in 1987, and for the first half of 1988?

Sources

* From what countries did you buy each of your coconut products from in 1987, and in the first half of 1988?
* How many pounds did you buy from each country in 1987, and for the first half of 1988?
* Which countries (or companies) are your most reliable suppliers?
* Which countries (or companies) are new suppliers, that is, since 1986?

Projections

* Since your company has been buying the coconut products (name each one), has the usage /market/purchase for these products been declining or rising?
* In your opinion, is the market for each of the products likely to decline or grow over the next few years, from 1988-1990?
* Why do you believe that usage is declining (or increasing)?
* What factors do you believe will influence increased usage?
* Could you explain what you mean by (repeat factor stated by respondent)?

Price

* (Price is likely to be one factor) What is the lowest price, and the highest price that you paid per pound in 1988, for your coconut products?
* What is the lowest and the highest price that you are prepared to pay for the products in 1989? in 1990?

Quality

* (Quality is a likely factor to influence usage and price) Could you elaborate on your firm's (or customers') requirements on quality?
* What technical specifications would you require from the products?
* (If detailed) Would you send a copy of your specifications to this address?
* Would you be willing to accept and comment on samples from the project?

* Exit. Thank you. Can you suggest other users of coconut products?

LIST OF RESPONDENTS CONTACTED IN INITIAL SURVEY

RESEARCH DATA GATHERING FIRMS

1. Dun's Marketing Services, 3 Century Drive Parsippany, NJ 07054; 1-800-526-0651; Dun & Bradstreet Principal International Businesses; Dun's Marketing Services.
2. The Journal of Commerce 110 Wall St., NY NY 10005; (212) 425-1616; Port Import/Export Reporting Service.
3. Gale Research Co., Book Tower, Detroit, MI 48226.
4. Thomas International Publishing Co. Inc., One Penn Plaza, 250 West 34th St., NY NY 10119; (212) 290-7343.
5. Standard and Poor's Register of Corporations, N.Y., 1988.

FROST & SULLIVAN REPORTS: INDUSTRY STUDIES

1. The U.S. Animal Feed Industry, 1983, 199 pages, #A854.
2. Europe's Dehydrated and Powdered Foods Market, 1982, 278 p., #E590.
3. Ethnic and Frozen Style Foods, 1982, 286 pages, #A1138.
4. Processed and Fresh Fish Markets, 1981, 265 pages, #A947.
5. Flavor and Fragrance Market in the U.S., 1982, 352 pages, #A1055.
6. Flavor and Fragrance Market in Europe, 1983, 277 pages, #E621.
7. Food Enhancers Market in the U.S., 1984, 2 vol., #A1341.
8. Frozen Foods Market in Europe, 1983, 2 vol., #E630.
9. Marketing Strategies for Cosmetics and Toiletries in Europe, 1983, 382 pages, #E605.
10. Meat and Meat Products Market in Europe, 1984, 352 pages, #E685.
11. Organic Pigments Market in Europe, 1983, 297 pages, #E608.
12. Protein Ingredients Market in the U.S., 1982, 207 pages, #A1014.

FOOD INDUSTRY ASSOCIATIONS: GENERAL

1. American Institute of Food Distribution, Inc., 28-12 Broadway, Fair Lawn, NJ, 07410; (201) 791-5570.
2. Food Industry Association Executives, 1001 Connecticut Ave. NW, Suite 800, Washington, D.C. 20036; (202) 296-8951.
3. National Food Brokers Association, 1010 Massachusetts Ave. NW, Washington, D.C. 20001; (202) 789-2844.
4. National Association of Specialty Food and Confection Brokers; 6501 Puco, Ft. Worth TX 76133 (817) 292-8495.
5. National Association for the Specialty Food Trade; 215 Park Avenue #1606, NY NY 10003 (212) 505-1770.
6. National Confectioners Association, Rhonda Applebaum (703) 790-5750.
7. American bakers Association 1111 14th St. N.W. # 300, Washington, D.C. (202) 296-5800.
8. American Institute of Baking, 1213 Bakers Way, Manhattan, KS 66502; (913) 537-4750.

FRAGRANCES AND PERFUMES

1. International Flavors and Fragrances, 521 W 57th St., NY NY 10019; (212) 765-5500; Mr. Arthur Roberts, VP Corp. Dir. off Purchasing for Natural Products IFF 600 Highway 36, Hazlet NJ 07730; (201) 264-4500.
2. Cosmetic Toiletry and Fragrance Association, 1110 Vermont Ave., NW, Suite 800, Washington, D.C. 20005; Edward Kavanaugh, Pres.; (202) 331-1770.
3. Fragrance Foundation, 142 E 30th St., NY NY 10016; Annette Green, Exec. Dir.; (212) 725-2755.
4. Fragrance Manufacturers/Materials (two names) Association of the U.S., 900 17th St., NW, Suite 650, Washington, D. C. 20006; Atty. Daniel Thompson, Exec. Sec.; (202) 293-5800.

FLAVORINGS & SPICES

1. Mc Cormick & Co. Inc., 11350 Mc Cormick Road, Hunt Valley, MD 21301; Al Goetze, Int'l Purchasing, (301) 667-7301, 771-6000, 771-510.
2. American Spice Trade Association, Box 1267 Englewood Cliffs, NJ 07632; Thomas Burns, EVP; (201) 568-2163.
3. Durkee PA, (215) 867-0521; R.D. Nelson, Purchasing Director.
5. Spice Islands CA, (415) 981-7600; N. Brunckhorst, Buyer.
6. Spice King CA; (213) 836-7770; Bart Stern.
7. Naarden Int'l USA, NY; Int'l Import Mrkting Mgr., Stanley White; (212) 371-5300.
8. MCP Foods CA; (714) 535-2871.
9. ITC Flavorings & Fragrances IL; (312) 827-2153.
10. ITC Spices & Seasonings; (312) 287-8572.

FLAVORS & OILS

New Jersey
* A & S Corp. (201) 575-6330
* Coldelite Corp.; Italy, ice cream; (201) 843-7400
* Crompton & Knowles (201) 2563850
* Elan chemical (201) 344-8014
* Firmenich (609) 452-1000
* Mane USA (France) (201) 633-5533
* Orbis Products (201) 824-3144
* Thomas & Co.; (201) 221-0990

Illinois
* Fantasy Flavors (312) 668-1000
* Food Materials Corp. (312) 463-7600
* J. D. Searle; artificial; (312) 982-7000

California

* Ajinomoto (213) 373-6891
* American Foods (415) 641-1040
* Flavurence (213) 727-1957
* Kovarich Brokerage (213) 222-7143
* Hasegawa USA 5341 W. 144th St. Lawndale, CA 90260; (213) 643-9711

New York
* Amazon Coffee (718) 507-8080
* Globe Extracts (516) 273-6200
* Hartog Trading (212) 687-2000
* Hartog Foods International (212) 687-2000
* Manheimer (718) 392-7800
* Rockley (212) 355-5770
* Standard Aromatics (212) 926-2000

Others
* Eclipse Food Products; RI (401) -739-3600
* Adams OH (216) 225-9135
* Berghausen OH (513) 541-5631
* Lucks Co. WA (206) 622-4608
* Ottens Manufacturing; PA (215) 627-5030
* Tannin Corp.; MA (617) 532-4010

FOODS & BEVERAGES

Alabama
* Marx Brothers; (205) 251-3139; 26 emp.

California
* American Fruit Processors 10725 Sutter Avenue, Pacoma CA 91331 (818) 899-9574
* MCP Borden; juices & powders; 421 S. Achison, Anaheim, CA 92805 (714) 535-2871
* Banta Associates (714) 597-7514
* Calavo Growers of California; (213) 587-4291; 350 emp., $65 M.
* Mother's Cake & Cookies; (415) 569-2323
* Crown Oil; (415) 433-4686
* Natural Nectar Products Corp; City of Industry CA 91745
* Nature's Warehouse, Inc.; Sacramento, CA 95816
* Del Monte Foods Department A, San Francisco CA 94105
* Hain Pure Food Co., LA CA 90061
* Dole, 50 California st. SF 94111; (415) 986-3000
* Spectrum Naturals; 133 Copeland St., Petaluma CA 94952
* T&P Custom Brokers 2500 E Colorado; 213-796-9008
* Kern's of California; City of Industry; Brian Lynmayer (Purchasing Manager) 818-369-8354

* L & A Juice co., Inc., City of Industry, CA 91745
* R. W. Knudsen & Co., Chico CA 90241; 213-744-7000
* Baker commodities (213) 268-2801
* Carnation Co.; (213) 932-6000
* Colgate-Palmolive; coco-oil RP; (212) 310-2000
* Lou Ana Foods (318) 948-6561
* Marubeni San Francisco (415) 954-0100
* Mother's Cake & Cookies (415) 569-2323
* Norman, Fox, & Co. (213) 583-0016
* Dreyer's (415) 652-8187
* Xenia Food Communications; PO Box 25919 (213) 479-1221
* Safeway Stores (Von's) 2800 Ygnacio Alley Rd., Walnut Creek CA 94548; (415) 944-4000
* Von's Grocery Co.; 10150 Lower Azusa Rd., El Monte CA 91731; (213) 579-1400
* Ralph's Grocery Store Co., P.O. Box 54143, LA CA 90054; VP Keri Hodges; Import Purchasing Manager John Mitchell (2130 637-1101 & 748-9471

Connecticutt
* Great Eastern Trading; (203) 348-7667
* Cadbury Scweppes (Peter Paul, Coco Casa, RoseHolland House), Naugatuck, CT 06770
* Pepperidge Farm, Inc., Norwalk CT 06856
* The Club Distilling Co., Hartford CT
* Hueblein, Munson Road, Farmington, CN 06032; 203-678-6500 & 240-5000
* House of Lawrence (203) 637-7887

Florida
* Adams Fruit & Import; (305) 751-7231; 25 emp.
* Ancel Products, Inc., Miami, FL 33142 (DR)
* Lincoln Diversified Systems; (305) 391-0880; 200 emp.
* Lakeview Products, Miami, FL 33242

Hawaii
* Hawaiian Flour Mills; coco milk & flakes; (808) 527-3264; 65 emp.
* Hawaiian Sun; RP coconuts; (808) 845-3211; 80 emp.
* Hawaiian Host; candy; (808) 949-5541
* Kotake Shokai; fruits & vegetables; (808) 533-2961
* Royal Trading Co.; confectionary; (808) 531-2002

Illinois
* Sun Diamond Growers of California; (317) 739-3000; 90 emp., 15000 Tons
* Stepan (312) 446-7500
* Borden's (312) 498-6200
* Home Juice Co. (312) 379-3000

* Beatrice Foods Co., 2 North La Salle St., Chicago 60602; (312) 782-3820

Indiana
* Cocktails for Two Distilling Co., Lawrenceburg, IN

Louissiana
* Valle & Sons; (504) 525-3424
* Bruce Foods Corp.; P.O. Drawer 1030, New Iberia 70560 (318) 364-5874

Maryland
* Castle & Cooke; (301) 992-0016 & (415) 986-3000

Massachusetts
* Stop & Shop, P.O. Box 1942, boston MA 02105
* Timberlake Candies (617) 484-6257
* Bailey's of Boston (617) 321-5700
* H P Hood (617) 242-0600

Michigan
* Everfresh Juice (313) 755-9500

Minnesota
* General Mills, Minn MN 55440; Pilsbury (612) 330-4966
* Land O'Lakes, Inc. PO Box 116, Minn MN 55440 (612) 481-2488

Missouri
* Pet Inc., 400 South 4th St. St. Louis MO 63102 (314) 621-5400

New Jersey
* Hershey Imports (201) 388-9000; 125 emp.
* Red V Coconut Products; Avenel, NJ 07001; (201) 388-8282
* Goya Foods; Secaucus, NJ 07094
* Paddington Corp., One Parker Plaza, Fort Lee NJ 07024 (Canada); 201-592-5700; Dean Arvanites
* Sunshine Biscuits, Inc., Woodbridge, NJ 07095-1196
* Thomas J. Lipton, (201) 567-8000
* Van Leer Choclate Corp. (201) 798-8080
* M & M/ Mars; Hackettstown, NJ (201) 852-1000
* Nabisco (201) 682-6400
* Quality Confections of America; Plaza Nine 900 Route 9, woodbridge, NJ 07095 (201) 636-3902
* Campbell Soup Co., Camden Place, Camden NJ 08101 (609) 342-3500
* American Kitchen Products, 812 Jersey Avenue, Jersey City NJ 07303 (201) 656-4800

New York
* Amato Agency (212) 943-4974

* Trucco; (212) 893-3060
* Cocoline Choclate Co., Inc.; (718) 522-4500
* Phildesco; (212) 986-8385; 5000 Tons
* Mars Fudge & Fruit; (718) 453-6770; 29 emp.
* Finest Foods; (718) 296-0700
* General Foods; White Plains, NY 10625 (302) 734-6100 & (914) 335-2500
* Iberia Foods Corp., Brooklyn NY 11207
* Nestle Foods, 914-251-3000
* NOG Inc. (716) 366-3322
* Naarden International USA (212) 371-5300
* Southland Frozen Foods (516) 222-9350
* Mercantum (US) Corporation (212) 233-0412
* Curtis Burns (716) 325-1020
* J.F. Braun & Sons (516) 997-2200
* United Fruit Co.1271 Ave. of the Americas NY NY 10020 (212) 307-2000

Ohio
* Virmurco; (216) 722-1102
* CocoRibe Co., Cincinnati OH
* Capitol City Products (614) 299-2801
* J. M. Smucker (216) 682-0015

Oregon
* Palmco (503) 286-8341

Pennsylvania
* Durkee Famous Foods; (215) 867-0521; 500 emp., $25 M.
* Hershey Foods (717) 534-7500
* Godiva (215) 779-3792

Puerto Rico
* Goya de Puerto Rico, Bayamon, PR 00621 (DR)
* Coco Lopez Corp., Bayamon, PR 00621
* Coco Rico Inc., PR
* Able Sales; pastes & juice; (809) 795-3131
* Costamar Corp; foods; (809) 786-0737
* Malgor & Co.; foods; (809) 781-3308
* Plaza Provisions; soap & foods; (809) 781-2070
* Suarez & Co., Inc.; (809) 782-6117

Texas
* Anderson Clayton Foods (214) 450-6000

Vermont
* Ben & Jerry's (802) 224-5641
* Spring Tree Corp.; P.O. Box 1160, Brattleboro, VT 05301; (802) 254-8784

Virginia

* Northern Virginia Beverage Co., 844 Terminal Road P.O. Box 0549, Newington VA 22122 (703) 550-9710 (Coco Lopez of Puerto Rico)

Washington

* Ayengar Associates; WA (206) 524-4040
* International Food Storage, PO Box 1924 W. 505 Riverside Ave., Suite 500, Spokane 99210 (509) 455-8523

CANADA

* Daltons; food; (416) 366-8921
* Preisco Foods; (604) 941-8502; 70 emp., $35 M.
* Seymour Importing; food; (604) 434-0221; 50 emp.
* Lawton; processed coconuts; (416) 672-0400
* Loretta Foods Ltd. (416) 678-9250
* Morris National Sales; confectionary; (514) 931-7525
* Dwersey Canada; soap (416) 822-3511
* Alma Foods; chocolate; (602) 420-5001
* Arkona Feed Mills (519) 828-3385
* Balcorp Ltd; fruits & nuts: (514) 387-7383
* Bertozzi Importing; Italy: (416) 746-7250
* Bowes Co.; fruits; (416) 233-5851
* Cosmopolitan Foods; European food; (604) 273-4546
* Culinar Foods; European Foods; (416) 689-9633
* Dalton's; coconuts; (416) 366-8921
* Empire Spice Co. (204) 942-2574
* H & T International Food Brokers; dried fruits, nuts, juices; (416) 622-6650
* ITC Canada; spices; (514) 332-3400
* Khazzam Inc.; dried fruits & nuts; (514) 397-1710
* Sun Pac Foods Ltd.; juice; (416) 741-3520
* Dominican Food Brokers (416) 474-0424

CARBONIZED SHELL

* Cameron Yakima; (509) 452-6605, WA

COCO COIR

* Blocksom & Co., 406 Centre St., Michigan City IN 463600; (219) 874-3231

HANDICRAFTS/ARTS & CRAFTS/BASKETS

* Ala Makana; HI (808) 841-7383
* Buhi Imports; HK & RP; OH (213) 593-6540
* Charlotte Charles; fine foods; IL (312) 772-8310
* Dell-Co Imports; Mexico; TX (512) 722-8368
* Greenspan & Co; baskets; NY (718) 894-7000
* Hecht Importers; PA (215) 925-5520

* Hickory Farms; fine foods; OH (419) 893-7611
* Hirt Co; fine foods; MI (313) 831-2020
* Imported Interiors; IL (312) 666-9366
* International Artware; FL (904) 737-8500
* Kuba International; TX (214) 353-9808
* Lucky Clover Trading; CA (707) 746-5885
* Luzon Imports; PR; MA (617) 482-5012
* Marshall Products Inc.; CA (213) 595-1223
* New Trends; TX (214) 243-2406
* Ohio Imports Co.; OH (216) 756-2700
* Pacific Rim Import Corp.; WA (206) 767-5000
* Pan American Import Co.; Mexico; TX (512) 542- 5292
* Panda Inc.; wooden articles; TX (214) 631-2042
* Pier 1 Imports; MA (617) 749-7292
* Polar Island Corp.; RP; NY (212) 402-8721
* Ponce's Creations; WA (206) 628-0815
* Watson Trading; wickerwork; MI (517) 439-9313

FLOOR MATTINGS
* ArtCo Import-Export; IL (312) 338-5820
* Burden's; craft items; FL (305) 835-5151
* Capel, Inc.; rugs; NC (919) 483-2151
* Euromarket Designs; mats from China; IL (312) 272-2888
* Eurotex Inc.; rugs; PA (215) 739-8844
* Forbo N.A.; PA (717) 291-5874
* Harmony Carpet Corp.; NY (212) 355-6000
* Interaco Corp.; cocoa mats; IL (312) 252-4995
* Kelly Carpet Co.; NJ (609) 662-0317
* Koffler Sales Corp.; cocoa mats; IL (312) 334-5200
* Puckett Supply; cocoa matting; NC (919) 292-1372
* Schober Co.; PA (215) 425-4623
* Seymour Inc.; mats; WA (206) 935-5471
* Trans-Ocean Import Co.; NY (212) 371-5656
* Tri-Par Carpets; IL (312) 467-6[illegible]0

COSMETICS & CREAMS
* W. H. Cooper & Co.; shampoos & cream; IL (312) 376-7675
* Faberge, Inc.; NJ (201) 529-5100
* Morrow's Unlimited; shampoos; CA (213) 367-5951
* Pont-Flores Corp.; Europe; PR (809) 784-6065
* Maybrook Inc.; derivatives; MA (617) 682-1716
* Allied of Chicago; IL (312) 459-0717
* Amiguet Brothers; Spain; PR (809) 761-3450
* Colonia Inc.; CT (203) 787-4711
* Fmali Herb Co.; spices & sopas; CA (408) 423-7913
* Focus Chemical Corp.; NH (603) 430-9802

* Fragrances Selective Inc.; Spain; NY (516) 586-5222
* Michaud Associates; sopas; CA (213) 650-4443
* Molnlycke Inc.; tissue; (415) 830-2970
* Original Bradford Soap Works; Italy; RI (401) 821-2141
* Plaza Provisions; Europe; PR (809) 781-2070
* The Perfume House; OR (503) 234-5375
* Tri-Par Corp.; NY (212) 677-0900
* Tropical Soap Co.; Box 31673 Dallas, TX 75231 (Mexico)
* Mountain Ocean Ltd., Box 951 Boulder CO 80306
* Sunshine LA, CA 90016
* Kiss My Face Corp., P.O. Box 804, New Paltz, NY 12561
* Schigg Bio-Food Products Dist., Moonachie, NJ 07074
* The Community Soap Factory P.O. Box 32057 D.C. 20007
* Helene Curtis IL (312) 661-0222
* Proctor & Gamble OH (513) 983-1100

COMPANIES CONTACTED IN THE FOLLOW-UP MARKET SURVEY

North America

Ajinomoto
American Foods
Flavurence
Kovarich Brokers
Marx Brothers
American Fruit Processors
MCP Borden
Mothers Cakes and Cookies
Cadbury Schweppes
Ralph's Grocery
the House of Lawrence
Borden's
Home Juice Co.
Beatrice Foods Co.
HP Hood
General Mills/Pillsbury
Land O Lakes
Hershey Imports
Red V Coconut Products
Goya Foods
M&M/Mars
Quality Confections of America
Durkee Famous Foods
Godiva
Loretta Foods Ltd.
Lafe Tropical Fruits
John B. Sanfillippo & Sons Ltd.
General Foods Bakers Chocolate and Coconut
Phildesco Inc.
Far Eastern Coconuts Inc.
Culinar Inc.
Wasco Foods Inc.
Combined Products Inc.
Midwestern Pecan Inc.
Rose Holland House
Ben & Jerry's
H. Schnell & Co.
Impact/Pacific Foods
Kelley Clark Inc.
Boyer Brokerage Co.
Bromar Inc.
Food Brokers Int'l.
William AG Commodities
Associated Gourmet Brokers
White's Food Products
Colonial Spice & Extract
Edenfruit Products Inc.
General Brokerage Inc.
Nabisco
Mercantum Corporation
Hershey Foods
Lawton's
Cade-Grawson & Co.
Sander & Co.
Charles Denneny Inc.

Japan

Daito Cacao Co. Ltd.
Co-Optrade Japan Ltd.
Jonan Shoji Co. Ltd.
Chatani Enterprises
Mitsubishi Corp.
KBK, Inc.
Ogawa & Co. Ltd.
T. Waico & Co.
Kitanihon Confectionary Co. Ltd.
Century Kraki Ltd.
Itoman & Co. Ltd.
Kabaya Confectionary Co.
Marubeni Corp.
Toshuko
Nishhin Trading Co.
Shin Sei Trading Co.

POTENTIAL FOR PRODUCTION AND MARKETING HIGH VALUE SOUTH PACIFIC COCONUT PRODUCTS

VOLUME II

ANNEX II. COUNTRY PROFILES

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ANNEX II. COUNTRY PROFILES

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REPORT ON AMERICAN SAMOA

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AMERICAN SAMOA OVERVIEW

LAND, GEOGRAPHY AND POPULATION

American Samoa is comprised of seven islands with a total land area of 197 square kilometers and a combined population of approximately 37,500 people. The largest island is Tutuila, approximately 135 square kilometers in area with over 90 percent of the population.

The islands are located along 14 degrees latitude south of the equator at about 170th meridian west longitude. American Samoa is about 3,700 kilometers southwest of Hawaii and 2,500 kilometers northeast of New Zealand. Western Samoa, an independent nation, is 130 kilometers to the west.

Economic Overview

American Samoa has essentially a single-industry economy. Canned tuna and related fish products account for virtually all exports from the Territory in terms of quantity and value. The two tuna canneries operating in American Samoa are wholly owned by multinational corporations from the United States. Fishing boats from the United States, Korea and Taiwan are the principle suppliers of fish to the canneries. The economy of American Samoa experienced significant growth in the mid-1980's, mainly as a result of a substantial increase in the production levels of the tuna processing industry. In 1987, the canneries produced a total of 18.7 million cases of canned tuna valued at $269 million, the highest level of output on record.

In spite of the growing importance of the tuna processing industry in American Samoa, financial aid from the United States continues to be a key component of the area's basic income. Grants from the U. S. Department of the Interior and other federal agencies account for more than half of the receipts of the American Samoa Government. In 1988, federal financial assistance to the Territory totaled about $52 million.

American Samoa has a well-developed retail, service and wholesale sector. In 1987, there were approximately 1,900 licensed businesses. Local enterprises provide such services as banking, accounting, insurance, architecture/engineering and data processing.

Language

The official language of American Samoa is Samoan but English is widely used.

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Currency

The currency is U. S. dollars. American Samoans are U.S. Nationals, have unrestricted assess to the U. S. and carry U. S. passports.

Air Transportation

American Samoa is currently served by one major U. S. air carrier and several regional air carriers. Pago Pago International Airport can accommodate any size commercial aircraft. Air traffic control is maintained by the U. S. Federal Aviation Administration. Despite good airport facilities, air transportation between American Samoa and the U. S. sometimes suffers from inadequate airline scheduling and service. Air cargo service is frequently unreliable due to inadequate service frequency and cargo capacity.

Shipping

Common carrier freight service between the west coast of the United States and American Samoa is excellent. Direct service is provided by fast, modern, high capacity ships. American Samoa's current shipping services are listed in table 1. In addition to the services shown, the Western Samoa Shipping Corporation operates an inter-island passenger/cargo ferry twice weekly between Western Samoa and American Samoa. There are two principle shipping agents in the Territory. At present, transshipment cargo is largely from the U. S. to Tonga and the Cook Islands. This cargo arrives in containers and is shipped outwards in break bulk form.

Communications

As a member of the International Telecommunications Satellite Organization, American Samoa is in direct 24-hour contact with 20 countries in the Pacific region and more than 100 nations world-wide. Telephone, telex, telegraph, fax and other services are available and in common use. American Samoa is part of the U. S. Postal system, and standard U. S. postal rates apply to the Territory.

Banking

Full international service banking is provided by Bank of Hawaii and the locally owned Amerika Samoa Bank. Commercial interest rates are currently 14-15%. The American Samoa Development Bank owned by the Government provides limited direct loans and loan guarantees to residents for home building and for small to medium local businesses at soft term rates. The American Samoa Economic Development Authority (EDA) can provide for tax exempt and taxable industrial development bond financing for commercial and infrastructure projects in excess of $US1.0 million that can demonstrate a solid ability to repay the loan from sale of bond

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proceeds. EDA bond financing is secured solely on the payback ability of the enterprise. EDA financing is for long term (15-25 years) capital financing with significant economic benefits. Interest rates are usually 2-4 points below the U. S. national prime rate.

Utilities

Power is widely available on all islands at the U. S. standard of 110 and 220 volts.

The government owned and operated central water system services 85% of the Territory's population pumped from high quality ground water and surface systems. Outlying villages depend on village or surface and catchment systems.

Sewerage is available in the Pago Pago Bay Area, Tafuna Industrial Park and Nuuuli-Tafuna area. Most outlying villages rely on septic tank systems.

The American Samoa Government (ASG) contracts private business to collect and dispose of solid waste generated from all villages in the main island of Tutuila which are accessible by paved roads.

American Samoa has more than 70 kilometers of roads, 85% of which are paved (sealed).

Government

American Samoa has been an unincorporated territory of the United States since 1900. After periods of direct administration by the U. S. Navy and the U. S. Department of the Interior, American Samoa is now virtually self governing. It has its own judicial system, legislature, governor and non-voting representative to the U. S. Congress. The U. S. Department of the Interior continues to have executive responsibility for the territory. American Samoa's currency is the U. S. Dollar.

Land

The topography of Pago Pago Bay with a narrow shelf bordered by steep mountains is a severe constraint on the potential area available for industrial development in the harbor area. Industrial sites are available on long-term lease, 55 years with a renewal option, at the Tafuna Industrial Park located adjacent to the Pago Pago International Airport. The Park includes a total of 45 acres, divided into lots ranging from one-third to one acre. The final size of a site may be adjusted to fit specific business needs. there are presently 12 acres available, and 10 additional acres not yet fully developed. Full electrical, water, sewage and drainage are provided. The annual lease rate is $0.15 per square foot.

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Investment

Investment incentives including generous tax, financial, manpower training, land siting, transshipment and export incentives into the U. s. market are available under the government's Industrial Incentives Act.

Investment policy favors maximum local participation to the extent feasible and available.

Agriculture

American Samoa's agriculture industry is subsistence oriented with some commercial production in traditional crops and small but growing interest in high value vegetables for local market demand.

General Conclusions

Given the heavy subsistence nature of agriculture in the Territory, the access to local raw nuts is extremely limited to oil.

The prospects for processing of coconut products for export is favorable given the Territory's shipping advantages to the U. S. west coast, access to U. S. markets and relative appeal to U. S. investors, adequate and trained labor force and generous incentives. the limiting factor is the Territory's labor rate which is 3 to 5 times higher than most South Pacific countries.

COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

20 and 40 foot containers, reefer and breakbulk

1.2 Cost

American Samoa - U. S. West Coast US$140/ton or m3
(For regional and other shipping information see American Samoa Shipping Services attachment)

1.3 Frequency

3 times a month to U. S. west coast

1.4 Capacity

_____ ton vessels

1.5 Handling facilities from source (harvest) to collection points

1.6 Back loading problems

None.

1.7 Other transport problems

None.

2. EXPORT & IMPORT FACILITIES

2.1 Port

Pago Pago harbor, American Samoa's only port of entry, is a well-sheltered, natural deep water harbor. With a mid-channel depth of more than 60 meters between the harbor mouth and the commercial port, the harbor has more than ample depth for even the largest of modern container ships. The navigational channel has never required dredging.

The main cargo wharf is 340 meters long with a low water depth of 9.1 meters. The port includes full service facilities, including 21,000 square meters containerized storage yard, and approximately 3,500

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square meters of covered transit warehouse space available at dockside. The port has no cold storage but power points are available for refrigerated containers. The 120 meter fuel dock adjacent to the main wharf is used for ship refueling and for discharging fuel from tankers to the oil tank depot.

The port is government administered. The Port Director is in direct control of the harbor and all its services such as pilot services, traffic control, customs and security and engineering services. cargo loading and off-loading is carried out by two stevedoring firms, who supply all labor and equipment required for freight handling. The following port fees are currently in effect.

Dockage	- Two cents per GRT per day or 10 cents per foot per day, whichever is greater.
Wharfage	- $2.00 per ton of cargo, 30 days free storage n incoming vessels only.
Dues	- $1.00 per ton of cargo.
Pilotage	- $100.00 for first 12 feet of draft plus $3.00 for each additional foot.
Tug Hire	- $200 per hour.
Customs	- Entry/Clearance $6.00.
Water	- $0.85 per ton.
Electricity	- Approximately $27 to $29 per day per plug-in point when used.

2.2 Warehouses

A 3,500 square meter transit warehouse is at dock side.

2.3 Handling machinery

All cargo loading and off-loading is carried out by three stevedoring firms who supply all equipment and labor required for freight handling.

2.4 Water depth

Mid-channel depth of 60+ meters.
Low water depth at main wharf of 9.1 meters.

2.5 Harbor size

Harbor ocean area covers 11.8 sq. kilometers. Two 3-lane paved roads line the full perimeter of harbor.

2.6 Problems

Limited additional land availability in harbor area. Approximately 5 acres of government land available 1 mile west of main wharf. No cold storage.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Available at $0.85 per ton.

3.2 Electrical

U. S. standard 110 and 220 volts.
Charge - US$0.125 per kw hr.

3.3 Fuel

Fuel supplies are delivered by chartered vessel. The principal charterer is Pacific Resources, Inc., Honolulu, with a call approximately monthly. From 3 to 5 million gallons are delivered each trip - approximately 60 percent diesel, 28 percent jet fuel and 12 percent gasoline. All fuel comes from the U.S., either the west coast or Hawaii. The current price of diesel fuel is $0.71 per gallon. Gasoline is about $1.13 per gallon.

3.4 Sewer

The Pago Pago Bay area, Tafuna Industrial Park, and the Nuuuli-Tafuna area is serviced by sewage system. Two waste-water treatment plants provide primary treatment. A nominal sewer connection fee is charged. Most outlying villages rely on septic tank systems. Both of the tuna processing firms operating in American Samoa have obtained special permits from the U. s. Environmental Protection Agency concerning disposal of cannery waste products.

3.5 Waste Disposal

The American Samoa Government contracts a private business to collect and dispose of solid waste material generated from all villages in Tutuila which are accessible by paved roads. The capacity of existing sanitary landfill sites is very limited. Solid waste collection charges are paid annually by businesses in operation. The fee ranges from $25 to $250 depending on the type of business activity and number of employees.

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3.6 Engineering Services

Engineering services are provided by a limited number of on-island consultants. Major projects have often relied on foreign engineering firms licensed to operate in American Samoa.

3.7 Labor/Manpower skills

American Samoa is subject to the U. S. Fair Labor Standards Act under which minimum wage rates for selected industries in American Samoa are established. Every two years the Wage and Hour Division of the U. S. Department of Labor prepares a report on the Territory which is used as a basis for setting a minimum wage schedule. The current schedule is listed in Table 2.

Employees in American Samoa usually work 40 hours per week. Most companies offer fringe benefits such as paid holidays, vacation and sick leave. Some employers also provide pension/retirement benefits and medical insurance. All employers are required to provide Worker's Compensation insurance against work connected injuries or death and must comply with the provisions of the U. S. Occupational Safety and Health Act which regulates working conditions as to the health and safety of employees. The U. S. National Labor Relations Board has extended its jurisdiction to American Samoa, making it possible for U. s. unions to expand into American Samoa. However, there are no labor unions in American Samoa at this time.

3.8 Regulations/Laws

Businesses in American Samoa are eligible to sponsor non-American Samoans for implement, provided approval from the local Immigration Board is granted. A quota system has been established to regulate the number of aliens allowed to enter the Territory by nation of origin. The approval of the Immigration Board is usually limited to one-year renewable periods.

A U. S. Job Training Partnership program is available in the Territory for on-the-job training and can subsidize up to 50 percent of the training costs to businesses to hire workers under the program.

3.8. Quarantine laws and procedures

Any person, firm or corporation wishing to import into American Samoa any plants or plant material must first obtain a permit from the Department of Agriculture of the American Samoa Government. The permit details the amount and kind of plants, point of origin, method of transportation and type of treatment required, if any,

at the point of origin.

All imported plants and plant material must be accompanied by a certificate issued by a competent authority of the country of origin, listing the contents of the shipment, their locality and type of treatment, if any, and stating that the plant material covered by the certificate was examined and found to be free from injurious pests and diseases.

3.13 Land cost and availability

The topography of Pago Pago Bay with a narrow shelf bordered by steep mountains is a severe constraint on the potential area available for industrial development in the harbor area. Industrial sites are available on a long-term lease, 55 years with a renewal option, at the Tafuna Industrial Park located adjacent to the Pago Pago International Airport. The Park includes a total of 45 acres, divided into lots ranging from one-third to one acre. The final size of a site may be adjusted to fit specific business needs. There are presently 12 acres available, and 10 additional acres not yet fully developed. full electrical, water, sewage and drainage are provided. The annual lease rate is $0.15 per square foot.

Approximately 90 percent of the land in American Samoa is registered as communal family land. Under the existing tenure law on communal lands, it is unlawful for non-American Samoans to purchase communal land or lease it for more than 55 years. Land siting assistance for alternative government or private land is also available through the Development Planning Office.

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

Two tuna processing companies operate in American Samoa. Star-Kist Samoa, Inc. (a subsidiary of the H. J. Heinz Company) and VCS Samoa Packing (a subsidiary of P. T. Mantrust, based in Indonesia, and recently purchased from Ralston Purina Company) began operations in 1963 and 1954, respectively. In 1986, the two canneries processed approximately 150 thousand tons of tuna. The main product of both canneries is lightmeat and whitemeat tuna packed in oil or water in airtight metal containers. Two by-products, pet food and fish meal, are made from portions of the fish unsuitable for canning. Frozen fish are supplied primarily by boats from the U. S., Korea and Taiwan. Miscellaneous ingredients are provided by parent companies in the United States. Star-Kist Samoa imports tin-plate and

manufactures cans on-island, while Samoa Packing imports complete cans. The following quantity and value of tuna related products were exported from American Samoa to the United States in 1987:

	Quantity (thousands of tons)	Value Product (millions of dollars)
Canned Tuna	332.7	$268.6
Pet Food	11.8	18.1
Fish Meal	1.3	0.3

The total processing capacity of the two canneries is 770 tons per day.

Since 1983, Pago Chips, Inc. has manufactured snack foods such as banana chips, ulu (breadfruit) chips, taro chips and shrimp chips. Bananas, ulu and taro are purchased from local farmers. Dry pellet shrimp are imported from Hong Kong and Japan. Plastic bags and miscellaneous ingredients are bought from U. S. Suppliers. Production capacity is 1,200 1.75-ounce bags per day. Products are sold to local retail outlets.

Haleck's West Dairy was established in 1985 and manufactures ice cream for the local wholesale and retail market. Raw materials are purchased from suppliers in the U. S. Production capacity is 2,950 gallons of ice cream per month.

Pacifica Foods, Inc. packs kegs of corned beef. The firm began operations in 1975. Beef is imported from Australia. Plastic 15 kilogram kegs and salt are purchased from U. S. suppliers. Processing capacity is 3,000 to 5,000 pounds of beef per day. Product is sold locally.

5. INSTITUTIONAL FACTORS

The economy of American Samoa is primarily based on the free market system. Investment in commercial enterprises is generally left to the private sector. However, in certain areas of the economy government intervention is considered necessary to preserve or enhance the health, safety and general welfare of the territory's residents.

5.1 Private sector involvement

Possible from select local well-to-do business.

5.2 Equity participation by Board's Government Private

Yes, Government (U.S. Foundation monies).

6. RAW MATERIALS (Coconuts)

Coconut production in American Samoa is primarily for subsistence and sale at local markets and does not constitute any export earnings. The last official agricultural census revealed a decline in coconut production from 3,586,958 pounds harvested in 1970 to 1,324,766 pounds in 1980. There are presently 1,584 acres under coconut production. There are a total of 396 plantations, with an average size of 2 to 3 acres per farmer. There are 158 farms producing coconuts for sale, and 297 farms producing coconuts for production. There are only a few sites where the coconut trees have been planted in plantation rows. Most villages have randomly planted coconut trees on communal lands which provide for local consumption needs.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Nil.

8. GOVERNMENT POLICIES PRESENT

Nil.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

The government currently has no major plans or programs regarding the coconut industry, other than participation in this project. The local agencies most involved in agricultural production are the American Samoa Government Department of Agriculture and the American Samoa Community College Land Grant Program. The Land Grant Program has been involved with coconut planting programs. During the cannery shutdown, 1984-1985, a work program was instituted jointly with JTPA which included the planting of 50 acres of coconut trees on farms located on Tutuila. Plantings have also occurred in the Manu'a Group after Hurricane Tusi struck. There is presently no program controlling supply.

The Government would be interested in fostering the development of a processing plant in American Samoa through its incentives programs. Its interest in limited equity investment in such a plant would depend on economic benefits and long term viability.

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10. RULES, REGULATIONS, STANDARDS

See 3.12.

11. IMPORTS

Although American Samoa is technically a duty-free port, excise taxes at the following rates are levied at the port of entry:

- one hundred percent on beer, wine, tobacco products and smoking accessories;
- seventy-five percent on firearms and ammunition;
- twenty-five percent on motorcycles, cars weighing less than 4600 pounds, commercial vehicles and vehicle parts and accessories;
- fifty percent on vehicles of 4600 pounds and more;
- ten percent on vehicles for personal use;
- thirty percent on second-hand vehicles and machines for resale;
- eleven and one half percent per gallon of gasoline;
- three and one half cents per gallon on diesel and fuel oils;
- one half cent per gallon on kerosene;
- fifteen percent on lubricating oils;
- twenty percent on construction materials of less than "standard grade";
- one half cent per eight ounces on soft drinks.

12. EXPORTS

No export or value added taxes exist.

13. LABOR

13.1 Labor Construction

- unskilled, low skilled - $2.60/hr.
- skilled - $4.00 to $7.00/hr.

13.2 Processing

- minimum wage for entry level for miscellaneous industries - $1.85/hr.

- competitive entry rate - $2.50/hr.

(See Minimum Wage Rate attachment)

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14. PIONEER INVESTMENT INCENTIVES

14.1 Transshipment Incentive

Thirty day free port storage charges are conveyed for transshipment freight through the Pago Pago Port.

14.2 Tax Incentives

Section 936 of the U. S. Internal Revenue Code provides that U. S. Corporations operating primarily in American Samoa and other U. S. territories are allowed a tax credit equal to the taxable income from the active conduct of a business within a territory of the U. S.

No Federal provision explicitly limits the authority of American Samoa to provide tax relief with respect to income derived from American Samoa. The tax incentive law of American Samoa provides for full or partial exemption from income and other taxes for qualifying domestic and foreign investors. The Governor may grant the exemption upon recommendation of a tax exemption board. To qualify, enterprises must employ residents of American Samoa to the extent of at least 75 percent of the total work force. The period of tax exemption is for up to 10 years, although it can be made to terminate earlier if the cumulative amount of taxes forgiven equals 100 percent of the company's net current investment in American Samoa. The Governor may waive the 75 percent requirement and may renew tax exemptions.

14.3 Investment Tax Credit

Approved businesses are given the option for a tax exemption or an investment tax credit on taxable income for the value of capital investment (non-recurring) made.

14.4 Business Losses

Business losses may be carried forward for tax purposes for up to seven (7) years.

14.5 Financial Incentives

Long-term and working capital loans are available to eligible enterprises through various business financial assistance programs administered by the U. S. Government. These credit programs include both direct loans and loan guarantees. The American Samoa Government also administers a revolving loan fund program that provides a subsidy on rates of interest charged on qualified business loans from local commercial lending institutions.

15. OTHER

15.1 Susceptibility to natural disasters

Last major hurricane in 1966. Infrequent short term droughts occurring every other year lasting 4 to 6 weeks. Severe drought occurred in 1974.

COOK ISLANDS OVERVIEW

The Cook Islands are made up of 15 Islands and atolls. They span an ocean area of more than 2 million square kilometers. To the north are the Line Islands of the Republic of Koubato. To the Southeast the Austrol Islands and to the west Niue Island and American Samoa.

LAND AREA

The total land mass covers 240 sq. miles the longest island and capital Rarotonga is some 67.1 sq. km.

Rarotonga is a high volcanic island while the other souther islands are more of the structure of raised atolls with a high plateau or outer rim and a sunken center of fertile land.

Population

The population stands close to 17,800 some 9,000 being resident in Rarotonga. The Cook Islanders are a handsome race well known for the dancing and entertaining skills. Cook Islanders are gentle, outgoing. and generous. They have natural talent for diving, fishing, and agricultural activity.

The Economy

The economy is a mix of tourism, agriculture and service industries including offshore banking. The tourist industry is particularly buoyant and attracts visitor levels up to double the country's base population, and this sector continues to expand.

Language

The official language is English. Cook Island Maori and English are both used frequently.

Currency

The base currency is N.Z. dollars but the Cook Island mints notes and coins as well.

Air Transport

Rarotonga hosts up to 8 international flights per week with connections to Australia, New Zealand, Hawaii, Tahiti, The Samoas, and Fiji. Tow internal airlines run daily services to most outer islands.

Shipping

Rarotonga is serviced regularly by small container vessels with links to New Zealand, Hawaii, The Samoas, and Niue, and transshipment points in Fiji and Australia.

Communications

The capital Rarotonga has access to worldwide communications by satellite. Fax, Telex, and Telephone services are readily available.

Banking

The Westpac Banking Corporation and the Australia/New Zealand Banking group offer a full range of commercial services. A government funded Development Bank operates also.

Utilities

On Rarotonga a good range of utilities is available. In some areas water in large quantities is not readily available. Similarly there are some constraints in 400 volt supply in certain areas of Rarotonga.

The outer islands generally have limited power and water resources and limited access to fuel suppliers.

Government

The Cook Islands has a democratically elected government totaling 24 members. The membership being fully representative of the entire Cook Island group. The Prime Minister selects his Cabinet and the Cabinet are the decision makers.

Land

Most land is privately owned by family interests. Leasing is the most common method of acquiring land. Generally these leases are negotiated on twenty year terms with renewal provisions.

Investment

The Cook Islands government encourages foreign investment and have in place investment legislation clearly laying out a full range of incentives.

Agriculture

The Cook Islands has highly fertile soil on some islands. Cash cropping for export is a major activity. The crops most commcn are papaya, bananas, oranges, pineapple, taro, capsuums and tomatoes.

Migration

Cook Islanders are highly mobile people and communitics of Cook Islanders exist in New Zealand and Australia.

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COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

3 medium sized container ships service Rarotonga monthly. Each vessell has reefer and dry box facilities. As new as break bulk cargo capacity.

1.1.1 Major port of cargo loading
Honolulu, Hawaii = 1 vessell
Auckland, New Zealand = 2 vessells

1.1.2 Internal Shipping:
The outer islands of the northern group are serviced on a regular schedule averaging 12 - 16 days. The southern group is serviced more frequently. The service is highly dependent on cargo inducements. Currently one vessell provides this service although other services are planned.

1.2 Cost

Export rates can be negotiated. Current rate between New Zealand and the Cook Islands is $2,500 U.S. per container general cargo.

Cook Islands' internal rate for coconuts from outer islands is $2.21 U.S. per 100 coconuts (husked)

1.3 Frequency

Contains vessells from New Zealand (2 vessells monthly) and from Hawaii (1 vessell monthly).

1.3.1 Current Routing

Example: New Zealand via Tonga, the Samoas, Niue Island to New Zealand.
Example: Hawaii via Samoas, Tonga, Fiji, Cooks, Hawaii.

1.4 Capacity

Southbound from Cooks to New Zealand = large capacity
Northbound from Cooks to Hawaii = large capacity
From New Zealand to Hawaii booking space in advance essential.

1.5 Handling facilities from source (harvest) to collection points

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In outer island ports very basic. In outer islands manual loading of sacks is normal.

Rarotonga has good wharf facilities and handling equipment capable of lifting 60 tonnes.

1.6 Back loading problems

Major problems is shortage of outbound cargo.

1.7 Other transport problems

Roadstead conditions, in outer island ports, very sensitive to rough seas in outer islands, thus turnaround time and loading rates are costly.

2. EXPORT & IMPORT FACILITIES

2.1 Port

Rarotonga has the only wharf. At all other ports roadsteads services by launches and barges apply.

2.2 Warehouses

On wharf Rarotonga and Aitutari, other ports, mostly small wharf sheds.

2.3 Handling machinery

Container fork lifts 1 x Unit
40 tonne crane available
8 tonne fork lifts x 2 units
Truck, cranes 5 ton capacity x 2 units

Aitutari - One truck crane capacity = 5 tonne

2.4 Water depth

6.2 meters Rarotonga

2.5 Harbor size

Wharf 128 m Berth x 1
132 m Berth x 1

Turning circle 62 m

2.6 Problems

Depth of wharf berths limit ship size. Turning circle small and very narrow entrance to harbor.

Entrance ____ requires skilled navigation

3. SUPPORT INFRASTRUCTURE

3.1 Water

Available on Rarotonga in most areas but shortages are common throughout the group and commercial quantities are limited to Rarotonga.

3.2 Electrical

420 volt and 240 volt service available consistently in capital but in some areas limited by cable size. Outer islands generally have limited service only during daylight hours.

3.3 Fuel

Diesel - freely available
Petrol - freely available

3.4 Sewer

Septic system necessary
Mains feed unavailable

3.5 Waste Disposal

Very limited, tightly controlled, own installation essential.

3.6 Labor

3.6.1 Engineering

Welding services to Lloyds certificate available.

Small engineering job capability only.

3.6.2 Manpower skills

Good availability in construction industry and service sectors. Staff training needed. Cook Islanders adapt and learn skills easily.

3.6.3 Regulations/laws

Wage Laws are in force as are most common laws appertaining to industry in the region.

3.6.4 Costs - Rarotonga

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Wage Rates - $1.18 per hour U.S.
Skilled Tradesmen - $4.50 per hour (U.S.)
National Average - $1.80 per hour (U.S.)

On outer islands wage levels are lower generally but skills are in short supply.

3.6.5 Availability

Steady supply of unskilled labor. Skilled workers are very hard to find locally.

3.6.6 Reliability

Very good. Generally will work well and arrive on time and put in extra hours required.

3.7 Quarantine laws and procedures

Very stringent. Active Agriculture Department inspect all produce for import or export. Fumigation is standard procedure.

3.8 Land cost and availability

On Rarotonga the availability of land is limited. Demand for tourist investment is high and affects land prices. Land cannot be purchased, only leased. To secure a lease in an area with good utilities for industrial use may require inducement of U.S. $20,000 for 5 hectares and an annual rental of some U.S. $2,500.

3.8.1 Problems, etc.

Mainly relate to the limitation and quality available.

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Size

Cook Islands Coconut Products Limited 150 sq. meters of processing area. 60 sq. meters covered storage.

4.2 Use

Canning operations

4.3 Type

Canning of coconut

4.4 Products

Coconut cream, coconut pressing by product

4.5 Capacity

Cream 180 tonnes p.a. Coconut pressing 180-200 tonnes p.a.

4.6 Utilization

Less than 40% of capacity

4.7 Age

3 years since establishment

4.8 Ownership

Joint Venture/Government/Development bank/Private

4.9 Location

Matavera or Rarotonga

4.10 Type Management

Private SEctor/Government Board

4.11 Interest in participating in this integrated venture

Yes

5. **INSTITUTIONAL**

5.1 Private sector involvement

See detail on other processors e.g. Cook Islands

5.2 Equity participation by Board's Government Private

Government is interested

5.3 % of GNP and export earnings from coconuts

Barely measurable

5.4 Other institutions involved with coconuts

Northern Group Copra Society (currently inactive). Government support available subject to consultation.

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5.5 Degree of control on supply, etc.

Nil

5.6 Competition (multinationals and local firms)

Nil

6. RAW MATERIALS (Coconuts)

6.1 Geographical concentration of productions

Northern Group - see Appendix 9 green Agriculture Department Book.

6.2 Tonnage available

As above.

6.3 Land ownership

Communal in most supply areas

6.4 Tree use rights

Communal in most supply areas

6.5 Size of holdings

Small. Atolls and groves of no fixed boundaries.

6.6 Age

Senile and Serescent	18%
Old and mature	11%
Young	16%
Not yet Bearing	55%

6.7 Variety

Cook Islands Talls

6.8 Productivity

Average 18 nuts per tree p.a.

6.9 Copra meat or cream yield/nut type

Cream 120 - 140 Northern Group
145 - 165 Southern Group

6.10 Yield and variation within the country

Substantial.

6.11 Replanting schemes and hybrid development

Very high proportion of young tree plantings in Northern Group = 55% of total trees.

6.12 Harvesting methods

Manually

6.13 Frequency

Infrequency in past years but generally in 6-8 week cycle except for areas closed for conservation. Conservation is common through the group as many of the coconut areas are wildlife habitats.

6.14 Labor availability

Limited to family groups/village groups which work on a piece meal/part-time basis.

6.15 Care and husbandry practices

Limited except for occasional ring weeding and spreading husks beneath palms.

6.16 Waste - not harvested

Currently very high due to lack of market opportunity. Could be as high as 50% of available resource.

6.17 Other losses

Rat attack, climatic factors, e.g. drought.

6.18 Domestic

15% maximum

6.19 Industry, % of total availability

Currently utilizing 5 - 10% throughout the group, except in Rarotonga where all are used for domestic use.

6.20 Cost of coconut production

6.21 Domestic pricing and policies

No formal pricing in place although government is active in price support. During periods of low copra prices, government subsidized production.

6.22 Controls

On nut quality between growers and producers.

6.23 Rural

Onus on grower, rarely do Agriculture Department reject nuts on size for sale except when rotten or broken.

6.24 National

Only on whole fruit exports do Agriculture inspect for quality.

6.25 Influence of stabilization schemes (effect of these on sale on non copra products)

Copra no longer produced: Price support to factory is .0126 each = $1.26 for 100.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Nil

8. GOVERNMENT POLICIES PRESENT

Government is reviewing the industry, and recognizes the need for the industry to develop.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

Replanting programs and crop management programs which support added value processing.

10. RULES, REGULATIONS, STANDARDS

11. IMPORTS

Subject to taxes/duty unless product is re-exported. Packaging free of duty.

12. EXPORTS

No export tax levied.

13. LABOR

13.1 Labor Construction

See Questionnaire

13.2 Processing

See Questionnaire

14. PIONEER INVESTMENT INCENTIVES

Available in some instances. High priority is given agricultural activities.

15. OTHER

15.1 Susceptibility to natural disasters

Droughts are the major hazard. A cyclone in 1986 caused widespread damage.

15.2 Disease such as "cadang cadang"

Some termite infection in Northern Group but is being monitored.

REPORT ON FIJI

FIJI OVERVIEW

The Fiji Islands spans the 180° meridian of Longitude and lie between 15° and 22° South of the Equator. The land mass of 18,333 square kilometers comprises 322 islands of which some 100 are inhabited.

Fiji is the crossroads of the South Western Pacific and is well serviced by international air traffic through Nadi Airport and Nausou Airport both of which are located on the most populous island of Viti Leveu.

Fiji's Capital Suva has a population of 74,000 and is the major seaport. The second city is Lautoka with 27,000 inhabitants is also a sea port, both these cities are on the main island of Viti Leveu.

Population

The population stands at some 700,000 and is made up of two major ethnic groups and a number of minorities.

The largest group are of Indian Descent and account for 48% of total population. The Fijian Race accounts for 44% of the population and the minority is made up of European, part European, Chinese, Rotuman's and other Pacific Islanders.

Climate

The climate is tropical and enjoys trade winds predominately from the East to South East. The weather is of two seasons - Dry and Wet. The Wet Season is from November through April when the heaviest rainfall is recorded. The Dry Season is from May through October.

Temperature ranges during the Wet Season average in high of 31.4°c to a low of 23.6°c. In the Dry Season or winter period, the high is in the order of 28.4° and the low of 18.6°.

The seasonal rainfall varies from a high of 1945 mm at Suva during the wet season to a low of 448mm at Nadi in the dry season.

Weather Season

During the past 10 years, tropical cyclones have been prevalent throughout the Fiji Islands and some crop and property damage does occur. Droughts occur less frequently but have a large term affect on the agricultural production.

Language

The official language is English and is widely used together with ethnic languages.

The Economy

The economy is primarily agrarian with sugar the major crop. Timber is a significant factor, as is coconut products, fish, gold and ginger which are exported.

Diversity into secondary industries is growing rapidly over a wide range of manufactured products.

Tourism is a major foreign exchange earner and challenges sugar in regard to earnings.

Investment

Fiji has an investment climate unique in the Pacific. The range of incentives is broad and generous. Tax free factory zones, free import access for plant and machinery, freedom to repatriate funds etc. are but a few of the investment package items available.

Banking

Five Trading Banks offer a full range of Commercial Banking facilities.

In addition the Fiji Development Bank provides loans for industrial and Agricultural developments.

Current the Commercial Banks enjoy a high liquidity position.

Labor

A solid supply of skilled and unskilled workers are available throughout Fiji. Generally multi-lingual the labor force has the ability to adapt and absorb skills.

Basic work skills are taught at Government and private technical institutions and prepare the youth for full time employment. Currently some 10% of the work-force is awaiting employment.

Telecommunications

Fiji is well serviced with a network of postal telephone and radio links.

The international service is among the most efficient in the world and offers the whole range of facsimile, telephone and telex links abroad.

Land Availability

Fee simple or Freehold land is available for purchase in some parts of Fiji.

In addition the Nature Land Trust Board leases land on behalf of

the Fijian landholders for various commercial users.

Prices vary widely given the district or island venue but generally are attractively priced.

Transport International

Fiji enjoys the most frequent sea and air services in the South Pacific region. Shipping services are available to Europe, U.S.A., Japan, Australia, New Zealand, Tonga, Samoa, Cook Islands, Kiribati, and Tuvalu.

Air services likewise are frequent and scheduled flights to Canada, Japan, United States, Australia and New Zealand are constant as are links with other Pacific Islands.

Local Shipping

The Islands of Fiji are linked by constant Air and Shipping services.

The major coconut producing areas including Taveuni and Savu Savu are serviced by a roll on roll off vessel namely the Spirit of Free Enterprises (SOFE) which has container capability as well as break bulk and reefer capability. On SOFE, rates are negotiable but generally the other shipping company's have standard rates above the SOFE level. Frequency is regular on all inter island vessels.

Transport Land

Fiji has some 3,300 kilometers of roads of which 1,200 kilometers are all weather links.

The main island or Veti Levea has a 500 kilometer highway encircling the island and is mainly tar sealed.

Rural and arterial roads are of good quality but are susceptible to surface scouring during the wet season.

Electric Power

Is available in the City and town areas in 440 volts and 240 volt services. Some rural areas and islands lack mains feed power in these areas so power is often privately generated.

Part of the Main Fiji Grid is Hydro powered.

Power charges are generally below the regional average.

Water

Is piped in cities and town areas and more than 60% of the population have easy access to water. The water quality is good.

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Sewerage

Is limited to the cities and part of the urban areas. Elsewhere septic tanks are installed.

Waste Disposal is the responsibility of the Producer and laws governing this are in place.

General

The Fiji Islands are a good point of investment, and the pace of life more relaxed than Western societies. The economy is returning to a buoyant state and the future is promising.

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COUNTRY: FIJI

COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

See Fiji Attachment No. 1.

1.2 Cost

Cartage: 7 tonne truck $10 - 12.00 per hour. City area
$12 - 14.00 per hour Country area

1.3 Frequency

Shipping locally - good, and export good. See Shipping Appendix

1.4 Capacity

See Shipping in Fiji Attachment No. 1.

1.5 Handling facilities from source (harvest) to collection points

Mainly truck, trailer. Bagged coconuts are manually carried from inaccessible areas or shifted in small boats.

1.6 Back loading problems

Frequent throughout Fiji. Generally relate to a limitation of back loading. Costs on some routes are high.

1.7 Other transport problems

Limited hireage availability, in some districts particularly when came is being harvested.

2. EXPORT & IMPORT FACILITIES

2.1 Port

See Port Study - Fiji Attachment No. 2.

2.2 Warehouses

Suva 5 cents per cubic foot per day in off wharf facility

2.3 Handling machinery

See Fiji Attachment No. 2.

2.4 Water depth

See Port Study - Attachment No. 2.

2.5 Harbor size

See Port Study - Attachment No. 2.

2.6 Problems

Security checks are compulsory for inward and outward cargo.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Available in all urban areas 60% of Fiji has accessible water of good quality.

3.2 Electrical

Available in all towns and most rural areas. Supply in towns 440 volt and 240 volt.

3.3 Fuel

Available in most areas

Diesel	= 44 cents liter
Petrol	= 67-69 cents liter
L.P. Gas	= 1.23 per kg.

3.4 Sewer

Available in some towns. Most city areas, but rural areas require septic tanks.

3.5 Waste Disposal

Available on conditional use basis in city areas, otherwise self contained system must be installed.

3.6 Engineering

A wide range of engineering skills are available. Medium/Light scale.

3.7 Manpower skills

A wide range of skilled/semi skilled and unskilled labor is readily available.

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3.8 Regulations/laws

Are in place for every industry. These include building codes, industry awards, labor awards etc.

3.9 Costs

Are embraced in industry awards but the Factory Act is under review. Refer to Labor Section for Rates

3.10 Availability

Ample manpower is available in most cities, towns and rural areas.

3.11 Reliability

Very good

3.12 Quarantine laws and procedures

Fiji relies heavily on agricultural exports, therefore it maintains firm control in quarantine matters. It is unlikely that a relaxation of this policy will occur.

3.13 Land cost and availability

Ample land is available for industrial use. It is leasehold on long or mid-term. Rates vary widely but land lease costs are realistic.

3.14 Problems, etc.?

In areas where free hold land is available, a general loss of $15,200,000 per 1/3 acre is indicative of value.

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Food Processors of Fiji Ltd.

4.1.1 Size

Nut Preparation/Paring Sheds = 200 sq. meters
Cream Processing Facility = 15 sq. meters
Blast Freezer Storage = 12 tonnes capacity
Holding Freezer Storage = 25 tonnes capacity
Some 300 meters square. Capability to process fruit, vegetables, beverages, sauces.

4.1.1.a Existing Processing Facilities
Chappalia Properties LTD. Taveuni Island

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4.1.2 Use

Multipurpose cannery, bottling operation.

4.1.3 Type

Mainly canned products, bottled sauces and preserves. Has desiccating plant of 300 tonnes per annum. Currently unused.

4.1.4 Products

Coconut cream and spinach, tomato sauce, chili sauce, local asparagus in coconut cream, coconut cream.

4.1.5 Capacity

About 400 tonnes per annum capacity all products excluding desiccated.

4.1.6 Utilization

Single shift basis
Coconut cream products = Est.: 10% capacity
Desiccating Plan = Nil
Other Products = Est. 40%
Note: No accurate Figures available

4.1.7 Age

Joint Venture Company established in the early eighties. Factory has been in place much earlier with different ownership.

4.1.8 Ownership

Private/Government joint venture

4.1.9 Location

Suva Industrial Area at Vatuuaga

4.1.10 Type Management

Private Enterprise/Corporate

4.1.11 Interest in participating in this integrated venture.

Interested in integrated ETC.
Yes. Joint Venture possibility.

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4.2 Chappalia Properties Ltd., Taveuni Island.

Chappalia Properties Ltd. has its own coconut plantations and a ready local supply from adjoining properties. The area has an ample supply of good water and a private power generation system. Currently the coconut cream plant is working on an order-supply basis.

Use Food Processing Facility

4.2.1 Size

Nut preparation/paring sheds	- 200 sq. meters
Cream processing facility	- 15 sq. meters
Blast freezer storage	- 12 tons capacity
Holding freezer storage	- 25 tons capacity

4.2.2 Use

Food processing facility.

4.2.3 Type

Cream expelling activities.

4.2.4 Products

Frozen bulk coconut cream, 25kg packs.

4.2.5 Capacity

Daily - 2.5 tons - single shift basis
Weekly - 12.5 tons - single shift
Per Annum - 500 tons

4.2.6 Age

Creaming plant - 4 years.

4.2.7 Ownership

Private Enterprise

4.2.8 Location

Taveuni Island, Northern Province, Vanua ____

4.2.9 Type Management

Private Enterprise/corporate

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4.2.10 Interest in participating in this integrated venture

Yes, joint venture possibility

4.3 Type/Cream Expelling activities

4.4 Products: Frozen Bulk Coconut Cream 25kg packs.

Capacity: Daily 2 1/2 tons, Single Shift bases
Weekly 12.5 tons Single Shift
P.A. 500 tons

Age: Creaming Plant - 4 years

Ownership: Private Enterprise

5. INSTITUTIONAL

5.1 Private sector involvement

Limited to the two current processors. Major activity is in oil milling.

5.2 Equity participation by Board's Government Private

The National Marketing Authority has been involved in whole nut exports and may invest further.

5.3 % of GNP and export earnings from coconuts

5.4 Other institutions involved with coconuts

The Coconut Board, quasi government agency, regulates and controls the primary part of the industry.

5.5 Degree of control on supply, etc.

Total control

5.6 Competition (multinationals and local firms)

With substantial investment in oil milling and oil based production in place, competition will occur for raw raw materials.

6. RAW MATERIALS (Coconuts) (See section 16 for more information)

6.1 Geographical concentration of productions

The Northern Division of Fiji has 55%
The Eastern Division 35%
Lemaiviti and Lau provinces _____ 15%

6.2 Tonnage available

Copra nuts - 1986 = 22,475 tonnes

6.3 Land ownership

Freehold or the medium _____

6.4 Tree use rights

Private 35% and communal 60%

6.5 Size of holdings

Large over 400 hectares
Medium over 100 hectares
Communal = generally located in _____, Southern _____, Vanua Lau Coast

6.6 Age

Senile and senescent approaching 60% of total palms

6.7 Variety

The major producer is Fiji Talls Rotuman, Rennells, Niulera.

6.8 Productivity

Variation in productivity is wide but in general terms Fiji Talls are the highest producer.

6.9 Copra meat or cream yield/nut type

<u>Fiji Talls</u>

Copra = 5,500 - 6,000 Nua per tonne Copra
Cream = 140-150 grams per nuts

<u>Hybrid Palms</u>

Copra = 6,500
Cream = 125-140 grams

6.10 Yield and variation within the country

Substantial / Hybrids average 6,500 nuts to tonne copra
Fiji tolls average 5,500 - 6000 nuts per tonne Copra

6.11 Replanting schemes and hybrid development

Hybrids were introduced to Fiji as early as 1928.

Since then many schemes of hybridization have followed. A concerted effort involving Malaysian Dwarfs is in progress at present.

6.12 Harvesting methods

Collecting mature nuts which have fallen naturally. For copra or husked nut trade. By pole and hook, or climbing for drinking nuts.

6.13 Frequency

Continuous for mature nuts, otherwise they sprout and root. Green as required for sale or consumption.

6.14 Labor availability

In rural district labor is readily available. Some copra plantations have contract harvesters and copra makers.

6.15 Care and husbandry practices

Apart from clearing beneath the palms and scattering the husks for mulch not a great deal of husbandry takes place. Some of the more enlightened farmers inter-crop and apply fertilizer.

6.16 Waste - not harvested

Minimal.

Except in times of poor prices to copra producers when nuts are not harvested regularly.

6.17 Other losses

Some rat attacks, and pest and disease infection. Nut spoilage in areas not consistently harvested.

6.18 Domestic

12,000 - 15,000 tonnes consumed domestically for food and animal feed. This figure is exclusive of copra production. The 1986 harvest total including domestic use amounted to 60% .

6.19 Industry, % of total availability

60% copra

6.20 Cost of coconut production

1-4 cents per nut depending on end product, e.g. copra cuttings 1-2 cents, processing 3-4 cents.

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6.21 Domestic pricing and policies

Nuts for retail consumption are not price controlled but generally follow copra prices as a basis for negotiating prices.

6.22 Controls

The Coconut Board exercises control over copra, unhusked nuts, and fresh coconut kernel, in terms of quality, pricing, and added native processing. See Attachment No. 3, Coconut Board.

6.23 Rural

Inspection of copra for quality/whole nuts for export

6.24 National

Inspection for size and quality of whole nuts at Suva or other main port.

6.25 Influence of stabilization schemes (effect of these on sale on non copra products)

Stabilization funds have a marked effect on on-copra products, because copra is the yardstick of a coconut's value. Fiji has an internal stabilizing fund. Food Processors of Coconuts must pay a levy to the Coconut Board for nuts purchased.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

None apply

8. GOVERNMENT POLICIES PRESENT

The Government has a very progressive policy to replanting, hybrid development and inter-cropping.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

Further processing reinvestment in plantations is supported by the Government. Dept. of primary industries is promoting inter-cropping, hybrid planting and replanting of senile tree areas.

10. RULES, REGULATIONS, STANDARDS

These are set by the Coconut Board which is a statutory body and has very wide powers. These Powers are to protect growers interests and to bring orderly marketing to the industry.

11. IMPORTS

Desiccated coconuts, confectionery coconut items, coconut cream.

12. EXPORTS

Coconut oil, coconut based soap, lotion

13. LABOR

13.1 Labor/Construction Industry

Each separate industry has award scales of pay, the rates quoted should be treated as indicative as considerable varieties occur.

13.2 Processing

14. PIONEER INVESTMENT INCENTIVES

Available. Excellent packages. See Attachment No. 4.

15. OTHER

15.1 Susceptibility to natural disasters

Drought, hurricanes and cyclones are very frequent but for coconuts recovery is good. Fiji covers a wide area and cyclones and hurricanes do not effect the whole country at any one time.

15.2 Disease such as "cadang cadang"

No cadang cadang, rhinoceros beetles (are in Fiji but are under control), stick insect infestation heavy, in some district leaf yellowing is becoming more evident.

All diseases are under control, and monitored constantly.

REPORT ON FRENCH POLYNESIA

COUNTRY PROFILE INFORMATION

FRENCH POLYNESIA

Transport sea/land

Sea : small schooner 100 to 300 t.

From Tahiti to Leeward Islands (or return) : $25/tm3, 2trips/week
From Tahiti to Tuamotu islands (or return) : 75 to 100US$/tm3,1 trip every 3 weeks.
From Tahiti to Marquisas islands (or return) : 87US$/tm3, 1 trip every 2 weeks.

Handling

Man to tractor or speed boat (Tuamotu Islands)
No back loading problems because ships returning to Tahiti are far from their full capacity.

Land

Tractors, trucks. Due to very short distances in islands, the corresponding costs of land transportation are generally very low and can be neglected at a first stage.

Import/export facilities:

There is one international port; Papeete. It is well equipped port with sufficient warehousing, good handling equipment for Ro-Ro containers or others. There are no problems with port facility and capacity. The good water depth and harbor size allows for passage of larger ships.

Support Infrastructure:

Water availability is a crucial problem in the Tuamotu islands (atolls). As far as infrastructure support is concern, the island of Tahiti is fairly central regarding the other producing islands that would supply the husked coconuts or the meat to a central facility in Tahiti has all the necessary infrastructure (water electricity, fuel, sewer, waste disposal, engineering, man power skills). However quarantine laws are very restrictive on fresh coconut introduction, land costs are high and availability is low. A pre-processing or processing facility will certainly be encouraged in Tahiti but the cost factor will be a determinant.

Existing processing facilities:

Hullerie de Tahiti has a maximum capacity of 25,000 mt/year of copra, that is 15,000 mt/year of oil. The present processing is 14,000 mt/year of copra, that is 9000mt of oil and 4400mt of copra meal (3800mt directly sold to farmers and 600mt used in the animal feed production). This plant was a second hand 1945 unit

from San Francisco installed in Papeete in 1967. It is very old and obsolete. It is owned by a "mixed economy company" with the Territory as a majority stock holder. It is located in Papeete harbor. The same company also produces animal feed using copra meal and imported corn and other ingredients. Animal feed production: 3500mt/year. Copra mill usage rates 4.: 600mt/year. This company should be interested in participating in the integrated venture proposed.

Sanque:

This privately owned company also produces animal feed. The production is 500mt/year. The copra meal usage rates is none. It is located in Tahiti on the small island. This company may be interested in the project. The animal feed imports are 3000mt/year

Jus de Fruits de Mooree:

Opened in 1981 2,000 l/year of tropical fruit juices and drinks are produced. Same type of Company as the previous one, located in Moorea Island. This company would not be interested in the coconut operation.

Brasserie de Tahiti

150,000 hl/year of beer and soft drinks are produced here. It is located in Papeete and Punaauia. This company could be interested in venturing with the project. 15 to 20 other smaller companies are in the dairy, meat, coffee, alcohols, soap and cosmetic business, to some extent they could also be interested in the project.

Other Companies

They are in the meat, dairy, alcohol, soap and cosmetic business, and are fairly good potential investors.

Food processing pilot plant and laboratory

This pilot plant, within the agriculture department, aims at helping the industry in its development. It opened in October 1988

Institutional

Generally speaking involvement of government and private sector can be visualized optimistically, provided the profitability of the operation is proven.

Other

The coconut products (oil only) represents 40% of export earning.
The coconut earnings represent 0.3% of the total GNP
The local copra market is channeled through the one oil company.

The only competition on coconut local market is the fresh coconut domestic consumption.
75% of the tree use rights go to the copra producer. The other 25% are for the owner.
The quality of copra is low to average.
Land is mainly undivided, the tree use rights are effective, and are sometimes a source of conflict and stagnation for tree replanting. The trees are quite old and the replanting schemes is very low, being about 1/3 of the maintenance rate. The yield is obviously quite low 300 Kg/Ha of copra production.

Plantations

They are very dispersed among more or less isolated islands Tuamotu:55%, Marquisas:25%, Leeward:20% this is over a radius of 6000Km.

Variety.

"Cocotier Grand de Polynesie"

Productivity:

Coconut meat per nut, in the Leeward Islands and Marquesas Islands 520g/nut and 3000-3500 nuts/t of copra for the Tuamotu Islands 410g of meat/nut and 4000-4500 nuts/t of copra.
Hybrid development: Extensive in Tuamotu Islands. There is no climbing of the nuts, there are 2,3 or 4 pickings of the nuts/year Labor is available but the economic conditions are not good because of the 50/50 producer/owner traditional contracting.

Care and husbandry

Very limited to a minimum or under that minimum the harvesting rates are between 40 to 50% depending on distance and isolation of the island 20% are not harvested, 20% are germed and 10 to 20% are wasted.

Other uses:

20,000,000 nuts/year as fresh nuts for food ingredients (direct household use) This represents 25% of the total availability.
Coconuts are sold as husked nuts and as grated refrigerated meat.
Storage of the nuts is minimal and very short termed under ordinary conditions and only for immediate transportation.

Cost of coconut production:

Very difficult to define, domestic pricing is, at farmgate: copra 550 US$/mt, husked nut .13 to .17/nut, fresh nut 10 to .13/nut.
Freight to Papeete: .10
Handling : .04
Miscellaneous : .02
Total FOB .29 to .33/husked nut.

Stabilization schemes

Stabilization policy does not concern non copra product sales.

Type of STABEX applied:

Copra is purchased by shipping companies at .55/Kg in the production islands and is sold to the oil factory at .63/kg.
The difference is detailed below:

Loading and unloading	1.8
Weight loss by desiccation	2.2
Commercial service	4.4
Profit	0.6

The freight is paid by the Government.

The copra purchase price is determined by the government.
The oil factory exports the oil at world price, then the Government, through a special fund, subsidizes the difference between the actual economical price and the world market price STABEX is paid to this special fund to help in the stabilization process.

Government policy

Copra is one of the rare resources for the remote islands and locations (Leeward, Tuamotu and Marquisas Islands)
This subsidy policy is motivated by the intention of maintaining the people in their islands through adequate incentives.
Nevertheless, effective action has taken place in view of diversifying production and generating revenues for the islanders (vanilla, tourism, black pearl,...)

The replanting program aims only at maintaining the production potential at the present level along with an increase in the agronomic yield.

The Territory is interested in any upgrading of the coconut production and processing, in view of added value for all concerned and of reducing the public aids.

Rules, regulations, standards:

Foreign investment is submitted to authorization and considered as foreign when a company has more than 20% of the capital as foreign input. Regulations are the same as in France.
Detailed texts are being airmailed to A.T.I.

Other

Plantations are fairly well protected against diseases due to our isolation and quarantine measures.
1983 cyclones have had adverse effects on production, but these occurrences are rare.

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OVERVIEW

LAND AREA

3,265 ag.km.

Population

The population in 1985 was 172,800

The Economy

Tourism is the major Component of the Territory. The Service sector is active as is industry Agricultures is among the lesser sector but activity is progressive in the outer Islands.

Language

The official language is French.

Currency

Pacific Franc's

Air Transport

The Capital Tahiti has one of the highest. Frequency rates in the Pacific with flights from U.S.A., Europe, New Zealand, Australia and Regional.

Shipping

Shipping tonnage and Frequency is excellent both containers and bulk cargo capacity. Similarly inter-island shipping for Frequency, although local shopping costs are high.

Communications

Are excellent and a full range of modern Satellite services are available.

Banking

The facilities are very good and the range of products and services are equal to any other if not better regional countries

Utilities

In the Capital Tahiti a full range of Utilities is available.

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COUNTRY: FRENCH POLYNESIA

COUNTRY PROFILE INFORMATION

1. **TRANSPORT (SEA/LAND)**

   1.1 Type (container, refrigerator, other)

   1.2 Cost

   1.3 Frequency

      1.3.1 Current Routing

   1.4 Capacity

   1.5 Handling facilities from source (harvest) to collection points

   1.6 Back loading problems

   1.7 Other transport problems

2. **EXPORT & IMPORT FACILITIES**

   2.1 Port

      Papeete has very good port facilities
      Roll on Roll of facilities

   2.2 Warehouses

      Good warehousing

   2.3 Handling machinery

      Container and general and refer handling capability

   2.4 Water depth

      8 - 10 meters

   2.5 Harbor size

   2.6 Problems

3. **SUPPORT INFRASTRUCTURE**

   3.1 Water
      In Papeete

   3.2 Electrical

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3.3 Fuel

3.4 Sewer

3.5 Waste Disposal

3.6 Labor

3.6.1 Engineering

3.6.2 Manpower skills

3.6.3 Regulations/laws

3.6.4 Wage regulations for public servants

3.6.5 Availability

3.6.6 Reliability

3.7 Quarantine laws and procedures

3.8 Land cost and availability

3.8.1 Problems, etc.?

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Size

4.1.2

4.2 Use

4.3 Type

Copra mill

4.4 Products

Oil and copra cake

4.5 Capacity

25,000 mt p.a.
14,000 mt p.a. oil

4.6 Utilization

underutilized

4.7 Age

4.8 Ownership

4.9 Location

4.10 Type Management

4.11 Interest in participating in this integrated venture

5. INSTITUTIONAL

5.1 Private sector involvement

5.2 Equity participation by Board's Government Private

5.3 % of GNP and export earnings from coconuts
3%

5.4 Other institutions involved with coconuts

5.5 Degree of control on supply, etc.

5.6 Competition (multinationals and local firms)

6. RAW MATERIALS (Coconuts) (See section 16 for more information)

6.1 Geographical concentration of productions

Outer islands	Tuamotu	55%	production radius
	Marquisas	25%	6000
	Leeward	20%	

6.2 Tonnage available

6.3 Land ownership

6.4 Tree use rights

6.5 Size of holdings

6.6 Age

6.7 Variety

Cocotier grand de polynesie and Hybrids extensively planted in Tuamotus

6.8 Productivity

Leeward and Marquisas per nut kernel = 520gr
nuts per ton's 3,000 - 3,300
(Hybrid) Tuamotu 410gr kernel per nut 4000-4500 nuts per ton copra.

6.9 Copra meat or cream yield/nut type

see above

6.10 Yield and variation within the country

6.11 Replanting schemes and hybrid development

6.12 Harvesting methods

By land loaded to trailer of small boats

6.13 Frequency

3-4 tonnes a year
particularly so in isolated regions

6.14 Labor availability

Irregular due to 50/50 owner/labor contract team for copra in some areas. More regular when copra cutter receive 75% and owner 25% of revenue.

6.15 Care and husbandry practices

Very little is practiced.

6.16 Waste - not harvested

Substantial 20% p.a. unharvested.

6.17 Other losses

Vermin inflation

6.18 Domestic

20%

6.19 Industry, % of total availability

6.20 Cost of coconut production

6.21 Domestic pricing and policies

Very heavily subsidized by government, this includes freight, handling.

6.22 Controls

6.23 Rural

6.24 National

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6.25 Influence of stabilization schemes (effect of these on sale on non copra products)

Government has the most general stabilization scheme we ever encountered.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Government subsidies shipping costs in full plus it gives the shipper a .09 handling and service charge. The miller gets a subsidy as well to guarantee a profitable operation This is guaranteed irrespective of world prices

8. GOVERNMENT POLICIES PRESENT

Very supportive of the industry. This is seen in various growing ways. Stabilization fund Hybrid Development etc.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

See above - Government has other incentives E.9 Vanilla growing, pearl shed farming. All aimed at keeping the outer Island populations from migration

10. RULES, REGULATIONS, STANDARDS

Set by Government

11. IMPORTS

Most government collected revenue is by way of import duties However a special license may be granted giving import to relief on plant and items

12. EXPORTS

13. LABOR

13.1 Labor Construction

13.2 Processing

14. PIONEER INVESTMENT INCENTIVES

15. OTHER

15.1 Susceptibility to natural disasters

Drought is the most serious of long tours effects Hurricanes are infrequent

15.2 Disease such as "cadang cadang"

REPORT ON REPUBLIC OF KIRIBATI

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REPUBLIC OF KIRIBATI

INTRODUCTION (adapted from the Sixth National Development Plan)

Kiribati is made up of thirty-three islands, located in the Central Pacific Ocean, straddling the Equator and the International Date Line. It is subdivided into three main groups:

1) The Gilbert Islands - a chain of 17 atolls spread over 680 kilometers in the western sector which includes Tarawa, the seat of Government;

2) The Phoenix Group - a cluster of 8 atolls lying about halfway between the Gilbert and Line islands;

3) The Line Islands - a chain of 8 atolls spread over 2,000 kilometers, located some 3,000 kilometers east of the Gilberts on the other side of the date line. They include Kiritimati Island which accounts for half the country's land area.

These atolls rarely rise more than five meters above sea level, and are composed entirely of coral debris and calcareous structures. frequently they consist of a thin broken ribbon of land partly enclosing a lagoon. They are widely dispersed within three distinct 200 mile exclusive economic zones (EEZ's) which cover three million square kilometers of ocean. Kiritimati Island is the east is about 3,870 kilometers from Banaba Island in the west. The distance between Washington Island in the north and Flint Island in the south is 2,050 kilometers. The total land area of all these islands, however, is only 746 square kilometers.

Kiribati's nearest neighbors are the Marshall Islands and Hawaii to the north; Nauru to the west; the Solomon Islands to the southwest; Tuvalu, Fiji and the Cook Islands to the south; and French Polynesia to the southeast.

NATURAL RESOURCES

Atolls represent one of the most limited resource bases for existence in the Pacific. Kiribati experiences a maritime equatorial climate. Rainfall is more frequent in the north gilbert and Line Island groups but drought conditions lasting up to three years have been experienced on most of the islands. Because of poor soil conditions, which are mostly sandy, filtration is quite rapid, and surface freshwater is therefore rarely present. The atoll environment produces limitations on agricultural production. A thin and porous layer of topsoil, a high level of salinity, salty sprays and lack of surface water produce only a few flora and fauna that are adapted to these rigorous conditions.

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For principal food crops, babai (swamp taro), pandanus and breadfruit are cultivated largely for subsistence, while coconut palms are grown both for subsistence and trade. The pelagic fish and other marine resources are deemed to be substantial and at present represent the greatest single potential for sustainable development. by declaring a 200 mile EEZ it is hoped to facilitate this development.

Until the end of the 1970's, significant phosphate deposits were exploited on Banaba Island and this single resource had quite a significant impact on the economic life. These mineral deposits, however, ceased to be mined in 1979, and at present there are no other known viable and immediately exploitable mineral resources. Surveys indicate possible commercial deposits of phosphate, manganese nodules, cobalt crusts and carbonate gypsum, mostly on the sea bed.

POPULATION

The population is mostly of Micronesian descent, though over the years some mixing with Chinese, Europeans, and Polynesians, particularly from Tuvalu, has taken place.

According to the last census carried out in May 1985, the population increased from 58,512 in 1978 to 66,110 in 1985. the 1985 population count includes 2,227 I-Kiribati known to be working overseas in Nauru, or on the ships of the South Pacific Marine Services or studying overseas. The resident population of 63,882 in 1985 represents an overall increase of 13.6 percent over the 1978 population, implying an annual actual population growth rate, which takes into account fertility, mortality and migration, of 2.1 percent per annum between the census years. The natural rate of growth of the indigenous population is 2.4 percent per annum.

The population is very young with nearly 40 percent under 15 years of age and nearly 90 percent under 50 years of age, which is the official age of retirement. This implies a strong future population growth, and also means increasing competition for monetary sector employment.

During much of the 1960's the bulk of the population increase was felt on South Tarawa because of substantial outer-island-to-South Tarawa migration. The population on the outer islands only changed a little. The percentage of the population living on South Tarawa increased from about five percent after World War II, to over 33 percent in 1985. This concentration of population has placed increased pressure for the provision of modern facilities, such as water, sewerage, roads and power.

The physical distribution of population is skewed towards the Gilberts Group, on which Tarawa is located. The number of people in South Tarawa rose from 17,921 in 1978 to 21,190 in 1985. Population density also rose from 1,134 persons per square kilometer to 1,311 person per square kilometer during the same

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period. Population density in South Tarawa is much higher than the rest of the country.

POLITICAL BACKGROUND

The Republic became independent from the United Kingdom in 1979. The constitution provides for a single tier system of government, with an executive present, known as the Beretitenti, at the helm. He is elected by universal suffrage from among candidates selected by the Maneaba ni Maungatabu (the Parliament). The single chamber legislature is composed of thirty-six elected members, the Attorney General, and a member appointed by the Rabi Council.

The central government is located in South Tarawa. It consists of Cabinet Ministers appointed by the Beretitenti from among the elected members of the legislature, and the Attorney General. The central government functions through Ministries, including the Office of the Beretitenti and Ministries of Finance, Home Affairs and Decentralization, Natural Resource Development, Communications, Works and Energy, Trade, Industry and Labor, Education, Health and Family Planning and a Ministry for the Line and Phoenix Islands. The Beretitenti is also responsible for the Ministry of Foreign Affairs.

ECONOMIC BACKGROUND

Economic dualism is a characteristic feature of production, where subsistence livelihood predominates in much of the outer islands and a monetized economy exist in urban Tarawa and Kiritimati Island. Over the years, gross domestic product originating from the monetary sector has fluctuated between 50.6 percent and 59.7 percent of total gross domestic product. Production in the monetary sector was it its peak during the phosphate years and has declined relatively after phosphate mining ended. GDP per capita was nearly $500 in 1985, although the technique for measuring subsistence activity requires improvement.

The subsistence sector is by and large self-sufficient in providing basic needs of the existing population on outer islands. Apart from fishing, which is an important occupation, and provides an important component in the nation's diet, the main subsistence crops are babai, pandanus and breadfruit. Coconuts are grown for domestic consumption and for export. Chickens and pigs are also raised for home consumption. Because of the difficult, indeed harsh, conditions and environment, cultivation of a variety of agricultural crops is difficult entailing a lot of effort. However, some expansion in home vegetable gardens is now taking place. Local materials are widely used in housing construction. The major trade goods required in the subsistence sector include fuel, cloth, some foods such as rice, sugar and flour, and items such as soap, tobacco and matches. Other items such as pots and crockery, radios, bikes and some motorbikes and outboard engines are also purchased.

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Public enterprise dominates the cash economy which is mainly entered in urban Tarawa, the administrative seat of Government, and Kiritimati Island which caters for a limited amount of tourism. The manufacturing sector is practically non-existent. Most private enterprise is situated on South tarawa and is concentrated in the small scale service sectors, such as taxis, buses, film showing and food vendors. Exports are basically copra and marine export, while imports consist of a wide range of consumer and capital goods. Up until 1979 Kiribati relied heavily on phosphate exports which in some years accounted for some 45 percent of gross domestic product. Since the end of mining, the focus has been to identify and develop other sources of economic livelihood, notably fish and other marine resources.

CULTURAL AND SOCIAL BACKGROUND

There are various dialects, traditional authorities and customs within the islands of the Gilberts. The people strongly identify with their home-island, from where their ancestors came. despite these differences, all islands speak the same language and have many similarities in custom.

Many changes have been experienced over the one-and-a-half centuries since Europeans first came to Kiribati shores. Some of these changes, such as the adoption of Christianity, have now become integral parts of life. despite these changes, the uniqueness of culture has generally been preserved, particularly on the outer islands. While observing new ways some people still hold allegiance to old beliefs such as the spirit world and pre-Christian deities.

The extended family plays a significant role in life, assuming many social, economic and political functions. It is still the single most important social unit within the community. The communities are small and closely knit organizations, in which an individual's roles, obligations and rights are clearly identified. Though still strong, this cohesion of family and community is becoming weaker on South Tarawa and Kiritimati. Land is highly valued both as a means of producing livelihood and for social functions. In earlier times many battles were fought over land. The ownership and transfer of land in the form of gifts are still crucial today.

Life on outer islands may be hard and demanding but the Kiribati people have adapted to it. Traditionally, there was enough time after work to produce a rich cultural heritage of song, dance and story-telling. These forms of entertainment are still widely practiced by many today.

OVERVIEW OF THE COPRA INDUSTRY

More so than most other Pacific Island countries except perhaps Tuvalu, Kiribati only has coconuts as its major source of its export earnings. Fish and fishing may take care of future

national demands; however, most people living on the islands will still have to rely upon copra as being their mainstay cash income.

Unlike some of the other major volcanic Pacific island countries, the atoll countries have tremendous hardships to live with. The very fragile nature of each island or atoll ecosystem means that exploitation of natural resources out of balance with nature results in disaster. Coconuts form a major food source for people living on atolls. The staple diet is fish, coconuts, breadfruit and to varying degrees swamp taro, bananas and pigs. Without coconuts the I-Kiribati people would find it very difficult to sustain good health.

The coconuts of Kiribati have a very wide variation in size. This variation is mainly caused by drought or fertility conditions of the soil. Therefore, when considering processing the standard Pacific method of using mechanized scrapers would not work because the nuts are too small and of various sizes. The only way that coconuts from Kiribati could be processed into cream or milk would probably be through utilizing the paring method of peeling the endosperm off the nut. This method is more labor intensive but would overcome the irregular shape of the Kiribati nuts and also labor would not be a problem due to the labor available in the areas of population.

With its proximity to American Samoa, it is quite possible that export of whole nuts from Kiribati may be economically viable. This factor alone, however, may not mean the export of whole nuts is possible. This is due to the fact that if the husk is taken away from coconut growing areas a potassium deficiency will quickly develop in the island's ecostructure which would mean a very costly input of fertilizers which would exceed any benefits derived from the added value of selling the whole nut. The only way nuts could be transported from outer islands would be in a semi-husked form, that is with most of the husk off or even all of the husk off other than for some covering the eyes. Considering details in the questionnaire and the above mentioned facts, it is considered that the only possibility for Kiribati in the regional project would be to have either husked nuts exported to a regional center for on-processing or to do semi-processing in Kiribati.

As mentioned for other countries, it is therefore suggested that subject to the availability of bulk aseptic packaging equipment that a bulk or aseptic packaging plant and coconut cream extraction facility be considered for Betio.

Another point which should be explored further is the manufacture of toddy and toddy products. It is considered that toddy could be likened to the production of maple syrup in many ways when trying to simulate a like industry in a temperate country such as the New England area of the United States. With the Kiribati Government forming a toddy bottling plant, technology into preservation of the product is currently underway. What may be

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of interest to the American market, though, could be the toddy syrup which is the residue of syrup left after rendering down the toddy liquid.

To explore this matter further, possible market testing must be done but it could provide countries with limited land areas and dense populations the opportunity of using the coconut for another purpose other than copra or cream.

This type of activity may also be suitable for Tuvalu.

COUNTRY: REPUBLIC OF KIRIBATI

COUNTRY PROFILE INFORMATION

The following outline provides useful information in planning a country's participation as a 'feeder' country or 'central processing' country. The attached annex also further explains some of the information that is desired.

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

Kiribati, even through it has limited tonnages to attract overseas shipping, still is able to maintain services in all types of cargo vessels.

Larger container vessels must anchor offshore and containers are brought ashore by way of lighter and lifted onto the dock by a crane. Kiribati has only one major overseas port in the Gilbert group and all produce from other islands must be brought there by way of interisland vessels. A limited road network exists on Tarawa but most coconuts are produced on outer islands.

All types of storage would be possible including container, reefer and bulk, but land scarcity would limit the size of facilities available. However, this would not affect a project if storage space was required in a modest way.

1.2 Cost

Refer Attachment I.

1.3 Frequency

The following services are provided:

- a Suva-Funafuti-Tarawa service operated by the Pacific Forum Line. (This service is subsidized by Australia and New Zealand.)

- The Japanese Bali Hai Service, once monthly from Japan

- The K-Asia Pacific and Warner Pacific Line, Australia and New Zealand. (K-Asia offers a 6-weekly service).

- A fuel run by charter vessel to the Line Islands from Pago Pago.

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- Nauru Pacific Line offers irregular calls from the west coast of the United States.

- Bank Line (joint service with Hamburg-SUD) uplift copra from Kiribati to Europe.

1.3.1 Current Routing

1.4 Capacity

Considered adequate for the purpose of the project, but some congestion of the port could occur if whole nuts were handled.

1.5 Handling facilities from source (harvest) to collection points

No handling facilities exist at all on outer islands. All harvesting and collection would be done by hand, and transport to export areas would be by interisland vessel. The only road system exists on the major center of population which is Tarawa and limited supply of coconuts could come from south Tarawa by way of road; however, there are still other areas in that location which would need to be picked up by boat.

1.6 Back loading problems

There is reasonable backloading on existing services throughout the islands; however, if larger quantities of material were to be shipped, such as whole coconuts, not all of these vessels would be able to backload with cargo.

1.7 Other transport problems

Kiribati, like most atoll island countries, has vast distances to travel between the individual islands which make up the group. In addition to this the fringing reef to many atolls is quite extensive and this results in ships having to anchor far away from the shore. In some cases, reef blasting has allowed the entry to lagoon, but not all lagoons allow ships to come close to the land even though the reef has been opened up.

The cost of internal shipping throughout the islands throughout Kiribati is very high. The only way this could be reduced for the future for the transport of bulk commodities would be by the utilization of very simple and basic landing barges which would have to have a distinct role as a bulk cargo carrier rather than a personnel carrier.

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2. EXPORT & IMPORT FACILITIES

2.1 Port

Refer Attachment 2.

See the National development Plan, page 314, for details. However, only one major overseas port exists in the country and that is on Betio which is now linked to the major center of population at Tarawa by way of a causeway. The harbor is shallow and does not allow large overseas vessels to come close to shore. Some upgrading has been done to wharves which can service the domestic interisland vessels and also smaller overseas vessels.

2.2 Warehouses

Land is a critical factor on Betio. This island has one of the highest rates of population per square kilometer in the world. Therefore, space for warehousing is at a premium.

The Copra Society operates a number of quonset huts for the storage of copra and a number of cold storage facilities exist for the local fishing company.

It is quite possible some new storage facilities would be available on the planned industrial estate located away from the port at south Tarawa.

2.3 Handling machinery

Handling machinery is limited and directed towards the limitations of the port. There are a number of barges or lighters capable of carrying containers from ships and these are loaded and discharged by way of a 25-ton capacity stiff-legged derrick crane. Movement of cargo on the wharf is by way of fork lift trucks and dollies - small trailer-type conveyances.

Note should be taken of the Government's new initiative to develop the Line Islands, particularly Kiritimati Island and its associated resources. Little infrastructure exists in that location at the moment.

2.4 Water depth

As mentioned, water depth for overseas vessels calling into Kiribati is a great problem and there are no overseas wharves existing to cater for them. All loading and discharge is done at anchor, on a roadstead basis.

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2.5 Harbor size

Extremely limited to launch and small freighter traffic up to 100 tons D.W.

2.6 Problems

The type of operation which may be envisaged for Kiribati under the project will determine suitability of transport infrastructure. There is the possibility that whole or husked nuts may be picked up from the Kiribati Islands for transportation to a centralized processing plant. This is because of its locality and also dispersity of production which may allow such an operation to be viable. Considerable evaluation is required for the collection of whole nuts.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Water is also a great problem for Kiribati, particularly on Tarawa and Batio.

As the southern islands of Kiribati suffer from prolonged drought most water comes from underground water lenses which have both a capacity problem as well as a hygiene problem.

Any factory installation must include the cost of a water purification plant.

The cost of water is US$.87 per metric ton.

3.2 Electrical

Only South Tarawa has a 24-hour electricity supply and it has a capacity of 2.4 Megawatts. A number of other generators exist and most large operations requiring power on a 24-hour basis, such as telecommunications and the TML freezers (the local fishing company) have their own standby generators. The cost of power is US$.31 per kwh (this cost is negotiable).

3.3 Fuel

Fuel is readily available on Betio and Tarawa; however, limited supplies reach the outer island. The exception to this would be the Line group which is under its current project for upgrading.

Limited possibilities exist to utilize the coconut husk as a fuel due to the critical link the coconut tree has with the echo system of all atolls. If coconut husk is

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burned or taken away from the coconut growing areas, then a potassium deficiency will be created in a very short period of time. This will result in a number of problems:

- If whole nuts are taken away fertilizer will have to be used to replace the potassium

- If shells are burned the resulting ash will not be sufficient to replace potassium in the soil due to the leaching effect with rain.

Coconut shell could be a possibility as fuel because it contains less potassium than husk.

The ideal situation on atoll environment is to leave the husk in the coconut growing area to allow slow disintegration and slow release of chemicals back into the soil.

3.4 Sewer

Sewerage is also a problem for such densely populated areas such as Tarawa and Betio. A major cholera outbreak in 1977 prompted the introduction of a salt water borne sewerage system which has been partially accepted by the population.

Traditional use of beach and bush for toilet and latrine use is still sometimes practiced in outer islands. This means that attention must be paid to the treatment of sewerage due to possible damage to the water lense.

There is no facility for industrial sewerage.

3.5 Waste Disposal

No facilities exist on outer islands for waste disposal and on Tarawa and Batio the local council operates a number of tips.

It is considered that the project would have to make its own arrangements for waste disposal and that once again strict attention would have to be paid to disposal of waste in a manner which does not interfere with the atoll ecology in any way.

3.6 Engineering

The only engineering services existing are those provided by Public Works and a number of artisans in the Tarawa/Betio area.

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The skills required to erect a factory exist and no problems occur in that regard.

Limited skills exist for the maintenance of technical equipment.

3.7 Manpower Skills

Generally speaking, considerable skill exists throughout Kiribati due to the fact that many people have worked overseas on a contract basis, thus bringing their skills back to Kiribati.

There would be no lack of unskilled or semi-skilled labor for any proposed project.

3.8 Regulations/Laws

All buildings and other facilities would have to comply with the Government's standards and recruitment and employment of labor would be in accordance with the labor laws existing.

3.9 Costs

Exact costs of building are yet to be received. However, most buildings in Kiribati are concrete slab with either concrete or concrete block walls together with corrugated iron roof. The material used for construction of concrete houses is coral sand and this utilizes a stronger cement/sand ratio than normal.

<u>Cost of labor</u>

U.S. $4.20/day unskilled
U.S. $6.96/day semiskilled

Both of these are subject to a National Provident Fund levy of 5% employee, 5% employer.

3.10 Availability

It is considered that there is no lack of availability of unskilled, semi-skilled and skilled personnel.

3.11 Reliability

As in other Pacific countries, generally speaking most unskilled and semi-skilled labor would be quite reliable; however, for skilled and technical positions adequate training and supervision may be necessary in some cases.

3.12 Quarantine laws and procedures

Kiribati being virtually disease free so far as coconut palms are concerned would not be in a position to import whole nuts from other countries, but may be in a position to export.

Quarantine regulations are similar to other countries in the South Pacific.

3.13 Land cost and availability

Land in Kiribati is subject to lease and so far as new industrial ventures are concerned the Government is encouraging development.

At the moment with the opening up of the Kiritimati Island development land is available at $2,600 per acre.

At Tamiku on Tarawa, land is available at approximately AU$4,300 per acre.

Availability of land could be a problem in Tarawa, particularly if required near the port area, although no great problem would seem to exist on the south Tarawa industrial estates. Land on Kiritimati Island would be readily available.

3.8.1 Problems, etc.?

The use of land on the atoll islands for industrial purposes would all incur similar problems due to the fragile environment in the case of Tarawa, the high pressure on land, and also the close proximity of any factory area to domestic living areas.

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Size

There are very limited processing activities carried out in Kiribati. One small oil mill and associated soap manufacturing plant exists and more recently a toddy bottling operation has commenced on Tarawa (toddy is the fermented sap of the flower of a coconut). It is a traditional drink of most Micronesians and could be developed into a new export product if handled correctly.

The size of these operations is very small and is only capable of servicing the domestic market if fully exploited. The toddy manufacturing plant is aimed at exports of toddy to workers on Nauru.

4.2 Use

See above.

4.3 Type

See as above.

4.4 Products

See as above.

4.5 Capacity

See as above.

4.6 Utilization

The soap manufacturing plant is under-utilized as is the small copra crushing mill used to make oil. The reason for this is the slow acceptance of the domestic product by outer island consumers. However, this attitude is changing.

4.7 Age

The oil mill and soap factory is several years old, whereas the toddy bottling plant is to be commissioned towards the end of 1989.

4.8 Ownership

The soap factory is privately owned by Mr. W. Shultz. It is understood that the toddy bottling plant will be privately run, with assistance from the Department of Industries.

4.9 Location

The soap factory is adjacent to Mr. Shultz's property on tarawa and the toddy bottling plant is to be at the Industrial Estate at Tamiku, also on Tarawa.

4.10 Type Management

The soap factory is managed by its owner and requires little supervision of staff but requires the manager to exercise all functions of management including marketing, planning, manufacture and distribution, etc. Details on the toddy bottling plant are not available.

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4.11 Interest in participating in this integrated venture

A number of people have expressed positive interest in the venture but it is unlikely that any individual in Kiribati would be in a position to be able to become totally involved due to the complexities of Kiribati culture and the fact that most coconuts would have to come from outer islands. It is considered that the copra marketing society would be the only organization capable of undertaking any control of supplies from outer islands; however, it may be possible for the society to become involved in a joint venture with another private (but to be identified) investor.

5. INSTITUTIONAL

5.1 Private sector involvement

The very small private sector existing in Kiribati is being given encouragement to develop and the Government is actively seeking new investors to enter the economy. Much of this effort at the moment is directed at the Kiritimati or Line Islands.

It is considered doubtful that any existing private sector investors would be capable or willing to become involved in the intended project. Part of the reason for this would be because of the intricate social political situation which exists in Kiribati, and also the fact that the Kiribati Copra Society is an effective organization with resources which would be necessary to be able to harness and mobilize the passage of whole nuts from outer islands.

5.2 Equity participation by Board's Government Private

The Kiribati Copra Society has indicated that they probably would be interested in seeing some sort of development in the diversification of coconuts and has indicated that upon receipt of a tabulated feasibility study they would then consider financial involvement or otherwise.

5.3 % of GNP and export earnings from coconuts

In 1986 the net contribution to GDP by copra was a negative $240,000. This figure arose from the fact that domestic and external shipping from Kiribati being so high, coupled to the fact that prices were stabilized through the stabilization scheme resulting in a net negative effect on GDP. The corresponding net effort values for the copra exports of 1987 amounted to AU$459,000. Generally, copra exports in 1987 amounted

to 4,437 metric tons, and a FOB value of AU$1,170,000. For further details, see Attachment 3, Copra Statistics 1987.

5.4 Other institutions involved with coconuts

The Kiribati Copra Society is the prime institution involved in the collection of coconut products. In the Line group of islands the plantations there are run by Burns Phillips and export of product is done direct by that company. It is quite possible that with the Line group's proximity to Hawaii, direct trade may be possible to service the large tourist population in that area.

The Department of Agriculture also has significant interest in the coconut industry through various extension programs existing for the replanting and improvement of the coconut industry.

5.5 Degree of control on supply, etc.

The Copra Society has control over the movement of coconut products both inside and outside the country. Even though some of its powers are not specific, it is considered that any development in the coconut industry would still have to be approved by the Copra Society due to the fact that its members are drawn from the representatives of the island cooperative which are very closely linked to the people on outer islands.

5.6 Competition (multinationals and local firms)

It is considered that no competition exists at the moment and that if the project were to go ahead there would be no competition developing for the activities of the project would have to be approved in the first place.

6. RAW MATERIALS (Coconuts) (See section 16 for more information)

6.1 Geographical concentration of productions

For full details see Attachment 3, Table 4.

6.2 Tonnage available

Even though tonnages fluctuate due to drought conditions and producers' response to the price for copra, it is considered that all coconuts currently used for the production of copra could be available for other use providing the price was more economically attractive. The big restraint, though, is transport.

If a transport technique was developed to economically collect the coconuts from outer islands, then most islands could participate. Or, if some of the larger producing islands were selected for semi-processing, providing infrastructure could be established to cater for such semi-processing, this too could be a possibility.

6.3 Land ownership

Land ownership varies between the Line Group and the Gilbert Islands, but is considered that for the purpose of leasehold land ownership would be available. The rest of the land for use for agricultural purposes is all customary land, as described in the introduction.

6.4 Tree use rights

6.5 Size of holdings

Size of holding is generally small due to the very limited amount of land. There are no plantations in Kiribati.

The majority of copra produced in the Kiribati islands is handled through the various cooperative societies in the islands which act as a collection point for all small-holder producers.

6.6 Age

The age of the trees throughout Kiribati is mixed. There has been a replanting and new planting program in existence for a number of years. This has been met with a limited success with producers planting new areas on marginal land rather than replanting existing groves.

Although no figures are available, it is accepted that at least half of the existing trees would be old, that is, over 40 years of age.

The replanting program has resulted to date in 7,000 acres being planted since 19890 with the current forecast of replanting of three 300 acres per year.

6.7 Variety

The main variety is the local Tall, a tree which bears well after sufficient rain, but nut size is reduced during periods of drought. There is also a hybrid being distributed through the replanting program which is believed to be a Rennell cross Malaysian Dwarf.

6.8 Productivity

Productivity varies from area to area and is strongly influenced by weather conditions. After prolonged periods of drought, nuts tend to become pinched and small. This condition exists mainly in the Gilbert Islands rather than the Line Group.

With only a low incidence of pests and diseases little effect is made on production by pests and diseases.

6.9 Copra meat or cream yield/nut type

Although no details were available on the Gilbert Island Local Tall, the Christmas Island Tall which is considered to be similar has the following characteristics:

Fruit shape - Spindle
Copra thickness - 9.4mm
Fruit size - polar circumference 70.8cm
Equatorial Circumference - 58.7cm
Fruit weight -
    Whole fruit - 1,927 gms.
    Dry copra - 307 gms per nut
Number of nuts per ton - 3,313

This particular nut was grown on research station conditions and would be typical of the optimum size and productivity of the Kiribati Islands.

As can be seen from the photographs attached to the report, the general nut size is very, very low, and it is considered that up to 7,000 nuts may be required to make one ton of copra at certain times of the year.

6.10 Yield and variation within the country

As can be seen from 6.9, variation between areas can be quite wide. Due to this irregularity in the size of nuts, the suitability of nuts for production with reamer extraction for the production of coconut cream would not be satisfactory.

It may be necessary, if Kiribati is to become involved in semi-processing or even processing for domestic use, to utilize the paring method of extracting the white coconut meat.

6.11 Replanting schemes and hybrid development

As mentioned previously, a U. K. funded coconut replanting and rehabilitation project exists.

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6.12 Harvesting methods

Normally, coconuts are left to fall from the trees and are then collected. Nuts for drinking purposes are plucked from the trees. Also it must be mentioned that for Kiribati, the production of toddy is an important factor and this is harvested by the collection of sap from the flower spades in the morning and in the evening.

6.13 Frequency

As coconut forms a major part of the diet of Kiribati people, continual harvesting of nuts for domestic purposes is done throughout the year. The harvesting of nuts for commercial use varies according to season and price.

6.14 Labor availability

There is no problem with obtaining labor for the production of coconuts mainly due to the fact that all coconuts produced on Kiribati islands, except the Line Group, are from small-holder areas. Laborers for the plantations in the Line Islands are recruited and live in that area.

6.15 Care and husbandry practices

Traditional planning methods are employed throughout the islands. The coconut replanting and rehabilitation scheme is attempting to introduce better husbandry practices; however, considering the very close inter-relationship between all activities on atolls, there is little scope for large plantation style development to take place.

6.16 Waste - not harvested

Wastage occurs at times of low prices when it is not interesting enough for producers to cut copra.

6.17 Other losses

Limited damage occurs from cyclone but drought is more prevalent than most other problems. there are minor pests and diseases which create minimal damage as well as some problems from rats.

6.18 Domestic

Domestic consumption of coconuts would be considered high, probably higher than most other Pacific island countries, due to the very strong place that coconut has in the diet for the country. No figures are

available on this consumption, but it is estimated that it could be double that of other Pacific countries, which could amount to a copra tonnage figure of 2,000 tons per annum.

6.19 Industry, % of total availability

No comparative percentages available; however, the usage could be related to the available tonnage for copra.

6.20 Cost of coconut production

Not available.

6.21 Domestic pricing and policies

Fixed by the Kiribati Copra Society.

6.22 Controls

Controls over the industry are exercised by the Copra Society, although there are no controls over the free movement of whole coconuts within the country.

6.23 Rural

One policy exists for the whole country.

6.24 National

One policy exists for the whole country.

6.25 Influence of stabilization schemes (effect of these on sale on non copra products)

The price of coconuts throughout Kiribati would ultimately be reflected back to the price payable by the Copra Society through its stabilization scheme for copra. If the operation was to be a joint venture including private sector involvement, then some sort of arrangement may have to be made to ensure that the new venture was able to participate in the domestic pricing policies of the Society.

The size of such undertaking would have bearing on the degree of participat n required.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Kiribati participates in the EEC STABEX arrangements and for details of STABEX transfers and disbursements see Attachment No. 4.

8. GOVERNMENT POLICIES PRESENT

The present Government policy in Kiribati is very flexible concerning the development of new industry. This fact is also reinforced by the desire to develop the Kiritimati Island sector of the country. However, full details can be seen of the incentives and arrangements required for investment in Attachment 6, Investment Opportunities in the republic of Kiribati.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

As mentioned above, the policy at present is to develop the industrial sector of the economy and also to develop the Kiritimati Island area of the country.

Future plan is to continue in this direction and in particular to try and upgrade the return to producers for coconut products. In addition to this, the Government is keen to continue with the replanting scheme and to enhance the stock of coconuts already existing in the country through better husbandry practices.

10. RULES, REGULATIONS, STANDARDS RE:

There are no rules, regulations and grading standards existing other than for copra.

11. IMPORTS

There are very few imported coconut products; however, one packet of hydro-soluble coconut cream powder was found in the Cooperative Society Supermarket which had come from Sri Lanka.
Kiribati has a relatively small retail sector and it is considered that very little market would be found domestically for processed coconut products.

12. EXPORTS

Exports are of copra only. Some interest has been shown in the export of whole nuts, but uniform nut size may be a problem in this particular market.

13. LABOR

13.1 Labor Construction

Construction labor would be available; however, any development of a larger size may possibly need to have imported contractors.

13.2 Processing

Processing labor is readily available. With the high density of population on the land areas in Kiribati, particularly Tarawa and Batio, no problem would exist in recruiting labor.

14. PIONEER INVESTMENT INCENTIVES

The Government encourages private investment and development incentives to suit industry needs within the national development plan objectives.

15. OTHER

15.1 Susceptibility to natural disasters

Kiribati is generally free of cyclone problems; however, drought could be considered a major problem for the coconut industry.

15.2 Disease such as "cadang cadang"

There are no major diseases in Kiribati. In 1965 there was considerable Stick Insect damage; however, now it is hard to find Stick Insects and is considered to be cyclical. Also in 1975 the Flat Moth had an infestation in Tarawa and has since spread to other islands. Recently a white fly, a vector for many diseases, was introduced to Kiribati through a gap in the quarantine laws or service. This fly at the moment does not carry any diseases, but would be capable of being the vector if any such diseases break out.

NEW CALEDONIA

1. INTRODUCTION

In relation to the country visit to Noumea and the time allowed under the work plan, it should be noted that unlike other Pacific countries, no contacts really exist which can be used to arrange meetings or make contacts prior to entry into the country,even though attempts were made through the French Embassy in Vila to do this. Considerable success was achieved though by utilizing contacts through private banks and the Chamber of Commerce and Industry. It should also be noted that in Noumea there is a certain reluctance, due to political sensitivities, to cooperate completely in any outside initiative before prior appraisal. Taking the above into account,it was pleasing to see that in the final meetings with officials that full cooperation was forthcoming.

Concerning data for the country profile, the publication "Guide to Investors" fortunately available in English, includes most of the requirements for the project. In fact, this publication is excellent in content and would be one of the best prepared in the Pacific. Therefore, the standard country profile papers have been referenced back to the guide where necessary, otherwise the guide covers most of the information we require.

A summary taken from the guide,is reproduced as an introduction to the physical configuration and demography of New Caledonia.

In relation to coconut statistics - time did not allow a visit to coconut growing areas and difficulty was experienced in making contact with those responsible for data on coconuts. Contact was made however with staff members of IRHO Vanuatu who will supply data required.

THE GEOGRAPHICAL SITUATION OF NEW CALEDONIA

Oceana covers more than one-third of the earth's surface and in its midst lies New Caledonia; this territory, and Wallis and Futuna, are the farthest from Metropolitan France of her overseas possessions. The Territory, as one of a group of micro-nations, has distinct economic advantages. Thanks to the economic and financial support of Metropolitan France, its standard of living is one of the highest in the region and it enjoys a large measure of political autonomy. The GDP (Gross Domestic Product) per head is roughly comparable to that of French Polynesia, and is lower than Australia's and higher than New Zealand's. In many fields, New Caledonia already occupies a prime place among the group of island States and Territories of the South Pacific and its development must surely progress in a region which many

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consider to be one of economic growth.

The third largest island of the South pacific,after New Guinea and New Zealand, New Caledonia lies near the tropic of Capricorn, between 19° and 23° latitude South and 158° and 172° longitude East,about 1,500 km from the coast of Australia.

2. THE PROFILE, AREA AND RELIEF OF NEW CALEDONIA

2.1 AREA

The main island or "Mainland" is 16,372 sq.km. in area, or in other terms five times the area of French Polynesia, seven times that of Reunion, fifteen times that of Martinique. In addition,there are the dependencies (this term being used in the purely geographical sense) which include the archipelago of the Loyalty Islands (1,981 sq. km.), the Isle of Pines (152 sq. km.), the Belep Islands (70 sq.km.)and a few scattered islands and islets. The marine area is immense,and it has been calculated that the 200 mile Economic Zone amounts to some 1,740,000 sq.km.

2.2 RELIEF

A mountain range, commonly known as the "central range", runs the whole length of the "Mainland" (nearly 400 km.) and is dominated by the Panie massif (1,628m.) in the South. In actual fact, this chain of hills is situated nearer to the East Coast than to the West, these two being on average 50 km. distant from each other, and so the hills fall more steeply on the East side.

The range does not however present a real obstacle and in fact, none of the passes that the transversal roads go through to cross the range is even as high as 500 m.

The contour of the Loyalty Island (Mare,Lifou,and Ouvea) contrasts strongly with the relief of the "Mainland". Situated 150km. North-East of Noumea,these ancient coral atolls that rose unevenly have become horizontal, flat and depressed islands, in which the altitude decreases steadily going northward through the group,from 138 metres in the South of Mare, to 104 metres on Lifou and 46 metres on Ouvea at the highest points.

A barrier-reef encircling New Caledonia, at a distance from the coast that varies between a few kilometres,forms the boundary of a lagoon which is scarcely deeper than 40 metres and whose fauna and flora make it one of the most beautiful in the world.

3. METEOROLOGY

New Caledonia has a relatively temperate climate known as "oceanic tropical". There is a hot season, frommid-November to mid-April, during which tropical depressions that sometimes become cyclones brush the Caledonia coast or pass nearby. Mid-April to mid-May is a transitional period. Tropical disturbances become less frequent. Rainfall diminishes and the ambient temperature drops noticeably. Mid-May to mid-September is the cool season. The temperature rises gradually and rainfall is at its lowest for the year.

3.1 TEMPERATURES

The average annual temperature is between 22° and 24°. In the course of the year the average temperature varies between a maximum in February of about 26° and a minimum in July or August of about 20°.

3.2 RAINFALL

Annual rainfall on the East Coast or "Windward Coast" is approximately double that on the West Coast or "Leeward Coast". In addition to the influence of the prevailing winds, the island's relief too has an essential effect on where the rain falls. Annual rainfall varies considerably from one year to another. This variation is partly due to the passage of tropical depressions and cyclones whose number and strength follow no patterns. Generally speaking there is most rain in the months of January, February and March. Thereafter the rainfall decreases steadily until May. Then it increases again in June, but only for a short while, for the approach of the dry season (September to November) starts as early as July. October is generally the driest month.

3.3 THE WINDS

The most common wind pattern on the Territory is that of the Trade Winds which blow from between East-North-East and South-East. These winds are usually moderate to fairly strong. To a large extent they are the prevailing winds throughout the year. The "westerly gales" are strong to very strong winds that may reach, or even exceed 40 to 50 knots, blowing from a sector between the North-West and the South-West, and associated with the passage over the South of the Territory of disturbances of polar origin. "Cyclonic winds" are caused by tropical disturbances and occur during the passage over the Territory, or nearby, of tropical depressions and cyclones.

3.4 HOURS OF SUNLIGHT

There are 2,564 hours of sunlight a year in Noumea as compared with 1,867 hours in Paris. The year's maximum sunlight occurs between October and December,while the minimum is in June. Generally speaking, there are few days in the year with no sunshine at all. On average in Noumea (in the South) as in Koumac (in the North) there is more than half a day's sunshine on 255 days of the year.

4. POPULATION

The last census, carried out in April 1983, showed that New Caledonia had a population of 145,368. The multi-racial population is one of great originality,as variegated as a painter's pallet and made up of successive additions since 1843. Like a number of other island countries in the South Pacific, the Territory's population is an amalgam of indigenous peoples and peoples from elsewhere. The resulting mixture comprises eight elements : Melanesians, Europeans, Indonesians, ni-Vanuatu, Tahitians, Vietnamese, Wallisians, and others. The Melanesians account for 43% of the total population, then come the Europeans who form 37% of it, followed by the Wallisians (8%), the Tahitians (4%), the Indonesians (4%), the Vietnamese, the ni-Vanuatu and others (4%).

5. FEATURES OF NEW CALEDONIA

5.1 NOUMEA,THE CAPITAL

Insignificant on the world scale, the actual importance of Noumea becomes apparent only when one studies its geographical position in relation to the island groups of the South Pacific, the activity of its port and its function as the capital of New Caledonia. Is is in fact the Territory's only real town. As such, it plays a decisive role in local life and activities. Viewed on the scale of other Pacific islands, the weight and the role of Noumea are seen to be important. Only Suva (Fiji) and Papeete (French Polynesia) are of similar size and have the same function,but without the influence and the economic weight of the capital of New Caledonia. Thus, no town in Melanesia, except Suva can compare with Noumea.

5.2 LESS URBAN CENTERS

Apart from the peninsula of Noumea, there is little urbanization in New Caledonia. The idea, comparatively recent in New Caledonia, of introducing some balance among the various townships did however lead to the improvement of communication with up-country are-as of

the Territory. Thus,certain up-country centres (such as Bourail, LaFoa,Koumac, Pondimie)were to serve as bases in a system decentralizing the Territory's administration and education and health services. While it could not be regarded as counterbalancing the urban centre of Noumea, this incipient urbanization is gradually attracting a new population.

5.3 TRIBALAREAS AND LANGUAGE

The tribal area is the administrative recognition of Melanesian social organization. There are 328 tribal areas, of which 237 are on the "Mainland"and 91 on the outlying islands. The linguistic variety found in New Caledonia has perhaps no equal elsewhere in the world : twenty-eight languages, very different from one another, are spoken in the archipelago by fewer than 60,000 people.

OVERVIEW OF NEW CALEDONIA

Unlike other Pacific countries, very little attention has been given to the coconut industry in New Caledonia.

Also, due to the unique characteristics relating to life in the Territory where plenty of information is produced about activities existing within the country and what should be done, but very little seems to be achieved in rural areas. The administration from first observation would seem to be self-generating in administrative functions. This, with the support from Metropolitan France can be afforded and many ways adds to the economic benefit of the country.

Economic activity, apart from nickel production is centered around the very large government bureaucracy, heavy consumerism and a very active leisure industry (this leisure industry is as much for residents as it is for tourists). The extension of this style of economy supports a number of service industries which in turn provide the goods and services to a very buoyant consumer society.

Few consumer goods, apart from foodstuffs and beverages, are produced locally. Even the, domestic production in some of these items is insufficient to satisfy local demand, and considerable imports of goods from overseas are made to supplement the local production. Attention has been given to the benefits of trading in imported goods for most of the high wage earners live in the urban society of Noumea. Only marginal headway has been made in developing internal infrastructure sufficient to support efficient and effective domestic import substitution from raw material through to finished goods.
It must be remembered though, that the wealth of New Caledonia, results in consumer spending and demands on luxury items which in many cases could not be manufactured locally. Notwithstanding this fact,compared to other Pacific Island countries, the manufacturing sector could be said to be quite strong and diverse. There is however, a large gap between urban and rural incomes even though rural incomes exceed most other Pacific Island countries.

POLITICS

The political situation in New Caledonia has not assisted widespread development of the country. The indigenous Melanesian people who mainly live in rural areas, basically maintain a traditional Melanesian way of life, supplemented by assistance from and access to the French administration, the high consumer market and the active leisure economy centered at Noumea.

COCONUTS

Due to the high level of incomes in New Caledonia compared to other Pacific Island countries, little development has taken

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place in recent years in the coconut industry. In fact, production, which is concentrated on off-shore islands, has declined.

Commercialization of coconuts apart from sale of fresh nuts in local markets, has been centered around the production of copra for a domestic oil crusher and soap factory. The relative low returns, even though producer prices are subsidized to double world price, coupled to the political unrest, has led to such a small supply that the factory is considering closing down. If producers could be enticed to sell their coconuts in whole form, and providing suitable freight rates were available, there would be sufficient resource to establish a reasonably sized coconut cream plant.

The fact that considerable quantities of coconut cream in canned and powdered form are imported from Thailand and Malaysia at the moment, signifies that domestic demand should give healthy support for such a venture.

PRODUCTION FACILITIES

The country has superior facilities compared to the rest of the Pacific.

Port facilities, transport and services are all of a very high standard.

The labor force is strong with high levels of technical competence.

Those manufacturing operations which do exist are of good standards and are capable of expansion.

So far as the project is concerned, sufficient freezer capacity exists for operations involving the freezer of coconut produce and also with the existence of a number of canneries and a can manufacturing plant, adequate idle capacity is available for coconut cream manufacture to develop in the short term.

Shortly, a foam form UHT plant will be commissioned expanding processing capacity considerably. It is not sure at this stage whether this project when complete will be interested in dealing in coconut products - this will need follow-up if necessary.

A DOMESTIC PRODUCTION FACILITY

IDENTIFIED MANUFACTURER

As mentioned previously, if the domestic infrastructure can be mobilized to transport coconuts from island centers, then one meat and vegetable cannery ("MOTULAR PACIFIC SCPP") is very interested in entering production of coconut cream.

Existing equipment and buildings could handle production past the

canning stage and all that would be required, would be the addition of the coconut cream unit (see photographs attached on Appendix).

Management of this operation seems confident that supply of sufficient raw materials would be possible for a modest size plant (that is utilizing up to 800 tonnes of copra equivalent per year). Also, with a limited amount of technical assistance, operations and capital investment could be made in a relatively short period of time.

POSSIBILITY FOR ISLAND MANUFACTURE

The area with the most concentrated production of coconuts of New Caledonia, is the island of Ouvea, with over 1,400 hectares of coconuts which produce some 12.5 million nuts per annum.

Establishment of a plant and factory on this island could be a possibility but would require considerable investment in both plant and personnel.

Two possibilities could be looked at. Firstly, coconuts could be processed to the cream stage where whole coconuts could be split and meat extracted and either pressed or left grated for freezing, with subsequent shipment to Noumea for on-processing and canning. The alternative could be the on-forwarding of that frozen produce to other destinations as a raw material or finished product.

The second situation would be the complete development of a factory on the island from processing raw material through to retail pack operation. As it was not possible to visit the area during the short visit or during the country profile work, the real implications of such a venture are unknown but it would be considered better to adopt the first option of semi-processing in Ouvea and transporting raw material or semi-processed raw material to Noumea. Such an option would possible by able to use freezing facilities in cooperation with Fisheries Development and would fit in well with the utilization of the Chamber of Commerce and Industry's freezer storage unit in Noumea which is adjacent to Mutular Pacific's factory.

A SUB REGIONAL PROCESSING CENTER

New Caledonia, particularly Noumea, could be likened to American Samoa where there is little coconut production (although more than American Samoa) but a large potential for the manufacturing and conversion of coconut products.

It could be possible for bulk raw materials to come from other Pacific Island countries for processing, providing the economics were positive.

With the high cost of labor in New Caledonia, it would be sensible for semi-finished products only to be considered for

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shipment to such a factory. This would also assist in the freight rates of carrying bulk cargo.

It could well be possible for counties in the South-West Pacific to ship either frozen or aseptic bulk packed coconut to New Caledonia for processing similar to a way in American Samoa. This processing could well have similar advantages to the E.E.C. as sale of produce to the U.S.A. has through the American Samoan concept.

Acceptance of frozen products creates no problem as the dockside freezer capacity does exist, however further knowledge of the cost and practicality of bulk aseptic equipment is required before evaluating the possible further use of this method of semi-processing.

GENERAL INVESTMENT CLIMATE

Apart from the political situation existing in the Territory, the degree of Government incentives for any industry is very high.

Numerous schemes and programs are available and a range of new developments are presently being drafted. It is estimated that within the next few years massive development projects will be sought after by the administration to fulfill the promises for the independence in ten years.

It is considered that any investor wishing to develop an industry, which could support the rural Melanesian population, particularly those on islands, would be given a very favorable reception.

Very detailed programs and information for investment is given in the two publications in the country formal file, namely, "The Loans and Assistance to Business and Investment in New Caledonia" (about to be revised) and the "The Investment Guide."

Following are a number of contact profiles pertinent to the report.

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COUNTRY PROFILE INFORMATION

Use the following outline guidelines on types of country profiles information which would be useful in planning a country's participation as a 'feeder' country or 'central processing' country. The attached annex also further explains some of the information that is desired.

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

(see page 158 "The Investor's Guide") Noumea is a major port that attracts high shipping volume in containers, breakbulk and bulk cargo capabilities. Noumea has frequency to Europe, Asia, the U.S. as well as request links.

1.2 Cost
(see page 169 "The Investor's Guide") The rates vary considerably but compare well with the rest of the region. Quotes are available upon request but these change rapidly.

1.3 Frequency
(As stated in 1.1)

1.4 Capacity
(As stated in 1.1)

1.5 Handling facilities from source (harvest) to collection points. The resources in this area are limited due to the low scale of activity in the coconut related ventures. However local resources are available for transfer to each sector.

1.6 Back Loading Problems, etc.
No problems as production is small at present. Should expansion of the industry occur back loading deficiencies will add to transportation cost.

1.7 Other Transport Problems
The internal freight rates are high and the administration already subsidizes the copra industry. Further subsidy may be required for internal shipping.

2. EXPORT & IMPORT FACILITIES

2.1 Port
Port facilities are excellent.

2.2 Warehouses
16000 m2 for stevedoring purposes at wharf in Noumea. 2x cold storage warehouses totaling 3,300 M3 and/or linking space 932 H.A.

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2.3 Handling Machinery

2.4 Water Depth

2.5 Harbor Size
The harbor has excellent boatage facilities. For large vessels, wharfs are 700 ML long, plus 600 metres of wharfs four small vessels. In addition, a passenger dock of 180 metres long and a Sealife vessel facility.

3. SUPPORT INFRASTRUCTURE

3.1 Water
No problems with water.

3.2 Electrical
(see page 181 of "The Investor's Guide").

3.3 Fuel
(see page 190 of "The Investor's Guide").

3.4 Sewer

3.5 Water Disposal

3.6 Engineering

3.7 Manpower skills
Wide and varied

3.8 Regulations/laws
(see page 44 "The Investor's Guide)

3.9 Costs
(see page 141 and 180 "The Investor's Guide").

3.10 Availability
Readily available.

3.11 Reliability
Engineering skills are wide and varied - reliability considered better than most other countries.

3.12 Quarantine Laws and Procedures
No problems for process materials

3.13 Land Cost and Availability
(see page 183-4 "The Investor's Guide").

3.14 Problems etc.

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4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Size

Most coconut produced commercially is used in the small copra crushing mill for the manufacture of soap, see pages 140 141, 142, 143. This factory is having difficulty in obtaining supplies and may possibly close down soon. The problem with supplies is that wage rates and other benefits in New Caledoni are so high that there is no incentive to produce a low value crop such as copra. Also, management of mill advised that imported copra was too expensive to allow the soap manufacturi end of the business to compete with imported products.

4.2 Use

4.3 Type
(see "The Investor's Guide")

4.4 Products
(see "The Investor's Guide")

4.5 Capacity
(see "The Investor's Guide")

4.6 Utilization
(see "The Investor's Guide")

4.7 Age
(see "The Investor's Guide")

4.8 Ownership
(see "The Investor's Guide")

4.9 Location
(see "The Investor's Guide")

4.10 Type Management

(see "The Investor's Guide")

4.11 Interest in Participating in this Integrated Venture
DIDER - The Territorial Department of Rural Development
The Chamber of Commerce and Industry
Possibly the community of Ouvea Island through DIDER

5. INSTITUTIONAL

5.1 Private sector involvement
Mutular Pacific

5.2 Equity participation by Board's Government Private

5.3 % of GNP and export earnings from coconuts
nil

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5.4 Other institutions involved with coconuts
The oil mill and soap factory - SCTO (Society Culture and Transformation of Oleogineux).

5.5 Degree of control on supplies, etc.
No controls exist.

5.6 Competition (multinationals and local firms)
None

6. RAW MATERIALS

6.1 Geographical concentration of productions
(see chart attached).

6.2 Tonnage available
Very dependent upon price,(see summary attached).

6.3 Land Ownership
(see page 35 "The Investor's Guide").

6.4 Tree use rights
The majority of plantings are communal and usage is on a communal basis.

6.5 Size of holdings
Customary land use - see statistical data on Inventory by communities.

6.6 Age
Most trees are in the 50-70 year age bracket.

6.7 Variety
New Caledonia Local Tall.

6.8 Productivity
About 80 small nuts per year.

6.9 (Copra meat or cream yield/nut) type
Mainly all local talls (very similar to Vanuatu Tall).

6.10 Yield and variation within the country
(see details 6.10 - Vanuatu Report.

6.11 Replanting schemes and hybrid development
No replanting scheme at present, however trials have been planted on Ouvea in 1983 using three hybrids for evaluation

NJM X GOA
NRM X GRL
NRM X GPY
with a local tall control

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6.12 Harvesting methods
Nuts fall to the ground

6.13 Frequency
Irregular collection

6.14 Labor availability
This is the main problem in New Caledonia - because of the strong welfare element and opportunity when working to receive high wages, labor for working with coconuts is hard to obtain.

6.15 Care and husbandry practices
Very little practiced.

6.16 Wastage - not harvested
A great quantity is not harvested and at the moment the majority of coconuts other than food nuts are wasted.

6.17 Other losses
Cyclone damage.

6.18 Domestic
Considerable amounts are used for domestic purposes. Most coconuts grown on the mainland are for domestic consumption.

6.19 Industry, % of total availability
Most of the coconuts from the islands are available for industry whilst those on the mainland are for consumption - estimated 80% of all coconuts available for industry.

6.20 Cost of Coconut Production
Cost of domestic production exceeds available revenue. This is even the case when the domestic price has been increased to create incentive for products. The fact that the local crushing mill cannot obtain raw material confirms this point.

6.21 Domestic pricing and policies
Previously the control of coconut prices was the responsibility of the "Caisse for Stabilization du Caffe (and coconuts) - now this organization has been absorbed by a new organization call "Operation Cafe" which has very little interest in coconuts.

Price for whole fresh green nuts at markets are - One Island Ouvea 25 Francs per nut and Noumea 100 Francs per nut. The cost of dry husked nuts in Noumea market is 40F CFP/U.

6.22 Controls
Now not operating due to non-production.

6.23 Rural

6.24 National
No real effect and also scheme now, when operating is a subsidy.

6.25 Influence of stabilization schemes (effect of these on sale on non-copra products)

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

As country is part of EEC - non-applicable.

8. GOVERNMENT POLICIES PRESENT

(see "The Investor's Guide").

9. FUTURE POLICIES AND PLANS RE : COCONUT INDUSTRY

10. RULES, REGULATIONS, STANDARDS RE:

None.

11. IMPORTS

Considerable imports of coconut products exist. Five different types of coconut cream, milk, and powder were found on sale in Noumea. No separate statistics exist on the volume of imports though it should be high on a per capita basis compared to other Pacific countries due to relative spending power of community, the amount of shelf space occupied by coconut products and the diversity of availability.

12. EXPORTS

There are no exports of coconut products.

13. LABOR

13.1 Labor Construction
(see "The Investor's Guide").

13.2 Processing
(see "The Investor's Guide").

14. PIONEER INVESTMENT INCENTIVES

Wide and various (ee "Loans and Assistance to Business and Investment in New Caledonia" and page 67 of "The Investor's Guide").

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15. OTHER

15.1 Susceptibility to natural disasters
Subject to normal tropical conditions including cyclone. However, on the islands droughts are quite a problem whereas on the mainland, temperature is a limiting factor as the climate is too cool in some areas.

REPORT ON NIUE

NIUE OVERVIEW

Niue is a coral island measuring some 260 S.W. km. of land much of which is rough coral. The location is 169° west longitude and 17.5° below the Equator.

The Island is roughly oval in shape and has the plateau between 20-40 meters above sea level and a depression toward the center of the island.

LAND AREA

252 sq. km.

Population

The populations numbering barely 2,000 inhabitants are Polynesian. Niueans are skilled in hunting, fishing and cane making. Planting root crops is an essential part of traditional agriculture which is partly cash cropping and subsistence.

The Economy

The economy is very limited and Niue relies heavily on overseas aid which is substantially supplied by New Zealand.

Subsistence farming is no longer a major element of activity. The cash economy has developed through ready access to paid employment.

Language

The official language is Niuean but English is widely used.

Currency

The currency is New Zealand Dollars.

Air Transport

Air transport is provided by Air Nauru on an Auckland-Niue-Auckland Service once weekly.

This service is the only scheduled service available.

Shipping

Shipping is currently supplied by Sofrana Unilines and calls to Niue from New Zealand and via the Cooks on roughly a five week cycle.

The current vessel Moana II offers reefer and general cargo services of break bulk.

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The limitations of this service severely inhibits market access for produce or manufactured goods other than to New Zealand.

Communications

Communications by telephone and telex are limited to a high frequency radio service which is erratic. However, a satellite system should come on line within the next six months.

Banking

Banking services are provided by the Westpac Corporation who offer a full commercial range of products.

A Development Finance Fund is also in place, however funds from this service are limited to specific development policies.

Utilities

Power is available all around the island, but only 240 volt systems operate outside Aloi the capital.

A water supply pumped from underground sources provides potable water to each village.

Sewerage is unavailable and septic systems must be installed.

Apart from tar sealing in Aloi central, most roads are unsealed.

Government

Government is chosen by democratic process. The Fono (Legislative Assembly) has a total of 20 elected members.

The Government has a high profile and consensus plays a major part in political decision making.

Land

Land is not available for outright purchase.

Land leasing is common, and terms of 20 + 20 years are general annual lease fees for commercial block U.S. $200.00 P.A.

Investment

Investment incentives for industry are available on request. No investment act is in force.

Agriculture

Niue has a recent history in the cash cropping of passion fruit, papaya, limes, taro, yams and a variety of less significant crops.

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In the late sixties, the major crops for export were passion fruit and limes. Later pawpaw was grown in volume and in the main these fruits were targeted for export in processed form. Up until that time the time the major export crop was copra.

The Government build and equipped a food processing factory in the early seventies which produced for export:

1. Frozen juice and pulp e.g. passion fruit
2. Lime juice or lime oil
3. Papaya puree

A series of severe droughts, a major cyclone and a diminishing market value saw the end of passion fruit and pawpaw exports by 1984.

Coconut cream became a significant export between 1980-1983 when a severe drought stopped production for 2 years.

The industry was revived in 1986 but high components costs and limited labor made the venture uneconomic.

Currently no processed products are exported other than lime juice for the New Zealand market.

General

Migration to New Zealand has diminished Niue's potential to develop primary or secondary industry.

The only growth sector is tourism in which Niue has much to offer by way of its unique structure of the island, excellent diving and game fishing.

Conclusions

Given the very limited labor force and the severe labor resource, the chances of Niue returning to coconut related activities is unlikely.

COUNTRY: NIUE

COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

Breakbulk and reefer cargo.

1.2 Cost

Niue - New Zealand - U.S. $91.00 cubic meter

1.3 Frequency

5 weekly service

1.3.1 Current Routing

New Zealand - Niue - Cook - New Zealand

1.4 Capacity

1,200 tonne vessel

1.5 Handling facilities from source (harvest) to collection points

1.6 Back loading problems

Very little export cargo

1.7 Other transport problems

A limited road transport capacity: Hireage often difficult.

Average size vehicle 3 tonne - private ownership
6 - 7 tonne - Government ownership.

2. EXPORT & IMPORT FACILITIES

2.1 Port

Roadstead anchorage/good lifting equipment
20 tonne capacity, steel barges, lighter cargo to small wharf. Ample mechanical lifting gear, (refer to item 2.3)

2.2 Warehouses

Nil

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2.3 Handling machinery

1 x 20 tonne lift capacity - mobile
1 x 10 tonne lift capacity - mobile
1 x 5 tonne fork hoist - mobile
1 x 8 tonne fork hoist - mobile

2.4 Water depth

Small lighterage wharf
Depth: Low tide =5 meters
High Tide = 6 meters

2.5 Harbor size

Open roadstead on leeward side of island
Depth 300 meters - 600 meters

2.6 Problems

Heavy swells - November - March
Channel width 30 meters maximum at entrance, tapering to 20 meters
Rough seas swamp wharf in westerly winds

3. SUPPORT INFRASTRUCTURE

3.1 Water

Available without charge

3.2 Electrical

400 volt 3 phase
240 volt single phase
Charge - U.S. $174 per kw hr.
Town area is land wide

3.3 Fuel

Petrol = U.S. $.54 per liter
Diesel = U.S. $.51 per liter

3.4 Sewer

Septic storage installation required

3.5 Waste Disposal

Limited by law to designated fringe areas to avoid water lens contamination.

3.6 Labor

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3.6.1 Engineering

Government Workshop facilities only. Private work by arrangement.

3.6.2 Manpower skills

Small private sector, service sector, otherwise very limited.

3.6.3 Regulations/laws

3.6.4 Wage regulations for public servants

Costs: private sector follow government rates guidelines

No National Provident Fund.

3.6.5 Availability

Very limited at all levels.

3.6.6 Reliability

Good

3.7 Quarantine laws and procedures

Strict quarantine inspection. Limited fumigation service.

3.8 Land cost and availability

Land leases available: Terms negotiable. No fixed pricing system. Indicative rate $200 U.S. P.A. rental for commercial site.

3.8.1 Problems, etc.?

Multiple ownership of land.

4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

4.1 Size

1 x 80 square meters of food processing space
1 x 30 square meters of closed storage space
1 x 40 square meters of open storage space

4.1.2 Owned Niue vs. government

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4.2 Use

Coconut cream processing operation (Canning Line)
Lime juice operation and 40 tonnes of storage tanks
Lime oil distillation process equipment
1x Blast freezer/8 tonne capacity
3 Storage Freezers each 10 tonne capacity
1 x cooker at 8 tonne

4.3 Type

Multipurpose Food Processing (Refer 4.2)

4.4 Products

Refer to 4.2

4.5 Capacity

Refer to 4.2

4.6 Utilization

Current, Nil.

4.7 Age

15 years

4.8 Ownership

Government. Available for leasing.

4.9 Location

Central business area - 4 km from port/adjacent to port

4.10 Type Management

Government from July 1988 - previously private 83-88

4.11 Interest in participating in this integrated venture

Yes

5. INSTITUTIONAL

5.1 Private sector involvement

Unlikely

5.2 Equity participation by Board's Government Private

Yes, Government

5.3 % of GNP and export earnings from coconuts

Current, Nil.

5.4 Other institutions involved with coconuts

Nil

5.5 Degree of control on supply, etc.

Nil

5.6 Competition (multinationals and local firms)

Nil

6. RAW MATERIALS (Coconuts) (See section 16 for more information)

6.1 Geographical concentration of productions

All on one island - 60% crop on North East of Island.

6.2 Tonnage available

Maximum copra equivalent 150 tonnes or 750,000 nuts p.a. if harvesting was available.

6.3 Land ownership

Private extended family.

6.4 Tree use rights

Private extended family.

6.5 Size of holdings

Very small - (family lots). Range 1 - 20 hectares.

6.6 Age

60% senile

6.7 Variety

Niue mediums

6.8 Productivity

9 - 12 nuts p.a. average island wide
15 - 22 nuts p.a. average in North East Region

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6.9 Copra meat or cream yield/nut type

Cream only - 170 gr. average per nut

6.10 Yield and variation within the country

Yield is consistent except for nuts from government experimental farm. Nuts from North and Eastern side of Island are larger on average by 15%.

6.11 Replanting schemes and hybrid development

U.N.D.P have committed $150,000 for a replanting scheme development still experimental.

6.12 Harvesting methods

Manual

6.13 Frequency

Infrequent - except for home consumption.

6.14 Labor availability

Very limited. Particularly in agricultural sector.

6.15 Care and husbandry practices

Occasional weeding of groves.

6.16 Waste - not harvested

70% remain unharvested.

6.17 Other losses

Some rat attacks

6.18 Domestic

Consumption: 100,000 Nun = 20 tons copra equiv.

6.19 Industry, % of total availability

70%

6.20 Cost of coconut production

Unavailable (no industry activity)

6.21 Domestic pricing and policies

Free Market System

6.22 Controls

Nil

6.23 Rural

Nil

6.24 National

Nil/Controls for quality on exported nuts.

6.25 Influence of stabilization schemes (effect of these on sale on non copra products)

Nil/Government stabilization ended in the 1970's.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Nil

8. GOVERNMENT POLICIES PRESENT

Replanting program. Review likely to consider continuing given surplus of nuts remaining unharvested.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

Under review, possibility of further retrenchment.

10. RULES, REGULATIONS, STANDARDS

Generally follow standard food handling hygiene laws (NZ) or value natural food processing law (NZ) standards

11. IMPORTS

Subject to duty charges on non-food items. No origin restriction or licensing of imports.

12. EXPORTS

No export taxes levied.

13. LABOR

13.1 Labor Construction Industry

NZ - contract labor = $8.00 U.S. per hr.
- locally trained tradesmen $5.00 per U.S. hr.

13.2 Processing

$1.77 hour minimum - $5.00 hour for skilled
$7 - $10 hour New Zealand for management

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14. PIONEER INVESTMENT INCENTIVES

By application. No standard incentive legislation. Government very receptive to agricultural development.

15. OTHER

15.1 Susceptibility to natural disasters

Susceptible. Drought 1977 and 1983. Hurricane 1979 - all severe.

15.2 Disease such as "cadang cadang"

Minor Stick Insect infestation, minor leaf yellowing

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PAPUA NEW GUINEA

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OVERVIEW OF COCONUT INDUSTRY IN PAPUA NEW GUINEA

Papua New Guinea is the largest and richest of all South Pacific countries. With a population exceeding 3.5 million people and vast mineral and strong agricultural resources, the country's economic future looks very bright.

Papua New Guinea (PNG) is situated between the equator and 12°S at the longitude of 131° and 151°E. The country consists of six large and a number of small islands. The main island is divided between PNG and Irian Jaya of Indonesia. New Britain, New Ireland, Bouganville, New Haever and Manus are the other large islands. The total land area in the country amounts to 462,243 sq. kilometres.

The PNG economy is basically agricultural but has been changing rapidly since 1968 as a result of the development of copper mines. At present, the share of agriculture to GNP accounts for less than a third.

The population of PNG totaled to 3.4 million in 1986. The country is a producer of copper, timber, coffee, cocoa, palm oil, copra and coconut oil.

The relative importance of the coconut industry in the PNG economy is on the decline. The value of coconut products which amount to 90% of the total export earnings in 1921-1922 declined to 5% by 1975-1977. It slid further to 2.2% by 1986.

The coconut industry however continues to pay a dominant role in agriculture and the rural economy of the country. As reported in the Rural Industries Survey of 1973-74, 104,403 smallholders depend on a coconut as a cash crop. This represents nearly a half of country's rural population. Coconut forms a staple food of the rural population Coconut forms a staple food of the rural population. According to an ADB estimate about 20% of the smallholder coconut product is consumed on farm.

Accurate data on coconut area PNG is not available. According to one estimate total area under coconut is about 265,000 ha consisting of 110,000 ha of large plantations and the balance in smallholdings. The area under plantations has remained fairly static over the past two decades while smallholder plantations have steadily expanded.

During 1950's and 1960's, a large number of coconut plantations were inter-cropped with cocoa and coffee. It is estimated that about 60% of coconut plantations receive more than 10%of their gross income from cocoa and coffee.

The coconut production in 1986 was estimated at 208,000 MT of copra equivalent, shows a decline of 16% compared with previous years productions of 250,000 MT of copra equivalent.

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About 75-80% of the coconut produced in the country is further processed for value addition. The processing is limited to primary processing namely, copra production and oil extraction. In 1986, copra production, estimated at 158,000 MT reported a decline of 11% as against 176,000 MT of copra processed in 1985. The decline in production is mainly attributed to the farmers response to low domestic prices prevailing throughout that year.

In contrast to copra, coconut oil production increased by 6% from about 39,000 MT in 1985 to 42,000 MT by 1986.

The total earnings from coconut products, totaling to K21.9 million in 1986 recorded a decline of 62% over 1985's earnings of K57.7 million. It accounted for 2.2% of the total export earnings of Papua New Guinea.

Within the agricultural sector though,particularly in coastal and inland areas, the coconut industry will continue in many cases to be a source of economic activity regardless of the future of world markets.

Copra and coconut oil prices have been insufficient to maintain operations of coconut plantations on a mono crop basis. Intercropping with cocoa and in some cases, cattle, is now necessary to maintain viability.

Government policy and the attitude of the Copra Marketing Board has recently recognized the need to diversify the industry if it is to survive economically in the long term.

For the purpose of this study, the resource of raw material is no problem in Papua New Guinea. Also, there is a large untapped market for coconut products in the domestic highland areas where coconuts do not grow but food tastes are similar. Also a significant amount of coconut cream is currently imported from overseas to satisfy domestic demand for coconut cream in convenient forms. This is particularly so in urban areas.

The most promising factor though, when considering alternative use of coconuts in Papua New Guinea, is the existence of appropriate and modern but under utilized processing plants. These plants are used in other industries but which, with limited additional capital investment could easily produce canned and tetrabrik/tetrapak type coconut cream products.

It would most certainly be possible utilizing these plants, particularly that of Barnes Meats of Madang, where some 5,000 metric tonnes of processing capacity is available, which could easily service an export market.

Further development of the industry will be a distinct possibility, when details of the USA market have been determined.

It is unlikely that Papua New Guinea would want to shift coconuts to a centralized plant when such opportunities exist within the

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country. However sufficient product exists to be able to supply other plants with whole coconuts or semi processed product.

The Copra Marketing Board has recognized the need to try and diversify coconut uses but like other Pacific Island marketing institutions, little scope existed for diversification until recently. The only possible diversification in the past, was in to oil milling which in most cases did not give any further added value back to producers.

In Papua New Guinea, the Government, the Copra Marketing Board and the various institutions are all willing to consider new developments in the industry.

The investment corporation of Papua New Guinea, the various provident funds and pension funds of Papua New Guinea, the Development Bank have all indicated that they would be willing to consider projects with overseas investors provided that market access for any such new process or products could be definitely quantified.

PAPUA NEW GUINEA

COUNTRY PROFILE INFORMATION

Use the following outline guidelines on types of country profiles information which would be useful in planning a country's participation as a feeder country or central processing country.

1. Transport (sea/Land)

1.1 Type (container, refrigerator, other)

Full container, reefer, dry and breakbulk services are available.

1.2 Cost

West Coast USA	:	Reefer US $5,000 Dry US $2,500
Europe	:	Reefer US $3,500 Dry US $2,000

1.3 Frequency

See Regional Schedule - Passage time 5 weeks both cases.

1.4 Capacity

In excess of requirements.

1.5 Handling facilities from source (harvest) to collection points

See Ports Study (Attachment No. 1) for detailed and complete analysis of this.

1.6 Back loading problems, etc.

In some cases there are problems with backloading but this is seasonal - when coffee and cocoa are in season shortage of shipping space sometimes occurs.

1.7 Other transport problems

The main transport problem in Papua New Guinea is the high cost of domestic shipping. This means that the shipment of coconut products from one area to another would act as a disincentive for the transportation of raw materials within the country. Such problem is

offset by the fact that sufficient availability of coconuts exists in most area considered suitable for development.

2. Export and Import Facilities

2.1 Port

See Port Development - Attachment No. 1

2.2 Warehouses

See Port Development - Attachment No. 1

2.3 Handling machinery

2.4 Water depth

See Port Development - Attachment No. 1

2.5 Harbor size

See Port Development - Attachment No. 1

2.6 Problems

3. Support Infrastructure

3.1 Water

Supply ex mains varies considerably from locaties and locations as does water quality, e.g. hardness. In instances of large demand - a rainwater catchment from factory roofs with storage and treatment in house is best source into establishments.

3.2 Electrical

Sources of power vary widely from Hydro systems in the Central Province to diesel generators in remote and island situations.

3.3 Fuel

Petrol, diesel and solid fuels (timber and coconut husks) are available.

3.4 Sewer

Connections of this nature vary widely. Province to Province.

3.5 Water Disposal

Very stringent codes are practiced throughout the country.

3.6 Engineering

Services in Port Moresby and major Ports, e.g. Lae, Madang, Kieta, Rabaul etc. are available but limited in the range of services offered. When compared to other Pacific countries a high level of development exists.

3.7 Manpower Skills

Are limited - training programs are essential.

3.8 Regulations/laws

Laws relating to building codes etc. are based on Australian standards.

3.9 Costs

Costs are reasonable - see copy of statistical bulletin.

3.10 Availability

Most operations rely upon their own maintenance capacity although, depending on location, a number of engineering firms can supply service.

3.11 Reliability

Generally speaking most services are reliable, the exception may be with electricity. This too depends on the area but considerable disruptions were experienced in both Port Moresby and Lae during consultants visit.

3.12 Land cost and availability

Is all by negotiation. The procedure is that the Government negotiates with the landowner on behalf of the investor and upon agreement of price, the Government becomes the leasor. The minimum price for a commercial site in Port Moresby is in the order of $12,500 per 1/2 acre.

3.14 Problems etc.

Problems in the main relate to time elapsed to implementation due to the many approvals required.

4. Existing Processing Facilities (coconut, fruit, vegetables, beverages, etc.) See Attachment No. 2

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4.1 Size

See Attachment No. 2

4.2 Use

See Attachment No. 2

4.3 Type

See Attachment

4.4 Products

See Attachment

4.5 Capacity

See Attachment

4.6 Utilization

See Attachment

4.7 Age

See Attachment

4.8 Ownership

See Attachment

4.9 Location

See Attachment

4.10 Type Management

See Attachment

4.11 Interest in participating in this integrated venture

Yes, see Attachment

5. Institutional

5.1 Private sector involvement

Private sector development in the coconut processing area has been very limited to date but much enthusiasm exists for expansion into new areas of added value products.

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5.2 Equity participation by Board's Government Private

The Copra Board is not empowered by its Act to invest in coconut processing operations but recent changes in Government policy decisions in coconut product development by the private sector.

The Papua New Guinea Investment Board have under consideration in Activated Charcoal Project. The Investment Board provides an excellent opportunity for growth in downstream activity. Other sources of funding available are the Development Bank/The National Provident Fund/The Private Pension Funds.

Private sector have ample opportunity to develop coconut based ventures particularly the existing Food Packers withe excess capacity.

Two such organizations could move swiftly into creaming operations with very limited capital investment. They are:

James Barnes Papua New Guinea Limited, Meat Cannery Operators, Madang, and

Tanubada Food Processors Pty. Ltd., Lae.

Several privatelyowned plantation owners are seeking products in which to diversify. However, they tend to lean toward low-tech and limited cheap products, e.g. soap manufacturing.

5.3 % of GNP and export earnings from coconuts

See Attachment No. 3 TAble 16 Page 89

5.4 Other institutions involved with coconuts

5.5 Degree of control on supply, etc.

Up until very recently the Copra Board has held a near monopoly on the industry. While formally this is still the case, the current attitude to acceptance of change by the board is promising.

6. Raw Materials

6.1 Geographical concentration of productions

See Attachment No. 3

6.2 Tonnage available

See attachment No. 3

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6.3 Land ownership

6.4 Tree use rights

6.5 Size of holdings

6.6 Age

6.7 Variety

6.8 Productivity

6.9 (Copra meat or creamy yield/nut) type

See Attachment No. 4

6.10 Yield and variation within the country

6.11 Replanting schemes and hybrid development

6.12 Harvesting methods

Nuts fall off trees

6.13 Frequency

Continuous with some variation in dry season.

6.14 Labor availability

Varies from location to location

6.15 Care and husbandry practices

On plantations, generally good and smallholder plots vary

6.16 Wastage - not harvested

This depends upon the price of Copra -when the price is high most coconuts are harvested - when prices are low, fluctuations occur in the range as shown on copra export tables.

6.17 Other losses

Papua New Guinea does not have as many cyclones as other Pacific countries and loss from insect damage is light

6.18 Domestic

It is estimated that 20% of production is used

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domestically or for feeding farm animals.

6.19 Industry, % of total availability

80% of total production

6.20 Cost of coconut production

See Attachment No. 5

6.21 Domestic pricing and policies

Fixed by the Copra Board in accordance with rules and formulations to stabilize the market.

6.22 Controls

The Copra Marketing Board controls the export of all coconut products.

6.23 Rural

6.24 National

6.25 Influence of stabilization schemes (effect of these on sale of non copra products)

The stabilization of prices for copra acts as a bench mark indicator for the sale of fresh and mature nuts.

7. Type of STABEX Conditions Applicable to Country

Papua New Guinea has access to compensatory funding under under the STABEX system - funds are available at 1% and are non repayable if not possible after seven years of use. STABEX funds are given by the EEC to the Government which decides what use is to be made of them. The Copra Marketing Board is currently negotiating for US $4 million.

8. Government Policies Present

Current policy by Government is to encourage diversification. Current policy of the Copra Marketing Board is to consider diversification.

9. Future Policies and Plans Re: Coconut Industry

It would seem that recently Government and the Copra Board (CMB) will actively encourage new developments providing they are profitable.

10. Rules, REgulations, Standards Re:

Other than the need to obtain a license from the CMB, no regulations exist over the use of coconuts until they are

processed in Copra or coconut oil.

11. Imports

Normal tariff rules apply - concerning importation of whole nuts from other countries, strict quarantine would apply. It is doubtful whether whole nuts could be imported from Solomons or Vanuatu due to disease problems.

12. Exports

Normal tariff rules apply - for manufactured good, this would form part of Pioneer Status package with no serious diseases in Papua New Guinea, exports to some other destinations may be a possibility.

13. Labor

13.1 Labor Construction

Available for construction

13.2 Processing

Available in most areas.

14. Pioneer Investment Incentives

15. Other

15.1 Susceptibility to natural disasters and

PNG because of geographic spread is relatively unaffected by cyclones. There is a possibility of volcanic eruption at Rabaul.

15.2 Disease such as 'cadang cadang'

There are no serious coconut diseases in Papua New Guinea. See Attachment 8.

REPORT ON SOLOMON ISLANDS

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OVERVIEW OF THE SOLOMON ISLANDS

The Solomon Islands is currently the second largest coconut producer in the South Pacific. The Solomons has expanded due to a high percentage of young coconut trees and less damage from cyclones.

The Solomons has a reasonably diversified economy and though showing signs of strain at the moment has should in the long. If managed diligently, the country has a good chance of obtaining economic independence. There are two areas of concern which exist though and these are the very high birth rate of 3.5% and a large public service where the cost and consumption from this sector is drawing heavily on the revenues created by the productive sector.

The economy is basically primary industry with fishing, logging, palm oil, coconuts and cocoa being the main revenue earners. Some mining is underway but has not developed fully.

The coconut industry in the Solomons is in good position compared to other countries is the average age of palms is low. Also the Levers Pacific Plantations at Yandina in the Russell Islands is the South Pacific's largest hybrid plantation.

Light industrialisation has grown strongly over the last ten years, but, with a heavy tax system coupled to strong controls over the repartriation of profits, it is doubtful that further rapid general development will take place unless a generous and clear incentive policy is introduced. The low value of the Solomons Dollar will alsodampen demand for manufactured goods with a high content of imported raw materials. This effect should however in the long term assist those local industries which can take advantage of low wages and produce for import substitution for the wage structure in the Solomons is relatively low - therefore industry requiring high labor content should prosper in times of low currency values. Exports will also benefit fromthe currency differential.

Expectations have been raised in some provincial areas of the Solomons concerning the development of coconut cream manufacturing. These areas are without support infrastructure. Although this may sound like development at grass roots level, a number of points should be considered:

- To establish a new high-tech industry in a country with limite skills and constraints in transport and other fields, is difficult.

- Proximity to and access to packaging machinery is essential.

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- Proximity to technical skills to maintain machinery is vital.

- Proximity to market determines viability or if not end market to export infrastructure; communications are the vital link.

So far as the Solomons is concerned relating to the regional project, it would be possible for bulk loading of coconuts to take place for trans-shipment to other areas. However, it is doubtful whether this concept would work in any place in the Pacific. The reasons for this are covered in an overall regional observation on the transport of whole coconuts, (see Papua New Guinea report with Moorehead Shipping). The following two concepts have been considered:

Firstly, it is obvious that Levers Pacific Plantations at Yandina would be the most logical location in the region to establish a large coconut processing plant. The coconut supply capacity of the area is such that production would have to be geared towards bulk export products although, retail packing could be considered, too. Lever's management at the moment is aaggressively pursuing opportunities to diversify processing of coconuts away from their present product copra. With the Solomon Island Government owning 40% of the company, even though Unilever is multinational, such development could well act as a corner stone to other feeder operations based on semi-processing of coconut in the Solomons and elsewhere.

It is doubtful that the transport of whole nuts to any other place from the Solomons would take place because of the incidence of Cadang Cadang which as yet has not been confirmed as being endemic to coconuts but only to oil palm, however sufficient risk exists toi prevent any shipment of whole nuts other than processed product.

The second situation that could develop is the creation of a small processing plant in Honiara. This plant could well service the domestic market by utilizing the Petrapak machine available at present with idle capacity. Proviued further pastuerizing plant was installed, any surplus would be exported. An interesting point to note is the ready demand at the moment for more than 1.5 tonnes of coconut by-product per week from that pressings after the milk has been squeezed from the grated coconut. This product is currently used in natural form for the manufacture of coconut bread and also coconut biscuits.

In most Pacific Island countries coconut cream is mixed with other processed food, such as, meat, fish and vegetables and creates demand for the product. It is not necessarily so that the product should be solely marketed as a mono-product. Most South Pacific Island countries use coconut cream in their various customary customary dishes and convenience food is very much in demand by urban societies. The development of say beef and coconut milk or fish and coconut milk mixed with local island

cabbage is an excellent prospect for sale to the convenience conscious urban dwellers.

In conclusion, the Solomons can be identified as being an ideal location for a sub-regional processing plant at the Yandina base of Unilever. It is also likely that the processing of product in Honiara is viable. If the large processing plant is developed at Yandina then possibly and easier way to cater for domestic demand would be to transport frozen coconut milk and other produce to Honiara for contract packing by the U.H.T. plant.

Investment

- no problems with Joint Venture arrangements - normal rules and for 2:1 debt equity ratio.
- Government is positively encouraging private investment
- Expect by December to have new incentives and wish to streamline the approval process of gaining licenes etc. by having one committee to look afer such matters.
- Also work permits when required will be linked with investment.

Industrial Estate

The present industrial estate located at Ranadi is in the process of being upgraded.

New estate is also planned near Henderson Airfield.

RUSSELL ISLANDS YANDINA

Levers operations in the Russell Islands would be the largest coconut growing entity in the South Pacific.

The company is 40% owned by the Solomon Islands Government. Production concentrates on coconuts with cocoa intercropping and cattle grazing under the palms.

Copra production is on the increase with an annual tonnage ranging between seven to eight thousand tonnes.

Levers have develped hybrid nuts using the Gian' Rennell tall crossed with the Malysian Red Dwarf - most old local tall stands have now been replanted with the hybrid and production from young palms should increase gradually as palms mature. Production is lower than anticipated at the moment due to drought and also due to the cessation of the application of fertilizer dueto recent low prices.

Plans exist to expand the areaplanted when economic conditions are more attractive.

The company is very keen to develop products from coconuts away from copra. In fact at the moment a capital expenditure programme isbeing formulated to build a facility to allow trial processing to begin. In recent months, trial shipments of mature husked nuts have been made to Australia.

Infrastructure at the privately owned export port is comprehensive. The company has its own town for labor with all social support facilities including police, schools, medical and other government departments represented.

The company is an agent for CEMA, basically handling and buying its own copra and a small proportion of third party smallholder production on behalf of CEMA.

Present processing of copra is carried out by the cutting green copra in the field then transporting that to a central drying facility which use forced air drying machine which are wood fired to dry the copra.

The Government's current attitude is to support Levers in the diversification of activities into new process and product areas. Similar support is expressed by CEMA although some degree of control over supply would seem a requirement by CEMA.

Lever's management intends to create a modular processing concept where as products and markets are developed, additional machinery and production lines can be added to a basic processing facility.

Access to the worldwide Unilever marketing system has been identified by management as an advantage for their somewhat isolated location.

PORT DEVELOPMENT

Port of Noro

The port of Noro was established during the late 1970's by the then Solomon Island Copra Board as an alternative to the small Western Province of Port of Gizo due to the reluctance of overseas ships calling there because of shoaling in the harbour area.

Originally, operations for Noro were based on a lighter system. Copra was loaded into barges which were then towed to anchored vessels. This system was quite satisfactory but was looked upon as a transitional step until full port facilities could be developed.

An overseas whart is now nearing completion. This together with the decision of Solomon Taiyo (a Japanese fishing venture) to construct a large cannery there has led to the Solomon Islands Government obtaining some 7,500,000 ECU's from the EEC to pay for the wharf and other support infrastructure.

Other construction currently underway include the tar sealing of roads, water reticulation and a sewerage treatment plant. A whole town is also to be built within the next twelve months.

If any collection of coconuts was to take place in the Western Province, Noro would be the export port. A drawback to direct development in coconuts is the fact that very little coconut is grown nearby.

An important development to occur next year will be the establishment of a can manufacturing plant next to the fish cannery also to be located at Noro. An idependent company will be formed to produce two piece cans in 7 oz. and 3 1/2 oz. sizes. Enquiries made with Solomon Taiyo management revealed that larger size cans could be manufactured if larger dies were used. such a factory would allow the Solomons a cost advantage over other Pacific Islands countries if canning coconut products were to be produced. In fact this can manufacturing plant may be able to supply other Pacific Island countries as well.

COUNTRY: SOLOMON ISLANDS

COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

Honiara - good roads on Northern side of island - good wharf suitable all types of cargo - bulk, breakbulk, container, reefer.

Yandina - good road system but not near coconut growing area - perfect position for centralising. Western Province coconuts - wharf suitable for all types of cargo, bulk, breakbulk, container and reefer.

Noro - reasonably road system but not near coconut growing area - perfect position for centralising. Western Province coconuts - wharf suitable for all types of cargo, bulk, breakbulk, container and reefer.

New town under construction.

1.2 Cost

1.3 Frequency

See R.D. No.1
See pages 17, 18, 19 of UNIDO Report RAS/86/075 Attachment 8.

1.4 Capacity

Adequate

1.5 Handling facilities from source (harvest) to colelction Points

Honiara - Road transport system adequate for north coast Guadalcanal.
Yandina - Road transport system excellent
Noro - Limited production by road but excellent sea connection.

1.6 Back loading problems, etc.

Honiara - greatest possibility for backloading general cargo
Yandina - very limited backloading
Noro - some chance of backloading but distinct possibilityof transhipment developing

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1.7 Other transport problems

No worsethan for other Pacific Island countries in fact due to location, probably better serviced than most butwith no diret service to U.S.A.

2. EXPORT & IMPORT FACILITIES

2.1 Port

See RD 2

See Solomon Island Ports Authority annual report Attachment 7.3. However three overseas ports exist - the principal port at Honiara on Guadalcanal, the Univerlever port at Yandina, Russell Islands and the new Western Province port at Noro near Georgia.

2.2 Warehouses

Honiara - adequate for reasonable volumes

Yandina - can be acommodated - a new warehouse being built.

Noro - new warehouse to be built.

2.3 Handling machinery

Honiara - adequate see Ports Authority Annual Report - Attachment 7.3 and Port Inventory Attachment

Yandina - machinery is modest but no problem envisaged in adapting or acquiring.

Noro - In process of upgrading due recent completion of new wharf.

2.4 Water depth

See R.D.3

Honiara - depth 10 metres suitable vessels to 200 metres

Yandina - depth 6.4 metres suitable vessels to 150 metres

Noro - not available at moment but exceeds Honiara and Yandina

2.5 Harbour size

See Solomon Islands Ports Authority 7.3 (RD4)

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2.6 Problems etc.

General opinion no real problem with infrastructure - question of whether Yandina wharf can cope with containers.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Honiara - water is treated to drinking standards

Yandina - water is OK but could be limited for industrial see photos of water area Attachment 4

Noro - water no problem as new system recently commissioned.

3.2 Electrical

Honiara - adequate
Yandina - adequate
Noro - new power house recently commissioned

3.3 Fuel

Honiara - adequate
Yandina - power from husk and shell a great possibility
Noro - adequate

3.4 Sewer

Honiara - adequate for normal waste
Yandina - may have to have some facility but area under-developed
Noro - adequate (new sewerage treatment plant recently commissioned) with sea water outfall - some primary processing may be necessary all locatrions for industrial waste.

3.5 Waste Disposal

Honiara)
Yandina) likely waste can be accommodated
Noro)

3.6 Engineering

Honiara - good facilitiesexist for light engineering.
Yandina - full light engineering workshop exists
Noro - minimal engineering facilities exist at moment but with fishing company operation and establishment of new town problem will certainly be overcome in the short term.

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3.7 Manpower skills

Honiara - good labor source
Yandina -) manpower may have to be imported however
Noro -) not considered a problem

3.8 Regulations/laws

Buildings would have to comply with Public Works standards.

Business would have to have approval from Government, Commodities Export Marketing Authority and Provincial Government.

3.9 Costs

For building costs. See RD4

3.10 Availability

Labor and engineering skills could be consiered to be scarce cmpared to a developed country but for any planned development most skills could be acquired within the country with only specialist manpower recruited overseas.

3.11 Reliability

Generally most unskilled and semi-skilled labor is reliable. However, for skilled and technical positions adequate training is necessary in most cases.

3.12 Quarantine laws, and procedures

Similar to other Pacific countries however a recent report of the incidence of Cadang Cadang would present the transferof any whole nuts to other Pacific countries.

Mr. Abington is in control of research with coconut industry. Concerning Cadang Cadang. Mr. Abington said that the incience of abnormality was first noticed in the palm oil plantation. There are doubts as to whether the disease is in coconuts for a new type of analysis has been used and it could well be that the analysis may be only picking up a condition which may be similar in characteristics to Cadang Cadang but which may also have been present in coconut palms for a long time.

3.13 Land cost & availability

The Industrial Estate at Honiara has no problems -

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Yandina has land already allocated for further development of coconut processing and Noro will have space made available if required - cost of land at the Honiara Industrial Estate see Attachment 12.

3.14 Problems,etc.

No freehold title but should be no problems with urban lands as leased industrial estate areas have been development.

4. EXISTING PROCESING FACILITIES (Coconut, fruit, vegetables, beverages, etc.)

4.1 Size

One Tetrapak Machine capable of producing 250 ml packs

Plans for a second machine for 750 ml shortly to be acquired.

4.2 Use

For making fruit drinks from concentrate imports. Second machine will pack larger cartons fromd omestic milk production from the SDA mission farm.

4.3 Type

Tetrapak

4.4 Products

As above

4.5 Capacity

The unit presently being used at approximately two thirds idle capacity. the second machine planned to be acquired will possibly have less use.

The owner of the company has indicated interest in contract packing but not in full processing of coconut products.

4.6 Utilization

Underutilized - has excess capacity.

4.7 Age

One year for existing machine

4.8 Ownership

Machinery is on marginal rent basis from Tetrapak company - the company is called De-Lux Investment Co. Limited - Executive Director is Mr. Robert Leong - see Report on Company Attachment ( ).

4.9 Location

Ranandi - Honiara

4.10 Type of management

Good management - Solomon Island Chinese Holding company - backed up by a small but strong integrated food business.

4.11 Interest in participating in this integrated venture

Has definite interestin participating but would prefer to be a contract packer rather than a manufacturer. This point could be overcome if market prospects looked bright.

5. INSTITUTIONAL

5.1 Private sector involvement

Private Sector is presently being given full encouragement from Government. A strong but small industrial base exists within the country. The private cconut base exists within the country. The private coconut sector is dominated bu Unilever's which runds a very large estate at Yandina in the russell Islands. This operation is subject to a separate report.

It is considered that there will be no great problem in having the private sector participate in the project.

5.2 Equity Participation by Board's Government Private

The Commodities Export Marketing Authority (CEMA) has very wide powers which were passed by both sides of Govrnment during successive terms of office. Many provisions of the legislation are very powerful and may act as a disincentive for the private sector to invest in commodity related activities.

Notwithstanding the above, the current management and Board of CEMA are quiet receptive to the project and it would seem more than likely that they would welcome the chance to participate in any major development.

There are a number of other institutions which may have interest in investing including the National Provident

Fund and the Government's investment corporation. It is most probable that any investment in coconut related industries would be through CEMA.

5.3 % of GNP and export earnings from coconuts

Value of copra exported amounted to 10.3 million SI$ in 1987 or 8% of total export earnings. It is interesting to note that copra accounted for 15% of total exports in 1970 and 100% of Agricultural exports in 1960.

5.4 Other institutions involved with coconuts

The Government's Department of Agriculture and Land Develpment Authority have inerest in coconuts.

5.5 Degree of control on supply, etc.

CEMA has absolute power over the movement of coconut products outside the country, licences can be issued to approved exporters. Provincial Governments also can control business activities within their jurisdiction.

5.6 Competition (multinationals and local firms)

There is no competition at the moment in the Solomon Islands as very little processing is done. There could be competition if Levers Pacific Plantations become involved and also say a small operation in Honiara competes for processing of coconut milk.

Once again it should be noted that Levers is 40%owned by the Solomon Islands Government.

6. RAW MATERIALS

6.1 Geograpnical concentration of products

Refer to SD No5

6.2 Tonnage Available

Tonnage available for project would vary according to location of plant but ifoptimum locations were ued - between 2 and 4000 tonnes of copra equivalent would be available on Guadalcanal (Honiara). Large new planting on Guadalcanal have yet to mature.

6.3 Land ownership

Landownership varies but for areas where the project is viable there would be no difficulty acquiring land.

6.4 Tree use rights

The sample survey of smallholder coconuts 195 - contains details of ownership however for the matter under review, coconuts at Yandina are all owned by the company and in other areas would be sold by those having ownership or in the customary sense those who have the right to harvest at that time.

6.5 Size of holdings

Size of holding varies - total estimated number of palms is approximaely 9 million trees. The smallholder census shows that 79% of smallholders have plots of between one and two hectares and 15% between 2 ha. and 4 ha. the balance ranging up to 10 ha. and above.

6.6 Age

Generally speaking, the age of trees is much youner than other Pacific Island contries. Excluding plantation areas, which are also quite young, smallholders have the following distribution:

6 years or less	20%
6-15 years	30%
15-40 yers	40%
40 years plus	10%

6.7 Variety

Apart from plantations which have mainly Rennel x Malaysian dwarf hybrids - 90% of smallholders have local talls growing.

6.8 Productivity

Productivity varies from area to area - in most instances productivity is related to soil type, planting density, pest and disease problems and maintenance. For the purpose of the study it could be said that the yield per hectare at Yandina would the highest at 2 to 4 tons of copra equivalent. For other areas one ton per hectare would be the average expected yield for smallholder plantings.

6.9 Copra meat or cream yield/nut type

Taken from "Coconut Collection"

1. Local Tall
   Fruit Size - polar circ 57.4 cm - equatorialcirc 50.0 cm
   Fruit weight - whole 1221 gr - dry copra 190 gr.
   Number of nuts per ton (copra) - 5,352

2. Hybrid
   10 - 15 smaller

6.10 Yield and variation within the country

Variation is quite wide depending on variety - the two notable exceptions are the Giant Rennell and Bellona nuts which contain average copra per nut of 330 gr.

6.11 Replanting schemes and hybrid development

Smallholder Sector

There was a replanting subsidy scheme in the Solomons some years ago which has mixed results - many hybrid nuts distributed were not planted. However, the smallholder setor has een quite active in replantin local tall and other non-hybrid selected palms.

Plantation Sector

Significant replanting has taken place in the plantation sector - see major developments in contact report on Levers Pacific Plantations.

6.12 Harvesting methods

Coconuts are left to fall from trees and are then collected. Only green nuts for drinking purposes are picked.

6.13 Frequency

Harvesting frequency varies, usually depending upon area and method of operating. Smallholders tend to collect nuts a little at a time until they have a workable number to make copra. Plantations on the other hand usually harvest on a cyclical basis of around about one month.

6.14 Labor availability

There are always problems in recruiting plantation labor particularly for cutting copra. If however labor was required only for collection of nuts there could be change - Unilever recruits labor from other parts of the country and has its own town to house.

6.15 Care and husbandry practices

This varies greatly - generally smallholders with local talls practice fairly loose brushing and clearing. Plantations tend to intercrop with cattle and now

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increasingly with cocoa - hybrid plantations use fertilizer at times.

6.16 Wastage - not harvested

Wastage is considerable at times of low prices. Smallholders tend not to produce in periods of low prices.

The correllation of price fluctuations to copra production is quite positive.

6.17 Other losses

Other losses occurfrom cyclone, and drought but particularly from a bug called Amblpelta Cocophaga or anothe Cocophaga Malaitensis. Rats are alsoa caue of loss.

6.18 Domestic

Domestic consumption of coconuts - se Sample of Smallholder Coconuts Attachment 2 Page 34 - average 5 nuts per day per family and also Table 16A and 16B Page 89 for further details.

6.19 Industry, % of total availability

See Table of Copra Production - CEMA Report Attachment 3.

6.20 Cost of coconut production

See Attachment 1 Section (V) for models with and without cocoa intercrop.

6.21 Domestic pricing and policies

Domestic pricing of copra, which also sets the price levels for coconuts, is determined bythe commodities Export Marketing Authority. RD No__

6.22 Controls

Controls over the industry are also exercised by CEMA - the at controlling CEMA is very extensive and is included as. For the purpose of the report however any required licensing of activities would be granted by CEMA.

6.23 Rural

One policy exists for the whole country.

6.24 National

One policy exists for the whole country.

6.25 Influence of stabilization schemes (effect of these on sale of non copra products

The influence of copra prices which are stabilized is reflected in the price of whole nuts - prices for fresh nuts sold in markets vary within a range according to copra price but are heavily influenced by transport costs. As there is very little activity in other products a situation similar to that of sales of whole nuts would apply.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

See CentralBank Report RD No___

Maintain Central Reserve - Smallholder Investment Program

SI$ 2 million - Land Ue Development - solomon Islanders taking over coconut plantation rehabilitation.

SI$ 4 million - coconut and cocoa - new planting and fixing Cyclone damage

8. GOVERNMENT POLICIES PRESENT

Present Government policy is to strengthen the coconutindustry with greater support infrastructure (the cost effectiveness of this in some locations may be questionable) and toencourage downstream processing.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

Future policy is similar to present however the question of whether producers, particularly Levers Pacific Plantations will be given export licenses from CEMA for copra exports, is currently being debated. From observation, even though at the moment Levers can see short term benefits in direct exports it is a fact that in the long run they would be worse off thanif they remained as is. This would apply to other copra producers as well. For non-copra products, the situation is different and direct exports would be better.

10. RULES, REGULATIONS, STANDARDS

There are rules, regulations and grading standards existing, for copra. However, at this stage non-existent for other coconut products.

11. IMPORTS

There is very little import of coconut products. Imports

are mainly dessicated coconut however to the surprise of authorities canned coconut milk from Malyasia was able to be bought froma supermarket in Hnoiara. There are no planned imports of coconut or coconut products.

12. EXPORTS

Exports are copra only - in the past, progression to copra crushing has been avoided as it would give a net negative return to producers and current plans are to continue exporting copra until such stage as alternative downstream products are developed.

13. LABOR

13.1 Labor Construction

Construction labor is readily available - there should be no problem in obtaining a contractor although normal commercial prudence should be applied.

13.2 Processing

Processing labor is readily available. The existence of two fish canning factories demonstrates that processing labor is available and reliable.

14. PIONEER INVESTMENT INCENTIVES

On a case by case basis at the moment spread between various Ministries involved - move underway to have all incentives to be placed under control of one Board for ease of facilitation - legislation to be passed shortly.

Comment is made on this in Central Bank Report. It is understood that any proposed project would receive favorable attention.

15. OTHER

15.1 Susceptibility to natural disasters

The Solomon's major problem is from cyclone - considerable damage was caused by cyclone Namu however in the past the Solomons has had less cyclones than most other Pacific Island countries. Droughts in some areas also effect production however this is not considered serious.

15.2 Disease such as "cadang cadang"

See Attachment (1) Annex 1, Section 4.5 - Prevalence of Diseases and Pests. Solomons has reported the incidence of cadang cadang.

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REPORT ON KINGDOM OF TONGA

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TONGA OVERVIEW

Tonga is comprised if 169 islands, of which 36 are inhabited.

Geographic Location

The population stands near to 100,000 and the TONGAN'S are of Polynesian Heritage

The Tonga people are hardworking, industrious and well organized. They practice Christianity with great zeal and are a friendly and robust race.

Economy

The Economy of Tonga is a mix of subsistence and cash.

The trend in Tonga is toward a greater cash economy and although agriculture remains the mainstay in production their secondary industries are growing at a remarkable rate, as is Tourism.

A major source of foreign exchange comes to Tonga in the form of remittances from Tongans living abroad. This is the Single largest & foreign exchange earner.

Language

The language is officially Tongan, but English is widely used.

Currency

The currency is expressed in Pa'aga equivalent to dollars, and Seniti, equivalent to cents. The currency is closely aligned in value to the Australian Dollar.

Air Transport

Air Transport is frequent and services to and from New Zealand, Australia, Fiji, Samoa, Honolulu are readily available by recognised carriers.

In addition Friendly Island Airways provides inter island services to Eua, Vaoau, Haapai by a Twin otter aircraft.

Shipping

Shipping for export products is available to Australia, New Zealand, Hawaii, by direct services and to other points by feeder via Fiji. Pacific Forum Line and Warner Pacific both offer regular services. Inter-island shipping is regular and conventional and Roro Services are available.

The main ports are Nukualofa and Vaoau. Both have deep water facilities. Container operations are handled mainly at Nukualofa.

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Communications

Communications with the outside world are by satellite transmission and a full range of services are available.

Local telephone services are available in the main island and in some of the outer islands.

Utilities by way of power and water are readily available in Nukualofa and throughout Tongatapu the main island

On outer islands locations power is not always available on a 24 hours basis.

Banking

Banking is available via the Bank of Tonga which offers full commercial bank facilities, in the capital and operates agencies elsewhere.

The Development Bank also offers services. Generally aligned to selected agricultural, fisheries and manufacturing facilities.

Government

Tonga is unique in that is has the reigning Monarchy in the Pacific. The Constitution of Tonga was adopted in 1875 and embraces three bodies:

The King in Privy Council and Cabinet, the Legislative Assembly, and the Judiciary.

Land

Land cannot be purchased in tonga but leases are available and and an industrial estate is in place.

Investment

Investment is encouraged by Government and the industrial estate has attracted foreign investment and is the model for smaller Pacific States.

A whole range of incentives is available and are shown in the Research Document

General

Tonga is aptly named the Friendly Islands and enjoys a quiet relaxed atmosphere. Generally cooler than the rest of the Pacific with a high mean temperature of 27o and a low of 15o.

Pleasant trade winds remove much of humidity and the pace of life is attractive.

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The Coconut Industry

The coconut industry is controlled by a Government institution namely The Tonga Commodities Board. This board is dominant in the agriculture sector. It is questionable whether the best interests of the producers are achievable given the diversity of the Board's operations overall.

The Tonga Commodities Board's main base is in Nukualofa and covers some 10 acres of land.

The milling of oil, soap making, desiccating plant and copra drying operations appear in conflict with their other activities of construction, building services, other manufacturing. Agricultural exports of bananas, vanilla, etc., are another function of the Board.

The accounting and administration of these diverse activities involves a large staff and inevitably costs and duties to various sections overlap and true processing a accounting is highly unlikely to be achieved. Currently the T.C.B. is now being reviewed to decide the future direction, and scope of the operations.

ECONOMIC OVERVIEW

A dual economic system operates in Tonga. Many Tongans, particularly in the outer islands, participate in the subsistence economy - fishing, growing food and exchanging goods and services with relatives and neighbors. Others participate in a mixed economy, where cash crops are grown for sale and handicrafts are sold to the tourist market. A small but increasing number of Tongans working in countries such as Australia, New Zealand and the United States are an important source of income.

The average growth rate of the national economy during the 1970s was 3.5% although the latter part of the decade saw a faster rate of growth. Over the same period per capita GDP rose from TP161 to TP395 - an increase in real terms of 25%.

In recent years there have been significant changes in the structure of the economy. Though primary production remains dominant, its percentage contribution to GDP has declined from 56% in 197[illegible] to 44% in 1980. The contribution of secondary industry grew from 6.2% to 12.7% over the same period.

Agriculture

The Tongan economy is largely based on agriculture and it is estimated that 70% of the population depend primarily on it for their livelihood. However, the percentage of the labour force engaged mainly in agriculture has declined in the past 25 years from 80 to 60%.

There is potential for a substantial increase in agricultural output, given the fertile soils and favourable climate. At present around 60% of crop production (fruit and vegetables) is consume locally, with the remainder being exported.

Coconut is an important domestic and export industry. It is estimated that 57% of Tonga's total land area is planted with coconut palms. Exports of copra, desiccated coconut, and more recently coconut oil have been the major export earners.

A wide range of fruit and vegetables is grown, of which over 60% is consumed locally. These include root crops, water melons, tomatoes, capsicums and pineapple. New Zealand is the major export market.

Coconuts provide the ideal environment for crops which crow best in shady conditions such as vanilla, kava, cocoa, coffee, ginger and black pepper. At presently only vanilla and kava are grown commercially in Tonga. Substantial exports of kava have taken place since the mid-1970s. The vanilla industry has expanded rapidly, especially in Vava'u. There are no large pastoral activities, and only 34% of the total meat requirement is met from local production.

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Manufacturing

The manufacturing sector has grown rapidly in recent years. Between 1975 and 1980 its contribution to GDP rose from 5 to 7.8%. It is currently estimated to account for 10% of GDP. In 1980 there were 72 factories employing over 1,000 people.

Approximately half of all manufacturing activity involves food and beverages, wood and wood products. Over 80% of manufacturing is located on Tongatapu, largely in and around Nukualofa.

The Small Industries Centre, (SIC) opened in May 1980 by His Majesty the King has proved to be an important stimulus to manufacturing. The centre was jointly financed by the Asian Development Bank and the Government of Tonga. Industries already established at the SIC include knitwear, leather goods, paint, mini excavators, and steel furniture.

Fishing

Tonga has substantial fishing resources which are commercially underdeveloped. The contribution of fisheries to GDP has been around 5% since the mid-1970s. Three main resource areas exist. About 80% of the total catch is caught in the inner reef area. An FAO/UNDP Marine Resources Development Report (1976-77) estimated an annual potential of 1,000 tonnes of bottom fish in the outer reef and deep water slope areas, as well as an additional 2,000 tonnes of seasonal species such as skipjack and yellow fin tuna.

The minimal potential catch of albacore and yellow fin tuna in the deep sea area is estimated at 4,600 tonnes per year. In addition it is estimated that are potential seasonal catches in Tongan waters of at least 10,000 tonnes of skipjack per year.

In recent years effort has gone into development of an effective artisanal fishing fleet.

Icemaking, cold storage and marketing facilities are available in Nukualofa, and similar facilities are planned for Ha'apai and Vava'u.

Forestry

The forestry industry is still small, contributing less that 0.2% to GDP. Forestry output increased almost threefold between 1975 and 1980. The long term aim is to achieve self sufficiency in sawn timber. Although native hardwood reserves are limited, senile coconut palms represent a significant resource. An estimated 600,000 senile palms could yield up to 100,000 cubic metres in the short term.

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COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

Pacific Forum Lines (container ships) provide regular services to and from Australia, New Zealand and region ports. Warner Pacific Lines based in Tonga provides regular Australia and New Zealand services as well as servicing regional posts. Warners Vessels provide be sides containers breakbulk and reefers services. In addition Inter-island Shipping in roll on roll off and conventional vessels service the major ports of Nukualofa (the capital) and Vavau as well as island ports. A new service by small container vessel has begun a service between Honalulu, Pago Pago, Apia, Tonga, Cook Islands and return direct to Hawaii.

1.2 Cost

See Resource Documents.

1.3 Frequency

See Resource Documents

1.4 Capacity

Resource Documents

1.5 Handling facilities from source (harvest) to collection points

Resource Documents

1.6 Back loading problems, etc.

Backloadings are in short supply for overseas ports. Inter-island the problem is not so critical.

1.7 Other transport problems

The cost of Inter-island shipping is a problem and in some ports lighterage adds costs due to the time taken in loading and discharge.

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2. EXPORT & IMPORT FACILITIES

2.1 Port

The main wharf in Nuku'alofa has a length of some 340 metres and ample scope for further extension. The depth is more than adequate to handle large container ships.
Vavau has an excellent harbour but has drought limitations.

2.2 Warehouses

General and bonded goods warehouses are in place.

2.3 Handling machinery

Very good facilities e.g. fork hoists etc. at main ports.

2.4 Water depth

Resource Document - Harbour Report

2.5 Harbour size

See separate Attachment - Port Details

2.6 Problems

Customs/stevedoring can be arduous on occasions.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Adequate water services are available in Nuku'alofa and Vavau.

3.2 Electrical

Services are available in the main centres on a 24 hour basis - 440 volts and 240 volts are available in central Nuku'alofa.

3.3 Fuel

Diesel, petrol, kerosene and white spirits are freely available.

3.4 Sewer

Sewerage is by septic tank
No Main Service is available

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3.5 Waste Disposal

Waste disposal is extremely limited. Treatment of waste will be required due to the water source being drawn from wells.

3.6 Engineering

Welding, fabrication and medium sized engineering jobs can be carried out. Heavy engineering is very limited.

3.7 Manpower skills:

Somewhat limited given their earlier agriculture back ground. However Tongans are quick learners and acquire skills readily. The industrial estate success services attests to this. The Tongans retain a traditional work ethic

3.8 Regulations/laws

Regulations to almost all facets of business. From wage levels through to waste disposals.

3.9 Costs

See Resource Document for wage levels, current costs and increments.

3.10 Availability

The growth of secondary employment has taken up a large percentage but ample labour remains level

3.11 Reliability

Consistent and loyal.

3.12 Quarantine laws, and procedures

Quarantine laws are stringent. Fumigation is available on a limited basis.

3.13 Land cost and availability

Land is not readily available except in the small industries centre. Land can be acquired by leasing but is not available for purchase.

3.14 Problems etc.

From time to time power shortage occur. Water required in large volume will require a storage facility. Generally tap water is hard.

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4. EXISTING PROCESSING FACILITIES: (Coconut) fruit, vegetables beverages etc.) List fruit vegetables etc under Appendix.

4.1 Size

Tonga Commodities Board operates from a large compound (in excess of 10 acre's), that includes, a desiccated mill, oil mill and soap factory

4.2 Use

Desiccated coconut	Copra Drying
Oil Milling	Soap Factory

In the private sector small factories produce passion fruit juice, ice-cream, soft drinks, carbonated beverages and very recently a small batch brewery began operating.

4.3 Type

4.4 Products

Commodities Board
Oil, copra cake, and desiccated coconut
Private sector as above

4.5 Capacity

Desiccated coconut	2,000 tonnes p.a.
Coconut Oil	9,000 tonnes p.a.
Soap	
Copra Cake	3,000 tonnes p.a.

4.6 Utilization

Utilization coconut	Between 30-60 hrs weekly
Oil Mill	Consistently dependent upon copra
Soap factory	Subject to demand
Copra Cake	Consistently

Desiccated production	1986	863 tonnes
	1987	615 tonnes

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4.7 Age : Established

Desiccated plant new 1986
Oil mill 1987

4.8 Ownership

Government via Tongan Commodities Board, for all coconut based products.

Passion fruit Industry - Private Enterprise
Brewery Joint Venture/ Private Enterprise/Good

4.9 Location

Nuku'alofa - Capital of Tonga

Other facilities, e.g. ice-cream soft drink or similar operations are privately owned and are located in the small industries centre or adjacent in the capital, Nuku'alofa.

4.10 Type Management

Commodities Board : Quasi Government with expatriates in key positions.

4.11 Interest in participating in this integrated venture

The Commodities Board is interested in further processing opportunities, and in this venture.

5. INSTITUTIONAL

5.1 Private sector involvement

Some private sector people have shown an interest in coconut processing. In the main their attention has been on local market. The exception in regard to food processing for export is Golden Passions Limited. There interest is in the export of tropical fruit mainly passion fruit in frozen form.

5.2 Equity participation by Board's Government Private

The Tonga Commodities Board has control of all coconut resource. Besides their own activities they issue licenses to parties wishing to trade in coconuts. The Commodities Board are interested in joint venture operations relative to the coconut industry.

The Tongan Development Bank can take equity shares and hold in trust for Tongan participation in commercial ventures.

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Similarly the Bank of Tonga is another source of funding.
The Government of Tonga encourages private sector development and has proven itself very successful in attracting foreign investment.

5.3 % of GNP and export earnings from coconuts

1987 - Tonga (dollar) Pa'aga = $2,352.000

5.4 Other institutions involved with coconuts and

No other processors, private and institutional whole nut exports.

5.5 Degree of control on supply, etc.

Commodities Board controls all supplies for export products by licensing regulation

5.6 Competition (multinationals and local firms)
Nil

6. RAW MATERIALS

6.1 Geographical concentration of productions

Coconuts

Tongatapu (capital)	48% =	Haapai	= 21%
Vavau	25% =		= 6%

6.2 Tonnage available

Copra : Approximately 12500 tonnes p.a. copra local consumption : 3000 ton p.a. - (Copra Equivalent)

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6.3 Land ownership

The Nobility own the Largest holdings, and under Tongan Law. All males on reaching their majority year are entitled to a plot of land of 8.25 acres.

6.4 Tree use rights

The trees on private land are those of the owner. On the estates of the nobility the harvest is generally shared.

6.5 Size of holdings

Small holdings = 8.25 acres

Larger estates are held by the nobility and vary considerably in size.

6.6 Age

The trees very widely in age. See item on page of input supply.

6.7 Variety

Mainly Tongan Talls.

6.8 Productivity

The variation in size due to age of tree is very large e.g.

A mature tree yields	30 nuts p.a.
Young mature trees	20 nuts p.a.
Senile trees	14 nuts p.a.
Senescent	17 nuts p.a.

6.9 (Copra meat or cream yield/nut) type

6.10 Yield and variation within the country

Considerably kernel weight high - 380 gr.
low - 280 gr.

6.11 Replanting schemes and hybrid development

This is an ongoing process. 34% of the total trees are young or yet to bear hybrids and the strategy is an ongoing replanting program.

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6.12 Harvesting methods

6.13 Frequency

6.14 Labour availability

Becoming limited due to expansion of secondary education in the Capital
Outside the Capital Labour is generally attainable

6.15 Care and husbandry practices

The Agriculture Department have active pest and disease control programs. Private owners ring weed trees occasionally.

6.16 Wastage - not harvested

The harvest size depends on the price and labour available. In general 80% of the nuts are harvested

6.17 Other losses

Drought and cyclones are fairly common and contribute losses. Pest and disease contribute also but nothing of significance.

6.18 Domestic

Consumption - 17,000,000 p.a. = 18% of group.

6.19 Industry, % of total availability

Desiccated coconut - 8% on current performance
Copra -74%

6.20 Cost of coconut production

Processing Sector : Unavailable

6.21 Domestic pricing and policies

Undertaken by the Commodities Board

6.22 Controls

Pricing set by Commodities Board
Licensing set by Commodities Board

Coconut Industry under Commodities Board

6.23 Rural

Tonga Commodities Board

6.24 National

Tonga Commodities Board

6.25 Influence of stabilization schemes (effect of these on sale of non copra products)

Very little influence

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Not Applicable

8. GOVERNMENT POLICIES PRESENT:

Expansion of Existing resource
Favour added value activities.

9 FUTURE POLICIES AND PLANS RE : COCONUT INDUSTRY

Progressive but realistic in goods for greater

10. RULES, REGULATIONS, STANDARDS

11. IMPORTS

Duty free access for plant and machinery under incentives. Development and Incenses available for specified projects allow duty free entry

12. EXPORTS

Tax Free most agricultural products

13. LABOUR

13.1 Labour/Construction

Industry = Government Award Rates/8 hr.day U.S.$
Local Tradesman = 6.60
Local = 8.54 p.hr

13.2 Processing

Government award rules unskilled = 5.62 per 8hr.day
Semi = 5.95 per 8hr.day
Skilled/Technical 12.62 per 8hr.shif

NOTE: These rates will vary as Skills re:in high Demand

14. PIONEER INVESTMENT INCENTIVES

The range of incentives are excellent, pioneer status is negotiable.

15. OTHER

15.1 Susceptibility to natural disasters and

Cyclones and hurricanes occur fairly regularly. Drought occasionally.

15.2 Disease such as 'cadang cadang' : No

Some infestation of stick Insect and Rhinoceros Beetle but are under control.

REPORT ON TUVALU

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COUNTRY : TUVALU

GEOGRAPHY/GEOLOGY

Tuvalu consists of nine coral atolls, of which eight are permanently inhabited. The chain stretches between 5 degrees and 10 degrees south of the equator. The capital and main island is Funafuti, which is about 1,100 km. north of Suva, the capital of Fiji. Funafuti is 2.8 sq. km. and Vaitupu, the largest land mass in the group, is 5.6 sq. km. Other atolls are Nanumea, Niutao, Namumanga, Nui, Nukufetau, Nukulaelae, and Niulakita. The atolls are low lying islets enclosing wide lagoons. The soil is generally thin and poor which limits the types of plants that can be grown successfully.

CLIMATE

During the dry season from March through October, the constant trade winds temper the tropical heat. The rainy season lasts from November through February and is characterized by westerly gales. Extremes of temperature range from 22 degrees to 38 degrees celcius. Average rainfall is about 3,000 mm. per year.

HISTORY

The earliest inhabitants of Tuvalu probably came from Samoa, Kiribati and Tonga. The name 'Tuvalu' means 'eight standing together', and refers to the eight inhabited atolls. The ninth atoll is Niulakita, the southernmost of the group, which stands apart from the others and is not inhabited on a permanent basis.

The first of the Tuvalu Islands to become known to Europeans was Nui, which was sighted by the Spanish explorer Mendana in 1568. On his second voyage in 1595 he sighted Niulakita, but his discoveries had been forgotten by the time the next European reached Tuvalu almost two centuries later. In 1781 the Spaniard Francisco Mourelle came across two of the northern atolls, but Europeans did not locate any of the other islands until well into the 19th century. The group became known as the Ellice Islands in commemoration of the Englishman Edward Ellice who owned the ship in which Captain Arent De Peyster discovered Funafuti in 1819. In 1826 a Dutch sea captain rediscovered Nui after a lapse of almost 250 years.

Whalers frequented the seas around Tuvalu during the years between 1821 and 1870. Seamen from these ships occasionally deserted and settled ashore, sometimes becoming traders and agents for foreign firms. Starting in the 1860's, "blackbirders" kidnapped hundreds of islanders to work on plantations in South America, Hawaii, Fiji and Samoa. Missionaries arrived in Tuvalu in 1861, and within a few years most of the population had converted to Christianity. In 1877, British subjects in Tuvalu were brought within the jurisdiction of the High Commissioner for

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the Western Pacific in Fiji. Following the establishment of a protectorate over the Gilbert Islands about 15 years later, the inhabitants of Tuvalu agreed to come under the British flag, and in this manner the Gilbert and Ellice Islands Protectorate was formed. It became a colony in 1916.

Tuvalu remained outside the area of World War II hostilities, but the Americans established a military base on Funafuti and built airstrips on three of the islands. After the war ended, many Ellice islanders migrated to Tarawa in the Gilbert islands to find work. When Britain began to prepare the colony for self government in the 1970's, the people of Tuvalu voted to secede from the Gilbert Islands. In 1975 the Gilbert and Ellice Islands were legally separated, and the latter became Tuvalu. The nation gained independence in 1978.

PEOPLE/LANGUAGES

The people of Tuvalu are of Polynesian origin, but many now have admixtures of European blood. The Tuvaluan language is a Polynesian dialect closely related to Samoan. A Gilbertese dialect is spoken in Nui, and English is widely spoken throughout the islands.

GOVERNMENT

The Parliament of Tuvalu consists of a single chamber with 12 members. The Cabinet consists of the Prime Minister and four other ministers. Local government is in the form of a Town Council on Funafuti and Island Councils on the seven other main islands, each consisting of six elected members including a president. Members of Parliament are ex-officio members of Island Councils.

ECONOMY

The economy of Tuvalu is based on subsistence agriculture and fishing. Copra is the main crop and the country's chief export. Due to unstable prices for this commodity, the Government encourages diversification of the economy. The headquarters of the Agricultural Division is located on Vaitupu Atoll, north of Funafuti. Efforts are being made to increase the numbers of pigs, goats and poultry to lower import requirements.

There is a fisheries development station on Funafuti. A commercial fishing vessel, donated to Tuvalu by Japan, has been in operation since 1982. Vessels from South Korea and Taiwan have been in operation since 1982. Vessels from South Korea and Taiwan have been licensed to fish inside Tuvalu's 200 mile zone.

Philatelic sales to overseas collectors has generated a significant amount of revenue, considerably in excess of the income from Tuvalu's usual exports.

GOVERNMENT BUDGET

Government revenues are derived from personal income tax, customs duties and philatelic sales. Major expenditures are allocated to works andcommunications, social services, commerce and natural resources, finance, and to offices of the Prime Minister and other government officials. Shortfalls in the budget are made up by aid from Australia, Britain, New Zealand, Canada, Japan and West Germany.

INFRASTRUCTURE

International flights connect Funafuti to Fiji and Kiribati, and internal flights service all the atolls except Nanumanga, Niutao and Niulakita.

The only port of entry for Tuvalu is Funafuti which has a deep water lagoon with three entrance passages. There is a wharf which can accommodate ships drawing up to five meters. Tuvalu is serviced by Pacific Forum Line and Karlander Line. Funafuti has roads of compacted coral, and the other atolls have feeder roads or tracks that provide access to the cultivated areas.

The Tuvalu Electricity Authority maintains the supply of electricity, which is 240 volts, 50 cycles. There is a limited electricity supply on Vaitupu, and there are plans to provide electricity through solar energy to the outlying areas. Since there are no streams or catchment areas, all water is obtained from roof catchments that run into household tanks.

COMMUNICATIONS

Tuvalu is connected with the international telephone and telex network through Fiji, and there is an efficient telegraph service supplemented by a radio telephone link between all islands in the group.

INTERNATIONAL RELATIONS

Tuvalu is a member of the Commonwealth of Nations, South Pacific Commission, SPEC and WHO. The nation has established diplomatic relations with Belgium, Chile, Netherlands, the Republic of China, France, West Germany, Japan, South Korea, Turkey and the U. S. It is represented in Fiji by a High Commissioner, who also acts as the High Commissioner to Papua New Guinea. There are Tuvalu consulates in New Zealand and Australia.

LIVING AND WORKING

The housing situation for expatriates in Tuvalu is extremely limited, and foreigners who intend to reside in Funafuti or elsewhere should make arrangements for accommodation well in advance of their arrival.

Since the air and shipping links to Tuvalu are not frequent, the amounts and types of imported foods are correspondingly limited. Fresh foods such as fish, poultry, pork and some fruits and vegetables are available locally, however, and provide a nutritious diet. Small trade stores carry supplies of basic staples.

The islander's favorite forms of recreation are singing and dancing at local style feasts. Sports such as volleyball are especially popular, and foreigners usually enjoy activities such as swimming, diving and fishing.

There are several public bars that are openfrom 1100 to 1500 and from 1830 to 2000.

The only newspaper is the "Tuvalu News Sheet', a government publication that comes out every second week. Radio Tuvalu broadcasts from Funafuti for four hours a day. Most of the programs are in Tuvaluan with English language news broadcasts. There is no television service.

Education: Primary schools exist on each of the nine islands, and all children attend. Secondary education is provided on Vaitupu island, and some secondary students study overseas. The Maritime Training School is located on the Funafuti islet of Amutuku and prepares young men for work with overseas shipping companies.

Health Services: There is a hospital in Funafuti that includes a dental clinic, an X-ray facility, an operating theater, laboratory and family planning clinic. Each island has a registered nurse and other medical personnel.

Public Safety and Personal Security: Serious crime is rare in the islands. The majority of the offenses are minor and are usually matters of assault, infringement of drinking laws, and traffic violations.

BUSINESS TIPS

Currency/Banks: The currency of tuvalu is the Australian dollar, but Tuvalu has its own coins which are also used. The National Bank of Tuvalu and Barclays Bank are in operation in Tuvalu.

Legal Holidays: Public holidays are New Year's Day, Commonwealth Day (second Monday in March); Good Friday and Easter Monday; Queen's Birthday (June); National Children's Day (August); Tuvalu Days (two days in October); Prince Charles Birthday (November 12); Christmas Day and Boxing Day (December 26).

(From Pacific World Directory, 1987 Ed., Pub. 1986, Saipan)

The major industry in Tuvalu is the production of copra. Tuvalu only produces a very small amount of copra in the range of 300 to 400 tons per year. This copra is sold to Fiji for crushing in Fiji's copra crushing mills. The copra is collected from the various islands in the Tuvaluan group and has been of fairly poor quality until recently.

The smallness of Tuvalu and the geographic dispersity of these islands means that the shifting of cargo from outer islands to Funafuti, the island's capital, is very difficult.

The government owns one ship which does a monthly run to most islands carrying food, cargo and people to the islands and bringing back people and copra to the capital.

In previous years a coconut soap factory was built on the island of Vaitupu, the country's major coconut-producing island. This project turned out to be non-profitable. Two of the reasons for the problems with the soap factory were domestic resistance against the soap produced from the factory, also disappointment that the operation did not prove to be successful. In effect, the factory was built from a very poor base with lack of professional input and failed to reach what could be called normal commercial production. Following a review of operations, it was decided to remodel the operation and utilize the services of the United Nations personnel rather than close the operation down. The programs is ongoing.

Coconut trees on Tuvalu are reasonably healthy. The country experiences good rainfall and does not suffer from the same problems as Kiribati with drought. If anything, rainfall prevents Tuvaluan copra producers from producing good copra because of mould and wetness. A program is now underway to improve copra drying facilities throughout the islands.

As for Kiribati, it is difficult for Tuvalu to export whole nuts with husks on because by doing so, a potassium deficiency will be created in the atoll's ecosystem which will ultimately require replenishment of potassium levels through the use of fertilizer. The cost would exceed the possible value of export of nuts. Also, when applying fertilizer to coconuts in atoll conditions, after the first shower of rain the fertilizer leaches through the sandy soil and dissipates. Far greater control exists when the husks from the coconuts are left to slowly rot away in the coconut groves. This allows the release of potassium gradually from the rotting husk, in time with the natural requirements of the tree, thus perpetuating the growing cycle.

In relation to coconut products, coconut toddy, coconut syrup, and in the case of Vaitupu, possibly coconut honey and coconut based soap may be available for export if the proposed regional marketing setup could facilitate the marketing of minor

products to overseas markets.

Due to the smallness of the Tuvalu coconut industry, it seems unlikely that any significant input could be made to the regional project. It must be remembered, though, that the coconut industry is very important to the people of Tuvalu, and if possible the project should cater for their participation in whatever way could be possible.

The export of limited quantities of husked nuts could be made through a central location, even though it may be a small amount. This would, of course, depend upon shipping connections; however, the underlying decision would be the economic benefit to the country. The coconut in Tuvalu is treated as a prime crop, for as well as providing cash from the production of copra, coconut forms a very large part of Tuvaluan diet. It is estimated that Tuvaluans would eat more coconut on a per capita basis than most other Pacific islanders.

There is also a shortage of fuel on Funafuti, the main island. Some benefit could be obtained from having coconut shells shipped from other islands to Funafuti for either conversion into charcoal or for direct use as firewood. There has been thought in Tuvalu in the past for the preservation and canning of the cake of the growing coconuts (the embryo). This 'utanu'(coconut Haustorium), as it is called in Tuvalu, is considered a delicacy and may have some place in the international marketing of coconut products.

In conclusion, it is thought that Tuvalu may be able to benefit from the marketing connections and expertize which may develop from the original project, if the relative size of the Tuvaluan production can be catered for and specialized market outlets can be identified.

REPORT ON REPUBLIC OF VANUATU

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INTRODUCTION TO VANUATU

GEOGRAPHY

The Republic of Vanuatu consists of a Y shaped chain of some eight islands located in the South West Pacific Ocean. The chain stretches over a distance of approximately 850 kilometer in a north-south direction from the Torres group in the north to the uninhabited active volcanoes of Matthew and Hunter Islands in the south. The group lies between 13 and 22 degrees south of the equator and between 166 and 172 degrees east of Greenwich. Vanuatu is approximately 800 kilometers south-east of the Solomon Islands and about the same distance west of Fiji. To the south west, New caledonia is 400 kilometers away and Sydney 1,750 kilometers. The total land area of the group is 12,189 square kilometers (km2). Port Vila, the capital, is situated on the is land of Efate (887 km2) in the southern half of the group. Activity in the northern half of the group revolves around the town of Luganville on the island of Espiritu Santo (4,010 km2) which is the largest island in the archipelago. Other major islands are Malakula, Pentecost, Ambae, Ambae, Ambrym and Tanna.

Most of the islands in the group are of volcanic origin and there are a number of active volcanoes including Yasur on the island of Tanna, which offers a spectacular tourist attraction, and the more grandiose but less accessible volcanoes of Benbow and Marum on the island of Ambrym. Due to Vanuatu's situation on the Pacific/Australian plate margin the country also experiences frequent earth tremors.

CLIMATE

Vanuatu lies in the region of the south-east trade winds which predominate for most of the year. The climate varies from tropical in the north to sub-tropical in the south but a wet tropical climate, similar to the equatorial type generally characterizes the greater part of the group. There are two quite distinct seasons with the 'hot' or 'rainy' season from November to April, which is also the cyclone season, and the 'cool' or 'dry' season from May to October. The average temperature on Efate varies from a high of around 30 degrees celsius in February to a low of around 20 degrees celsius in August. Table 1A shows details of the climate over the last 20 years for three locations in the group, Santo in the north, Efate in the center and Tanna in the south to give an idea of the conditions prevailing in the group.

Table 1A

Summary of Climatic Conditions 1961-1983 Average

Mean Temperature - Celsius

	Santo		Efate		Tanna	
	Min	Max	Min	Max	Min	Max
Jan	29.4	22.8	30.1	23.4	29.5	22.4
Feb	29.6	22.8	30.2	23.5	29.7	22.7
Mar	29.4	22.9	29.9	23.4	29.3	22.6
Apr	28.5	22.6	28.8	22.4	28.1	21.2
May	27.5	22.1	27.5	21.1	26.7	20.0
Jun	27.0	21.6	26.7	20.5	25.7	19.2
Jul	26.2	21.1	25.8	19.4	24.7	17.8
Aug	26.4	20.8	26.0	19.3	24.8	17.8
Sep	26.8	21.1	26.5	19.5	25.5	18.1
Oct	27.5	21.8	27.6	20.5	26.8	19.0
Nov	28.2	22.2	28.8	21.5	28.2	20.2
Dec	29.1	22.4	29.6	22.2	29.2	21.3
Annual	28.0	22.0	28.1	21.4	27.4	20.2

Rainfall mm

	Santo	Efate	Tanna
Jan	339	325	216
Feb	347	298	229
Mar	348	343	234
Apr	325	219	127
May	205	149	103
Jun	202	152	102
Jul	130	111	84
Sep	137	94	55
Oct	193	121	70
Nov	226	160	70
Dec	229	197	111
Annual	2,832	2,281	1,486

Population

Official estimates of the population have only existed in recent years. However it is worth mentioning some of the estimates of the size of the population from some of the earliest records if only to show the wide divergence of these estimates. They ranged from 40 millions (Roche, 1846) down to 57,900 (Beaune 1894) with most of the estimates around the turn of the century being between 70 and 100 thousand. These estimates indicate that the size of the population has fluctuated widely over the years and that there may well have been far more people living in this group of islands in the 17th and 18th centuries than there are today. Certainly, it is known that the diseases brought in by

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the explorers and traders had an disastrous impact on the local population with many deaths resulting. Likewise the forceful abduction of young men to work on the sugar cane plantations is also known to have affected the structure and size of the population.

The first official estimate of the population was made in 1910 and put the indigenous population at 64,555 with a further 854 Europeans. Later estimates indicate that the population remained very static through most of the first half of this century and the first full population census in 1967 recorded only 77,988 persons. The next and latest population census in 1979 records 111,251 persons in the country showing a market increase in the size of the population for the first time this century.

The majority of the indigenous population (ni-Vanuatu) are of Melanesian origin and at the time of the 1979 Census accounted for 94 per cent of the total population. The European population at that time numbered 2,406 or 2 percent of the total and the remaining 4 percent included Vietnamese, Chinese and other ethnic groups from the Pacific Region (Melanesia, Micronesians and Polynesians). The population is currently estimated to be growing at 3.1 percent per annum which would give a mid-1983 population of approximately 128,000. The population, as with most developing countries, has a very large percentage of young per sons with 45 percent under 15 years of age. Other demographic features of note are that the male population exceeds the female population by 13 percent and make life expenctancy at birth is estimated at 56 years whilst for females it is 53 years. Some 84 percent of the total population were recorded as living in the rural areas at the time of the 1979 Census.

LAND RESOURCES AND POTENTIAL

Vanuatu is fortunate not only to have a relatively low population density (9 person per km2) but also to be endowed with a large percentage of its surface area covered in soils of good fertility (estimated at some 44 percent of the total surface area) and a fairly substantial additions proportion of the total surface area covered in soils suitable for forestry. At present only about a quarter of the former area is currently under cultivation leaving considerable scope for expansion of the agricultural sector both for subsistence agriculture to cope with increasing population and also for major economically important agricultural projects. However having said this it is important to note that on some of the smaller islands of the group, and in some areas of high population density on some of the larger islands, there are already signs of severe land pressure. This can to some extent be overcome by internal migration but land usage and development will be influenced very significantly by historical customs and cultures amongst the indigenous population which are particularly strong in Melanesian society.

ECONOMY

Perhaps the most important feature of the economy in the context of this report is that over 80 per cent of the population are al most entirely dependent on subsistence agriculture for their food supply and as a source of income. The main source of income is from copra with cocoa also providing and important source of revenue in some areas. The vast majority of rural households have their own small coconut and or cocoa plantations which they work as and when they need money. It is generally recognized that the cash economy, although beginning to make an impact in some parts of the rural area, still has little role in the majority of the rural villages. This has presented economists and planners with some degree of frustration in the past since the usual rules of economics do not apply in this situation and economic development is often difficult to encourage.

Domestic exports are very heavily dominated by copra which accounts for some 60-70 percent of domestic exports. Cocoa, beef, beef products and timber constitute the other main domestic ex ports at the present time (See Table 1B). The economy used to benefit from an off-shore fishing industry based on Santo where Taiwanese trawlers landed their catches of tuna prior to re exportation. This operation is now under renegotiation.

Table 1C
Summary of Imports by Broad Economic Category (BEC) 1979-1984

Value (million vatu c.i.f.)

	1979	1980	1981	1982	1983	1984
Food and drink	1,184	993	1,113	1,143	1,223	1,404
Industrial Materials	620	608	634	846	950	922
Fuels and lubricants	290	508	496	624	556	687
Machinery	460	351	428	377	577	686
Transport Equipment	400	350	318	353	460	600
Consumer goods	820	656	882	1,156	1,293	1,491
Other	88	10	7	74	170	35
Not Classified	150	120	49	58		
Total Imports for HC	4,012	3,565	3,905	4,631	5,229	5,825
Imports for re-export	1,008	1,428	1,211	1,032	1,063	986
Total Imports	5,020	4,993	5,116	5,663	6,292	6,811

Source : NPSO

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Imports have grown steadily over the last few years and the total import bill is usually well in excess of the value of domestic exports. Although imports of food account for approximately 20 percent of total imports (see Table 1C), which would in turn in dictate a high degree of dependency on imported foodstuffs, a detailed analysis of the food imports shows that a considerable proportion of these goods are imported to satisfy the demands of the expatriate and tourist sections of the community and that a further significant proportion of these imports are of items such as rice and tinned fish consumed by the indigenous population in preference to their own foodstuffs. It would therefore be wrong to assume that the population was dependent on these foods but rather than changing tastes, the convenience of such foods and their increasing availability all contribute to this demand.

Tourism plays a significant roles in the economy with some 32,000 visitors coming to Vanuatu in 1984 of which 67 per cent were from Australia. There is at present very little manufacturing industry in Vanuatu but there is an active financial sector as Vanuatu is classed as a 'tax haven' and provides off-shore financial facilities. There is also a very active retail and wholesale sector.

AGRICULTURE IN VANUATU

Agriculture is a very important sector of the economy of Vanuatu, in fact few would deny it is currently the most important sector and is likely to remain so for many years to come. Exports are almost entirely made up of agricultural products and over 80 per cent of the population are dependent on the land for their food and as the main source of their income.

Agricultural activity in Vanuatu, in the very broadest terms, falls into three main categories. Firstly the subsistence sec tor which includes, garden crops grown, and animals kept, mainly for the household's own consumption. Then, the smallholder sec tor which includes smallholdings of cash crops, such as coconuts, cocoa and coffee as well as cattle smallholders. Firally, there is the plantation sector which represents the main commercial sector of the industry.

THE SMALLHOLDER SECTOR

This sector compliments the subsistence sector and provides a source of income should household need it. The vast majority of rural households have their own small areas of coconuts often growing in old gardens in a haphazard and 'ad hoc' manner. As well as providing the household with a source of food for them selves and their animals the coconuts are also used to make copra which in turn provides the main source of rural income. Cocoa is also historically a major cash crop particularly on the islands in the northern half of the group. Coffee, which used to be a significant crop in Vanuatu in the 40s and 50s but which subsequently diminished almost to the point of non existence is now

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the focus of a development program on the southern island of Tanna where neither cocoa or coconuts grow particularly well because of the cooler climate. Other tree crops such as citrus fruit also provide a source of income to some farmers, particularly those that have access to the urban markets. More recently the importance of kava as a cash crop both for the domestic market and also for the overseas market is being increasingly recognized although only a very small proportion of total population is actually marketed at present, most being drunk buy the producer in the context of the villages' social customs. For farmers with access to the urban markets of Vila and Luganville, garden crops also provide a source of income. Finally, there has been a market increase in recent years in the number of cattle smallholdings. Cattle combine extremely well with coconuts. The animals keep the ground clean while the coconuts provide them with shade. This combination is being encouraged and smallholding cattle are likely to play an increasing role in the smallholding sector in future years.

When studying the agricultural sector in Vanuatu and the importance of the smallholder sector, its role in village life must never be forgotten. It may help to think of the smallholings as the rural population's bank. The holdings are always there for when their owners need money but they will not take the money out of the bank if they do not need it. This example is intended to provide some explanation as to why such considerable proportions of crops appear to be left unharvested and therefore wasted each year and why such terms as 'potential' production have very different meanings in the context of subsistence agriculture.

THE PLANTATION SECTOR

The plantation sector began with the arrival of European traders in the later half of the 19th century. Large areas of the rich and fertile land were planted with coconuts and later with cocoa and coffee. However, with the attainment of Independence on 30th July 1980 all land was returned to its customary owners and the land had to be leased from these owners if the plantations wished to continue their operations. Although the nature of plantation agriculture in Vanuatu has undergone significant shifts in emphasis over the years, coconuts and copra production have survived as the main thrust of this sector although many of the coconut palms are now nearing the end of their productive life and little interest has been shown in any large-scale replanting. Cocoa and coffee both featured significantly in the plantations in the early part of this century however in the early 50s much of the coffee was cleared to make way for pasture with the introduction of cattle as a major component of the plantation industry.

The plantation sector has undoubtedly suffered from the uncertainty over the land situation in recent years and it is only now beginning to show signs of stability and development. Most of the expatriate operations are concentrated on the islands of Efate and Santo with a heavy emphasis on cattle. On the other

islands, most of the plantations have been returned to the custom owners and are being run as village or community projects.

For the future, the widescale re-planting of tree crops is vital if this sector of the industry is to continue to contribute in a significant way to the economy of the country. To encourage this development the Government is supporting two major projects, a cocoa project on Malakula and a coffee project on Tanna, and it is hoped that by setting this example others will follow and the plantation sector will become a healthy sector of the agriculture industry once more.

OVERVIEW OF THE COCONUT INDUSTRY IN VANUATU

The coconut industry in Vanuatu, has been seriously affected by a number of cyclones over recent years. This affect has also been magnified by the fact that most plantation trees in Vanuatu are very old. Even in the case of some smallholder production areas which carry younger trees these too have been affected to the degree where nuts have been stripped from the trees and it has taken some 12 to 18 months for trees to recover.

Vanuatu operates to a dual economy situation. In the north, coconuts are the main stay of the economy dominating all economic activities in the outer islands particularly the northern export port of Luganville on Espiritu Santo (often called just Santo).

In the central district Port Vila, a cosmopolitan town caters for both the rural and urban societies. Port Vila is also the center of the country's tourist industry and in addition to that is the center for the financial tax haven that exists in Vanuatu.

The life style and quality of infrastructure in Port Vila is therefore far advanced compared to that existing in the northern port. Attached to this is the fact that Port Vila can support higher levels of technical skill, financial services and general communications and support services.

Luganville on the other hand, is ideally suited towards coconut processing either in semi processed or fully processed form be cause of the considerable number plantations which are adjacent to the town and have feeder road networks to them, also it has an overseas wharf no shortage of land, no shortage of labor and the freezer facility mentioned elsewhere in the report.

All of the other outer islands away from the export centers, have varying degrees of disadvantage so far as infrastructure is concerned. The only other island which could be considered as being capable of servicing the supply side for semi-processing of coconuts would be Malekula. On this island a large plantation called PRV exists which has basic support infrastructure which would support some degree of processing.

The coconut industry in Vanuatu has been directed towards the

production of copra only. Even up to recent years the quality of

Vanuatu copra has been very very poor. It has only been in the last five years that the quality of copra has improved to a degree where it can stand and rank equally with copra from the rest of the world. Notwithstanding the fact that copra is a low priced commodity, Vanuatu has done well to be able to recover its industry from a stage where the world market had rejected its copra because of quality in the past. Therefore it is not difficult to understand why the Vanuatu Commodities Marketing Board and the Ministry of Agriculture are concerned about changing the industry too much too fast.

When considering the implications of the regional scheme, the authorities in Vanuatu readily welcomed any possibility to enhance the industry but in saying that clearly stated that any new ventures would have to be of a proven nature with sound and adequate marketing backup before they would entertain development of a new process.

Because of the very close socio-economic and political relation s: ip coconuts have with the people of Vanuatu (and for that matter most other Pacific countries) a wrong decision to embark upon the encouragement of national production of say a new coconut line could be disastrous at this stage of the country's growth.

In summarizing the situation in Vanuatu, it would seem that distinct opportunity exists for the establishment of either a feeder plant or a full processing facility located on the island of Espiritu Santo at Luganville utilizing the very good distribution network which exists there but such activity would have to be subject to a full feasibility study and backed by sound marketing prospects even to the stage of having contractual outlets in place.

So far as the investment climate in Vanuatu is concerned there are many advantages for investors with the tax haven, financial center status existing whereby considerable benefits would be readily available to any investor either investing direct in the country or trading within the region.

In conclusion it is suggested that subject to the availability of an aseptic bulk packaging plant and a contracted market for frozen coconut meat that a facility could be built to supply semi processed products at Luganville as well as frozen coconut meat from the same center.

COUNTRY : VANUATU

COUNTRY PROFILE INFORMATION

Use the following outline guidelines on types of country profiles information which would be useful in planning a country's participation as a 'feeder' country or 'central processing' country. The attached annex also further explains some of the information that is desired.

1. TRANSPORT (SEA/LAND)

1.1 Type (container, refrigerator, other)

Port Vila :
Reasonable roads around the island of Efate - good general overseas cargo wharf and reasonable secondary overseas cargo wharf capable of handling all types of cargo-bulk, breakbulk, container, reefer etc.

Luganville, Espiritu Santo (Northern Export Port) :
Good road network on eastern, south and northern coasts of the island but little roads elsewhere - consider that most coconut growing areas on this island are well serviced. Port facilities - one existing overseas general cargo wharf and one new wharf in construction capable of handling all types of cargo, bulk, break build, container and reefer.

Other Islands :
All other islands are developed with only minor roads transport links to main export centers are provided by a fleet on inter-island vessels.

1.2 Cost

For cost of sea transport see Attachment 9, Page 3.

1.3 Frequency

For overseas vessels see Attachment 3 which summarizes the various overseas vessel's schedules to and from Vanuatu but for full details of transport frequency see Attachment 4, Section 5, Subheading 5.1 (Overseas Ship ping Present Services). This report has aged a little but is still relatively accurate.

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1.4 Capacity

Also see Attachment 4 for full details.

1.5 Handling facilities from source (harvest) to collection points

Generally speaking the major coconut producing areas on the isolated islands do not have good facilities for the storage of coconuts. Normally these are centered around village locations which have simple copra dryers which are not being used for the drying of copra are used for the storage of copra and coconuts. Some is lands have wharves but in most cases, produce is picked from beaches by way of lighter from the inter-island vessel. In the case of the two islands with export ports that is Port Vila and Luganville, Port Vila has adequate storage facilities and handling facilities to load bulk copra and Luganville has the same however Luganville does have far better access from coconut growing areas to port facilities. In addition to the above at the Palakula fishing base a very large freezer storage capacity exists - 3,000 cubic meters for storage -this is presently not utilised and would be available for storage of coconut products.

1.6 Back loading problems, etc.

Both overseas ports have the possibility of backloading because considerable quantities of general cargo come into both of these ports with substantial exports going out. For full details of cargo movements see Attach ment 4.

1.7 Other transport problems

The transport problems for Vanuatu are similar to most other Pacific island archipelagoes where inter-island shipping play a major role in the movement of cargo within the country. Because of the nature of the is lands land and road transport systems, wharves and other facilities are scarce and the both economical way of transporting goods is by inter-island ship direct from village or production areas.

2. EXPORT & IMPORT FACILITIES

2.1 Port

As mentioned previously there are two major ports in Vanuatu one at Port Vila and one at Santo (Luganville), see Attachment 4 for full details.

2.2 Warehouses

Port Vila :
Adequate and further storage capacity is planned.

Santo :
Adequate and further facilities planned.

See Attachment 4 for full details.

2.3 Handling machinery

Adequate stevedoring and handling equipment exists at both ports to cater for any anticipated flow of raw materials. See Attachment 4 for full details of stevedoring, however the stevedoring operators have changed since the date of that report but services are still similar. Current bulk loading of coconuts is done in Luganville by the storage of copra in bulk sheds and the loading of bulk bins for hoisting onto ships. The bins are filled on shore by way of a front end loader then tipped into the hold of vessels.

2.4 Water depth

See Attachment 4, Section 4.1.2, 4.1.3 and 4.2.2. In summary :-

Port Vila main overseas wharf: minimum depth 10.4 meters, length of wharf 213 meters overall.

Santo wharf main overseas wharf : minimum depth 10.7 meters, length of wharf 140 meters overall.

2.5 Harbor size

See Attachment 4.

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2.6 Problems

Consider that there is no real problem existing with export port infrastructure and that if any special purpose machinery is required then the country would be able to cope with that need.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Both Port Vila and Santo water supplies are treated to drinking standards and the water is quite good, possibly for industry use, some secondary treatment would be necessary in both cases.

Cost of water in both locations is 40 Vatu for one cubic meter.

3.2 Electrical

Power is provided in Vanuatu by a private French company called UNELCO and the service is extremely efficient.

Cost of power is $0.205 perkilowatt-hour.

3.3 Fuel

Port Vila and Luganville both have fuel depots. The cost of diesel fuel is 48.8 Vatu per liter or approximately 47-48 cents per liter.

In Santo/Luganville it is also quite possible that significant amounts of coconuts husk would be available for power.

3.4 Sewer

Port Vila adequate for normal use, however some secondary treatment may be required if a facility was to be placed in the town area.

Luganville - should be a lesser problem due to the larger land area and water movement in the area.

3.5 Waste Disposal

In both locations waste disposal should be possible but care should be noted that in the Port Vila area pollution does exist in some cases from septic tanks into lagoons.

3.6 Engineering

Port Vila a strong light engineering and fabrication infrastructure exists with a reasonable supply of skilled engineering expertise.

Luganville once again a general light engineering infrastucture exists but with a lesser degree of skilled personnel.

Outside of these two areas the only other location with any engineering facilities would be on Malakula at the PRV Plantation.

3.7 Manpower skills

Port Vila - good labor source
Luganville - good labor source

It is considered that manpower skills to staff a factory as envisaged would not create serious problems.

3.8 Regulations/laws

Buildings would have to comply with the regulations of the Municipalities wherever the factory was to be built.

A business license would have to be obtained from the Ministry of Finance and this would require some submission through Department of Industries.

If any overseas aid was to be a factor in the project then the project would also have to be approved by the National Development Council (NDC).

For further details see Investment Guidelines Attachment.

3.9 Cost

For building costs a figure of 25,000 Vatu per square meter could be used.

3.10 Availability

Labor and engineering skills for the building of factories and other structural work is readily available. If some developments of a higher technical nature were required these could be readily obtained from outside the country.

3.11 Reliability

This situation would be similar to most other Pacific countries whereas unskilled and semi-skilled labor is usually quite reliable. For skilled and technical positions however adequate training may be required or expatriate technicians may have to be employed in the short term.

3.12 Quarantine laws, and procedures

Vanuatu has strict quarantine laws and it is doubtful whether coconuts in any form other than husked nuts would be allowed into the country. Semi-processed coconut meat etc. would have no problem with entry.

It must be noted that Vanuatu does not export any coconut products due to the folia leave decay disease which exists within the country. This disease is a real threat to all other Pacific countries. See notes on pests and diseases.

3.13 Land cost and availability

Generally speaking land would be available in both Port Vila and Santo for development of a coconut processing unit and when looking at Santo the site near the industrial estate would be quite suitable.

No freehold title exists but land can be leased in urban areas on a 50 year lease arrangement.

3.14 Problems etc.

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4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages etc.)

4.1 Size

4.2 Use

4.3 Type

4.4 Products

4.5 Capacity

4.6 Utilization

4.7 Age

4.8 Ownership

4.9 Location

4.10 Type Management

4.11 Interest in participation in this integrated venture

5. INSTITUTIONAL

5.1 Private sector involvement

In the industrial sector government is giving considerable assistance to develop this area, however, in relation to coconuts very little activity exists beyond the manufacture of copra for export. The majority of producers are smallholders and the plantation sector which accounts for only 25% of production is dominated by one plantation PRV which is located at Norsup on Malakula. This particular plantation may have the capacity to do an autonomous operation in relation to coconut cream however it lacks overseas port facilities and some infrastructure. The operation does have though its own workshop and inter-island port facility.

The private sector have indicated that if the marketing opportunities were positive and the VCMB were to issue authority for them to become involved in the processing of coconuts then they would have interest.

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5.2 Equity participation by Board's Government Private

The Vanuatu Commodities Marketing Board controls the movement of copra and coconut products outside the country. The Board is still relatively young but has done a very good job in putting some order into the coconut industry in Vanuatu. Even though advantages can be seen to exist through downstream processing of coconut products, VCMB is reluctant to make too many changes too quickly because of the socio-economic situation existing in the country. This does not mean to say that nothing would be done about the pursing of downstream industry but the Board would be very cautious in becoming involved in such an industry it self or approving others even in the private sector be coming involved without full evaluation of the viability

Notwithstanding the above, the VCMB would act very positively towards any project which could be presented to enhance the development and strength of the coconut industry.

Regarding other interested organizations for investment Port Vila is unique in the South Pacific because it has a number of private banks and investors who may be interested in participation in such a venture, also there is the Development Bank and the National Provident Fund that may have interest in becoming involved.

5.3 % of GNP and export earning from coconuts

In 1987 the value of copra exported from Vanuatu amounted to 599 Million Vatu or around 6 Million US Dollars. In relation to total export earnings for the country this equaled 48.1%. It is interesting to note that in 1983 the value of copra exports were 1,308 Mil lion Vatu compared to a total exports of 1,781 Million Vatu which shows that the dependence upon copra through out the country is diminishing in favor of exports of logs, beef and cocoa.

5.4 Other institutions involved with coconuts

The Department of Agriculture and the Coconut Improve ment Program are also very interested in coconuts. In addition to this Governmental operation the French re search station IRHO which is located at Saratou on the island of Espiritu Santo, is probably the Pacific's most active research institute into coconut develop ment.

The IRHO's IHRO station mainly deals with diseases, nybridization and varietarial selection of coconuts, they are also involved experimenting with processing techniques and inter-cropping of coconuts with other products.

5.5 Degree of control on supply, etc.

VCMB has control over the export of coconut and coconut products and also imposes certain rules and regulations to allow orderly marketing of the product within the country. The VCMB does not place any controls over the free movement of fresh coconuts within the country for domestic consumption.

5.6 Competition (multinationals and local firms)

There is no real competition in the country concerning the processing of coconuts. Prior to Independence a coconut oil mill existed in Santo but this operation was non profitable and was destroyed during problems at the time of Independence.

6. RAW MATERIALS

6.1 Geographical concentration of productions

Full details of the dispersity of production is contained in the Agricultural Census 1983-84, Attachment 8, however in general terms, the island of Espiritu Santo has far more congregations of coconuts in a concentrated area than in any other island in the group. Also a good road network makes this quite a viable opportunity for development of concentrated coconut processing.

Malakula is the largest producer and on that island one large plantation exists (PRV Norsup) and could also be considered as a possibility of a source of raw materials. All other island produce significant coconuts in certain areas but logistics and transport facilities are lacking. On the island of Efate where Port Vila is located road access exists to some areas but the total production of coconuts on the island is far less than in Santo.

6.2 Tonnage available

As in other countries, the tonnage would vary according to location of the factory site. It could be said that all coconuts made into copra at the moment would be possibly available for other commercial use however, in reality only those coconuts accessible to a process facility would be available. By looking at Attachment 1, Page 5 it can be seen that copra available on the island of Malakula is around 10,000 tonnes per annum and around Espiritu Santo 6-7,000 tonnes per annum. In realistic terms it should be noted that the island of Espiritu Santo would be the best possible location therefore a conservative tonnage of 4,000 tonnes could be expected to be obtained from Espiritu Santo.

6.3 Land ownership

All land in Vanuatu is owned by customary owners. The only variation to this is in urban areas where land owned by customary owners is handled by the Department of Lands in the government. There have been a number of disputes over the method of dealing with this land but it would seem that leases are readily available to third parties and the problems exists between the Government and the traditional land owners. It is not considered that land ownership would be a problem when it comes to the creation of a factory.

6.4 Tree use rights

Most producers who have planted coconuts on customary land retain the rights to harvest coconuts from those trees during their lifetime. Tree use rights are passed from father to son or from father to uncle to nephew and it means that the usage is kept within the family. Pure communal use rights do exist but they are not as significant as individual ownership.

Plantations on the other hand through a lease for alienated land are entitled to full use of those trees for the period of the lease.

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6.5 Size of holdings

1. Plantations
   Number of plantations growing coconuts 142
   Average are of plantation coconuts 133 ha

2. Smallholdings
   Average area of smallholding coconuts per household 3.4 ha

For further details on smallholder arrangements see Attachment 8.

6.6 Age

Generally speaking the average age of coconuts in Vanuatu is reasonably old in the plantation sector and with younger trees existing in the smallholder sector, the following table illustrates.

Plantations

Percentage with trees under 14 years old	1%
Percentage of trees aged 14-30 old	6%
Percentage of area with trees aged 31-50 yrs	29%
Percentage of area with trees aged 50 yrs	64%

Smallholdings

Percentage of area to young to bear coconuts	11%
Percentage of area with trees bearing coconuts	78%
Percentage of area with trees too old to bear coconuts	11%

6.7 Variety

Generally the Vanuatu Local Tall is the most common coconut grown throughout the country, however see Attachment 5 and Attachment 7 for the coconut collection in Vanuatu.

6.8 Productivity

As in all countries productivity varies from area to area but from the Agricultural Census it can be seen that the average productivity of plantation holdings (which are old trees) gives a yield of around 460 kilos per hectare, whereas in the smallholder area where coconuts are generally younger the average yield of copra per hectare is 626 kilos. Further details of this can be seen in Attachment 8 and for further details on the proposed plantings of hybrids and improved material see Attachment 7.

6.9 (Copra meat or cream yield/nut) type

For full details see Attachment 5, but in summary form for the Vanuatu Local Tall the following summary is given :

Total weight see 17.13

6.10 Yield and variation within the country

Variation is not that significant in Vanuatu unless trees have been affected by cyclone or drought. The nuts are generally of a small nature with 6,250 per one tonne of copra but a generally quite uniform.

6.11 Replanting schemes and hybrid development

See full report on this in Attachment 7, but generally speaking a hybrid development program has been hindered by the problem associated with the Vanuatu disease which kills imported varieties of coconuts. This is now been overcome by a certain degree by a certain selection of varieties which can be used for the hybridization of local parent material and also the discovery the vector which carries the disease. Hybridization of plantation areas is planned for the future and also the planting of improved local material to smallholders. (See Report).

6.12 Harvesting methods

Coconuts are left to fall from the trees and are collected fro the ground.

6.13 Frequency

Harvesting frequency varies depending on area and method of operations, for smallholder relationships see Attachment 8, Table 10 and 11, Page 16, 13. Generally smallholders harvest small amounts on a continuing basis until they have sufficient to dry a bed of copra. Plantation of the other hand produces regularly as possible to maintain daily through put.

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6.14 Labor availability

Generally speaking there is no lack of labor in Vanuatu but some problems do exist in recruiting labor to cut copra.

6.15 Care and husbandry practices

In Vanuatu generally for plantation areas inter cropping with cattle or cocoa takes place which ensures good maintenance whereas with smallholders unless cattle are also grazed, very little maintenance is done unless the coconuts are intercropped or are used as garden areas.

6.16 Wastage - not harvested

Wastage varies according to price. At times of low prices considerable quantities are not cut into copra Graphical presentation of this can be seen from the charts and the tonnages on page 15 of The Overseas Trades Commerce and Exterior Statistical Bulletin 1982-1987 Attachment 10.

6.17 Other losses

The major cause of loss other than the affect of price is from cyclone damage. Cyclones have become a regular feature in Vanuatu over the last few years. Drought also affects certain islands but this is not considered as critical as cyclones. There are also a number of pests and diseases which have some affect on coconuts, these are detailed in Attachment 6.

6.18 Domestic

Average domestic consumption for human use is 16 nuts per day and for animal feed 9 nuts per day. It is estimated that 16,058 tonnes of coconut is consumed each year in this way. Further details of this use can be seen in the smallholder census Attachment 8.

6.19 Industry, % of total availability

See Attachment 1 for details of copra production

6.20 Cost of coconut production

For Vanuatu the conditions existing are similar to those of the Solomon Island so for details on this see Solomon Island Report Attachment 1, Section 4 for models with and without cocoa intercrop and also Attachment 9 of the Vanuatu report which gives different wages rates for Vanuatu.

6.21 Domestic pricing and policies

Domestic pricing is controlled by the VCMB which through the development of price stabilization fund publicizes prices payable for copra throughout the is lands and at export port depots. A scheme is used called the price equalization scheme which ensures producers on any island receives the same 'beach price' as elsewhere in the country. In effect this is a scheme where freight rates are controlled and vary between those areas close the export ports and those far way. Details of these can be seen on Attachment 9. Prices for fresh market coconuts is determined by supply and demand however there is no shortage of supply and in the long term price of a fresh coconut is related back to the price for copra.

6.22 Controls

Controls over the sale and export of copra are exerted by VCMB but there are no controls over the movement of fresh coconuts throughout the country.

6.23 Rural

One policy exists for whole country.

6.24 National

One policy exists for whole country.

6.25 Influence of stabilization schemes (effect of these on sale of non copra products

As mentioned above the price of non-copra coconut products will ultimately be related back to the domes tic price payable for copra through the VCMB's stabilization scheme.

Only one difficulty could be seen with the supply of coconuts to the project and that is if the input from STABEX receipts added to the domestic price of coconuts exceeds the long term pr e that can be paid for whole coconuts then some relationship of having STABEX payments assist the free market of whole nuts may have to be considered.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

Vanuatu does not have all destination status for STABEX receipts. Therefore any exports of coconut products to non EEC countries will preclude it from receiving STABEX benefits. In the past considerable funds from STABEX have gone from into the establishment of th VCMB stabilization scheme.

It is considered that if significant quantities of coconuts were to be diverted away from the EEC market then there would be some reluctance on behalf of Vanuatu authorities to give full support to such a move. This would definitely be related to the size of the project and the return to the country and to producers.

8. GOVERNMENT POLICIES PRESENT

Present Government Policy is to strengthen the coconut and rural industries generally. Efforts up to date have been concentrated on the improvement of copra quality and also improving planting materials. Further processing has been restricted to looking at the reintroduction of oil milling but this has been discounted due to low forecast profitability. There is a strong desire for diversification and industrialization and it is considered that any project with positive and profitable market opportunities would be welcomed.

9. FUTURE POLICIES AND PLANS RE: COCONUT INDUSTRY

At the moment there are no existing projects in the pipeline than the continuous appraisal of a copra crushing mill.

The VCMB is very interested in appraising new down-stream processing possibilities but subject to viability.

As mentioned in 8 above and in other country reports the Vanuatu Government would welcome new initiative in the coconut industry.

10. RULES, REGULATIONS, STANDARDS RE:

There are various rules and regulations existing covering the handling of copra but these would not have any affect on the transformation of whole nuts into products being spoken about. Details of these are enclosed on Attachment.

11. IMPORTS

Imports of coconut products are negligible however as in other Pacific countries there is the opportunity to be able to service the domestic urban market with canned products. There are no planned imports of coconut products other than planting material for research purposes.

12. EXPORTS

Copra is the only of coconut products from Vanuatu.
The export of whole nuts has been looked at in the past but due to quarantine problems it is unlikely that any exports of this nature will take place.

13. LABOR

13.1 Labor Construction

Construction labor is readily available there should be no problem in recruiting suitable labor and con tractors to build any factory or building required.

13.2 Processing

Processing labor would be readily available there is an excess of unutilized labor in urban societies

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14. PIONEER INVESTMENT INCENTIVES

See Attachment from the Department of Industries.

15. OTHER

15.1 Susceptibility to natural disasters

Vanuatu's major problem has been from recurrent cyclone damage even though damage has been significant in previous years it is estimated that tonnage would not be disseminated to a degree which would put any proposed project into jeopardy. Normal cyclones cut a path through certain areas of the country but rarely do they affect all areas at the same time.

15.2 Disease such as 'cadang cadang'

See Attachment 6 for details on the Vanuatu Folia decay disease which is quite serious and has a large bearing on the movement of coconuts out of and into Vanuatu.

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OVERVIEW ON WESTERN SAMOA

Western Samoa would be the most advanced country in the South Pacific in regards to coconut processing. The country has a medium-sized copra crushing mill and a number of coconut cream and coconut manufacturing units. There are two reasonably-sized coconut cream canning factories, one other canning factory which manufactures coconut-based meat and vegetable products and also fried chips from taro, and finally there is a developing enterprise utilizing coconut cream with frozen bananas, breadfruit and taro. This latter enterprise is also looking at the production of UHT coconut milk.

Out of all of the Pacific countries, the establishment of a regional coconut processing plant in American Samoa, would affect Western Samoa more than other locations. This is because Samoa is the dominant manufacturer at the moment of non-traditional coconut products. Entrepreneurs have worked hard to develop markets for their product in New Zealand, Australia and elsewhere.

The businesses concerned have all indicated their willingness to participate in some form of regional cooperation, but an underlying fact to this point is that they would require some degree of indemnity against a large regional organization assuming their already established markets in the Australasian area. Any agreement to establish inroads into these markets would meet with resistance from the Western Samoan cream industry.

A fairly volatile time has been gone through in the coconut industry in Western Samoa over the last five years or so. This primarily results from the problems associated of the Copra Board and the subsequent polarization of government interest in these areas. Also the lack of success of the copra crushing mill has highlighted the fact that the conversion of copra into oil and meal is not a satisfactory answer for the coconut industry. Users of whole coconuts in Western Samoa for the manufacture of cream and other items do not have any difficulty in attracting raw material in competition with the oil mill.

The oil mill is run efficiently but is faced with the problem of being able to go beyond the value added that is allowed to be gained by any enterprise in this industry because of the world oil seeds markets and international substitutes. The mill has plans to embark upon the refining of oil esterfication; however, this will result in limited added value. It may possibly create marketing problems in the conversion of products to an area of a narrow marketing range.

Coconut cream producers at the moment in the country seem to operate on a fairly compatible basis where market territories have been identified and serviced without too much entrepreurial

jealousy existing between them. This could change, though, with a proposed new UHT plant coming into operation where that product may be aimed at penetrating the same territories as are serviced by Samoan products at the moment. Also, if the tonnage requirements of the new enterprise are significant, there will be added pressure placed on the available resource of coconuts available for all users in the country, unless total production incomes.

In relation to the government's attitude towards the establishment of a large coconut processing facility in American Samoa, it was noted that the Western Samoan government would appreciate the establishment of such an operation, mainly due to the fact that most labor in American Samoa comes from Western Samoa. This would mean that their people working in American Samoa would earn higher wages and there would be greater remittances sent back from such employment.

There is a great deal of activity in the area of privatization of certain operations within the country. Some of these are very much needed whereas others will possibly create a degree of confusion and in the medium turn could create some socio-political problems if not handled correctly. In fact, some operations earmarked for privatization may be well better handled by structural change within existing institutional establishments.

Therefore, in looking at the Western Samoa coconut industry, it is seen that the proliferation of numerous small coconut cream manufacture units is healthy and will fit into the acceptable framework of Samoan lifestyle; however, the question of the oil mill and associated Copra Board may have more technical and structural problems to deal with an it would be beneficial if these were resolved in the short term.

Overall, the rest of the Pacific, and for that matter the project can learn a lot from the entrepreneurs of Western Samoa. Their product is regarded by the rest of the world as being the premier canned coconut product produced. It could well be that the expertise existing in Western Samoa would be very helpful in the establishment of other entities throughout the Pacific or on a regional basis.

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RICHARD COOK ENTERPRISES
P. O. Box 4350
Matautu-uta, Apia, Western Samoa
Telephone: 22077 (work) 20408

Mr. Richard Cook, currently the General Manager of Westec Estates, however recently resigned due to overall problems with the Board of Directors in Westec, has been associated with the coconut cream and other product industries for many years.

Mr. Cook has an interest in a small factory producing two products, "luau", and "palusami" which are very much traditional Samoan dishes. Mr. Cook was able to introduce coconut cream into a specially lined can to cater for the meat or another taro-based dish to be prepared. He was also involved in the established in the Meredith coconut cream manufacturing plant in Apia, as well as being involved in a number of other activities including experimenting with coconut cheese, coconut nibbles and coconut and taro dishes.

Mr. Cook is a practical person who has both managerial and technical skills. He may well be an ideal person to assist some of the other smaller countries with technical assistance in the establishment of coconut cream plants. It is considered that he would have sufficient skill to be able to handle the physical planning, installation and commissioning of small plants which would require fairly intensive hands-on experience. Mr. Cook's operation has recently merged to a degree with Samoan Tropical Products for the production of some selected lines.

Mr. Cook indicated that he would be very interested in supplying the American market with his "luau" and "palusami", particularly to the ethnic market on the west coast of the United States.

In evaluating the possibility of marketing such products the project in hand at the moment must remember that considerable time and effort has been spent by Western Samoan entrepreneurs such as Mr. Cook in developing these products, and their interest must be preserved first and foremost before any attempt is made to copy what they have done and enter into activities which may be to their detriment.

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NATURAL FOODS INTERNATIONAL
P. O.Box 1972
Apia, Western Samoa
Contact: Papaliitele Steve Percival - Managing Director
Steven Percival (son) - Director

This company has basically been developed parallel to another family company which deals in paper products, the production of taro chips, and other snack food products.

The current plan for the company in the natural food line, is to market complete meal-type products, suitable for retail sale to ethnic groups in Australia and New Zealand. This is to take the form of frozen taro, banana and breadfruit mixed with coconut cream in plastic bags ready for cooking. Accompanying this activity is also the plan to install a Tetrapac machine to package coconut cream and fruit juices.

The factory building for this project is at the moment almost complete. The standard of the building is quite high, however there are a few basic design defects which would not take much to correct.

The company hopes in the future to be able to branch out into the down-stream processing of cocoa. The plant they intend to install will have the capacity to do such work.

SAMOA TROPICAL PRODUCTS LTD.
P. O. Box 379
Apia, Western Samoa
Contact: Tuiganana Lam Sam

This company is the largest processor of coconut cream in Western Samoa. Production at the moment ranges between 22,000 and 30,000 nuts per day.

Samoan coconut cream from this factory and also the factory of Meredith have both been stated to be of premium quality compared to other products from Asia.

The maximum capacity of the plant in its present condition is around 50,000 nuts per day. This plant would not require the commissioning of additional equipment. The company has, however, another plant which could be brought into operating condition in a fairly short period of time. This would mean the rapid expansion of capacity if required.

The company does not have many difficulties in obtaining raw materials. Producers' first choice is the factory to sell their coconuts, and if not possible then they turn to making copra. Collection is carried out by the factory having its own truck pick up nuts from producers on the side of the road. This operation seems quite successful. Nuts are graded on the roadside by well-experienced employees.

The current cost of one nut in the factory is WS$0.123 (12.3 sene). This price is determined by the Copra Board. In relation to copra, 5,000 nuts per ton is the figure used for calculating production and price matters. Approximately 3,200 nuts are required to produce one ton of cream. The extraction rate from one nut after paring (that is, taking the skin off the coconut) is about 60% milk to residue.

The company expressed its interest in becoming involved in either an operation in American Samoa or, for that matter, elsewhere in the Pacific. One reservation was that any project developed along regional lines should take into account the fact that Western Samoa has been the pioneer in the Pacific in the production of coconut cream and that some sort of guarantee must be given not to interfere in the markets developed by Samoan producers.

To this extent, whilst seeking development and also participation by themselves, the Samoan producers must be considered in any long-term plans generated by the project.

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A.V. MEREDITH HOLDINGS
Apia, Western Samoa
Contact: Mr. Dick Meredith - Managing Director

The manufacture of coconut cream by Meredith is second to that produced by Samoan Tropical Products. Current production from Samoan Tropical Products for the New Zealand market is said to be 3 containers to 1 of Meredith's.

Whilst Samoan Tropical Products have diversified their marketing activities away from New Zealand, Meredith on the other hand has concentrated solely in New Zealand and therefore its market potential for growth is somewhat limited.

The quality of the product is similar for both companies.

Production methods used are different to Samoan Tropical Products to the degree where coconuts are not pared for extraction of meat but half shells are scooped out using mechanical reamers.

This process is relatively quick and uses less labor than the paring method and also produces half-shell coconut which is ideal for conversion into carbon for fuel.

The coconut fibrous residue is used as pig food in the main and the coconut shells are sold to carbon producers who then resell to consumers on the domestic market.

Management indicated their interest in the project and would be willing to participate in any worthwhile operation which may come up but would require to see a full feasibility study before commenting further.

Meredith would be able to increase production because at the moment they are only working on a one-shift basis, and if orders for an additional supply of bulk material were forthcoming they could easily double their capacity by working an additional shift.

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THE WESTERN SAMOAN COPRA BOARD
and the OIL MILL
Apia, Western Samoa
Contact: (Copra Board) Mr. Vaitera Telepe - Secretary
(Oil Mill) Mr. Sete Ah

The Western Samoan Copra Board and the associated Oil Mill have gone through a number of changes in the last few years. Previous management of the Copra Board was quite inflexible to change and also were not completely in control of the country's coconut operations. This led to a fairly high degree of leakages in stock and funds at lower management levels and also the weakening of control over quality for purchase of copra which had a very high moisture content, resulting in significant and unaccounted for losses through shrinkage. Losses from moisture loss far outweighed losses from other causes.

The Oil Mill, on the other hand, has been operating at a loss for some considerable time due to the differential between the available world price of copra and the available world price for coconut oil and meal. The mill is run generally efficiently but cannot go beyond the fact that it is tied into commodity markets with a price disadvantage on finished product compared to Samoa's capacity to sell copra for more than what the Mill's added value can bring taking into account the dual overheads and costs of administration etc. of both the Copra Board and Oil Mill when really only one establishment can be afforded.

In relation to the future, so far as the project is concerned, the Copra Board would more than likely provide some form of control over quality and price for coconuts and coconut products. For the Mill it is considered very difficult for this operation to earn much more than marginal income; however, plans do exist for the down-stream processing of oil to take place with refining esterfication. This additional processing will only give revenue increases if marketing connections are serviceable and if combined with moisture control and a reduction in overhead costs to the industry, some benefit may filter back through the Mill and result in higher prices for producers. What it may do is give the Mill more profit for itself which may not go beyond the stage of giving a better return on capital investment.

In conclusion, although the Copra Board and Mill are significant when looking at the coconut industry in Samoa, for the purpose of the study, it is considered that sufficient coconuts will be available if the price is more attractive to enable some sort of activity to take place.

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COUNTRY PROFILE INFORMATION

1. TRANSPORT (SEA/LAND)

1.1 Type (container, Refrigerator, other)

The main port facilities are located at Apia harbor where deep water overseas wharf exists together with adequate handling facilities to cater for all types of transport, that is including container, reefer and bulk handling of products.

The road system is quite good with access to most areas on the main island linked to Savaii with a ferry service which means trucks and other vehicles can move between the two islands and a reasonable roadwork exists on Savaii to major producing areas.

Unlike other Pacific countries, Samoa with only two main islands does not have some of the disadvantages that other Pacific islands do have with internal transportation.

1.2 Cost

1.3 Frequency

Frequency is considered capable of exporting to most places in the world with a very good service in the Pacific region provided by the Pacific Forum line and Warner Pacific line.

1.4 Capacity

Adequate.

1.5 Handling facilities from source (harvest) to collection points.

The generally good transport system allows reasonable access by farmers to collection points. Much of the collection of nuts done in the village or communal-owned plantation is done manually with transport of nuts to centralized locations for either conversion into copra or husking for sale as fresh nuts.

1.6 Back loading problems, etc.

It is not considered that there are back loading problems for Western Samoa for vessels calling to the country do so under sufficient inducement for imports; therefore, external trade would be considered beneficial to any of the operators.

1.7 Other transport problems

It is considered that these are no worse than any other Pacific country, if not better due to the fact that there are only two major islands, and also the close proximity for the purpose of the project to American Samoa.

2. EXPORT AND IMPORT FACILITIES

2.1 Port

See previous comments.

2.2 Warehouses

On the port area a number of large warehouses exist. One in particular is used for the bulk storage of copra. In other areas, particularly on the industrial side, a number of warehouse and factory facilities exist as well.

There is also a copra warehouse on Savaii which could be used for the storage of their products.

2.3 Handling machinery

Handling machinery is considered sufficient to cater for any opportunities which may arise to service the project.

2.4 Water depth

2.5 Harbor size

Apia harbor is not that large and is also subject to adverse conditions depending on wind direction.

The size of the harbor is not considered to be detrimental to facilitation of trade in relation to the project.

2.6 Problems

The only problem that could be cited is that the estate is situated away from the major port area, and this necessitates transport of materials through the main town center.

Plans are underway for the construction of a new wharf adjacent to the industrial center, but developments in this regard have not taken place yet.

3. SUPPORT INFRASTRUCTURE

3.1 Water

Drinking water is generally widespread so far as access is concerned in Western Samoa. For a food processing plant, secondary processing would probably be necessary but so far as supply is concerned quantity is not considered to be a limiting factor.

3.2 Electrical

Western Samoa has both hydro- as well as diesel power and can generally be said to be reasonably reliable, although fluctuations do occur.

3.3 Fuel

Adequate to all parts of the country.

3.4 Sewer

In the past there have been problems with improper sanitary conditions existing for domestic uses, however a program is underw for this to be rectified.

In relation to industrial waste, current processors tend to use natural drainage for the disposal of water, but if production were to increase dramatically some form of processing would be required.

3.5 Waste Disposal

Waste disposal can be accommodated.

3.6 Engineering

Reasonable facilities exist for engineering; however there is a lack of skilled tradesmen and technicians but a number of private sector engineers results in adequate facilities being available for most small jobs. An interesting note to make with Samoa is the fact that in many countries overseas a number of

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Samoans have highly skilled work, whereas back in Samoa there is a general lack of such people.

3.7 Manpower skills

As mentioned above, there is a good labor workforce but a general lack of skill in middle management, technical and high management positions.

3.8 Regulations/laws

Buildings must comply with government regulations.

3.9 Costs

3.10 Availability

3.11 Reliability

Generally speaking, most unskilled and semi-skilled labor is very reliable; however, for the higher technical levels of competence adequate training and possibly expatriate assistance may be required.

3.12 Quarantine laws and procedures

These laws are similar to other countries, and with Western Samoa not having many of the tropical pests and diseases strict adherence to this aspect must be taken into account. This is particularly so for the project if coconut products are to be brought from other Pacific countries to American Samoa which is so close to Western Samoa, thus placing Western Samoa at a degree of risk.

3.13 Land cost and availability

An industrial estate exists at Vaitele and arrangements can be made through Government for acquisition of ground in this area. It is not considered that availability of land is a restraining point, and also the cost of such land is quite reasonable.

3.14 Problems, etc.

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4. EXISTING PROCESSING FACILITIES (coconut, fruit, vegetables, beverages, etc.)

Western Samoa, unlike most other Pacific countries, has a high level of involvement in down-stream processing of coconut products and other tropical products.

Western Samoa, for its size, has quite a comprehensive range of processing facilities for natural food products. These include:

- a coconut oil producing plant
- 3 coconut cream manufacturing units, plus one currently being commissioned
- 1 natural juice processing factory
- a brewery and soft-drink manufacturing firm
- various snack-food manufacturers using taro and bananas for chips and crunchies
- one of the above coconut cream manufacturing plants also produces additional dishes in tins

For the purpose of the study, concentration on the coconut processing facilities only will be made because it is unlikely that any use would be made of other facilities in the short term.

4.1 Size

It is considered that the absolute maximum capacity of the existing facilities in Western Samoa would be able to produce or process 80,000 nuts per day. This would result in a maximum throughput of around about 500 tons of product a month. This figure would change if additional plant machinery were introduced by Samoan Tropical Products, and also if the Tetrapac operation of Percival comes into use.

4.2 Use

Most of this capacity is for the production of canned coconut cream. There is, however, considerable production of palusami and luau which are complete dishes of traditional Samoan food using a high quality of coconut cream. Frozen product is also a distinct possibility from these factories.

4.3 Type

The type of process is divided between two methods. This divergence is only in the primary processing where coconuts are either chipped and pared similar to the desiccated coconut operations throughout the world or the coconut flesh is reamed out of a half shell. The rest of the process is very similar to the companies where the meat is subject to pressing to take the coconut cream out of the fiber. It is then stabilized and then canned and pasteurized.

4.4 Products

Products are mainly 400 ml cans of coconut cream, although see individual country profiles for details on this.

4.5 Capacity

As mentioned in 4.1, the capacity of the current plant is subject to market demand. Significant increases could be achieved if confirmed markets were available.

4.6 Utilization

All plants are under-utilized at the moment and could be worked on additional shifts.

4.7 Age

Samoa Tropical Products and the coconut cream processing factory of Meredith were both established in the late 1970's. Over more recent years a number of changes and modifications have taken place to the plant and even though it could be said that it is getting a little old, basic capacity to produce is still quite good. In actual fact, it must be remembered that most of the plant utilized by the processors in Western Samoa is second-hand plant and machinery bought from other countries, particularly that machinery from the dairy industry.

4.8 Ownership

All of the processing factories are in private hands. The Meredith factory is part of a family business, Samoa Tropical Products is a private company with two major shareholders, and the small palusami and luau factory is owned by an individual family. All owners of these plants indicated their interest in possible joint venture arrangement for expansion purposes.

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4.9 Location

The plants are located in Apia fairly close to the town center. The planned Tetrapac operation is also in Apia close to the town center, and most of them have room for expansion.

4.10 Type management

All operations have good management and are run by successful businessmen in their own right. Also, most middle-management and technical staff have been trained over the years and are very competent in their work.

4.11 Interest in participating in this integrated venture

As mentioned previously, all parties are very keen to participate in this particular venture, subject to the undertaking that security of their own existing markets would be protected.

The concept of supplying bulk material from their plants for producing a label under license seems very attractive and for the smaller luau and palusami manufacturer direct marketing assistance into the American market would be greatly appreciated.

5. INSTITUTIONAL

5.1 Private sector involvement

As mentioned in the overview, private sector is presently going through a period of stimulus in Western Samoa, however, the extent as to how far the expansion of the private sector can be made is subject to question.

The current size of operations and their current share in the coconut market makes them quite acceptable in the pattern of economic power within Western Samoa. There should be no fear of interference by Government or by institutions if such balance is maintained.

5.2 Equity participation by Board's Government Private

The Copra Board of Western Samoa is currently going through a review of operations which may not necessarily result in further stability of the industry. The coconut Oil Mill is also in a position of uncertainty because it has been losing money for several years with no real answer to its predicament. The Oil Mill is a separate incorporated company but 100% owned by Government. It is not considered feasible that any structural change to the Oil Mill through modernization will have any major effect on its

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performance. The only way the mill could make money would be to be able to buy copra at a lower moisture content and assume some of the responsibilities of the Copra Board and be able to replace some of the Board's duplicated overhead costs with its own.

There were moves several years ago for the formation of a composite commodities corporation which would be in a position to facilitate development of new products and processes for hiring off to the private sector after development and also for the possible investment in down-stream production. This project, it seems, has been altered by a change in Government back to a number of individual boards with limited powers.

It would seem at this point that there would be minimal chance of equity participation by existing bodies; however, the Government may be interested if a firm proposal were to come forth.

Notwithstanding the fact of uncertainty, it could be said that the management of the Copra Board would be quite receptive to Samoa becoming involved in the venture.

5.3 % of GNP and export earnings from coconuts.

The coconut sector in 1987 produced exports of 54.7%. For further details on this, see Attachment 4, Annual Report of the Bank of Central Samoa, and Attachment 3, page 40, which is the Central Bank of Samoa's bulletin. Coconut cream, in 1987, accounted for 12% of total exports and in the first 9 months of 1987-88 this increased to 13%.

5.4 Other institutions involved with coconuts

As in most Pacific countries, the Ministry of Agriculture has significant input into the coconut industry and also in Western Samoa Westec, the largest plantation group in the country, has significant vested interest. For further details on Westec's operations see Appendix I, Vol. 2.

5.5 Degree of control on supply, etc.

The Copra Board has control over pricing and general supply of coconuts to the industry.
The coconut oil mill, being the dominant user of copra, is now buying direct from producers in competition to coconut cream manufacturers. However, shortly there is to be a review of pricing structure for coconuts within the country, and because of the growing dominance of demands for fresh nuts, some form of common pricing system may have to be worked out to ensure that all

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sectors of the community are on equal footing without penalty. In the past, the non-copra users and distributors were at a disadvantage because they were excluded from the stabilization scheme.

5.6 Competition (multinationals and local firms)

Considerable competition exists between the Oil Mill and the users of fresh coconuts. The private sector manufacturers, although competitors amongst themselves, are competitors in an amiable way. Up until recently markets have been divided between territories and there has been sufficient demand to satisfy the production of each particular factory.

With the possible emergence of the Tetrapac machine and related activities, some of the traditional expatriate Samoan market may be taken over by the new product. If this is the case may exist.

6. RAW MATERIALS

6.1 Geographical concentration of production

Most coconuts grow on the marginal strip of land around the perimeters of the two main islands. The major concentration of coconuts is on the estates and by Westec. The main island of Upolu has the most area under coconut, but considerable amounts are used for domestic consumption from that island.

For a typical pattern of vegetation and land use showing the range of coconut plantings see Attachment I, Vol. 2, page 189. Also for further details on this point, page 53.

6.2 Tonnage available

It is estimated that the total production of copra in Western Samoa is around 24,000 metric tons. Of this the majority goes to the coconut oil mill. So far as the project is concerned, if prices were better than what could be paid by the mill, taking into account added value, then a significant proportion of this could be available.

6.3 Land ownership

The majority of land in Western Samoa is customary land, owned in the traditional method of tenure. This is a very complex and involved matter, and for this information page 22 of Attachment I, Vol. 2 and the following few pages give a fair background. In effect, apart from the Westec estate and a few individual farms related to expatriate leases, most property is

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controlled through the matai system. Also see Appendix C-4, page 186, Attachment I, Vol. 2.

6.4 Tree use rights

Once again, as for the previous question, tree use rights go hand in hand with land ownership and are particularly related to the power of the matai in the matter, but the tree use rights go further than land ownership whereby a producer may not own the land but has a right to harvest the coconuts. Once again, see Attachment I, Vol. 2, for further details.

6.5 Size of holdings

The average size of holdings for coconut on the island of Upolu is 2.91 hectares, whereas on Savaii 2.67 hectares is the average size of coconut plots.

6.6 Age

See Table 53, page 52, Attachment I, Vol. 2., but in general it could be said that a significant percentage of the coconut trees in Samoa are old and more than 45 years old. However, the balance is spread generally throughout most ages. With the latest bonus scheme for the planting of new coconut holdings it is estimated that young tree production should increase dramatically in the short term.

6.7 Variety

The main variety in Samoa is the Samoan Tall, but a hybrid Malaysian dwarf cross giant Rennell Tall has also been established through an FAO/UNDP hybrid coconut project commenced in 1977. This project has the capacity of producing sufficient nuts to plant 1,200 hectares annually. The recent introduction of the bonus scheme has completely depleted the supply of nuts from this source, indicating that the capacity of the seed garden will be utilized to the full extent in the forthcoming period.

6.8 Productivity

Productivity is considered to range around 600 kilograms per hectare. There are a number of reasons for this low tonnage, some of which include the lack of disciplined planting, and the mixture of old trees with younger trees, significant damage by rats and pigs, and in some cases problems from the rhinoceros beetle, the major pest of coconuts in Western Samoa.

6.9 Copra meat or cream yield/nut type

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Full details on this are still waiting to be supplied by the Ministry of Agriculture; however, from the coconut cream industry it would seem that 60% of the pared weight of the coconut kernel could be expected to be extracted for cream.

Judging from nut size, data from the Solomon Islands could be used for this evaluation.

6.10 Yield and variation within the country

Generally speaking, the yield and variation within the country is not as wide as occurs in other Pacific countries. This is mainly due to the fact that Western Samoa consists of two islands in close proximity. Therefore, the geographical dispersity is less.

It is interesting to note that the buyers of palm nuts for production in milk extraction are very well experienced and reject nuts on the side of the road when they go to pick them up.

6.11 Replanting schemes and hybrid development

As mentioned previously, a hybrid seed garden has been established and can produce sufficient nuts to replant 1,200 hectares per annum. In the last quarter of 1988, the Western Samoan Government introduced a bonus scheme which pays a producer WS$2 per year for 4 years if he plants in the approved method more coconuts, and also by the way of note, he will receive WS$1 per cocoa tree under a similar bonus scheme.

This has led to very active interest in the new and replanting of coconuts. In the past most of the production from the hybrid seed garden had gone to Westec for replanting of their estate.

6.12 Harvesting methods

As in other Pacific countries, most coconuts fall to the ground and are collected by hand.

6.13 Frequency

Frequency varies but this is similar to other Pacific countries except in those circumstances where close to urban areas pressure on nut supply is critical, resulting in more frequent collection of nuts; however, generally, a monthly to six-weekly cycle could be expected for the production of copra but a more regular collection process for the supply of nuts to coconut cream manufacturers.

6.14 Labor availability

There is no shortage of labor in Western Samoa. In fact, many people migrate outside of the country to seek employment in Australia, New Zealand and America.

In 1981 a census showed there were some 80,000 odd persons in the 15-60 age group being the potential labor force. For further details on this, see Attachment I, pp. 8-10.

6.15 Care and husbandry practices

As in all Pacific countries, this varies greatly depending on the attitude of farmers towards coconuts so far as price is concerned.

In times of high price most coconut growing areas are very well maintained to ensure maximum nut recovery.

In Samoa, many places where coconuts grow are quite clean because they are grown on all garden land which will not support secondary growth. This is not the same in all cases, for in other areas cattle grazing is a common use for pasture under coconuts, and also significant quantities of cocoa is grown under coconuts, thus providing shade cover and clear ground for the recovery of nuts. No fertilizers are used on coconuts in Samoa and in village plots trees are not always planted in proper spacing.

6.16 Wastage - not harvested

As for other Pacific countries, this figure varies greatly depending upon the price payable for coconuts. It is estimated that between 15 and 16 percent of coconuts are not harvested. It is interesting to note that even though some reports say that the coconuts fall to the ground and are eaten by rats, normally the coconuts are eaten by rats before they fall to the ground so that the rat problem is not so much one from not harvesting the nuts, but is a problem in itself because the rats climb the tree and eat the young green coconut which eventually falls off by itself and looks as though it has been eaten on the ground.

6.17 Other losses

Samoa does not suffer as much as other Pacific countries from cyclone, but some losses do occur with premature nut-fall from high wind, and there is some problem with losses from the rhinoceros beetle although this is now limited by a control program introduced by the Department of Agriculture.

6.18 Domestic

There is some difference of opinion as to the exact consumption of coconuts by Samoans and farm animals (see Attachment I, p. 53, which indicates that an average of half of one coconut per person a day is consumption, whereas other estimates go as high as 2 or 3 coconuts per person per day). Based on experience in other countries and through observation of the food of Samoans, it is estimated that somewhere between these two figures would be more correct, probably around 2 coconuts per person per day, resulting in a domestic consumption figure of somewhere around 12,000 to 14,000 ton of copra equivalent per year.

6.19 Industry, % of total availability

Apart from domestic consumption, all coconut products produced in Western Samoa are available for industry. The question is which part of the industry will get the supply. As mentioned previously, this depends upon price.

6.20 Cost of coconut production

See Attachment I, Vol. 2, p. 167, Table 5.26.

For further details on actual farm cost, it is suggested that the example in the Solomons country profile be used adjusted by labor rates. (Please note the value of the WS Dollar and the Solomon Dollar are almost the same.)

6.21 Domestic pricing and policies

See Attachment I, p. 162, and also Attachment V.

As mentioned earlier in the report the domestic pricing policies for all coconut products are to be reviewed in February-March, 1989.

6.22 Controls

Controls over pricing at the moment are exercised by the Copra Board under direct influence from Government (see previous notes on this matter).

6.23 Rural

One policy exists for the whole country with some recognition taken for the transport cost from Savaii to Upolu.

6.24 National

See above.

6.25 Influence of stabilization schemes (effect of these on sale of non-copra products.

As mentioned before, some disparity exists between the manufacturers of copra and the supply of nuts to the creaming operations. This point is to be reviewed.

7. TYPE OF STABEX CONDITIONS APPLICABLE TO COUNTRY

The Treasury Department maintains tight control over STABEX funds to Western Samoa, and in the past STABEX funds have been paid over to the Board by way of grant without requiring repayment, but in 1986 these have been made as advances with 5% interest based on a 10-year repayment. At the moment the Copra Board cannot pay back these advances (see comments on Attachment V, p. 2).

8. GOVERNMENT POLICIES PRESENT

The present Government policy is to encourage investment throughout the economy in general. Also, the Government policy is at present to privatize all Government or semi-Government organizations where possible. The Government would be willing to give incentive and support to any new enterprise which could benefit the Western Samoan economy.

9. FUTURE POLICIES AND PLANS RE : COCONUT INDUSTRY

Subject to the preceding comments on government policy, it would seem that there is some confusion as to how the various statutory bodies and the Oil Mill are to be handled in the future.

It is now obvious, and many countries throughout the Pacific have learned from the Western Samoan experience,

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that oil milling is not in itself a viable alternative to the export of copra, per se.

It would seem that the Government, in encouraging producers to plant more coconuts, would have to receive greater return from the refining of coconut oil.

This may not be the answer and the real benefit may be from the extension of down-stream processing such as coconut cream and other coconut products.

10. RULES, REGULATIONS, STANDARDS

Rules and regulations existing relate to the production of copra, but very little has been done in relation to coconuts for other purposes. At present legislation is awaiting assent for enactment (see Attachment VI).

11. IMPORTS

Due to the degree of activity in Western Samoa there are very little imports of other coconut products, if any at all.

12. EXPORTS

For details on exports see Attachment III, page 40, Table B-5, which summarizes exports in 1987:

coconut oil - 8,730 tons
copra meal - 5,170 tons
copra - 561 tons
coconut cream in value of WS$3,900,000
(tonnage not available)

Also see page 53 of the same attachment for movement in indicators and particularly that of coconut cream which shows the most dramatic increase in activity during the period 1983-1987.

13. LABOR

13.1 Labor construction

There are a number of local construction companies available; however, some shortages of skilled personnel may be experienced but it is not considered as being detrimental for the construction of the type of building that would be considered necessary for the project if one were to use Western Samoa as a site for further processing.

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13.2 Processing

Processing labor is readily available and also certain skills exist in the country for the processing of coconut cream and related products.

14. PIONEER INVESTMENT INCENTIVES

A fairly good standard exists for pioneer incentives. These can be seen by reviewing the Enterprise Incentive Act, 1974, (Attachment VII).

15. OTHER

15.1 Susceptibility to natural disasters

Western Samoa suffers from cyclones on a fairly infrequent basis, although recently one has passed the country causing considerable damage by flooding, but very little damage to coconut trees.

One significant event which does occur in Samoa is the problem associated with volcanic eruption. On the island of Savaii and in certain other places lava flows have occurred which burned out large areas of existing forest at the time of eruption. It is interesting to note, however, that re-growth of trees in these areas is quite dramatic, and in one instance reforestation of those places has taken effect with considerable success.

15.2 Disease such as 'cadang cadang'

There is no serious disease in Western Samoa and a unique biological control program has been mounted for the eradication or control of the rhinoceros beetle by utilization of neutered male beetles which utilize a virus to render the reproduction cycle of the female beetles ineffective.

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POTENTIAL FOR PRODUCTION
AND MARKETING HIGH VALUE
SOUTH PACIFIC COCONUT PRODUCTS

VOLUME III

ANNEX III

CASES ANALYZED: LOCATION, PRODUCTS,
PACKAGING AND SCALE OF PRODUCTION

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ANNEX III. CASES ANALYZED: LOCATIONS, PRODUCTS, PACKAGING AND SCALE OF PRODUCTION

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE			PACKAGING TYPE				CAPACITY	
			Complete Processing	Satellite	Central Processing (and Satellite Location)	StarAsept	TetraPak	Cans	Plastic	Low[1]	High[2]
a	American Samoa	Coconut Cream			X (Tonga)	X				X	
b	American Samoa	Coconut Cream			X (Cook Is.)	X				X	
c	American Samoa	Coconut Cream			X (W. Samoa)	X				X	
d	Cook Island	Coconut Cream		X					X	X	
e	Cook Island	Coconut Cream	X			X				X	
f	Cook Island	Coconut Cream	X				X			X	
g	Fiji	Coconut Cream			X (Kiribati)	X				X	
h	Fiji	Coconut Cream			X (Vanuatu)	X				X	
i	Fiji	Coconut Cream			X (Vanuatu)		X			X	
j	Fiji	Coconut Cream	X			X				X	
k	Fiji	Coconut Cream	X				X			X	
l	Kiribati	Coconut Cream		X					X	X	
m	New Caledonia	Coconut Cream	X			X				X	
n	New Caledonia	Coconut Cream	X				X			X	

ANNEX III (continued)

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE			PACKAGING TYPE				CAPACITY	
			Complete Processing	Satellite	Central Processing (and Satellite Location)	StarAsept	TetraPak	Cans	Plastic	Low[1]	High[2]
c	Papua N. G.	Coconut Cream	X			X				X	
p	Papua N. G.	Coconut Cream	X				X			X	
q	Papua N. G.	Coconut Cream	X					X		X	
r	Papua N. G.	Coconut Cream	X			X					X
s	Papua N. G.	Coconut Cream	X				X				X
t	Papua N. G.	Coconut Cream	X					X			X
u	Solomon Islands	Coconut Cream	X			X				X	
v	Solomon Islands	Coconut Cream	X				X			X	
w	Solomon Islands	Coconut Cream	X					X		X	
x	Solomon Islands	Coconut Cream	X			X					X
y	Solomon Islands	Coconut Cream	X				X				X
z	Solomon Islands	Coconut Cream	X					X			X
aa	Solomon Islands	Skim/Milk/ Virgin Oil	X (skim milk price of $0.50/l)			X	X				X

ANNEX III. (continued)

ANNEX	LOCATION	PRODUCT	PROCESSING TYPE			PACKAGING TYPE				CAPACITY	
			Complete Processing	Satellite	Central Processing (and Satellite Location)	StarAsept	TetraPak	Cans	Plastic	Low[1]	High[2]
ab	Solomon	Skim Milk/ Virgin Oil	X (skim price b $0.55/l)		X	X	X				X
ac	Solomon	Skim Milk/ Virgin Oil	X (skim price c $0.60/l)			X	X				X
ad	Solomon	Skim Milk/ Virgin Oil	X (skim price d $0.65/l)			X	X				X
ae	Solomon	Skim Milk/ Virgin Oil	X (skim price e $0.70/l)			X	X				X
af	Tonga	Coconut Cream		X					X	X	
ag	Vanuatu	Coconut Cream		X					X	X	
ah	Vanuatu	Coconut Cream	X					X	X	X	
ai	Vanuatu	Coconut Cream	X						X	X	
aj	Vanuatu	Frozen Flakes	X								
ak	Vanuatu	Frozen Flakes	X								
al	Western Samoa	Coconut Cream									
am	Western Samoa	Coconut Cream	X								
an	Western Samoa	Coconut Cream	X								

ANNEX a

FINISHING PROCESS, REPACKING OF COCONUT CREAM
Am. Samoa; starAsept bag (Tonga satellite), 1,000 l/h
Double shift, 2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl. delivery)	1.20
3. Unskilled wage, $/day (w/fringe benefits, leave)	23.94
4. Electricity, $/kw-hr	0.13
5. Building cost, $/sq.m.	400.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	55.776
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/25 l bag	4.13
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing syster	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Starasept filler (lease rights)	3	55,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	459	1,709,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	670,000

ANNEX a

E. Installation	85,494													
F. Start-up costs, legal fees	20000													
G. TOTAL CAPITAL COSTS	2,485,369	2,485,369	0											
H. VARIABLE COSTS														
Frozen cream	4,752,000													
Transport of raw materials ($1060/FCL)	256,520													
Electricity	107,131													
Packaging materials	784,080													
Other supplies and materials	10,000													
Transport of product ($2450/FCL)	711,480													
Stabilizers, disinfectants, etc	10,000													
Labor	71,812	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	
Total	6,703,022	0	2,010,907	4,021,813	4,692,116	4,692,116	4,692,116	4,692,116	4,692,116	4,692,116	4,692,116	4,692,116		
I. FIXED COSTS														
Land rent	25,000	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		
Lease for starasept filler	19,200	0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200		
Indirect labor	21,543	0	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543		
Administrative expenses	129,413	0	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413		
Night supervisor	13944	0	13944	13944	13944	13944	13944	13944	13944	13944	13944	13944		
Depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488		
Maintenance	118,994	0	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994		
Insurance	23,799	0	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799		
Interest	402,630	0	0	402,630	402,630	402,630	402,630	402,630	0					
TOTAL	964,010	0	561,380	964,010	964,010	964,010	964,010	964,010	561,380	561,380	561,380	561,380	0	
E. Total annual costs	7,667,032													
Breakeven price of coconut cream	1.61													
Sales price	1.54													

ANNEX a

Revenues from product (w/1% wastage)	7,244,899	0	2,173,470	4,346,940	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	
Net revenues before taxes		(2,485,369)	(398,817)	(639,884)	(584,696)	(584,696)	(584,696)	(584,696)	(182,066)	(182,066)	(182,066)	(182,066)	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(2,485,369)	(398,817)	(639,884)	(584,696)	(584,696)	(584,696)	(584,696)	(182,066)	(182,066)	(182,066)	(182,066)	0
Other adjustments to cashflows (fin)													
Loan proceeds	2,236,832	2,236,832	0										
Repayment of principal	447,366	0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	
Replacement costs (vehicle)		0						40,000	0				
Salvage value	335,000												335,000
Net cashflows (financial, 18% interest)		(248,537)	(189,330)	(876,763)	(822,575)	(822,575)	(822,575)	(862,575)	27,421	27,421	27,421	27,421	335,000
Cumulative net cashflows (fin, 18% interest)		(248,537)	(437,867)	(1,314,629)	(2,137,204)	(2,959,779)	(3,782,354)	(4,644,929)	(4,617,503)	(4,590,087)	(4,562,666)	(4,535,245)	(4,200,245)
Interest (at 12%)	268,420	0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	
Net cashflows (financial, 12% interest)		(248,537)	(189,330)	(742,555)	(688,365)	(688,365)	(688,365)	(728,365)	27,421	27,421	27,421	27,421	335,000
Cumulative net cashflows (fin, 12% interest)		(248,537)	(437,867)	(1,180,419)	(1,868,784)	(2,557,150)	(3,245,515)	(3,973,880)	(3,946,459)	(3,919,038)	(3,891,616)	(3,864,195)	(3,529,195)
Adjustments for economic analysis													
Exclusion of loan proceeds	2,236,832	2,236,832											
Exclusion of principal		0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of interest		0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	0
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, w/o financing)		(2,485,369)	(189,330)	(26,767)	27,421	27,421	27,421	(12,579)	27,421	27,421	27,421	27,421	335,000
Cumulative net cashflows (economic)		(2,485,369)	(2,674,699)	(2,701,465)	(2,674,044)	(2,646,623)	(2,619,202)	(2,631,781)	(2,604,360)	(2,576,938)	(2,549,517)	(2,522,096)	(2,187,096)

At listed nut price	
IRR (financial, 18% interest)	(0.31)
IRR (financial, 12% interest)	(0.29)
IRR (economic)	(0.16)
NPV (fin, 18%, r=15%)	(2,409,891)
NPV (fin, 12%, r=15%)	(2,062,708)
NPV (econ, r=15%)	(2,193,468)

Extra cost at 20% higher frozen cream cost	950,400	0	285,120	570,240	665,280	665,280	665,280	665,280	665,280	665,280	665,280	665,280	
Net cashflows (fin, 18%)	(950,400)	(248,537)	(474,450)	(1,447,003)	(1,487,855)	(1,487,855)	(1,487,855)	(1,527,855)	(637,859)	(637,859)	(637,859)	(637,859)	335,000
Net cashflows (fin, 12%)	(950,400)	(248,537)	(474,450)	(1,312,793)	(1,353,645)	(1,353,645)	(1,353,645)	(1,393,645)	(637,859)	(637,859)	(637,859)	(637,859)	335,000
Net cashflows (econ)	(950,400)	(2,485,369)	(474,450)	(597,007)	(637,859)	(637,859)	(637,859)	(677,859)	(637,859)	(637,859)	(637,859)	(637,859)	335,000

IRR (financial, 18% interest)	(0.66)
IRR (financial, 12% interest)	(0.66)
IRR (economic)	(0.66)
NPV (fin, 18%, r=15%)	(4,956,325)
NPV (fin, 12%, r=15%)	(4,616,142)
NPV (econ, r=15%)	(4,746,902)

ANNEX b

FINISHING PROCESS, REPACKING OF COCONUT CREAM
Am. Samoa; starAsept bag (Cook Is. satellite), 1,000 l/h
Double shift, 2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl. delivery)	1.36
3. Unskilled wage, $/day (w/fringe benefits, leave)	23.94
4. Electricity, $/kw-hr	0.13
5. Building cost, $/sq.m.	400.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	55.776
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/25 l bag	4.13
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing system	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Starasept filler (lease rights)	3	55,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	459	1,709,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	670,000

ANNEX b

E. Installation	85,494													
F. Start-up costs, legal fees	20000													
G. TOTAL CAPITAL COSTS	2,485,369	2,485,369	0											
H. VARIABLE COSTS														
Frozen cream	5,385,600													
Transport of raw materials ($1100/FCL)	266,200													
Electricity	107,131													
Packaging materials	784,080													
Other supplies and materials	10,000													
Transport of product ($2450/FCL)	711,480													
Stabilizers, disinfectants, etc	10,000													
Labor	71,812	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	
Total	7,346,302	0	2,203,891	4,407,781	5,142,412	5,142,412	5,142,412	5,142,412	5,142,412	5,142,412	5,142,412	5,142,412		
I. FIXED COSTS														
Land rent	25,000	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		
Lease for starasept filler	19,200	0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200		
Indirect labor	21,543	0	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543		
Administrative expenses	129,413	0	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413		
Night supervisor	13944	0	13944	13944	13944	13944	13944	13944	13944	13944	13944	13944		
Depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488		
Maintenance	118,994	0	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994		
Insurance	23,799	0	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799		
Interest	402,630	0	0	402,630	402,630	402,630	402,630	402,630	0					
TOTAL	964,010	0	561,380	964,010	964,010	964,010	964,010	964,010	561,380	561,380	561,380	561,380	0	
J. Total annual costs	8,310,312													
Breakeven price of coconut cream	1.75													
Sales price	1.54													

ANNEX b

Revenues from product (w/1% wastage)	7,244,899	0	2,173,470	4,346,940	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	
Net revenues before taxes		(2,485,369)	(591,801)	(1,024,852)	(1,034,992)	(1,034,992)	(1,034,992)	(1,034,992)	(632,362)	(632,362)	(632,362)	(632,362)	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(2,485,369)	(591,801)	(1,024,852)	(1,034,992)	(1,034,992)	(1,034,992)	(1,034,992)	(632,362)	(632,362)	(632,362)	(632,362)	0
Other adjustments to cashflows (fin)													
Loan proceeds	2,236,832	2,236,832	0										
Repayment of principal	447,366	0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	
Replacement costs (vehicle)		0						40,000	0				
Salvage value	335,000												335,000
Net cashflows (financial, 18% interest)		(248,537)	(382,314)	(1,262,731)	(1,272,871)	(1,272,871)	(1,272,871)	(1,312,871)	(422,875)	(422,875)	(422,875)	(422,875)	335,000
Cumulative net cashflows (fin, 18% interest)		(248,537)	(630,851)	(1,893,581)	(3,166,452)	(4,439,323)	(5,712,194)	(7,025,065)	(7,447,940)	(7,870,815)	(8,293,690)	(8,716,565)	(8,381,565)
Interest (at 12%)	268,420	0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	
Net cashflows (financial, 12% interest)		(248,537)	(382,314)	(1,128,521)	(1,138,661)	(1,138,661)	(1,138,661)	(1,178,661)	(422,875)	(422,875)	(422,875)	(422,875)	335,000
Cumulative net cashflows (fin, 12% interest)		(248,537)	(630,851)	(1,759,371)	(2,898,032)	(4,036,694)	(5,175,355)	(6,354,016)	(6,776,891)	(7,199,766)	(7,622,640)	(8,045,515)	(7,710,515)
Adjustments for economic analysis													
Exclusion of loan proceeds	2,236,832	2,236,832											
Exclusion of principal		0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of interest		0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	0
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, w/o financing)		(2,485,369)	(382,314)	(412,795)	(422,875)	(422,875)	(422,875)	(462,875)	(422,875)	(422,875)	(422,875)	(422,875)	335,000
Cumulative net cashflows (economic)		(2,485,369)	(2,867,682)	(3,280,477)	(3,703,292)	(4,126,167)	(4,549,042)	(5,011,917)	(5,434,792)	(5,857,666)	(6,280,541)	(6,703,416)	(6,368,416)

At listed nut price	
IRR (financial, 18% interest)	(0.57)
IRR (financial, 12% interest)	(0.57)
IRR (economic)	(0.56)
NPV (fin, 18%, r=15%)	(4,131,188)
NPV (fin, 12%, r=15%)	(3,791,004)
NPV (econ, r=15%)	(3,921,764)

Extra cost at 20% higher frozen cream cost	1,077,120	0	323,136	646,272	753,984	753,984	753,984	753,984	753,984	753,984	753,984	753,984	
Net cashflows (fin, 18%)	(1,077,120)	(248,537)	(705,450)	(1,909,003)	(2,026,855)	(2,026,855)	(2,026,855)	(2,066,855)	(1,176,859)	(1,176,859)	(1,176,859)	(1,176,859)	335,000
Net cashflows (fin, 12%)	(1,077,120)	(248,537)	(705,450)	(1,774,793)	(1,892,645)	(1,892,645)	(1,892,645)	(1,932,645)	(1,176,859)	(1,176,859)	(1,176,859)	(1,176,859)	335,000
Net cashflows (econ)	(1,077,120)	(2,485,369)	(705,450)	(1,059,007)	(1,176,859)	(1,176,859)	(1,176,859)	(1,216,859)	(1,176,859)	(1,176,859)	(1,176,859)	(1,176,859)	335,000

IRR (financial, 18% interest)	(0.78)
IRR (financial, 12% interest)	(0.78)
IRR (economic)	(0.78)
NPV (fin, 18%, r=15%)	(7,025,079)
NPV (fin, 12%, r=15%)	(6,684,896)
NPV (econ, r=15%)	(6,815,656)

ANNEX c

FINISHING PROCESS, REPACKING OF COCONUT CREAM
Am. Samoa; starAsept bag (Western Samoa satellite), 1,000 l/h
Double shift, 2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl delivery)	1.18
3. Unskilled wage, $/day (w/fringe benefits, leave)	23.94
4. Electricity, $/kw-hr	0.13
5. Building cost, $/sq.m.	400.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	55.776
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/25 l bag	4.13
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing system	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Starasept filler (lease rights)	3	55,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	459	1,709,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	670,000

ANNEX c

E. Installation	85,494												
F. Start-up costs, legal fees	20000												
G. TOTAL CAPITAL COSTS	2,485,369	2,485,369	0										
H. VARIABLE COSTS													
Frozen cream	4,672,800												
Transport of raw materials ($735/FCL)	177,870												
Electricity	107,131												
Packaging materials	784,080												
Other supplies and materials	10,000												
Transport of product ($2450/FCL)	711,480												
Stabilizers, disinfectants, etc	10,000												
Labor	71,812	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Total	6,545,172	0	1,963,552	3,927,103	4,581,621	4,581,621	4,581,621	4,581,621	4,581,621	4,581,621	4,581,621	4,581,621	
I. FIXED COSTS													
Land rent	25,000	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	
Lease for starasept filler	19,200	0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	
Indirect labor	21,543		21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	21,543	
Administrative expenses	129,413	0	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	129,413	
Night supervisor	13944	0	13944	13944	13944	13944	13944	13944	13944	13944	13944	13944	
Depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	
Maintenance	118,994	0	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	118,994	
Insurance	23,799	0	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	23,799	
Interest	402,630	0	0	402,630	402,630	402,630	402,630	402,630	0				
TOTAL	964,010	0	561,380	964,010	964,010	964,010	964,010	964,010	561,380	561,380	561,380	561,380	
J. Total annual costs	7,509,182												
Breakeven price of coconut cream	1.58												
Sales price	1.54												

ANNEX C

Revenues from product (w/1% wastage)	7,244,899	0	2,173,470	4,346,940	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	
Net revenues before taxes		(2,485,369)	(351,462)	(544,174)	(474,201)	(474,201)	(474,201)	(474,201)	(71,571)	(71,571)	(71,571)	(71,571)	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(2,485,369)	(351,462)	(544,174)	(474,201)	(474,201)	(474,201)	(474,201)	(71,571)	(71,571)	(71,571)	(71,571)	0
Other adjustments to cashflows (fin)													
Loan proceeds	2,236,832	2,236,832	0										
Repayment of principal	447,366	0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of depreciation	209,488	0	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	209,488	
Replacement costs (vehicle)		0						40,000	0				
Salvage value	335,000												335,000
Net cashflows (financial, 18% interest)		(248,537)	(141,975)	(782,053)	(712,080)	(712,080)	(712,080)	(752,080)	137,916	137,916	137,916	137,916	335,000
Cumulative net cashflows (fin, 18% interest)		(248,537)	(390,512)	(1,172,564)	(1,884,644)	(2,596,724)	(3,308,804)	(4,060,884)	(3,922,968)	(3,785,052)	(3,647,136)	(3,509,220)	(3,174,220)
Interest (at 12%)	268,420	0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	
Net cashflows (financial, 12% interest)		(248,537)	(141,975)	(647,843)	(577,870)	(577,870)	(577,870)	(617,870)	137,916	137,916	137,916	137,916	335,000
Cumulative net cashflows (fin, 12% interest)		(248,537)	(390,512)	(1,038,354)	(1,616,224)	(2,194,095)	(2,771,965)	(3,389,835)	(3,251,919)	(3,114,003)	(2,976,086)	(2,838,170)	(2,503,170)
Adjustments for economic analysis													
Exclusion of loan proceeds	2,236,832	2,236,832											
Exclusion of principal		0	0	447,366	447,366	447,366	447,366	447,366	0	0	0	0	0
Exclusion of interest		0	0	268,420	268,420	268,420	268,420	268,420	0	0	0	0	0
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, w/o financing)		(2,485,369)	(141,975)	67,948	137,916	137,916	137,916	97,916	137,916	137,916	137,916	137,916	335,000
Cumulative net cashflows (economic)		(2,485,369)	(2,627,343)	(2,559,400)	(2,421,484)	(2,283,568)	(2,145,652)	(2,047,736)	(1,909,820)	(1,771,903)	(1,633,987)	(1,496,071)	(1,161,071)

At listed nut price	
IRR (financial, 18% interest)	(0.23)
IRR (financial, 12% interest)	(0.21)
IRR (economic)	(0.07)
NPV (fin, 18%, r=15%)	(1,978,797)
NPV (fin, 12%, r=15%)	(1,638,613)
NPV (econ, r=15%)	(1,769,374)

Extra cost at 20% higher frozen cream cost	934,560	0	280,368	560,736	654,192	654,192	654,192	654,192	654,192	654,192	654,192	654,192	
Net cashflows (fin, 18%)	(934,560)	(248,537)	(422,343)	(1,342,789)	(1,366,272)	(1,366,272)	(1,366,272)	(1,406,272)	(516,276)	(516,276)	(516,276)	(516,276)	335,000
Net cashflows (fin, 12%)	(934,560)	(248,537)	(422,343)	(1,208,579)	(1,232,062)	(1,232,062)	(1,232,062)	(1,272,062)	(516,276)	(516,276)	(516,276)	(516,276)	335,000
Net cashflows (econ)	(934,560)	(2,485,369)	(422,343)	(492,793)	(516,276)	(516,276)	(516,276)	(556,276)	(516,276)	(516,276)	(516,276)	(516,276)	335,000

IRR (financial, 18% interest)	(0.62)
IRR (financial, 12% interest)	(0.61)
IRR (economic)	(0.61)
NPV (fin, 18%, r=15%)	(4,489,673)
NPV (fin, 12%, r=15%)	(4,149,490)
NPV (econ, r=15%)	(4,280,250)

ANNEX d

SEMI-PROCESSED COCONUT CREAM, 1000 l/hr
Cook Islands (double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1. Product is frozen cream with fat content of 27%													
2. Price of dehusked nuts, $,nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.15												
4. Electricity, $/kwh	0.24												
5. Building cost, $/sq. m	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	81,218												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, liters/day	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yr 1--60% single shift; Yr 2--60%, double shift, yrs 3-10 --70% double shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	50.00												
B. Equipment (duty-free)													
Nut opening	38,500		14 (hp)										
Washing and inspection area	34,650		10										
Grinding/blanching/pressing area	238,000		64										
Flakes dryer	420000		50										
Screening and packing area	42000		10										
Pasteurizing	240,000		5										
FDA Standard Extra	36000		0										
Holding tank	30,900		1										
Blast freezers	60,000		40										
Storage freezers (4 week capacity)	420,000		400										
Dryer for parings	140,000		25										
Lab equipment	30,000		2										
Filling system	30,000		2										
Generator	46,875												
Boiler	210,000		5										
Office equipment	40,000		2										
Truck scale	40,000		0										
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000		5										
Waste disposal system	100000												
CIP	43,000		1										
TOTAL	2,509,025		636										

ANNEX d

C. Buildings

Nut storage		260 sq. m.											
Nut preparation area		725											
Sanitary line		150											
Freezer area (4 week's output)		1250											
Drying for parings		200											
Drying for flakes		390											
Administrative		125											
Powerhouse		125											
Warehouse		250											
Warehouse for dry flakes		375											
Total building space	962,500	3,850											
D. Installation (1% of equipment)	25,090												
E. Start-up costs, legal fees, etc.	20,000												
F. Total capital costs	3,516,615	3,516,615	0	0	0	0	0	0	0	0	0	0	0
G. Variable costs													
Coconuts	2,030,457	0	609,137	1,218,274	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	0
Electricity	285,009												
Packaging for frozen cream	320,000												
Packaging for flakes	120,203												
Packaging for parings	12,670												
Other supplies and materials	20,000												
Stabilizers, disinfectants, etc.	10,000												
Unskilled labor	639,193												
Transport of cream (paid by central)	0												
Transport of parings	15,838												
Transport of flakes	45,076												
TOTAL	3,492,443	0	1,047,733	2,095,466	2,444,710	2,444,710	2,444,710	2,444,710	2,444,710	2,444,710	2,444,710	2,444,710	0
H. Fixed costs													
Land rent	45,000	0	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	0
Indirect labor	21,311	0	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	0
Administrative, managerial, technical labor	165,160	0	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	0
Night supervisor	12,500	0	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	0
Depreciation	306,537	0	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	0
Insurance	34,715	0	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	0
Interest	569,692	0	0	569,692	569,692	569,692	569,692	569,692	0	0	0	0	0
Maintenance	173,576	0	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	
Other	174,622	0	174,622	174,622	174,622	174,622	174,622	174,622	174,622	174,622	174,622	174,622	
TOTAL	1,503,112	0	933,421	1,503,112	1,503,112	1,503,112	1,503,112	1,503,112	933,421	933,421	933,421	933,421	0
I. Total annual costs	4,995,555												
J. Sales of byproducts													
Dried parings	70,213												

ANNEX d

Dried parings	70,213												
Low fat coconut flakes	199,838												
TOTAL	270,051	0	81,015	162,030	189,036	189,036	189,036	189,036	189,036	189,036	189,036	189,036	0
Breakeven price at 100% capacity use	1.18												
Price w/ 15% margin	1.36												
Revenues from product (w/15% margin, 1% wastage)	5,379,987	0	1,613,996	3,227,992	3,765,991	3,765,991	3,765,991	3,765,991	3,765,991	3,765,991	3,765,991	3,765,991	0
										0	0	0	0
Net revenues before taxes		(3,516,615)	(286,142)	(208,556)	7,204	7,204	7,204	7,204	576,896	576,896	576,896	576,896	0
Taxes and annual license fees	56,500	0	16,950	33,900	39,550	39,550	39,550	39,550	39,550	39,550	39,550	39,550	0
Net revenues after taxes		(3,516,615)	(303,092)	(242,456)	(32,346)	(32,346)	(32,346)	(32,346)	537,345	537,345	537,345	537,345	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of depreciation	306,537	0	306,537	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(351,662)	3,444	(643,904)	(375,221)	(375,221)	(375,221)	(425,221)	839,220	839,220	839,220	839,220	225,000
Cumulative net cashflows (fin, 18% interest rate)		(351,662)	(348,217)	(992,121)	(1,367,343)	(1,742,564)	(2,117,785)	(2,543,006)	(1,703,786)	(864,566)	(25,345)	813,875	1,038,375
										0	0	0	0
Interest (at 12%)	379,794	0	0	379,794	379,794	379,794	379,794	379,794	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(351,662)	3,444	(454,007)	(185,324)	(185,324)	(185,324)	(235,324)	839,220	839,220	839,220	839,220	225,000
Cumulative net cashflows (fin, 12% interest rate)		(351,662)	(348,217)	(802,224)	(987,548)	(1,172,872)	(1,358,196)	(1,593,520)	(754,300)	84,920	924,141	1,763,361	1,988,361
Adjustments for economic analysis													
Exclusion of loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of interest	379,794	0	0	379,794	348,165	348,165	348,165	348,165					
Exclusion of taxes	56,500	0	16,950	33,900	39,550	39,550	39,550	39,550	39,550	39,550	39,550	39,550	0
Net cashflows (economic, without financing)		(3,516,615)	20,394	663,011	847,141	847,141	847,141	797,141	878,771	878,771	878,771	878,771	225,000
Cumulative net cashflows (economic)		(3,516,615)	(3,496,221)	(2,833,210)	(1,986,069)	(1,138,928)	(291,786)	505,355	1,384,125	2,262,896	3,141,667	4,020,437	4,245,437
At listed nut price													
IRR (financial, 18% interest rate)	0.06												
IRR (financial, 12% interest rate)	0.15												
IRR (economic, without financing)	0.15												
NPV (fin, 18%, r=15%)	(506,943)												
NPV (fin, 12%, r=15%)	(25,609)												
NPV (econ,r=15%)	(49,881)												
Nut cost at a higher unit price ($.013/nut)	2,639,594	0	791,878	1,583,756	1,847,716	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(351,662)	(179,297)	(1,009,386)	(801,617)	(972,100)	(972,100)	(1,022,100)	242,342	242,342	242,342	242,342	225,000
Net cashflows (fin, 12%)		(351,662)	(179,297)	(819,489)	(611,720)	(782,202)	(782,202)	(832,202)	242,342	242,342	242,342	242,342	225,000
Net cashflows (econ, w/o fin)		(3,516,615)	(162,347)	297,529	420,745	250,263	250,263	200,263	281,892	281,892	281,892	281,892	225,000
IRR (fin, 18%, high nut price)	(0.25)												
IRR (fin, 12%, high nut price)	(0.22)												
IRR (econ, w/o fin)	(0.04)												
NPV (fin, 18%, r=15%)	(2,549,040)												
NPV (fin, 12%, r=15%)	(2,067,705)												
NPV (econ,r=15%)	(2,091,978)												

ANNEX e

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Cook Islands (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.15												
4. Electricity, $/kw-hr	0.24												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	50.00												

B. Equipment

Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	550000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	232	2,923,025

ANNEX e

C. Buildings															
Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			292,303												
F. TOTAL CAPITAL COSTS			3,885,328	3,885,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			103,966												
Packaging materials for cream			660,800												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			542,388												
Transport of cream ($3400/FCL)			822,800												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			4,026,631	0	1,207,989	2,415,979	2,818,642	2,818,642	2,818,642	2,818,642	2,818,642	2,818,642	2,818,642	2,818,642	2,818,642
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			21,311	0	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311
Administrative expenses			165,160	0	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160
Night supervisor			12,500	0	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Depreciation			329,803	0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803
Maintenance			194,266	0	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266
Other			201,332	0	201,332	201,332	201,332	201,332	201,332	201,332	201,332	201,332	201,332	201,332	201,332
Insurance			35,730	0	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730
Interest			629,423	0	0	629,423	629,423	629,423	629,423	629,423	0	0	0	0	0
Total			1,619,524	0	990,101	1,619,524	1,649,524	1,649,524	1,649,524	1,649,524	1,020,101	1,020,101	1,020,101	1,020,101	0
E. Total annual costs			5,646,156												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	37,296
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	107,855
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824

ANNEX e

G. Breakeven price of coconut cream	1.37													
Sales price	1.54													
Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
Net revenues before taxes		(3,885,328)	(313,360)	(266,043)	(70,462)	(70,462)	(70,462)	(70,462)	558,961	558,961	558,961	558,961		0
Taxes and annual license fees	62,824	0	18,847	37,695	43,977	43,977	43,977	43,977	43,977	43,977	43,977	43,977		0
Net revenues after taxes		(3,885,328)	(332,208)	(303,737)	(114,440)	(114,440)	(114,440)	(114,440)	514,984	514,984	514,984	514,984		0
Other adjustments to cashflows (fin)														
Loan proceeds	3,496,795	3,496,795												
Repayment of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359	0	0	0	0		0
Exclusion of depreciation	329,803	0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803		
Replacement costs (vehicle)	40,000							40,000						
Salvage value	325,000													325,000
Net cashflows (financial, 18% interest rate)		(388,533)	(2,405)	(673,294)	(483,996)	(483,996)	(483,996)	(523,996)	844,786	844,786	844,786	844,786		325,000
Cumulative net cashflows (fin, 18% interest rate)		(388,533)	(390,938)	(1,064,232)	(1,548,228)	(2,032,224)	(2,516,220)	(3,040,216)	(2,195,430)	(1,350,643)	(505,857)	338,929		663,929
Interest at 12%	419,615	0	0	419,615	419,615	419,615	419,615	419,615	0	0	0	0		0
Net cashflows (fin, 12% interest)		(388,533)	(2,405)	(463,486)	(274,188)	(274,188)	(274,188)	(314,188)	844,786	844,786	844,786	844,786		325,000
Cumulative net cashflows (fin, 12% int)		(388,533)	(390,938)	(854,424)	(1,128,612)	(1,402,801)	(1,676,989)	(1,991,177)	(1,146,391)	(301,605)	543,181	1,387,967		1,712,967
Adjustments for economic analysis														
Exclusion of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359						
Exclusion of interest	419,615	0	0	419,615	419,615	419,615	419,615	419,615						
Exclusion of taxes	62,824	0	18,847	37,695	43,977	43,977	43,977	43,977	43,977	43,977	43,977	43,977		0
Exclusion of loan proceeds	3,496,795	3,496,795												
Net cashflows (econ, w/o financing)		(3,885,328)	18,442	693,183	888,763	888,763	888,763	848,763	888,763	888,763	888,763	888,763		325,000
Cumulative net cashflows (econ, w/o financing)		(3,885,328)	(3,866,885)	(3,173,703)	(2,284,940)	(1,396,176)	(509,413)	339,350	1,228,113	2,116,876	3,005,639	3,894,402		4,219,402

IRR (financial, 18% interest)	0.04
IRR (financial, 12% interest)	0.11
IRR (economic, w/o financing)	0.13
NPV(fin, 18%, r=15%)	(738,520)
NPV(fin, 12%,r=15%)	(206,718)
NPV(econ, r=15%)	(242,343)

Extra nut cost at a higher unit price ($0.13/nut)														
Net cashflows (fin, 18%)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738		
Net cashflows (fin, 12%)		(388,533)	(154,948)	(978,379)	(839,928)	(949,734)	(949,734)	(989,734)	379,048	379,048	379,048	379,048		325,000
Net cashflows (econ, w/o fin)		(388,533)	(154,948)	(768,571)	(630,120)	(739,926)	(739,926)	(779,926)	379,048	379,048	379,048	379,048		325,000
		(3,885,328)	(136,100)	388,096	532,831	423,025	423,025	383,025	423,025	423,025	423,025	423,025		325,000

IRR (fin, 18%), high nut price	(0.18)
IRR (fin, 12%), high nut price	(0.14)
IRR (econ, w/o fin), high nut price	0.01
NPV(fin, 18%, r=15%)	(2,365,834)
NPV(fin, 12%,r=15%)	(1,834,032)
NPV(econ, r=15%)	(1,869,657)

ANNEX f

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/YR)
Cook Islands (doubtetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.15												
4. Electricity, $/kw-hr	0.24												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	50.00												

B. Equipment		
Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Aseptic filling system (tetrapak	2	635,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	231	3,373,025

ANNEX f

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			337,303												
F. TOTAL CAPITAL COSTS			4,380,328	4,380,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			103,518												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			542,388												
Transport of cream ($3400/FCL)			822,800												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,605,383	0	1,681,615	3,363,230	3,923,768	3,923,768	3,923,768	3,923,768	3,923,768	3,923,768	3,923,768	3,923,768	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			21,311	0	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	21,311	
Administrative expenses			165,160	0	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	165,160	
Night supervisor			12,500	0	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	
Depreciation			374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Maintenance			219,016	0	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	
Other			280,269	0	280,269	280,269	280,269	280,269	280,269	280,269	280,269	280,269	280,269	280,269	
Insurance			40,230	0	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	
Interest			709,613	0	0	709,613	709,613	709,613	709,613	709,613	0	0	0	0	0
Total			1,852,902	0	1,143,289	1,852,902	1,882,902	1,882,902	1,882,902	1,882,902	1,173,289	1,173,289	1,173,289	1,173,289	0
E. Total annual costs			7,458,285												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,165	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX f

G. Breakeven price of coconut cream	1.82												
Sales price	1.98												
Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,380,328)	(417,454)	(401,231)	(189,286)	(189,286)	(189,286)	(189,286)	520,327	520,327	520,327	520,327	0
Taxes and annual license fees	80,248	0	24 075	48,149	56,174	56,174	56,174	56,174	56,174	56,174	56,174	56,174	0
Net revenues after taxes		(4,380,328)	(441,528)	(449,380)	(245,460)	(245,460)	(245,460)	(245,460)	464,153	464,153	464,153	464,153	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,942,295	3,942,295											
Repayment of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459	0	0	0	0	0
Exclusion of depreciation	374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(438,033)	(66,726)	(863,037)	(659,117)	(659,117)	(659,117)	(699,117)	838,955	838,955	838,955	838,955	325,000
Cumulative net cashflows (fin, 18% interest rate)		(438,033)	(504,758)	(1,367,795)	(2,026,912)	(2,686,029)	(3,345,145)	(4,044,262)	(3,205,307)	(2,366,351)	(1,527,396)	(688,440)	(363,440)
Interest at 12%	473,075	0	0	473,075	473,075	473,075	473,075	473,075	0	0	0	0	0
Net cashflows (fin, 12% interest)		(438,033)	(66,726)	(626,499)	(422,579)	(422,579)	(422,579)	(462,579)	838,955	838,955	838,955	838,955	325,000
Cumulative net cashflows (fin, 12% int)		(438,033)	(504,758)	(1,131,258)	(1,553,837)	(1,976,415)	(2,398,994)	(2,861,573)	(2,022,618)	(1,183,663)	(344,707)	494,248	819,248
Adjustments for economic analysis													
Exclusion of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459					
Exclusion of interest	473,075	0	0	473,075	473,075	473,075	473,075	473,075					
Exclusion of taxes	80,248	0	24,075	48,149	56,174	56,174	56,174	56,174	56,174	56,174	56,174	56,174	0
Exclusion of loan proceeds	3,942,295	3,942,295											
Net cashflows (econ, w/o financing)		(4,380,328)	(42,651)	683,184	895,129	895,129	895,129	855,129	895,129	895,129	895,129	895,129	325,000
Cumulative net cashflows (econ, w/o financing)		(4,380,328)	(4,422,979)	(3,739,794)	(2,844,665)	(1,949,536)	(1,054,407)	(199,278)	695,851	1,590,981	2,486,110	3,381,239	3,706,239
IRR (financial, 18% interest)	(0.02)												
IRR (financial, 12% interest)	0.05												
IRR (economic, w/o financing)	0.11												
NPV(fin, 18%, r=15%)	*********												
NPV(fin, 12%,r=15%)	(690,397)												
NPV(econ, r=15%)	(705,252)												
Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(438,033)	(219,268)	(1,168,122)	(1,015,049)	(1,124,855)	(1,124,855)	(1,164,855)	373,217	373,217	373,217	373,217	325,000
Net cashflows (fin, 12%)		(438,033)	(219,268)	(931,584)	(778,511)	(888,317)	(888,317)	(928,317)	373,217	373,217	373,217	373,217	325,000
Net cashflows (econ, w/o fin)		(4,380,328)	(195,193)	378,099	539,197	429,391	429,391	389,391	429,391	429,391	429,391	429,391	325,000
IRR (fin, 18%), high nut price	(0.21)												
IRR (fin, 12%), high nut price	(0.18)												
IRR (econ, w/o fin), high nut price	(0.01)												
NPV(fin, 18%, r=15%)	*********												
NPV(fin, 12%,r=15%)	*********												
NPV(econ, r=15%)	*********												

ANNEX g

FINISHING PROCESS, REPACKING OF COCONUT CREAM
Fiji; starAsept bag (Kiribati satellite), 1,000 l/h
Double shift, 2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl. delivery)	1.24
3. Unskilled wage, $/day (w/fringe benefits, leave)	5.18
4. Electricity, $/kw-hr	0.17
5. Building cost, $/sq.m.	250.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	18
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/25 l bag	4.13
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing system	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
StarAsept filler (lease rights)	3	55,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	459	1,709,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	418,750

ANNEX g

E. Installation	85,494												
F. Start-up costs, legal fees	20000												
G. TOTAL CAPITAL COSTS	2,234,119	2,234,119	0										
H. VARIABLE COSTS													
Frozen cream	4,910,400												
Transport of raw materials ($120/t)	522,720												
Electricity	143,984												
Packaging materials	784,080												
Other supplies and materials	10,000												
Transport of product ($3300/FCL)	958,320												
Stabilizers, disinfectants, etc	10,000												
Labor	15,525												
Total	7,355,029	0	2,206,509	4,413,017	5,148,520	5,148,520	5,148,520	5,148,520	5,148,520	5,148,520	5,148,520	5,148,520	
I. FIXED COSTS													
Land rent	25,000	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	
Lease for starasept filler	19,200	0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	
Indirect labor	4,658	0	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	
Administrative expenses	59,948	0	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	
Night supervisor	4500	0	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500	
Depreciation	196,925	0	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	
Maintenance	106,431	0	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	
Insurance	21,286	0	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	
Interest	361,927	0	0	361,927	361,927	361,927	361,927	361,927	0				
TOTAL	799,875	0	437,948	799,875	799,875	799,875	799,875	799,875	437,948	437,948	437,948	437,948	0
J. Total annual costs	8,154,904												
Breakeven price of coconut cream	1.72												
Sales price	1.54												

ANNEX g

Revenues from product (w/1% wastage)	7,244,899	0	2,175,470	4,348,940	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429		
Net revenues before taxes		(2,234,119)	(470,987)	(865,953)	(876,966)	(876,966)	(876,966)	(876,966)	(515,038)	(515,038)	(515,038)	(515,038)		
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0	
Net revenues after taxes		(2,234,119)	(470,987)	(865,953)	(876,966)	(876,966)	(876,966)	(876,966)	(515,038)	(515,038)	(515,038)	(515,038)	0	
Other adjustments to cashflows (fin)														
Loan proceeds	2,010,707	2,010,707	0											
Repayment of principal	402,141	0	0	402,141	402,141	402,141	402,141	402,141	0	0	0	0	0	
Exclusion of depreciation	196,925	0	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	0	
Replacement costs (vehicle)		0						40,000	0					
Salvage value	209,375													209,375
Net cashflows (financial, 18% interest)		(223,412)	(274,062)	(1,071,169)	(1,082,182)	(1,082,182)	(1,082,182)	(1,122,182)	(318,113)	(318,113)	(318,113)	(318,113)		209,375
Cumulative net cashflows (fin, 18% interest)		(223,412)	(497,474)	(1,568,643)	(2,650,825)	(3,733,007)	(4,815,189)	(5,937,371)	(6,255,485)	(6,573,598)	(6,891,712)	(7,209,825)		(7,000,450)
Interest (at 12%)	241,285	0	0	241,285	241,285	241,285	241,285	241,285	0	0	0	0		
Net cashflows (financial, 12% interest)		(223,412)	(274,062)	(950,527)	(961,540)	(961,540)	(961,540)	(1,001,540)	(318,113)	(318,113)	(318,113)	(318,113)		209,375
Cumulative net cashflows (fin, 12% interest)		(223,412)	(497,474)	(1,448,000)	(2,409,540)	(3,371,080)	(4,332,619)	(5,334,159)	(5,652,273)	(5,970,386)	(6,288,500)	(6,606,613)		(6,397,238)
Adjustments for economic analysis														
Exclusion of loan proceeds	2,010,707	2,010,707												
Exclusion of principal		0	0	402,141	402,141	402,141	402,141	402,141	0	0	0	0	0	
Exclusion of interest		0	0	241,285	241,285	241,285	241,285	241,285	0	0	0	0	0	
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0	
Net cashflows (economic, w/o financing)		(2,234,119)	(274,062)	(307,103)	(318,113)	(318,113)	(318,113)	(358,113)	(318,113)	(318,113)	(318,113)	(318,113)	209,375	
Cumulative net cashflows (economic)		(2,234,119)	(2,508,181)	(2,815,284)	(3,133,395)	(3,451,508)	(3,769,622)	(4,127,735)	(4,445,849)	(4,763,962)	(5,082,076)	(5,400,189)	(5,190,814)	

Net cashflows before taxes	982,080	0	294,624	589,248	687,456	687,456	687,456	687,456	687,456	687,456	687,456	687,456		
Taxes and annual license fees	(982,080)	(223,412)	(568,686)	(1,660,417)	(1,769,638)	(1,769,638)	(1,769,638)	(1,809,638)	(1,005,569)	(1,005,569)	(1,005,569)	(1,005,569)		
Net revenues after taxes	(982,080)	(223,412)	(568,686)	(1,539,775)	(1,648,996)	(1,648,996)	(1,648,996)	(1,688,996)	(1,005,569)	(1,005,569)	(1,005,569)	(1,005,569)	209,375	
Other adjustments to cashflows (fin)	(982,080)	(2,234,119)	(568,686)	(896,349)	(1,005,569)	(1,005,569)	(1,005,569)	(1,045,569)	(1,005,569)	(1,005,569)	(1,005,569)	(1,005,569)	209,375	
Net cashflows (fin, 18%)													209,375	
Net cashflows (fin, 12%)														
Net cashflows (econ)														

Extra cost at 20% higher frozen cream cost

IRR (financial, 18% interest)	(0.83)
IRR (financial, 12% interest)	(0.83)
IRR (economic)	(0.83)
NPV (fin, 18%, r=15%)	(6,093,159)
NPV (fin, 12%, r=15%)	(5,787,366)
NPV (econ, r=15%)	(5,904,907)

At listed nut price

IRR (financial, 18% interest)	(0.62)
IRR (financial, 12% interest)	(0.61)
IRR (economic)	(0.60)
NPV (fin, 18%, r=15%)	(3,454,611)
NPV (fin, 12%, r=15%)	(3,148,818)
NPV (econ, r=15%)	(3,266,359)

ANNEX h

FINISHING PROCESS, REPACKING OF COCONUT CREAM
Fiji: starAsept bag (Vanuatu satellite), 1,000 l/h
Double shift, 2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl. delivery)	1.20
3. Unskilled wage, $/day (w/fringe benefits, leave)	5.18
4. Electricity, $/kw-hr	0.17
5. Building cost, $/sq.m.	250.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	18
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/25 l bag	4.13
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing system	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Starasept filler (lease rights)	3	55,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	459	1,709,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	418,750

ANNEX h

E. Installation	85,494													
F. Start-up costs, legal fees	20000													
G. TOTAL CAPITAL COSTS	2,234,119	2,234,119	0											
H. VARIABLE COSTS														
Frozen cream	4,752,000													
Transport of raw materials ($1060/FCL)	256,520													
Electricity	143,984													
Packaging materials	784,080													
Other supplies and materials	10,000													
Transport of product ($3300/FCL)	958,320													
Stabilizers, disinfectants, etc	10,000													
Labor	15,525													
Total	6,930,429		0	2,079,129	4,158,257	4,851,300	4,851,300	4,851,300	4,851,300	4,851,300	4,851,300	4,851,300	4,851,300	4,851,300
I. FIXED COSTS														
Land rent	25,000		0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	
Lease for starasept filler	19,200		0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	
Indirect labor	4,658		0	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	4,658	
Administrative expenses	59,948		0	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	
Night supervisor	4500		0	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500	
Depreciation	196,925		0	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	
Maintenance	106,431		0	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	106,431	
Insurance	21,286		0	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	21,286	
Interest	361,927		0	0	361,927	361,927	361,927	361,927	361,927	0				
TOTAL	799,875		0	437,948	799,875	799,875	799,875	799,875	799,875	437,948	437,948	437,948	437,948	0
E. Total annual costs	7,730,304													
Breakeven price of coconut cream	1.63													
Sales price	1.54													

ANNEX h

Revenues from product (w/1% wastage)		7,244,895	2,173,470	4,346,94[illegible]	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	5,071,429	
Net revenues before taxes			(2,234,119)	(343,607)	(611,193)	(579,746)	(579,746)	(579,746)	(579,746)	(217,818)	(217,818)	(217,818)	(217,818)	0
Taxes and annual license fees		0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes			(2,234,119)	(343,607)	(611,193)	(579,746)	(579,746)	(579,746)	(579,746)	(217,818)	(217,818)	(217,818)	(217,818)	0
Other adjustments to cashflows (fin)														
Loan proceeds		2,010,707	2,010,707	0										
Repayment of principal		402,141	0	0	402,141	402,141	402,141	402,141	402,141	0	0	0	0	0
Exclusion of depreciation		196,925	0	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	196,925	
Replacement costs (vehicle)			0						40,000	0				
Salvage value		209,375												209,375
Net cashflows (financial, 18% interest)			(223,412)	(146,682)	(816,409)	(784,962)	(784,962)	(784,962)	(824,962)	(20,893)	(20,893)	(20,893)	(20,893)	209,375
Cumulative net cashflows (fin, 18% interest)			(223,412)	(370,094)	(1,186,503)	(1,971,465)	(2,756,427)	(3,541,389)	(4,366,351)	(4,387,245)	(4,408,138)	(4,429,032)	(4,449,925)	(4,240,550)
Interest (at 12%)		241,285	0	0	241,285	241,285	241,285	241,285	241,285	0	0	0	0	
Net cashflows (financial, 12% interest)			(223,412)	(146,682)	(695,767)	(664,320)	(664,320)	(664,320)	(704,320)	(20,893)	(20,893)	(20,893)	(20,893)	209,375
Cumulative net cashflows (fin, 12% interest)			(223,412)	(370,094)	(1,065,860)	(1,730,180)	(2,394,500)	(3,058,819)	(3,763,139)	(3,784,033)	(3,804,926)	(3,825,820)	(3,846,713)	(3,637,338)
Adjustments for economic analysis														
Exclusion of loan proceeds		2,010,707	2,010,707											
Exclusion of principal			0	0	402,141	402,141	402,141	402,141	402,141	0	0	0	0	0
Exclusion of interest			0	0	241,285	241,285	241,285	241,285	241,285	0	0	0	0	0
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, w/o financing)			(2,234,119)	(146,682)	(51,341)	(20,893)	(20,893)	(20,893)	(60,893)	(20,893)	(20,893)	(20,893)	(20,893)	209,375
Cumulative net cashflows (economic)			(2,234,119)	(2,380,801)	(2,432,141)	(2,453,035)	(2,473,928)	(2,494,822)	(2,555,715)	(2,576,609)	(2,597,502)	(2,618,396)	(2,639,289)	(2,429,914)
At listed nut price														
IRR (financial, 18% interest)	(0.38)													
IRR (financial, 12% interest)	(0.36)													
IRR (economic)	(0.23)													
NPV (fin, 18%, r=15%)	(2,313,841)													
NPV (fin, 12%, r=15%)	(2,008,048)													
NPV (econ, r=15%)	(2,125,589)													
Extra cost at 20% higher frozen cream cost														
Net cashflows (fin, 18%)		950,400	0	285,120	570,240	665,280	665,280	665,280	665,280	665,280	665,280	665,280	665,280	
Net cashflows (fin, 12%)		(950,400)	(223,412)	(431,802)	(1,386,649)	(1,450,242)	(1,450,242)	(1,450,242)	(1,490,242)	(686,173)	(686,173)	(686,173)	(686,173)	209,375
Net cashflows (econ)		(950,400)	(223,412)	(431,802)	(1,266,007)	(1,329,600)	(1,329,600)	(1,329,600)	(1,369,600)	(686,173)	(686,173)	(686,173)	(686,173)	209,375
IRR (financial, 18% interest)	(0.77)	(950,400)	(2,234,119)	(431,802)	(622,581)	(686,173)	(686,173)	(686,173)	(726,173)	(686,173)	(686,173)	(686,173)	(686,173)	209,375
IRR (financial, 12% interest)	(0.77)													
IRR (economic)	(0.77)													
NPV (fin, 18%, r=15%)	(4,867,275)													
NPV (fin, 12%, r=15%)	(4,561,481)													
NPV (econ, r=15%)	(4,679,023)													

ANNEX i

FINISHING PROCESS. REPACKING OF COCONUT CREAM
Fiji; tetrapak (Vanuatu satellite), 1000 l/h, double shift
2-10-89

A. Assumptions

1. Pasteurized frozen cream (27% fat) processed to 22.5% fat & packaged.	
2. Price of starting material, $/kg (excl. delivery)	1.18
3. Unskilled wage, $/day (w/fringe benefits, leave)	5.18
4. Electricity, $/kw-hr	0.17
5. Building cost, $/sq.m.	250.00
6. Yield of final product, liter/liter of semiprocessed product	1.20
7. Interest rate, %	0.18
8. Skilled wage, $/day (w/fringe benefits & leave)	18
9. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10-- 70% double shift)	
10. Maintenance costs	0.05
11. Frozen cream requirement, liters/day	15,840.00
12. Working days per year	250.00
13. Packaging materials for cream, $/250 ml tetrapak	0.14
14. Daily production, liters	19,008
15. Depreciation of building	0.05
16. Depreciation of machinery	0.10
17. Depreciation of vehicle	0.2
18. Insurance (% of equipment and buildings cost)	0.01
19. Fraction of capital investment to be loaned	0.90

B. Equipment

FDA Standard Extra	0	36000
Storage freezers (4 week input supply)	400	480000
Ice crusher and thawing system	5	50,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Tetrapak filler (lease rights)	2	635,000
Lab equipment	2	20,000
Generator		46,875
Boiler	5	50,000
Office equipment	2	20,000
Truck scale	0	40,000
Light transport vehicle		50,000
Water treatment plant	5	70,000
CIP	1	43,000
Total	458	2,289,875

C. Buildings

Sanitary line	150	
Storage freezer area(4 wk input supply)	1000	
Administrative	125	
Powerhouse	100	
Warehouse	300	
Total	1,675	418,750

ANNEX 1

E. Installation	114,494													
F. Start-up costs, legal fees	20000													
G. TOTAL CAPITAL COSTS	2,843,119	2,843,119	0											
FINISHING PROCESS, REPACKING OF COCONUT CREAM														
H. VARIABLE COSTS														
2-10-89														
Frozen cream	4,672,800													
Transport of raw materials ($1,750/t)	423,500													
Electricity	145,380													
Packaging materials	2,661,120													
Other supplies and materials	10,000													
Transport of product ($3300/FCL)	953,320													
Stabilizers, disinfectants, etc	10,000													
Labor	15,540	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	
7. Interest rate, %														
Total	8,896,660	0	2,668,998	5,337,998	6,227,662	6,227,662	6,227,662	6,227,662	6,227,662	6,227,662	6,227,662	6,227,662		
9. Capacity use (Yr 1--60% single shift; Yr 2--60%														
I. FIXED COSTS														
10. Maintenance costs	0.05													
Land rent	25,000	0	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		
Lease for starasept filler	19,200	0	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200		
Indirect labor	4,662	0	4,662	4,662	4,662	4,662	4,662	4,662	4,662	4,662	4,662	4,662		
Administrative expenses	59,948	0	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948	59,948		
Night supervisor	4500	0	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500		
Depreciation	254,925	0	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925		
Maintenance	135,431	0	135,431	135,431	135,431	135,431	135,431	135,431	135,431	135,431	135,431	135,431		
Insurance	27,086	0	27,086	27,086	27,086	27,086	27,086	27,086	27,086	27,086	27,086	27,086		
Interest	460,585	0	0	460,585	460,585	460,585	460,585	460,585	0					
TOTAL	991,338	0	530,752	991,338	991,338	991,338	991,338	991,338	530,752	530,752	530,752	530,752	0	
FDA Standard Exam	36000													
Storage freezers (4 week input supply)	480000													
J. Total annual costs	9,887,998													
Aseptic processing plant	504,000													
Homogenizer	105,000													
Breakeven price of coconut cream	2.08													
Sales price	1.98													
Lab equipment	20,000													

FDA Standard Exam	0
Storage freezers (4 week input supply)	400
Aseptic processing plant	5
Homogenizer	30
Lab equipment	2

ANNEX 1

Revenues from product (w/1% wastage)	9,314,870	0	2,794,461	5,588,922	6,520,409	6,520,409	6,520,409	6,520,409	6,520,409	6,520,409	6,520,409	6,520,409		
Net revenues before taxes		(2,843,119)	(405,289)	(740,412)	(698,591)	(698,591)	(698,591)	(698,591)	(238,005)	(238,005)	(238,005)	(238,005)	0	
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0	
Net revenues after taxes		(2,843,119)	(405,289)	(740,412)	(698,591)	(698,591)	(698,591)	(698,591)	(238,005)	(238,005)	(238,005)	(238,005)	0	
Other adjustments to cashflows (fin)														
Loan proceeds	2,558,807	2,558,807	0											
Repayment of principal	511,761	0	0	511,761	511,761	511,761	511,761	511,761	0	0	0	0	0	
Exclusion of depreciation	254,925	0	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925	254,925		
Replacement costs (vehicle)		0						40,000	0					
Salvage value	209,375												209,375	
Net cashflows (financial, 18% interest)		(284,312)	(150,364)	(997,248)	(955,427)	(955,427)	(955,427)	(995,427)	16,920	16,920	16,920	16,920	209,375	
Cumulative net cashflows (fin, 18% interest)		(284,312)	(434,676)	(1,431,924)	(2,387,351)	(3,342,778)	(4,298,205)	(5,293,632)	(5,276,712)	(5,259,793)	(5,242,873)	(5,225,953)	(5,016,578)	
Interest (at 12%)	307,057	0	0	307,057	307,057	307,057	307,057	307,057	0	0	0	0		
Net cashflows (financial, 12% interest)		(284,312)	(150,364)	(843,720)	(801,899)	(801,899)	(801,899)	(841,899)	16,920	16,920	16,920	16,920	209,375	
Cumulative net cashflows (fin, 12% interest)		(284,312)	(434,676)	(1,278,396)	(2,080,294)	(2,882,193)	(3,684,091)	(4,525,990)	(4,509,070)	(4,492,151)	(4,475,231)	(4,458,311)	(4,248,936)	
Adjustments for economic analysis														
Exclusion of loan proceeds	2,558,807	2,558,807												
Exclusion of principal		0	0	511,761	511,761	511,761	511,761	511,761	0	0	0	0	0	
Exclusion of interest		0	0	307,057	307,057	307,057	307,057	307,057	0	0	0	0	0	
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0	
Net cashflows (economic, w/o financing)		(2,843,119)	(150,364)	(24,931)	16,920	16,920	16,920	(23,080)	16,920	16,920	16,920	16,920	209,375	
Cumulative net cashflows (economic)		(2,843,119)	(2,993,483)	(3,018,384)	(3,001,465)	(2,984,545)	(2,967,625)	(2,990,706)	(2,973,786)	(2,956,866)	(2,939,947)	(2,923,027)	(2,713,652)	

At listed nut price	
IRR (financial, 18% interest)	(0.37)
IRR (financial, 12% interest)	(0.35)
IRR (economic)	(0.20)
NPV (fin, 18%, r=15%)	(2,767,898)
NPV (fin, 12%, r=15%)	(2,378,748)
NPV (econ, r=15%)	(2,528,330)

Extra cost at 20% higher frozen cream cost	934,560	0	280,368	560,736	654,192	654,192	654,192	654,192	654,192	654,192	654,192	654,192		
Net cashflows (fin, 18%)	(934,560)	(284,312)	(430,732)	(1,557,984)	(1,609,619)	(1,609,619)	(1,609,619)	(1,649,619)	(637,272)	(637,272)	(637,272)	(637,272)	209,375	
Net cashflows (fin, 12%)	(934,560)	(284,312)	(430,732)	(1,404,456)	(1,456,091)	(1,456,091)	(1,456,091)	(1,496,091)	(637,272)	(637,272)	(637,272)	(637,272)	209,375	
Net cashflows (econ)	(934,560)	(2,843,119)	(430,732)	(585,637)	(637,272)	(637,272)	(637,272)	(677,272)	(637,272)	(637,272)	(637,272)	(637,272)	209,375	

IRR (financial, 18% interest)	(0.75)
IRR (financial, 12% interest)	(0.75)
IRR (economic)	(0.75)
NPV (fin, 18%, r=15%)	(5,278,774)
NPV (fin, 12%, r=15%)	(4,889,624)
NPV (econ, r=15%)	(5,039,206)

ANNEX j

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Fiji (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	5.18												
4. Electricity, $/kw-hr	0.17												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	18.00												

E. Equipment		
Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	550000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	232	2,923,025

ANNEX j

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			292,303												
F. TOTAL CAPITAL COSTS			3,885,328	3,885,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			72,776												
Packaging materials for cream			660,800												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			276,592												
Transport of cream ($3300/FCL)			798,600												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			3,708,446		0	1,111,634	2,223,268	2,593,812	2,593,812	2,593,812	2,593,812	2,593,812	2,593,812	2,593,812	2,593,812
D. Fixed costs															
Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			10,868		0	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868
Administrative expenses			84,360		0	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360
Night supervisor			4,500		0	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Depreciation			329,803		0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803
Maintenance			194,266		0	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266
Other			185,272		0	185,272	185,272	185,272	185,272	185,272	185,272	185,272	185,272	185,272	185,272
Insurance			35,730		0	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730
Interest			629,423		0	0	629,423	629,423	629,423	629,423	629,423	0	0	0	0	0
Total			1,504,222		0	874,799	1,504,222	1,534,222	1,534,222	1,534,222	1,534,222	904,799	904,799	904,799	904,799	0
E. Total annual costs			5,209,668												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610		0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296
Low-fat coconut flakes	5,017		125,424		0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855
			184,034		0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX j

G. Breakeven price of coconut cream	1.26												
Sales price	1.54												
Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
Net revenues before taxes		(3,885,328)	(101,703)	41,970	269,669	269,669	269,669	269,669	899,092	899,092	899,092	899,092	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(3,885,328)	(101,703)	41,970	269,669	269,669	269,669	269,669	899,092	899,092	899,092	899,092	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,496,795	3,496,795											
Repayment of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359	0	0	0	0	0
Exclusion of depreciation	329,803	0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(388,533)	228,099	(327,586)	(99,887)	(99,887)	(99,887)	(139,887)	1,228,895	1,228,895	1,228,895	1,228,895	325,000
Cumulative net cashflows (fin, 18% interest rate)		(388,533)	(160,433)	(488,019)	(587,907)	(687,794)	(787,682)	(927,569)	301,326	1,530,220	2,759,115	3,988,010	4,313,010
Interest at 12%	419,615	0	0	419,615	419,615	419,615	419,615	419,615	0	0	0	0	0
Net cashflows (fin, 12% interest)		(388,533)	228,099	(117,778)	109,920	109,920	109,920	69,920	1,228,895	1,228,895	1,228,895	1,228,895	325,000
Cumulative net cashflows (fin, 12% int)		(388,533)	(160,433)	(278,212)	(168,291)	(58,371)	51,549	121,469	1,350,364	2,579,259	3,808,153	5,037,048	5,362,048
Adjustments for economic analysis													
Exclusion of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359					
Exclusion of interest	419,615	0	0	419,615	419,615	419,615	419,615	419,615					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,496,795	3,496,795											
Net cashflows (econ, w/o financing)		(3,885,328)	228,099	1,001,196	1,228,895	1,228,895	1,228,895	1,188,895	1,228,895	1,228,895	1,228,895	1,228,895	325,000
Cumulative net cashflows (econ, w/o financing)		(3,885,328)	(3,657,228)	(2,656,032)	(1,427,138)	(198,243)	1,030,652	2,219,546	3,448,441	4,677,336	5,906,230	7,135,125	7,460,125

IRR (financial, 18% interest)	0.31
IRR (financial, 12% interest)	0.47
IRR (economic, w/o financing)	0.22
NPV(fin, 18%, r=15%)	796,390
NPV(fin, 12%,r=15%)	1,328,192
NPV(econ, r=15%)	1,123,777

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(388,533)	75,557	(632,671)	(455,820)	(565,625)	(565,625)	(605,625)	763,157	763,157	763,157	763,157	325,000
Net cashflows (fin, 12%)		(388,533)	75,557	(422,863)	(246,012)	(355,818)	(355,818)	(395,818)	763,157	763,157	763,157	763,157	325,000
Net cashflows (econ, w/o fin)		(3,885,328)	75,557	696,111	872,962	763,157	763,157	723,157	763,157	763,157	763,157	763,157	325,000

IRR (fin, 18%), high nut price	0.01
IRR (fin, 12%), high nut price	0.09
IRR (econ, w/o fin), high nut price	0.12
NPV(fin, 18%, r=15%)	(830,924)
NPV(fin, 12%,r=15%)	(299,122)
NPV(econ, r=15%)	(503,537)

ANNEX k

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Fiji (double shifttetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	5.18												
4. Electricity, $/kw-hr	0.17												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day/w/ fringe benefits & leave)	18.00												

B. Equipment		
Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Aseptic filling system (tetrapak	2	635,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	231	3,373,025

ANNEX k

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			337,303												
F. TOTAL CAPITAL COSTS			4,380,328	4,380,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			72,462												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			276,592												
Transport of cream ($3300/FCL)			798,600												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,284,332		0	1,585,300	3,170,599	3,699,033	3,699,033	3,699,033	3,699,033	3,699,033	3,699,033	3,699,033	3,699,033
D. Fixed costs															
Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			10,868		0	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868	10,868
Administrative expenses			84,360		0	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360	84,360
Night supervisor			4,500		0	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Depreciation			374,803		0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803
Maintenance			219,016		0	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016
Other			264,217		0	264,217	264,217	264,217	264,217	264,217	264,217	264,217	264,217	264,217	264,217
Insurance			40,230		0	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230
Interest			709,613		0	0	709,613	709,613	709,613	709,613	709,613	0	0	0	0	0
Total			1,737,607		0	1,027,994	1,737,607	1,767,607	1,767,607	1,767,607	1,767,607	1,057,994	1,057,994	1,057,994	1,057,994	0
E. Total annual costs			7,021,939												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610		0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296
Low-fat coconut flakes	5,017		125,424		0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855
			184,034		0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX k

G. Breakeven price of coconut cream 1.71
Sales price 1.98

Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,380,328)	(205,843)	(93,306)	150,744	150,744	150,744	150,744	860,357	860,357	860,357	860,357	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(4,380,328)	(205,843)	(93,306)	150,744	150,744	150,744	150,744	860,357	860,357	860,357	860,357	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,942,295	3,942,295											
Repayment of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459	0	0	0	0	0
Exclusion of depreciation	374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(438,033)	168,959	(506,962)	(262,912)	(262,912)	(262,912)	(302,912)	1,235,160	1,235,160	1,235,160	1,235,160	325,000
Cumulative net cashflows (fin, 18% interest rate)		(438,033)	(269,073)	(776,036)	(1,038,948)	(1,301,860)	(1,564,772)	(1,867,684)	(632,524)	602,636	1,837,796	3,072,955	3,397,955
Interest at 12%	473,075	0	0	473,075	473,075	473,075	473,075	473,075	0	0	0	0	0
Net cashflows (fin, 12% interest)		(438,033)	168,959	(270,425)	(26,374)	(26,374)	(26,374)	(66,374)	1,235,160	1,235,160	1,235,160	1,235,160	325,000
Cumulative net cashflows (fin, 12% int)		(438,033)	(269,073)	(539,498)	(565,872)	(592,247)	(618,621)	(684,996)	550,164	1,785,324	3,020,484	4,255,644	4,580,644
Adjustments for economic analysis													
Exclusion of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459					
Exclusion of interest	473,075	0	0	473,075	473,075	473,075	473,075	473,075					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,942,295	3,942,295											
Net cashflows (econ, w/o financing)		(4,380,328)	168,959	991,110	1,235,160	1,235,160	1,235,160	1,195,160	1,235,160	1,235,160	1,235,160	1,235,160	325,000
Cumulative net cashflows (econ, w/o financing)		(4,380,328)	(4,211,368)	(3,220,258)	(1,985,099)	(749,939)	485,221	1,680,381	2,915,541	4,150,701	5,385,861	6,621,021	6,946,021

IRR (financial [illegible]est)	0.20
IRR (financial, [illegible]erest)	0.32
IRR (economic, [illegible]ancing)	0.19
NPV(fin, 18%, r=[illegible])	291,381
NPV(fin, 12%, r=15%)	890,936
NPV(econ, r=15%)	660,478

Extra nut cost at a higher unit price ($0.13/nut)	508,475												
Net cashflows (fin, 18%)		0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 12%)		(438,033)	16,417	(812,047)	(618,844)	(728,650)	(728,650)	(768,650)	769,422	769,422	769,422	769,422	325,000
Net cashflows (econ, w/o fin)		(438,033)	16,417	(575,509)	(382,307)	(492,112)	(492,112)	(532,112)	769,422	769,422	769,422	769,422	325,000
IRR (fin, 18%), high nut price		(4,380,328)	16,417	686,025	879,228	769,422	769,422	729,422	769,422	769,422	769,422	769,422	325,000

IRR (fin, 12%), high nut price	(0.03)
IRR (econ, w/o fin), high nut price	0.03
NPV(fin, 18%, r=15%)	0.09
NPV(fin, 12%, r=15%)	(1,335,933)
NPV(econ, r=15%)	(736,378)
	(966,836)

ANNEX 1

SEMI-PROCESSED COCONUT CREAM, 1000 l/hr
Kiribati (double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1. Product is frozen cream with fat content of 27%													
2. Price of dehusked nuts, $.nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	4.73												
4. Electricity, $/kwh	0.28												
5. Building cost, $/sq. m	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	81,218												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, liters/day	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yr 1--60% single shift; Yr 2--60%, double shift, yrs 3-10 --70% double shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	16.88												
B. Equipment (duty-free)													
Nut opening	38,500		14 (hp)										
Washing and inspection area	34,650		10										
Grinding/blanching/pressing area	238,000		64										
Flakes dryer	420000		50										
Screening and packing area	42000		10										
Pasteurizing	240,000		5										
FDA Standard Extra	36000		0										
Holding tank	30,000		1										
Blast freezers	60,000		40										
Storage freezers (4 week capacity)	420,000		400										
Dryer for parings	140,000		25										
Lab equipment	30,000		2										
Filling system	30,000		2										
Generator	46,875												
Boiler	210,000		5										
Office equipment	40,000		2										
Truck scale	40,000		0										
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000		5										
Waste disposal system	100000												
CIP	43,000		1										
TOTAL	2,509,025		636										

ANNEX 1

C. Buildings

Nut storage		260 sq. m.											
Nut preparation area		725											
Sanitary line		150											
Freezer area (4 week's output)		1250											
Drying for parings		200											
Drying for flakes		390											
Administrative		125											
Powerhouse		125											
Warehouse		250											
Warehouse for dry flakes		375											
Total building space	962,500	3,850											
D. Installation (1% of equipment)	25,090												
E. Start-up costs, legal fees, etc.	20,000												
F. Total capital costs	3,516,615	3,516,615	0	0	0	0	0	0	0	0	0	0	0
G. Variable costs													
Coconuts	2,030,457	0	609,137	1,218,274	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	0
Electricity	333,699											0	
Packaging for frozen cream	320,000											0	
Packaging for flakes	120,203											0	
Packaging for parings	12,670											0	
Other supplies and materials	20,000											0	
Stabilizers, disinfectants, etc.	10,000											0	
Unskilled labor	294,819											0	
Transport of cream (paid by central)	0											0	
Transport of parings	15,838											0	
Transport of flakes	45,076											0	
TOTAL	3,202,761	0	960,828	1,921,657	2,241,933	2,241,933	2,241,933	2,241,933	2,241,933	2,241,933	2,241,933	2,241,933	0
H. Fixed costs													
Land rent	45,000	0	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	
Indirect labor	9,923	0	9,923	9,923	9,923	9,923	9,923	9,923	9,923	9,923	9,923	9,923	
Administrative, managerial, technical labor	75,687	0	75,687	75,687	75,687	75,687	75,687	75,687	75,687	75,687	75,687	75,687	
Night supervisor	4,219	0	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	
Depreciation	306,537	0	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	
Insurance	34,715	0	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	
Interest	569,692	0	0	569,692	569,692	569,692	569,692	569,692	0	0	0	0	
Maintenance	173,576	0	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	
Other	160,138	0	160,138	160,138	160,138	160,138	160,138	160,138	160,138	160,138	160,138	160,138	
TOTAL	1,379,486	0	809,794	1,379,486	1,379,486	1,379,486	1,379,486	1,379,486	809,794	809,794	809,794	809,794	
I. Total annual costs	4,582,247												

ANNEX 1

J. Sales of byproducts										0	0	0	0
Dried parings	70,213									0	0	0	0
Low fat coconut flakes	199,838									0	0	0	0
TOTAL	270,051	0	81,015	162,030	189,036	189,036	189,036	189,036	189,036	189,036	189,036	189,036	0
Breakeven price at 100% capacity use	1.08												
Price w/ 15% margin	1.24												
Revenues from product (w/15% margin, 1% wastage)	4,909,435	0	1,472,831	2,945,661	3,436,605	3,436,605	3,436,605	3,436,605	3,436,605	3,436,605	3,436,605	3,436,605	0
Net revenues before taxes		(3,516,615)	(216,777)	(193,451)	4,222	4,222	4,222	4,222	573,913	0	0	0	
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	573,913	573,913	573,913	0
Net revenues after taxes		(3,516,615)	(216,777)	(193,451)	4,222	4,222	4,222	4,222	573,913	573,913	573,913	573,913	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	703,323	0	0	703,323	644,759	644,759	644,759	644,759	0	0	0	0	0
Exclusion of depreciation	306,537	0	306,537	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	5000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(351,662)	89,760	(594,899)	(338,653)	(338,653)	(338,653)	(388,653)	875,788	875,788	875,788	875,788	225,000
Cumulative net cashflows (fin, 18% interest rate)		(351,662)	(261,902)	(856,800)	(1,195,454)	(1,534,107)	(1,872,760)	(2,261,414)	(1,385,625)	(509,837)	365,951	1,241,740	1,466,740
Interest (at 12%)	379,794	0	0	379,794	379,794	379,794	379,794	379,794	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(351,662)	89,760	(405,002)	(148,756)	(148,756)	(148,756)	(198,756)	875,788	875,788	875,788	875,788	225,000
Cumulative net cashflows (fin, 12% interest rate)		(351,662)	(261,902)	(666,903)	(815,659)	(964,415)	(1,113,171)	(1,311,928)	(436,139)	439,649	1,315,437	2,191,226	2,416,226
Adjustments for economic analysis													
Exclusion of loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	703,323	0	0	703,323	644,759	644,759	644,759	644,759	0	0	0	0	0
Exclusion of interest	379,794	0	0	379,794	348,165	348,165	348,165	348,165					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, without financing)		(3,516,615)	89,760	678,116	844,159	844,159	844,159	794,159	875,788	875,788	875,788	875,788	225,000
Cumulative net cashflows (economic)		(3,516,615)	(3,426,855)	(2,748,739)	(1,904,581)	(1,060,422)	(216,263)	577,896	1,453,685	2,329,473	3,205,261	4,081,050	4,306,050
At listed nut price													
IRR (financial, 18% interest rate)	0.10												
IRR (financial, 12% interest rate)	0.19												
IRR (economic, without financing)	0.15												
NPV (fin, 18%, r=15%)	(301,561)												
NPV (fin, 12%, r=15%)	179,773												
NPV (econ,r=15%)	3,702												
Nut cost at a higher unit price ($.013/nut)	2,639,594	0	791,878	1,583,756	1,847,716	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(351,662)	(92,981)	(960,381)	(765,049)	(935,532)	(935,532)	(985,532)	278,910	278,910	278,910	278,910	225,000
Net cashflows (fin, 12%)		(351,662)	(92,981)	(770,484)	(575,152)	(745,634)	(745,634)	(795,634)	278,910	278,910	278,910	278,910	225,000
Net cashflows (econ, w/o fin)		(3,516,615)	(92,981)	312,634	417,763	247,281	247,281	197,281	278,910	278,910	278,910	278,910	225,000
IRR (fin, 18%, high nut price)	(0.23)												
IRR (fin, 12%, high nut price)	(0.19)												
IRR (econ, w/o fin)	(0.04)												
NPV (fin, 18%, r=15%)	(2,343,658)												
NPV (fin, 12%, r=15%)	(1,862,323)												
NPV (econ,r=15%)	(2,038,395)												

ANNEX m

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
New Caledonia (double shift, starAsept)
2-10-89

A. Assumptions

	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	31.73												
4. Electricity, $/kw-hr	0.09												
5. Building cost, $/sq.m.	430.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.16												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	70.81												

B. Equipment

Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		420000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
StarAsept lease rights	3		55,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	232		2,793,025

ANNEX m

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		1,118,000												
D. Start-up costs, legal fees			20,000												
E. Installation			279,303												
F. TOTAL CAPITAL COSTS			4,210,328	4,210,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			38,987												
Packaging materials for cream			660,800												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			1,695,855												
Transport of cream ($3000/FCL)			726,000												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,018,320	0	1,505,496	3,010,992	3,512,824	3,512,824	3,512,824	3,512,824	3,512,824	3,512,824	3,512,824	3,512,824	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			66,631	0	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	
Administrative expenses			247,801	0	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	
Night supervisor			17,701	0	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	
Depreciation			340,203	0	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	
Maintenance			210,516	0	210,516	210,516	210,516	210,516	210,516	210,516	210,516	210,516	210,516	210,516	
Other			250,916	0	250,916	250,916	250,916	250,916	250,916	250,916	250,916	250,916	250,916	250,916	
Insurance			39,110	0	39,110	39,110	39,110	39,110	39,110	39,110	39,110	39,110	39,110	39,110	
Interest			682,073	0	0	682,073	682,073	682,073	682,073	682,073	0	0	0	0	0
Total			1,884,952	0	1,202,879	1,884,952	1,914,952	1,914,952	1,914,952	1,914,952	1,232,879	1,232,879	1,232,879	1,232,879	0
E. Total annual costs			6,903,272												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX m

G. Breakeven price of coconut cream	1.68												
Sales price	1.54												
Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
Net revenues before taxes		(4,210,328)	(823,645)	(1,126,484)	(1,030,072)	(1,030,072)	(1,030,072)	(1,030,072)	(347,999)	(347,999)	(347,999)	(347,999)	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(4,210,328)	(823,645)	(1,126,484)	(1,030,072)	(1,030,072)	(1,030,072)	(1,030,072)	(347,999)	(347,999)	(347,999)	(347,999)	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,789,295	3,789,295											
Repayment of principal	757,859	0	0	757,859	757,859	757,859	757,859	757,859	0	0	0	0	0
Exclusion of depreciation	340,203	0	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	340,203	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	559,000												559,000
Net cashflows (financial, 18% interest rate)		(421,033)	(483,442)	(1,544,140)	(1,447,729)	(1,447,729)	(1,447,729)	(1,487,729)	(7,797)	(7,797)	(7,797)	(7,797)	559,000
Cumulative net cashflows (fin, 18% interest rate)		(421,033)	(904,475)	(2,448,615)	(3,896,344)	(5,344,073)	(6,791,801)	(8,279,530)	(8,287,327)	(8,295,124)	(8,302,920)	(8,310,717)	(7,751,717)
Interest at 12%	454,715	0	0	454,715	454,715	454,715	454,715	454,715	0	0	0	0	0
Net cashflows (fin, 12% interest)		(421,033)	(483,442)	(1,316,782)	(1,220,371)	(1,220,371)	(1,220,371)	(1,260,371)	(7,797)	(7,797)	(7,797)	(7,797)	559,000
Cumulative net cashflows (fin, 12% int)		(421,033)	(904,475)	(2,221,258)	(3,441,629)	(4,662,000)	(5,882,371)	(7,142,742)	(7,150,539)	(7,158,335)	(7,166,132)	(7,173,929)	(6,614,929)
Adjustments for economic ana' sis													
Exclusion of principal	757,859	0	0	757,859	757,859	757,859	757,859	757,859					
Exclusion of interest	454,715	0	0	454,715	454,715	454,715	454,715	454,715					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,789,295	3,789,295											
Net cashflows (econ, w/o financing)		(4,210,328)	(483,442)	(104,208)	(7,797)	(7,797)	(7,797)	(47,797)	(7,797)	(7,797)	(7,797)	(7,797)	559,000
Cumulative net cashflows (econ, w/o financing)		(4,210,328)	(4,693,770)	(4,797,978)	(4,805,775)	(4,813,571)	(4,821,368)	(4,869,165)	(4,876,962)	(4,884,758)	(4,892,555)	(4,900,352)	(4,341,352)

IRR (financial, 18% interest)	(0.33)
IRR (financial, 12% interest)	(0.31)
IRR (economic, w/o financing)	(0.19)
NPV(fin, 18%, r=15%)	(4,383,558)
NPV(fin, 12%,r=15%)	(3,807,272)
NPV(econ, r=15%)	(4,028,785)

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(421,033)	(635,985)	(1,849,225)	(1,803,661)	(1,913,467)	(1,913,467)	(1,953,467)	(473,535)	(473,535)	(473,535)	(473,535)	559,000
Net cashflows (fin, 12%)		(421,033)	(635,985)	(1,621,867)	(1,576,303)	(1,686,109)	(1,686,109)	(1,726,109)	(473,535)	(473,535)	(473,535)	(473,535)	559,000
Net cashflows (econ, w/o fin)		(4,210,328)	(635,985)	(409,293)	(363,729)	(473,535)	(473,535)	(513,535)	(473,535)	(473,535)	(473,535)	(473,535)	559,000

IRR (fin, 18%), high nut price	(0.50)
IRR (fin, 12%), high nut price	(0.50)
IRR (econ, w/o fin), high nut price	(0.46)
NPV(fin, 18%, r=15%)	(6,010,872)
NPV(fin, 12%,r=15%)	(5,434,586)
NPV(econ, r=15%)	(5,656,099)

ANNEX n

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
New Caledonia (doutetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	31.73												
4. Electricity, $/kw-hr	0.09												
5. Building cost, $/sq.m.	430.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--50% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	70.81												

B. Equipment

Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		550000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
Aseptic filling system (tetrapak	2		635,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	231		3,503,025

ANNEX n

C. Buildings															
Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		1,118,000												
D. Start-up costs, legal fees			20,000												
E. Installation			350,303												
F. TOTAL CAPITAL COSTS			4,991,328	4,991,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			38,819												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			1,695,855												
Transport of cream ($3000/FCL)			726,000												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			6,597,352	0	1,979,206	3,958,411	4,618,146	4,618,146	4,618,146	4,618,146	4,618,146	4,618,146	4,618,146	4,618,146	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			66,631	0	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	66,631	
Administrative expenses			247,801	0	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	247,801	
Night supervisor			17,701	0	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	17,701	
Depreciation			411,203	0	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203	
Maintenance			249,566	0	249,566	249,566	249,566	249,566	249,566	249,566	249,566	249,566	249,566	249,566	
Other			329,868	0	329,868	329,868	329,868	329,868	329,868	329,868	329,868	329,868	329,868	329,868	
Insurance			46,210	0	46,210	46,210	46,210	46,210	46,210	46,210	46,210	46,210	46,210	46,210	
Interest			808,595	0	0	808,595	808,595	808,595	808,595	808,595	0	0	0	0	0
Total			2,207,576	0	1,398,981	2,207,576	2,237,576	2,237,576	2,237,576	2,237,576	1,428,981	1,428,981	1,428,981	1,428,981	0
E. Total annual costs			8,804,928												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX n

G. Breakeven price of coconut crea	2.16													
Sales price	1.98													
Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,991,328)	(970,736)	(1,351,086)	(1,238,338)	(1,238,338)	(1,238,338)	(1,238,338)	(429,743)	(429,743)	(429,743)	(429,743)		0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(4,991,328)	(970,736)	(1,351,086)	(1,238,338)	(1,238,338)	(1,238,338)	(1,238,338)	(429,743)	(429,743)	(429,743)	(429,743)		0
Other adjustments to cashflows (fin)														
Loan proceeds	4,492,195	4,492,195												
Repayment of principal	898,439	0	0	898,439	898,439	898,439	898,439	898,439	0	0	0	0		0
Exclusion of depreciation	411,203	0	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203	411,203		
Replacement costs (vehicle)	40,000							40,000						
Salvage value	559,000													559,000
Net cashflows (financial, 18% interest rate)		(499,133)	(559,534)	(1,838,323)	(1,725,575)	(1,725,575)	(1,725,575)	(1,765,575)	(18,541)	(18,541)	(18,541)	(18,541)		559,000
Cumulative net cashflows (fin, 18% interest rate)		(499,133)	(1,058,666)	(2,896,989)	(4,622,564)	(6,348,139)	(8,073,713)	(9,839,288)	(9,857,829)	(9,876,369)	(9,894,910)	(9,913,451)		(9,354,451)
Interest at 12%	539,063	0	0	539,063	539,063	539,063	539,063	539,063	0	0	0	0		0
Net cashflows (fin, 12% interest)		(499,133)	(559,534)	(1,568,791)	(1,456,043)	(1,456,043)	(1,456,043)	(1,496,043)	(18,541)	(18,541)	(18,541)	(18,541)		559,000
Cumulative net cashflows (fin, 12% int)		(499,133)	(1,058,666)	(2,627,457)	(4,083,501)	(5,539,544)	(6,995,587)	(8,491,630)	(8,510,170)	(8,528,711)	(8,547,252)	(8,565,792)		(8,006,792)
Adjustments for economic analysis														
Exclusion of principal	898,439	0	0	898,439	898,439	898,439	898,439	898,439						
Exclusion of interest	539,063	0	0	539,063	539,063	539,063	539,063	539,063						
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0		0
Exclusion of loan proceeds	4,492,195	4,492,195												
Net cashflows (econ, w/o financing)		(4,991,328)	(559,534)	(131,289)	(18,541)	(18,541)	(18,541)	(58,541)	(18,541)	(18,541)	(18,541)	(18,541)		559,000
Cumulative net cashflows (econ, w/o financing)		(4,991,328)	(5,550,861)	(5,682,150)	(5,700,691)	(5,719,231)	(5,737,772)	(5,796,313)	(5,814,853)	(5,833,394)	(5,851,935)	(5,870,476)		(5,311,476)

IRR (financial, 18% interest)	(0.35)
IRR (financial, 12% interest)	(0.33)
IRR (economic, w/o financing)	(0.20)
NPV(fin, 18%, r=15%)	(5,235,539)
NPV(fin, 12%,r=15%)	(4,552,354)
NPV(econ, r=15%)	(4,814,958)

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738		
Net cashflows (fin, 18%)		(499,133)	(712,076)	(2,143,408)	(2,081,507)	(2,191,313)	(2,191,313)	(2,231,313)	(484,279)	(484,279)	(484,279)	(484,279)		559,000
Net cashflows (fin, 12%)		(499,133)	(712,076)	(1,873,876)	(1,811,975)	(1,921,781)	(1,921,781)	(1,961,781)	(484,279)	(484,279)	(484,279)	(484,279)		559,000
Net cashflows (econ, w/o fin)		(4,991,328)	(712,076)	(436,374)	(374,473)	(484,279)	(484,279)	(524,279)	(484,279)	(484,279)	(484,279)	(484,279)		559,000

IRR (fin, 18%), high nut price	(0.51)
IRR (fin, 12%), high nut price	(0.50)
IRR (econ, w/o fin), high nut price	(0.47)
NPV(fin, 18%, r=15%)	(6,862,853)
NPV(fin, 12%,r=15%)	(6,179,668)
NPV(econ, r=15%)	(6,442,272)

DATA

ANNEX o

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Papua New Guinea (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01												
4. Electricity, $/kw-hr	0.18												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	80,000												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	30.12												

B. Equipment

Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		550000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
StarAsept lease rights	3		55,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	232		2,923,025

ANNEX 0

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			292,303												
F. TOTAL CAPITAL COSTS			3,885,328	3,885,328											
C. Variable Costs															
Coconuts			2,000,000												
Electricity			77,108												
Packaging materials for cream			660,800												
Packaging for flakes			118,400												
Packaging for parings			12,480												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			616,686												
Transport of cream ($3600/FCL)			871,200												
Transport of parings			15,600												
Transport of flakes			44,400												
Total variable costs			4,456,674		0	1,337,002	2,674,004	3,119,672	3,119,672	3,119,672	3,119,672	3,119,672	3,119,672	3,119,672	3,119,672
D. Fixed costs															
Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			19,277		0	19,277	19,277	19,277	19,277	19,277	19,277	19,277	19,277	19,277	19,277
Administrative expenses			111,748		0	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748
Night supervisor			7,531		0	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531
Depreciation			329,803		0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803
Maintenance			194,266		0	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266	194,266
Other			222,834		0	222,834	222,834	222,834	222,834	222,834	222,834	222,834	222,834	222,834	222,834
Insurance			35,730		0	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730	35,730
Interest			629,423		0	0	629,423	629,423	629,423	629,423	629,423	0	0	0	0	0
Total			1,580,611		0	951,188	1,580,611	1,610,611	1,610,611	1,610,611	1,610,611	981,188	981,188	981,188	981,188	0
E. Total annual costs			6,037,285												
F. Sales of byproducts															
Dried paring	2,080	kg/day	69,160		0	20,748	41,496	48,412	37,296	37,296	37,296	37,296	37,296	37,296	37,296
Low-fat coconut flakes	5,920		148,000		0	44,400	88,800	103,600	107,855	107,855	107,855	107,855	107,855	107,855	107,855
			217,160		0	65,148	130,296	152,012	152,012	152,012	152,012	152,012	152,012	152,012	152,012	0

ANNEX O

G. Breakeven price of coconut cream 1.46

Sales price 1.54

Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
Net revenues before taxes		(3,885,328)	(393,522)	(465,279)	(309,391)	(309,391)	(309,391)	(309,391)	320,032	320,032	320,032	320,032	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(3,885,328)	(393,522)	(465,279)	(309,391)	(309,391)	(309,391)	(309,391)	320,032	320,032	320,032	320,032	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,496,795	3,496,795											
Repayment of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359	0	0	0	0	0
Exclusion of depreciation	329,803	0	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	329,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(388,533)	(63,719)	(834,836)	(678,947)	(678,947)	(678,947)	(718,947)	649,835	649,835	649,835	649,835	325,000
Cumulative net cashflows (fin. 18% interest rate)		(388,533)	(452,252)	(1,287,088)	(1,966,035)	(2,644,982)	(3,323,929)	(4,042,876)	(3,393,042)	(2,743,207)	(2,093,372)	(1,443,537)	(1,118,537)
Interest at 12%	419,615	0	0	419,615	419,615	419,615	419,615	419,615	0	0	0	0	0
Net cashflows (fin. 12% interest)		(388,533)	(63,719)	(625,028)	(469,139)	(469,139)	(469,139)	(509,139)	649,835	649,835	649,835	649,835	325,000
Cumulative net cashflows (fin. 12% int)		(388,533)	(452,252)	(1,077,280)	(1,546,420)	(2,015,559)	(2,484,699)	(2,993,838)	(2,344,003)	(1,694,168)	(1,044,333)	(394,498)	(69,498)
Adjustments for economic analysis													
Exclusion of principal	699,359	0	0	699,359	699,359	699,359	699,359	699,359					
Exclusion of interest	419,615	0	0	419,615	419,615	419,615	419,615	419,615					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,496,795	3,496,795											
Net cashflows (econ. w/o financing)		(3,885,328)	(63,719)	493,946	649,835	649,835	649,835	609,835	649,835	649,835	649,835	649,835	325,000
Cumulative net cashflows (econ. w/o financing)		(3,885,328)	(3,949,047)	(3,455,101)	(2,805,266)	(2,155,431)	(1,505,596)	(895,761)	(245,926)	403,909	1,053,744	1,703,578	2,028,578

IRR (financial, 18% interest)	(0.06)
IRR (financial, 12% interest)	(0.00)
IRR (economic, w/o financing)	0.07
NPV(fin, 18%, r=15%)	(1,466,300)
NPV(fin, 12%,r=15%)	(934,498)
NPV(econ, r=15%)	(1,138,912)

Extra nut cost at a higher unit price ($0.13/nut)	600,000	0	180,000	360,000	420,000	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(388,533)	(243,719)	(1,194,836)	(1,098,947)	(1,144,685)	(1,144,685)	(1,184,685)	184,097	184,097	184,097	184,097	325,000
Net cashflows (fin, 12%)		(388,533)	(243,719)	(985,028)	(889,139)	(934,877)	(934,877)	(974,877)	184,097	184,097	184,097	184,097	325,000
Net cashflows (econ, w/o fin)		(3,885,328)	(243,719)	133,946	229,835	184,097	184,097	144,097	184,097	184,097	184,097	184,097	325,000

IRR (fin, 18%), high nut price	(0.28)
IRR (fin, 12%), high nut price	(0.25)
IRR (econ, w/o fin), high nut price	(0.10)
NPV(fin, 18%, r=15%)	(3,187,114)
NPV(fin, 12%,r=15%)	(2,655,312)
NPV(econ, r=15%)	(2,359,727)

ANNEX p

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Papua New Guinea (, tetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01												
4. Electricity, $/kw-hr	0.20												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	30.12												

B. Equipment		
Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Aseptic filling system (tetrapak	2	635,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	231	3,373,025

ANNEX p

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			337,303												
F. TOTAL CAPITAL COSTS			4,380,328	4,380,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			86,265												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			535,218												
Transport of cream ($3600/FCL)			871,200												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,629,360	0	1,688,808	3,377,616	3,940,552	3,940,552	3,940,552	3,940,552	3,940,552	3,940,552	3,940,552	3,940,552	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			21,029	0	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	
Administrative expenses			111,748	0	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	
Night supervisor			7,531	0	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	
Depreciation			374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Maintenance			219,016	0	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	
Other			281,468	0	281,468	281,468	281,468	281,468	281,468	281,468	281,468	281,468	281,468	281,468	
Insurance			40,230	0	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	
Interest			709,613	0	0	709,613	709,613	709,613	709,613	709,613	0	0	0	0	0
Total			1,795,437	0	1,085,824	1,795,437	1,825,437	1,825,437	1,825,437	1,825,437	1,115,824	1,115,824	1,115,824	1,115,824	0
E. Total annual costs			7,424,798												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX p

G. Breakeven price of coconut cream	1.81												
Sales price	1.98												
Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,380,328)	(367,182)	(358,153)	(148,606)	(148,606)	(148,606)	(148,606)	561,007	561,007	561,007	561,007	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(4,380,328)	(367,182)	(358,153)	(148,606)	(148,606)	(148,606)	(148,606)	561,007	561,007	561,007	561,007	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,942,295	3,942,295											
Repayment of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459	0	0	0	0	0
Exclusion of depreciation	374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(438,033)	7,620	(771,810)	(562,262)	(562,262)	(562,262)	(602,262)	935,810	935,810	935,810	935,810	325,000
Cumulative net cashflows (fin, 18% interest rate)		(438,033)	(430,413)	(1,202,222)	(1,764,485)	(2,326,747)	(2,889,010)	(3,491,272)	(2,555,462)	(1,619,653)	(683,843)	251,966	576,966
Interest at 12%	473,075	0	0	473,075	473,075	473,075	473,075	473,075	0	0	0	0	0
Net cashflows (fin, 12% interest)		(438,033)	7,620	(535,272)	(325,725)	(325,725)	(325,725)	(365,725)	935,810	935,810	935,810	935,810	325,000
Cumulative net cashflows (fin, 12% int)		(438,033)	(430,413)	(965,685)	(1,291,409)	(1,617,134)	(1,942,859)	(2,308,584)	(1,372,774)	(436,964)	498,845	1,434,655	1,759,655
Adjustments for economic analysis													
Exclusion of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459					
Exclusion of interest	473,075	0	0	473,075	473,075	473,075	473,075	473,075					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,942,295	3,942,295											
Net cashflows (econ, w/o financing)		(4,380,328)	7,620	726,262	935,810	935,810	935,810	895,810	935,810	935,810	935,810	935,810	325,000
Cumulative net cashflows (econ, w/o financing)		(4,380,328)	(4,372,707)	(3,646,445)	(2,710,635)	(1,774,826)	(839,016)	56,793	992,603	1,928,413	2,864,222	3,800,032	4,125,032

IRR (financial, 18% interest)	0.03
IRR (financial, 12% interest)	0.10
IRR (economic, w/o financing)	0.12
NPV(fin, 18%, r=15%)	(887,985)
NPV(fin, 12%, r=15%)	(288,430)
NPV(econ, r=15%)	(518,888)

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(438,033)	(144,922)	(1,076,895)	(918,195)	(1,028,000)	(1,028,000)	(1,068,000)	470,072	470,072	470,072	470,072	325,000
Net cashflows (fin, 12%)		(438,033)	(144,922)	(840,357)	(681,657)	(791,463)	(791,463)	(831,463)	470,072	470,072	470,072	470,072	325,000
Net cashflows (econ, w/o fin)		(4,380,328)	(144,922)	421,177	579,877	470,072	470,072	430,072	470,072	470,072	470,072	470,072	325,000

IRR (fin, 18%), high nut price	(0.17)
IRR (fin, 12%), high nut price	(0.13)
IRR (econ, w/o fin), high nut price	0.00
NPV(fin, 18%, r=15%)	(2,515,299)
NPV(fin, 12%, r=15%)	(1,915,745)
NPV(econ, r=15%)	(2,146,202)

ANNEX q

DATA

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Papua New Guinea (double shift, canned)
2-10-89

A. Assumptions

	DATA
1. Product with fat content of 22.5%.	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01
4. Electricity, $/kw-hr	0.20
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	67,797
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 340 ml lithographed cans	0.23
17. Daily production, liters/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance, % of equipment and buildings cost	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)	
24. Skilled wage, $/day(w/ fringe benefits & leave)	30.12

B. Equipment

Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Aseptic canning system	2	466667
Can chillers	15	100000
Buffing, drying equipment	5	50000
Homogenizer	30	105,000
Aseptic tank	1	140,000
StarAsept lease rights	2	55,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000

ANNEX q

C. Buildings

Nut storage	260													
Nut preparation area	725													
Sanitary line	150													
Drying for parings	200													
Drying for flakes	390													
Administrative	125													
Powerhouse	125													
Warehouse	250													
Warehouse for dry flakes	375													
	2,600	650,000												
D. Start-up costs, legal fees		20,000												
E. Installation		340,969												
F. TOTAL CAPITAL COSTS		4,420,661	4,420,661											
G. Variable Costs														
Coconuts		1,694,915												
Electricity		94,480												
Packaging materials for cream		2,705,882												
Packaging for flakes		100,339												
Packaging for parings		10,576												
Other supplies and materials		20,000												
Stabilizers, disinfectants, etc		20,000												
Unskilled labor		535,218												
Transport of cream ($3600/FCL)		871,200												
Transport of parings		13,220												
Transport of flakes		37,627	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Total variable costs		6,103,456	0	1,831,037	3,662,075	4,272,421	4,272,421	4,272,421	4,272,421	4,272,421	4,272,421	4,272,421	4,272,421	
E. Fixed costs														
Land rent		30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor		21,029	0	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	21,029	
Administrative expenses		111,748	0	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	
Night supervisor		7,531	0	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	
Depreciation		378,469	0	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	
Maintenance		221,033	0	221,033	221,033	221,033	221,033	221,033	221,033	221,033	221,033	221,033	221,033	
Other		305,173	0	305,173	305,173	305,173	305,173	305,173	305,173	305,173	305,173	305,173	305,173	
Insurance		40,597	0	40,597	40,597	40,597	40,597	40,597	40,597	40,597	40,597	40,597	40,597	
Interest		716,147	0	0	716,147	716,147	716,147	716,147	716,147	0	0	0	0	0
Total		1,831,727	0	1,115,579	1,831,727	1,861,727	1,861,727	1,861,727	1,861,727	1,145,579	1,145,579	1,145,579	1,145,579	0

99 ANNEX q

100	I. Total annual costs		7,935,185											
101														
102	J. Sales of byproducts													
103														
104	Dried paring	1,763 kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
106	Low-fat coconut flakes	5,017	125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
107															
108			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0
109															
110	K. Breakeven price of coconut cream		1.94												
111	Sales price		1.98												
112															
113	Revenues from product (w/ 1% wastage)		7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
114															
115	Net revenues before taxes			(4,420,661)	(539,167)	(678,901)	(516,764)	(516,764)	(516,764)	(516,764)	199,384	199,384	199,384	199,384	0
	Taxes and annual license fees		0	0	0	0	0	0	0	0	0	0	0	0	0
	Net revenues after taxes			(4,420,661)	(539,167)	(678,901)	(516,764)	(516,764)	(516,764)	(516,764)	199,384	199,384	199,384	199,384	0
	Other adjustments to cashflows (fin)														
	Loan proceeds		3,978,595	3,978,595											
	Repayment of principal		795,719	0	0	795,719	795,719	795,719	795,719	795,719	0	0	0	0	0
	Exclusion of depreciation		378,469	0	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	
	Replacement costs (vehicle)		40,000							40,000					
	Salvage value		325,000												325,000
	Net cashflows (financial, 18% interest rate)			(442,066)	(160,698)	(1,096,151)	(934,013)	(934,013)	(934,013)	(974,013)	577,853	577,853	577,853	577,853	325,000
	Cumulative net cashflows (fin, 18% interest rate)			(442,066)	(602,764)	(1,698,915)	(2,632,928)	(3,566,941)	(4,500,955)	(5,474,968)	(4,897,115)	(4,319,263)	(3,741,410)	(3,163,557)	(2,838,557)
	Interest at 12%		477,431	0	0	477,431	477,431	477,431	477,431	477,431	0	0	0	0	0
	Net cashflows (fin, 12% interest)			(442,066)	(160,698)	(857,435)	(695,298)	(695,298)	(695,298)	(735,298)	577,853	577,853	577,853	577,853	325,000
	Cumulative net cashflows (fin, 12% int)			(442,066)	(602,764)	(1,460,199)	(2,155,497)	(2,850,794)	(3,546,092)	(4,281,390)	(3,703,537)	(3,125,684)	(2,547,831)	(1,969,979)	(1,644,979)
	Adjustments for economic analysis														
	Exclusion of principal		795,719	0	0	795,719	795,719	795,719	795,719	795,719					
	Exclusion of interest		477,431	0	0	477,431	477,431	477,431	477,431	477,431					
	Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0	0
	Exclusion of loan proceeds		3,978,595	3,978,595											
	Net cashflows (econ, w/o financing)			(4,420,661)	(160,698)	415,715	577,853	577,853	577,853	537,853	577,853	577,853	577,853	577,853	325,000
	Cumulative net cashflows (econ, w/o financing)			(4,420,661)	(4,581,359)	(4,165,644)	(3,587,791)	(3,009,938)	(2,432,085)	(1,894,233)	(1,316,380)	(738,527)	(160,674)	417,178	742,178
	IRR (financial, 18% interest)	(0.13)													
	IRR (financial, 17% interest)	(0.09)													
	IRR (economic, w/o financing)	0.02													
	NPV(fin, 18%, r=15%)	(2,314,066)													
	NPV(fin, 12%,r=15%)	(1,708,990)													
	NPV(econ, r=15%)	(1,941,570)													
	Extra nut cost at a higher unit price ($0.13/nut)		508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
	Net cashflows (fin, 18%)			(442,066)	(313,240)	(1,401,236)	(1,289,946)	(1,399,751)	(1,399,751)	(1,439,751)	112,115	112,115	112,115	112,115	325,000
	Net cashflows (fin, 12%)			(442,066)	(313,240)	(1,162,520)	(1,051,230)	(1,161,036)	(1,161,036)	(1,201,036)	112,115	112,115	112,115	112,115	325,000
	Net cashflows (econ, w/o fin)			(4,420,661)	(313,240)	110,630	221,921	112,115	112,115	72,115	112,115	112,115	112,115	112,115	325,000
	IRR (fin, 18%), high nut price	(0.33)													
	IRR (fin, 12%), high nut price	(0.31)													
	IRR (econ, w/o fin), high nut price	(0.15)													
	NPV(fin, 18%, r=15%)	(3,941,380)													
	NPV(fin, 12%,r=15%)	(3,336,304)													
	NPV(econ, r=15%)	(3,568,884)													

440

ANNEX r

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Papua New Guinea (double shift, starAsept)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%.	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01
4. Electricity, $/kw-hr	0.20
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169.492
13. Shelling rate, nuts day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (Yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	30.12

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching pressing	95	476,000
Drying area	100	560,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Payloader		150000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	270	4,038,850

ANNEX r

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	300													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5.200	1.300.000												
D. Start-up costs, legal fees		20000												
E. Installation		403.885												
F. TOTAL CAPITAL COSTS		5.762.735	5.762.735											
VARIABLE COSTS														
Coconuts		4.237.288												
Electricity		100.829												
Packaging materials for cream		1.652.000												
Packaging materials for flakes		250.847												
Packaging for parings		26.441												
Transport of cream ($3600/FCL)		2.178.000												
Transport of flakes		94.068												
Transport of parings		33.051												
Other supplies and materials		50.000												
Stabilizers, disinfectants, etc		50.000												
Labor		1.259.185												
Total		9.931.709												
FIXED COSTS														
Land rent		60.000												
Rent for starAsept filling system		19200												
Indirect labor		30.042												
Night supervisor		7.531												
Administrative expenses		111.748												
Depreciation		473.885												
Maintenance		288.137												
Others		496.585												
Insurance		53.389												
Interest		864.894												
		2.405.409												

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
	0	2.979.513	5.959.025	6.952.196	6.952.196	6.952.196	6.952.196	6.952.196	6.952.196	6.952.196	6.952.196	
	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	
	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	
	0	30.042	30.042	30.042	30.042	30.042	30.042	30.042	30.042	30.042	30.042	
	0	7.531	7.531	7.531	7.531	7.531	7.531	7.531	7.531	7.531	7.531	
	0	111.748	111.748	111.748	111.748	111.748	111.748	111.748	111.748	111.748	111.748	
	0	473.885	473.885	473.885	473.885	473.885	473.885	473.885	473.885	473.885	473.885	
	0	288.137	288.137	288.137	288.137	288.137	288.137	288.137	288.137	288.137	288.137	
	0	496.585	496.585	496.585	496.585	496.585	496.585	496.585	496.585	496.585	496.585	
	0	53.389	53.389	53.389	53.389	53.389	53.389	53.389	53.389	53.389	53.389	
	0	0	864.894	864.894	864.894	864.894	864.894	0				
	0	1.540.515	2.405.409	2.405.409	2.405.409	2.405.409	2.405.409	1.540.515	1.540.515	1.540.515	1.540.515	0

99 ANNEX r

100	E. Total annual costs			12,337,118										
101														
102	F. Sales of by products													
103														
104	Dried paring	4.407	kg/day	146,525										
106	Low-fat coconut flakes	12.542		313,559										
107														
108														
109				460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	
110	G. Breakeven price of coconut cream			1.19										
111	Sales price			1.54										
112														
113	Revenues from product (w/ 1% wastage)			15,246,000	0	4,573,800	9,147,600	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	0
114															
115	Net revenues before taxes				(5,762,735)	191,797	1,059,216	1,636,654	1,636,654	1,636,654	1,636,654	2,501,548	2,501,548	2,501,548	2,501,548	0
	Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
	Net revenues after taxes				(5,762,735)	191,797	1,059,216	1,636,654	1,636,654	1,636,654	1,636,654	2,501,548	2,501,548	2,501,548	2,501,548	0
	Other adjustments to cashflows (fin)															
	Loan proceeds			5,186,462	5,186,462											
	Repayment of principal			1,037,292	0	0	1,037,292	1,037,292	1,037,292	1,037,292	1,037,292	0	0	0	0	0
	Exclusion of depreciation			473,885	0	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	
	Replacement costs (vehicle)			40,000							40,000					
	Salvage value			650,000												650,000
	Net cashflows (financial, 18% interest rate)				(576,274)	665,682	495,809	1,073,247	1,073,247	1,073,247	1,033,247	2,975,433	2,975,433	2,975,433	2,975,433	650,000
	Cumulative net cashflows (fin, 18% interest rate)				(576,274)	89,409	585,218	1,658,465	2,731,711	3,804,958	4,838,205	7,813,638	10,789,070	13,764,503	16,739,936	17,389,936
	Interest at 12%			622,375	0	0	622,375	622,375	622,375	622,375	622,375	0	0	0	0	0
	Net cashflows (fin, 12% interest)				(576,274)	665,682	738,327	1,315,765	1,315,765	1,315,765	1,275,765	2,975,433	2,975,433	2,975,433	2,975,433	650,000
	Cumulative net cashflows (fin, 12% int)				(576,274)	89,409	827,736	2,143,501	3,459,266	4,775,031	6,050,796	9,026,229	12,001,662	14,977,095	17,952,527	18,602,527
	Adjustments for economic analysis															
	Exclusion of principal			1,037,292	0	0	1,037,292	1,037,292	1,037,292	1,037,292	1,037,292					
	Exclusion of interest			622,375	0	0	427,466	427,466	427,466	427,466	427,466					
	Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
	Exclusion of loan proceeds			5,186,462	5,186,462											
	Net cashflows (econ, w/o financing)				(5,762,735)	665,682	2,203,086	2,780,523	2,780,523	2,780,523	2,740,523	2,975,433	2,975,433	2,975,433	2,975,433	650,000
	Cumulative net cashflows (econ, w/o financing)				(5,762,735)	(5,097,053)	(2,893,967)	(113,444)	2,667,080	5,447,603	8,188,126	11,163,559	14,138,992	17,114,425	20,089,857	20,739,857
	IRR (financial, 18% interest)	1.25														
	IRR (financial, 12% interest)	1.40														
	IRR (economic, w/o financing)	0.35														
	NPV (fin, 18%, r=15%)	5,642,900														
	NPV (fin,12%, r=15%)	6,257,614														
	NPV(econ, r=15%)	5,460,386														
	Extra nut cost at a higher unit price ($0.13/nut)			1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
	Net cashflows (fin, 18%)				(576,274)	284,326	(266,903)	183,416	607,509	607,509	567,509	2,509,695	2,509,695	2,509,695	2,509,695	650,000
	Net cashflows (fin, 12%)				(576,274)	284,326	(24,384)	425,935	850,027	850,027	810,027	2,509,695	2,509,695	2,509,695	2,509,695	650,000
	Net cashflows (econ, w/o fin)				(5,762,735)	284,326	1,440,374	1,890,693	2,314,785	2,314,785	2,274,785	2,509,695	2,509,695	2,509,695	2,509,695	650,000
	IRR (fin, 18%), high nut price	0.57														
	IRR (fin, 12%), high nut price	0.70														
	IRR (econ, w/o fin), high nut price	0.26														
	NPV (fin, 18%, r=15%)	3,236,415														
	NPV (fin,12%, r=15%)	3,851,129														
	NPV(econ, r=15%)	3,053,901														

ANNEX S

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Papua New Guinea (double shift, tetrapak)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%.	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01
4. Electricity, $/kw-hr	0.20
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169,492
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 250 ml tetrapak	0.14
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24 Skilled wage, $/day, (w/fringe benefits & leave)	30.12

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Drying area	100	560,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
Aseptic filler (tetrapak)	2	635,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Payloader		150000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	269	4,618,850

ANNEX 5

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	300													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5,200	1,300,000												
D. Start-up costs, legal fees		20000												
E. Installation		461,885												
F. TOTAL CAPITAL COSTS		6,400,735	6,400,735											
VARIABLE COSTS														
Coconuts		4,237,288												
Electricity		100,455												
Packaging materials for cream		5,000,000												
Packaging materials for flakes		250,847												
Packaging for parings		26,441												
Transport of cream ($3600/PCL)		2,178,000												
Transport of flakes		94,068												
Transport of parings		33,051												
Other supplies and materials		50,000												
Stabilizers, disinfectants, etc		50,000												
Labor		1,259,185	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Total		13,879,335	0	4,163,801	8,327,601	9,715,535	9,715,535	9,715,535	9,715,535	9,715,535	9,715,535	9,715,535	9,715,535	
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor		30,042	0	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	
Night supervisor		7,531	0	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	
Administrative expenses		111,748	0	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	
Depreciation		531,885	0	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	
Maintenance		320,037	0	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	
Others		693,967	0	693,967	693,967	693,967	693,967	693,967	693,967	693,967	693,967	693,967	693,967	
Insurance		59,189	0	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	
Interest		958,854	0	0	958,854	958,854	958,854	958,854	958,854	0				
		2,773,250	0	1,814,397	2,773,250	2,773,250	2,773,250	2,773,250	2,773,250	1,814,397	1,814,397	1,814,397	1,814,397	0

ANNEX 5

E. Total annual costs			16,652,586												
F. Sales of by products															
Dried paring	4,407	kg/day	146,525												
Low-fat coconut flakes	12,542		313,559												
			460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059	
G. Breakeven price of coconut cream			1.62												
Sales price			1.98												
Revenues from product (w/ 1% wastage)			19,602,000	0	5,880,600	11,761,200	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	[illegible]
Net revenues before taxes				(6,400,735)	40,428	936,399	1,554,674	1,554,674	1,554,674	1,554,674	2,513,528	2,513,528	2,513,528	2,513,528	[illegible]
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
Net revenues after taxes				(6,400,735)	40,428	936,399	1,554,674	1,554,674	1,554,674	1,554,674	2,513,528	2,513,528	2,513,528	2,513,528	[illegible]
Other adjustments to cashflows (fin)															
Loan proceeds			5,760,662	5,760,662											
Repayment of principal			1,152,132	0	0	1,152,132	1,152,132	1,152,132	1,152,132	1,152,132	0	0	0	0	[illegible]
Exclusion of depreciation			531,885	0	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	
Replacement costs (vehicle)			40,000							40,000					
Salvage value			650,000												650,000
Net cashflows (financial, 18% interest rate)				(640,074)	572,313	316,152	934,427	934,427	934,427	894,427	3,045,413	3,045,413	3,045,413	3,045,413	650,000
Cumulative net cashflows (fin, 18% interest rate)				(640,074)	(67,760)	248,391	1,182,818	2,117,245	3,051,672	3,946,099	6,991,511	10,036,924	13,082,337	16,127,750	16,777,750
Interest at 12%			691,279	0	0	691,279	691,279	691,279	691,279	691,[illegible]9	0	0	0	0	[illegible]
Net cashflows (fin, 12% interest)				(640,074)	572,313	583,726	1,202,001	1,202,001	1,202,001	1,162,001	3,045,413	3,045,413	3,045,413	3,045,413	650,000
Cumulative net cashflows (fin, 12% int)				(640,074)	(67,760)	515,966	1,717,967	2,919,968	4,121,969	5,283,970	8,329,383	11,374,796	14,420,209	17,465,621	18,115,621
Adjustments for economic analysis															
Exclusion of principal			1,152,132	0	0	1,152,132	1,152,132	1,152,132	1,152,132	1,152,132					
Exclusion of interest			691,279	0	0	427,466	427,466	427,466	427,466	427,466					
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds			5,760,662	5,760,662											
Net cashflows (econ, w/o financing)				(6,400,735)	572,313	2,163,324	2,781,599	2,781,599	2,781,599	2,741,599	3,045,413	3,045,413	3,045,413	3,045,413	650,000
Cumulative net cashflows (econ, w/o financing)				(6,400,735)	(5,828,422)	(3,665,097)	(883,498)	1,898,101	4,679,701	7,421,300	10,466,713	13,512,126	16,557,539	19,602,951	20,252,951
IRR (financial, 18% interest)		0.99													
IRR (financial, 12% interest)		1.14													
IRR (economic, w/o financing)		0.31													
NPV (fin, 18%, r=15%)		5,213,211													
NPV (fin,12%, r=15%)		5,891,434													
NPV(econ, r=15%)		4,885,988													
Extra nut cost at a higher unit price ($0.13/nut)			1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)				(640,074)	190,957	(446,560)	44,596	468,689	468,689	428,689	2,579,675	2,579,675	2,579,675	2,579,675	650,000
Net cashflows (fin, 12%)				(640,074)	190,957	(178,986)	312,171	736,263	736,263	696,263	2,579,675	2,579,675	2,579,675	2,579,675	650,000
Net cashflows (econ, w/o fin)				(6,400,735)	190,957	1,400,613	1,891,769	2,315,861	2,315,861	2,275,861	2,579,675	2,579,675	2,579,675	2,579,675	650,000
IRR (fin, 18%), high nut price		0.45													
IRR (fin, 12%), high nut price		0.57													
IRR (econ, w/o fin), high nut price		0.23													
NPV (fin, 18%, r=15%)		2,806,726													
NPV (fin,12%, r=15%)		3,484,949													
NPV(econ, r=15%)		2,479,503													

ANNEX t

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Papua New Guinea (double shift, canned)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%.	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	10.01
4. Electricity, $/kw-hr	0.20
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169,492
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 340 ml lithographed cans	0.23
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	30.12

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	98	476,000
Drying area	100	560,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
Can chillers	30	200,000
Buffing, drying equipment	5	100,000
Aseptic canning system	2	700,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150,000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	304	4,983,850

ANNEX t

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	300													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5,200	1,300,000												
D. Start-up costs, legal fees		20000												
E. Installation		498,385												
F. TOTAL CAPITAL COSTS		6,802,235	6,802,235											
VARIABLE COSTS														
Coconuts		4,237,288												
Electricity		113,526												
Packaging materials for cream		6,764,706												
Packaging materials for flakes		250,847												
Packaging for parings		26,441												
Transport of crear ($3600/FCL)		2,178,000												
Transport of flakes		94,068												
Transport of parings		33,051												
Other supplies and materials		50,000												
Stabilizers, disinfectants, etc		50,000												
Labor		1,259,185	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Total		15,057,112	0	4,517,133	9,034,267	10,539,978	10,539,978	10,539,978	10,539,978	10,539,978	10,539,978	10,539,978	10,539,978	
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor		30,042	0	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	30,042	
Night supervisor		7,531	0	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	7,531	
Administrative expenses		111,748	0	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	111,748	
Depreciation		568,385	0	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	
Maintenance		340,112	0	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	
Others		752,856	0	752,856	752,856	752,856	752,856	752,856	752,856	752,856	752,856	752,856	752,856	
Insurance		62,839	0	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	
Interest		1,017,984	0	0	1,017,984	1,017,984	1,017,984	1,017,984	1,017,984	0				
		2,951,494	0	1,933,511	2,951,494	2,951,494	2,951,494	2,951,494	2,951,494	1,933,511	1,933,511	1,933,511	1,933,511	0

ANNEX t

E. Total annual costs			18,008,606												
F. Sales of by products															
Dried paring	4,407	kg/day	146,525												
Low-fat coconut flakes	12,542		313,559												
			460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059	
G. Breakeven price of coconut cream															
Sales price			1.75												
			1.98												
Revenues from product (w/ 1% wastage)			19,602,000	0	5,880,600	11,761,200	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	0
Net revenues before taxes				(6,802,235)	(432,019)	51,490	551,987	551,987	551,987	551,987	1,569,971	1,569,971	1,569,971	1,569,971	0
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes				(6,802,235)	(432,019)	51,490	551,987	551,987	551,987	551,987	1,569,971	1,569,971	1,569,971	1,569,971	0
Other adjustments to cashflows (fin)															
Loan proceeds			6,122,012	6,122,012											
Repayment of principal			1,224,402	0	0	1,224,402	1,224,402	1,224,402	1,224,402	1,224,402	0	0	0	0	0
Exclusion of depreciation			568,385	0	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	
Replacement costs (vehicle)			40,000							40,000					
Salvage value			650,000												650,000
Net cashflows (financial, 18% interest rate)				(680,224)	136,366	(604,528)	(104,030)	(104,030)	(104,030)	(144,030)	2,138,356	2,138,356	2,138,356	2,138,356	650,000
Cumulative net cashflows (fin, 18% interest rate)				(680,224)	(543,857)	(1,148,385)	(1,252,415)	(1,356,446)	(1,460,476)	(1,604,507)	533,849	2,672,205	4,810,560	6,948,916	7,598,916
Interest at 12%			734,641	0	0	734,641	734,641	734,641	734,641	734,641	0	0	0	0	0
Net cashflows (fin, 12% interest)				(680,224)	136,366	(321,185)	179,312	179,312	179,312	139,312	2,138,356	2,138,356	2,138,356	2,138,356	650,000
Cumulative net cashflows (fin, 12% int)				(680,224)	(543,857)	(865,043)	(685,731)	(506,419)	(327,107)	(187,795)	1,950,561	4,088,916	6,227,272	8,365,627	9,015,627
Adjustments for economic analysis															
Exclusion of principal			1,224,402	0	0	1,224,402	1,224,402	1,224,402	1,224,402	1,224,402					
Exclusion of interest			734,641	0	0	427,466	427,466	427,466	427,466	427,466					
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds			6,122,012	6,122,012											
Net cashflows (econ, w/o financing)				(6,802,235)	136,366	1,330,683	1,831,180	1,831,180	1,831,180	1,791,180	2,138,356	2,138,356	2,138,356	2,138,356	650,000
Cumulative net cashflows (econ, w/o financing)				(6,802,235)	(6,665,869)	(5,335,186)	(3,504,006)	(1,672,825)	158,355	1,949,535	4,087,891	6,226,246	8,364,602	10,502,957	11,152,957
IRR (financial, 18% interest)	0.29														
IRR (financial, 12% interest)	0.39														
IRR (economic, w/o financing)	0.18														
NPV (fin, 18%, r=15%)	1,320,374														
NPV (fin,12%, r=15%)	2,038,565														
NPV(econ, r=15%)	902,085														
Extra nut cost at a higher unit price ($0.13/nut)															
Net cashflows (fin, 18%)			1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 12%)				(680,224)	(244,990)	(1,367,240)	(993,861)	(569,768)	(569,768)	(609,768)	1,672,618	1,672,618	1,672,618	1,672,618	650,000
Net cashflows (econ, w/o fin)				(680,224)	(244,990)	(1,083,897)	(710,519)	(286,426)	(286,426)	(326,426)	1,672,618	1,672,618	1,672,618	1,672,618	650,000
IRR (fin, 18%), high nut price	0.07			(6,802,235)	(244,990)	567,971	941,350	1,365,442	1,365,442	1,325,442	1,672,618	1,672,618	1,672,618	1,672,618	650,000
IRR (fin, 12%), high nut price	0.12														
IRR (econ, w/o fin), high nut price	0.10														
NPV (fin, 18%, r=15%)	(1,086,111)														
NPV (fin,12%, r=15%)	(367,920)														
NPV(econ, r=15%)	(1,504,400)														

ANNEX u

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Solomon Islands (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78												
4. Electricity, $/kw-hr	0.18												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	15,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	17.18												

B. Equipment		
Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40,000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	232	2,793,025

ANNEX u

C. Buildings															
Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			279,303												
F. TOTAL CAPITAL COSTS			3,742,328	3,742,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			77,108												
Packaging materials for cream			660,800												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			201,952												
Transport of cream ($3600/FCL)			871,200												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			3,707,738		0	1,112,321	2,224,643	2,595,417	2,595,417	2,595,417	2,595,417	2,595,417	2,595,417	2,595,417	2,595,417
D. Fixed costs															
Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			7,935		0	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935
Administrative expenses			80,676		0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676
Night supervisor			4,294		0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294
Depreciation			316,803		0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803
Maintenance			187,116		0	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116
Other			185,387		0	185,387	185,387	185,387	185,387	185,387	185,387	185,387	185,387	185,387	185,387
Insurance			34,430		0	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430
Interest			606,257		0	0	606,257	606,257	606,257	606,257	606,257	0	0	0	0	0
Total			1,452,898		0	846,640	1,452,898	1,482,898	1,482,898	1,482,898	1,482,898	876,640	876,640	876,640	876,640	0
E. Total annual costs			5,160,636												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610		0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296
Low-fat coconut flakes	5,017		125,424		0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855
			184,034		0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

108 ANNEX u

110 G. Breakeven price of coconut cream	1.24												
111 Sales price	1.54												
113 Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
115 Net revenues before taxes		(3,742,328)	(74,232)	91,920	319,389	319,389	319,389	319,389	925,647	925,647	925,647	925,647	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(3,742,328)	(74,232)	91,920	319,389	319,389	319,389	319,389	925,647	925,647	925,647	925,647	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,368,095	3,368,095											
Repayment of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619	0	0	0	0	0
Exclusion of depreciation	316,803	0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(374,233)	242,571	(264,897)	(37,427)	(37,427)	(37,427)	(77,427)	1,242,449	1,242,449	1,242,449	1,242,449	325,000
Cumulative net cashflows (fin, 18% interest rate)		(374,233)	(131,662)	(396,559)	(433,986)	(471,413)	(508,839)	(585,266)	656,183	1,898,632	3,141,081	4,383,530	4,708,530
Interest at 12%	404,171	0	0	404,171	404,171	404,171	404,171	404,171	0	0	0	0	0
Net cashflows (fin, 12% interest)		(374,233)	242,571	(62,811)	164,659	164,659	164,659	124,659	1,242,449	1,242,449	1,242,449	1,242,449	325,000
Cumulative net cashflows (fin, 12% int)		(374,233)	(131,662)	(194,473)	(29,814)	134,845	299,503	424,162	1,666,611	2,909,060	4,151,509	5,393,958	5,718,958
Adjustments for economic analysis													
Exclusion of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619					
Exclusion of interest	404,171	0	0	404,171	404,171	404,171	404,171	404,171					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	3,368,095	3,368,095											
Net cashflows (econ, w/o financing)		(3,742,328)	242,571	1,014,979	1,242,449	1,242,449	1,242,449	1,202,449	1,242,449	1,242,449	1,242,449	1,242,449	325,000
Cumulative net cashflows (econ, w/o financing)		(3,742,328)	(3,499,757)	(2,484,777)	(1,242,328)	121	1,242,570	2,445,019	3,687,468	4,929,917	6,172,366	7,414,815	7,739,815

IRR (financial, 18% interest)	0.37
IRR (financial, 12% interest)	0.54
IRR (economic, w/o financing)	0.23
NPV(fin, 18%, r=15%)	992,785
NPV(fin, 12%,r=15%)	1,505,014
NPV(econ, r=15%)	1,308,123

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(374,233)	90,028	(569,981)	(393,359)	(503,165)	(503,165)	(543,165)	776,711	776,711	776,711	776,711	325,000
Net cashflows (fin, 12%)		(374,233)	90,028	(367,896)	(191,273)	(301,079)	(301,079)	(341,079)	776,711	776,711	776,711	776,711	325,000
Net cashflows (econ, w/o fin)		(3,742,328)	90,028	709,895	886,517	776,711	776,711	736,711	776,711	776,711	776,711	776,711	325,000

IRR (fin, 18%), high nut price	0.04
IRR (fin, 12%), high nut price	0.12
IRR (econ, w/o fin), high nut price	0.13
NPV(fin, 18%, r=15%)	(634,529)
NPV(fin, 12%,r=15%)	(122,300)
NPV(econ, r=15%)	(319,191)

ANNEX v

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Solomon Islands (d. tetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78												
4. Electricity, $/kw-hr	0.18												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--50% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	17.18												

B. Equipment			
Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		550000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
Aseptic filling system (tetrapak	2		635,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	231		3,503,025

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ANNEX V

C. Buildings

Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			350,303												
F. TOTAL CAPITAL COSTS			4,523,328	4,523,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			76,776												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			201,952												
Transport of cream ($3600/FCL)			871,200												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,285,606	0	1,585,982	3,171,963	3,700,624	3,700,624	3,700,624	3,700,624	3,700,624	3,700,624	3,700,624	3,700,624	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			7,935	0	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935	7,935	
Administrative expenses			80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	
Night supervisor			4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	
Depreciation			387,803	0	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	
Maintenance			226,166	0	226,166	226,166	226,166	226,166	226,166	226,166	226,166	226,166	226,166	226,166	
Other			264,330	0	264,330	264,330	264,330	264,330	264,330	264,330	264,330	264,330	264,330	264,330	
Insurance			41,530	0	41,530	41,530	41,530	41,530	41,530	41,530	41,530	41,530	41,530	41,530	
Interest			732,779	0	0	732,779	732,779	732,779	732,779	732,779	0	0	0	0	0
Total			1,775,513	0	1,042,734	1,775,513	1,805,513	1,805,513	1,805,513	1,805,513	1,072,734	1,072,734	1,072,734	1,072,734	0
E. Total annual costs			7,062,119												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX v

G. Breakeven price of coconut cream	1.72												
Sales price	1.98												
Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,523,328)	(221,265)	(132,576)	111,247	111,247	111,247	111,247	844,026	844,026	844,026	844,026	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(4,523,328)	(221,265)	(132,576)	111,247	111,247	111,247	111,247	844,026	844,026	844,026	844,026	0
Other adjustments to cashflows (fin)													
Loan proceeds	4,070,995	4,070,995											
Repayment of principal	814,199	0	0	814,199	814,199	814,199	814,199	814,199	0	0	0	0	0
Exclusion of depreciation	387,803	0	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	387,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(452,333)	166,537	(558,973)	(315,150)	(315,150)	(315,150)	(355,150)	1,231,828	1,231,828	1,231,828	1,231,828	325,000
Cumulative net cashflows (fin, 18% interest rate)		(452,333)	(285,796)	(844,768)	(1,159,918)	(1,475,068)	(1,790,217)	(2,145,367)	(913,539)	318,290	1,550,118	2,781,946	3,106,946
Interest at 12%	488,519	0	0	488,519	488,519	488,519	488,519	488,519	0	0	0	0	0
Net cashflows (fin, 12% interest)		(452,333)	166,537	(314,713)	(70,890)	(70,890)	(70,890)	(110,890)	1,231,828	1,231,828	1,231,828	1,231,828	325,000
Cumulative net cashflows (fin, 12% int)		(452,333)	(285,796)	(600,509)	(671,399)	(742,289)	(813,179)	(924,069)	307,760	1,539,588	2,771,416	4,003,245	4,328,245
Adjustments for economic analysis													
Exclusion of principal	814,199	0	0	814,199	814,199	814,199	814,199	814,199					
Exclusion of interest	488,519	0	0	488,519	488,519	488,519	488,519	488,519					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	4,070,995	4,070,995											
Net cashflows (econ, w/o financing)		(4,523,328)	166,537	988,005	1,231,828	1,231,828	1,231,828	1,191,828	1,231,828	1,231,828	1,231,828	1,231,828	325,000
Cumulative net cashflows (econ, w/o financing)		(4,523,328)	(4,356,790)	(3,368,785)	(2,136,957)	(905,128)	326,700	1,518,528	2,750,357	3,982,185	5,214,013	6,445,841	6,770,841

IRR (financial, 18% interest)	0.17
IRR (financial, 12% interest)	0.29
IRR (economic, w/o financing)	0.18
NPV(fin, 18%, r=15%)	141,281
NPV(fin, 12%,r=15%)	760,409
NPV(econ, r=15%)	522,428

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(452,333)	13,995	(864,057)	(671,082)	(780,888)	(780,888)	(820,888)	766,090	766,090	766,090	766,090	325,000
Net cashflows (fin, 12%)		(452,333)	13,995	(619,798)	(426,822)	(536,628)	(536,628)	(576,628)	766,090	766,090	766,090	766,090	325,000
Net cashflows (econ, w/o fin)		(4,523,328)	13,995	682,921	875,896	766,090	766,090	726,090	766,090	766,090	766,090	766,090	325,000

IRR (fin, 18%), high nut price	(0.05)
IRR (fin, 12%), high nut price	0.01
IRR (econ, w/o fin), high nut price	0.08
NPV(fin, 18%, r=15%)	(1,486,033)
NPV(fin, 12%,r=15%)	(866,905)
NPV(econ, r=15%)	(1,104,886)

ANNEX w

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Solomon Islands (double shift, canned)
2-10-89

	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
A. Assumptions													
1. Product with fat content of 22.5%.		0.10											
2. Price of dehusked nuts, $/nut		3.78											
3. Unskilled wage, $/day(w/fringe benefits, leave)		0.18											
4. Electricity, $/kw-hr		250.00											
5. Building cost, $/sq.m.		0.24											
6. Yield of cream, liters/nut		0.18											
7. Interest rates, %		0.13											
8. Selling price of parings, $/kg		0.10											
9. Selling price of low-fat flakes, $/kg		0.05											
11. Maintenance costs		67,797											
12. Raw material requirement, nuts per day (two shifts)		750.00											
13. Shelling rate, nuts/day		750.00											
14. Paring rate, nuts/day		250.00											
15. Working days per year		0.23											
16. Packaging materials, 340 ml lithographed cans		16,000.00											
17. Daily production, liters/day (two shifts)		0.05											
18. Depreciation of building		0.10											
19. Depreciation of machinery		0.2											
20. Depreciation of vehicle		0.03											
21. Insurance, % of equipment and buildings cost		0.90											
22. Fraction of capital investment loaned													
23. Capacity use (Yr 1--60% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)		19.67											
B. Equipment													
Nut opening	14 hp	35,500											
Washing and inspection area	10	34,650											
Grinding/blanching/pressing	64	238,000											
Flakes dryer	50	420000											
Screening and packing area	10	42000											
Pasteurizing	5	240,000											
FDA Standard extra	0	36,000											
Aseptic processing plant	5	504,000											
Aseptic canning system	2	466667											
Can chillers	15	100000											
Buffing, drying equipment	5	50000											
Homogenizer	30	105,000											
Aseptic tank	1	140,000											
StarAsept lease rights	2	55,000											
Lab equipment	2	50000											
Dryer for parings	25	140,000											
Generator		46,875											
Boiler	5	210,000											
Office equipment	2	40,000											
Truck scale	0	40,000											
Payloader		150000											
Land transport vehicle		50,000											
Water treatment plant	5	70,000											
Waste disposal system		100000											
CIP	1	43,000											

ANNEX w

C. Buildings

Nut storage	260		
Nut preparation area	725		
Sanitary line	150		
Drying for parings	200		
Drying for flakes	390		
Administrative	125		
Powerhouse	125		
Warehouse	250		
Warehouse for dry flakes	375		
	2.600	650.000	
D. Start-up costs, legal fees		20.000	
E. Installation		340.969	
F. TOTAL CAPITAL COSTS		4.420.661	4.420.661

C. Variable Costs

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Coconuts	1.694.915												
Electricity	84.087												
Packaging materials for cream	2.705.882												
Packaging for flakes	100.339												
Packaging for parings	10.576												
Other supplies and materials	20.000												
Stabilizers, disinfectants, etc	20.000												
Unskilled labor	201.952												
Transport of cream ($3600/FCL)	871.200												
Transport of parings	13.220												
Transport of flakes	37.627												
Total variable costs	5.759.800	0	1.727.940	3.455.880	4.031.860	4.031.860	4.031.860	4.031.860	4.031.860	4.031.860	4.031.860	4.031.860	

D. Fixed costs

Land rent	30.000	0	30.000	30.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	
Indirect labor	7.935	0	7.935	7.935	7.935	7.935	7.935	7.935	7.935	7.935	7.935	7.935	
Administrative expenses	84.420	0	84.420	84.420	84.420	84.420	84.420	84.420	84.420	84.420	84.420	84.420	
Night supervisor	4.918	0	4.918	4.918	4.918	4.918	4.918	4.918	4.918	4.918	4.918	4.918	
Depreciation	378.469	0	378.469	378.469	378.469	378.469	378.469	378.469	378.469	378.469	378.469	378.469	
Maintenance	221.033	0	221.033	221.033	221.033	221.033	221.033	221.033	221.033	221.033	221.033	221.033	
Other	287.990	0	287.990	287.990	287.990	287.990	287.990	287.990	287.990	287.990	287.990	287.990	
Insurance	40.597	0	40.597	40.597	40.597	40.597	40.597	40.597	40.597	40.597	40.597	40.597	
Interest	716.147	0	0	716.147	716.147	716.147	716.147	716.147	0	0	0	0	0
Total	1.771.509	0	1.055.362	1.771.509	1.801.509	1.801.509	1.801.509	1.801.509	1.085.362	1.085.362	1.085.362	1.085.362	0

ANNEX w

E. Total annual costs			7,531,309											
F. Sales of byproducts														
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0
G. Breakeven price of coconut cream			1.84											
Sales price			1.98											
Revenues from product (w/ 1% wastage)			7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes				(4,420,661)	(375,852)	(412,489)	(215,985)	(215,985)	(215,985)	(215,985)	500,162	500,162	500,162	500,162	0
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes				(4,420,661)	(375,852)	(412,489)	(215,985)	(215,985)	(215,985)	(215,985)	500,162	500,162	500,162	500,162	0
Other adjustments to cashflows (fin)															
Loan proceeds			3,978,595	3,978,595											
Repayment of principal			795,719	0	0	795,719	795,719	795,719	795,719	795,719	0	0	0	0	0
Exclusion of depreciation			378,469	0	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	378,469	
Replacement costs (vehicle)			40,000							40,000					
Salvage value			325,000												325,000
Net cashflows (financial, 18% interest rate)				(442,066)	2,618	(829,738)	(633,235)	(633,235)	(633,235)	(673,235)	878,631	878,631	878,631	878,631	325,000
Cumulative net cashflows (fin, 18% interest rate)				(442,066)	(439,449)	(1,269,187)	(1,902,422)	(2,535,657)	(3,168,892)	(3,842,127)	(2,963,496)	(2,084,865)	(1,206,234)	(327,603)	(2,603)
Interest at 12%			477,431	0	0	477,431	477,431	477,431	477,431	477,431	0	0	0	0	0
Net cashflows (fin, 12% interest)				(442,066)	2,618	(591,023)	(394,519)	(394,519)	(394,519)	(434,519)	878,631	878,631	878,631	878,631	325,000
Cumulative net cashflows (fin, 12% int)				(442,066)	(439,449)	(1,030,471)	(1,424,991)	(1,819,510)	(2,214,030)	(2,648,549)	(1,769,918)	(891,287)	(12,656)	865,975	1,190,975
Adjustments for economic analysis															
Exclusion of principal			795,719	0	0	795,719	795,719	795,719	795,719	795,719					
Exclusion of interest			477,431	0	0	477,431	477,431	477,431	477,431	477,431					
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds			3,978,595	3,978,595											
Net cashflows (econ, w/o financing)				(4,420,661)	2,618	682,128	878,631	878,631	878,631	838,631	878,631	878,631	878,631	878,631	325,000
Cumulative net cashflows (econ, w/o financing)				(4,420,661)	(4,418,044)	(3,735,916)	(2,857,285)	(1,978,654)	(1,100,023)	(261,392)	617,239	1,495,870	2,374,501	3,253,132	3,578,132
IRR (financial, 18% interest)			(0.00)												
IRR (financial, 12% interest)			0.07												
IRR (economic, w/o financing)			0.10												
NPV(fin, 18%, r=15%)			(1,127,963)												
NPV(fin, 12%,r=15%)			(522,888)												
NPV(econ, r=15%)			(755,467)												
Extra nut cost at a higher unit price ($0.13/nut)			508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)				(442,066)	(149,925)	(1,134,823)	(989,167)	(1,098,973)	(1,098,973)	(1,138,973)	412,893	412,893	412,893	412,893	325,000
Net cashflows (fin, 12%)				(442,066)	(149,925)	(896,108)	(750,452)	(860,257)	(860,257)	(900,257)	412,893	412,893	412,893	412,893	325,000
Net cashflows (econ, w/o fin)				(4,420,661)	(149,925)	377,043	522,699	412,893	412,893	372,893	412,893	412,893	412,893	412,893	325,000
IRR (fin, 18%), high nut price			(0.20)												
IRR (fin, 12%), high nut price			(0.16)												
IRR (econ, w/o fin), high nut price			(0.02)												
NPV(fin, 18%, r=15%)			(2,755,277)												
NPV(fin, 12%,r=15%)			(2,150,202)												
NPV(econ, r=15%)			(2,382,782)												

ANNEX x

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Solomon Islands (double shift, starAsept)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169,492
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Drying area	100	560,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	270	4,038,850

ANNEX x

C. Buildings

Nut storage	520														
Nut preparation area	1450														
Sanitary line	300														
Drying for parings	400														
Drying for flakes	780														
Administrative	250														
Powerhouse	250														
Warehouse	500														
Warehouse for dry flakes	750														
	5,200	1,300,000													
D. Start-up costs, legal fees		20000													
E. Installation		403,885													
F. TOTAL CAPITAL COSTS		5,762,735	5,762,735												
VARIABLE COSTS															
Coconuts		4,237,288													
Electricity		89,736													
Packaging materials for cream		1,652,000													
Packaging materials for flakes		250,847													
Packaging for parings		26,441													
Transport of crear ($3600/FCL)		2,178,000													
Transport of flakes		94,066													
Transport of parings		33,051													
Other supplies and materials		50,000													
Stabilizers, disinfectants, etc		50,000													
Labor		475,125	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Total		9,136,559	0	2,740,967	5,481,933	6,395,590	6,395,590	6,395,590	6,395,590	6,395,590	6,395,590	6,395,590	6,395,590	
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Rent for starAsept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	
Indirect labor		11,336	0	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	
Night supervisor		4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	
Administrative expenses		80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	
Depreciation		473,885	0	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	
Maintenance		288,137	0	288,137	288,137	288,137	288,137	288,137	288,137	288,137	288,137	288,137	288,137	
Others		456,828	0	456,828	456,828	456,828	456,828	456,828	456,828	456,828	456,828	456,828	456,828	
Insurance		53,389	0	53,389	53,389	53,389	53,389	53,389	53,389	53,389	53,389	53,389	53,389	
Interest		864,894	0	0	864,894	864,894	864,894	864,894	864,894	0				
		2,312,637	0	1,447,743	2,312,637	2,312,637	2,312,637	2,312,637	2,312,637	1,447,743	1,447,743	1,447,743	1,447,743	0

ANNEX x

E. Total annual costs		11,449,195												
F. Sales of by products														
Dried paring	4,407 kg/day	146,525												
Low-fat coconut flakes	12,542	313,559												
		460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059	
G. Breakeven price of coconut cream		1.10												
Sales price		1.54												
Revenues from product (w/ 1% wastage)		15,246,000	0	4,573,800	9,147,600	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	10,672,200	0
Net revenues before taxes			(5,762,735)	523,115	1,629,079	2,286,032	2,286,032	2,286,032	2,286,032	3,150,926	3,150,926	3,150,926	3,150,926	0
Taxes and annual license fees		0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes			(5,762,735)	523,115	1,629,079	2,286,032	2,286,032	2,286,032	2,286,032	3,150,926	3,150,926	3,150,926	3,150,926	0
Other adjustments to cashflows (fin)														
Loan proceeds		5,186,462	5,186,462											
Repayment of principal		1,037,292	0	0	1,037,292	1,037,292	1,037,292	1,037,292	1,037,292	0	0	0	0	0
Exclusion of depreciation		473,885	0	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	473,885	
Replacement costs (vehicle)		40,000							40,000					
Salvage value		650,000												650,000
Net cashflows (financial, 18% interest rate)			(576,274)	997,000	1,065,672	1,722,625	1,722,625	1,722,625	1,682,625	3,624,811	3,624,811	3,624,811	3,624,811	650,000
Cumulative net cashflows (fin, 18% interest rate)			(576,274)	420,726	1,486,398	3,209,023	4,931,648	6,654,273	8,336,898	11,961,708	15,586,519	19,211,330	22,836,141	23,486,141
Interest at 12%		622,375	0	0	622,375	622,375	622,375	622,375	622,375	0	0	0	0	0
Net cashflows (fin, 12% interest)			(576,274)	997,000	1,308,190	1,965,143	1,965,143	1,965,143	1,925,143	3,624,811	3,624,811	3,624,811	3,624,811	650,000
Cumulative net cashflows (fin, 12% int)			(576,274)	420,726	1,728,917	3,694,060	5,659,203	7,624,346	9,549,489	13,174,300	16,799,111	20,423,921	24,048,732	24,698,732
Adjustments for economic analysis														
Exclusion of principal		1,037,292	0	0	1,037,292	1,037,292	1,037,292	1,037,292	1,037,292					
Exclusion of interest		622,375	0	0	427,466	427,466	427,466	427,466	427,466					
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds		5,186,462	5,186,462											
Net cashflows (econ, w/o financing)			(5,762,735)	997,000	2,772,949	3,429,901	3,429,901	3,429,901	3,389,901	3,624,811	3,624,811	3,624,811	3,624,811	650,000
Cumulative net cashflows (econ, w/o financing)			(5,762,735)	(4,765,735)	(1,992,786)	1,437,115	4,867,016	8,296,918	11,686,819	15,311,630	18,936,441	22,561,251	26,186,062	26,836,062
IRR (financial, 18% interest)	1.91													
IRR (financial, 12% interest)	2.04													
IRR (economic, w/o financing)	0.43													
NPV (fin, 18%, r=15%)	8,184,099													
NPV (fin,12%, r=15%)	8,798,813													
NPV(econ, r=15%)	8,001,585													
Extra nut cost at a higher unit price ($0.13/nut)		1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)			(576,274)	615,644	302,960	832,794	1,256,887	1,256,887	1,216,887	3,159,073	3,159,073	3,159,073	3,159,073	650,000
Net cashflows (fin, 12%)			(576,274)	615,644	545,479	1,075,313	1,499,405	1,499,405	1,459,405	3,159,073	3,159,073	3,159,073	3,159,073	650,000
Net cashflows (econ, w/o fin)			(5,762,735)	615,644	2,010,237	2,540,071	2,964,163	2,964,163	2,924,163	3,159,073	3,159,073	3,159,073	3,159,073	650,000
IRR (fin, 18%), high nut price	1.13													
IRR (fin, 12%), high nut price	1.27													
IRR (econ, w/o fin), high nut price	0.35													
NPV (fin, 18%, r=15%)	5,777,614													
NPV (fin,12%, r=15%)	6,392,328													
NPV(econ, r=15%)	5,595,100													

ANNEX y

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Solomon Islands (double shift, tetrapak)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%.	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169,492
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 250 ml tetrapak	0.14
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Drying area	100	560,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
Aseptic filler (tetrapak)	2	635,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Payloader		150000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	269	4,618,850

ANNEX y

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	300													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5,200	1,300,000												
D. Start-up costs, legal fees		20000												
E. Installation		461,885												
F. TOTAL CAPITAL COSTS		6,400,735	6,400,735											
VARIABLE COSTS														
Coconuts		4,237,288												
Electricity		89,405												
Packaging materials for cream		5,600,000												
Packaging materials for flakes		250,847												
Packaging for parings		26,441												
Transport of cream ($3600/FCL)		2,178,000												
Transport of flakes		94,068												
Transport of parings		33,051												
Other supplies and materials		50,000												
Stabilizers, disinfectants, etc		50,000												
Labor		475,125	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Total		13,084,225	0	3,925,268	7,850,535	9,158,958	9,158,958	9,158,958	9,158,958	9,158,958	9,158,958	9,158,958	9,158,958	
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor		11,336	0	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	
Night supervisor		4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	
Administrative expenses		80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	
Depreciation		531,885	0	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	
Maintenance		320,037	0	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	320,037	
Others		654,211	0	654,211	654,211	654,211	654,211	654,211	654,211	654,211	654,211	654,211	654,211	
Insurance		59,189	0	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	59,189	
Interest		958,854	0	0	958,854	958,854	958,854	958,854	958,854	0				
		2,680,480	0	1,721,627	2,680,480	2,680,480	2,680,480	2,680,480	2,680,480	1,721,627	1,721,627	1,721,627	1,721,627	0

99 ANNEX y

100	E. Total annual costs			15,764,706														
101																		
102	F. Sales of by products																	
103																		
104	Dried paring	4.407	kg/day	146,525														
106	Low-fat coconut flakes	12,542		313,559														
107																		
108				460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059		
109																		
110	G. Breakeven price of coconut cream																	
111	Sales price			1.53														
112				1.98														
113	Revenues from product (w/ 1% wastage)																	
114				19,602,000	0	5,880,600	11,761,200	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400		
115	Net revenues before taxes																	
	Taxes and annual license fees				(6,400,735)	371,731	1,506,235	2,204,021	2,204,021	2,204,021	2,204,021	3,162,875	3,162,875	3,162,875	3,162,875			
	Net revenues after taxes			0	0	0	0	0	0	0	0	0	0	0	0			
					(6,400,735)	371,731	1,506,235	2,204,021	2,204,021	2,204,021	2,204,021	3,162,875	3,162,875	3,162,875	3,162,875			
	Other adjustments to cashflows (fin)																	
	Loan proceeds			5,760,662	5,760,662													
	Repayment of principal			1,152,132	0	0	1,152,132	1,152,132	1,152,132	1,152,132	1,152,132	0	0	0	0			
	Exclusion of depreciation			531,885	0	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885	531,885			
	Replacement costs (vehicle)			40,000							40,000							
	Salvage value			650,000														
	Net cashflows (financial, 18% interest rate)				(640,074)	903,616	885,938	1,583,774	1,583,774	1,583,774	1,543,774	3,694,760	3,694,760	3,694,760	3,694,760	650,000		
	Cumulative net cashflows (fin, 18% interest rate)				(640,074)	263,543	1,149,531	2,733,305	4,317,079	5,900,853	7,[illegible]27	11,133,387	14,834,147	18,528,907	22,223,667	650,000		
	Interest at 12%			691,279	0	0	691,279	691,279	691,279	691,279	691,279	0	0	0	0	22,873,667		
	Net cashflows (fin, 12% interest)				(640,074)	903,616	1,153,562	1,851,348	1,851,348	1,851,348	1,811,348	3,694,760	3,694,760	3,694,760	3,694,760	0		
	Cumulative net cashflows (fin, 12% int)				(640,074)	263,543	1,417,105	3,268,454	5,119,802	6,971,150	8,782,499	12,477,259	16,172,019	19,866,779	23,561,539	650,000		
	Adjustments for economic analysis																	
	Exclusion of principal			1,152,132	0	0	1,152,132	1,152,132	1,152,132	1,152,132	1,152,132					24,211,539		
	Exclusion of interest			691,279	0	0	427,466	427,466	427,466	427,466	427,466							
	Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0		
	Exclusion of loan proceeds			5,760,662	5,760,662													
	Net cashflows (econ, w/o financing)				(6,400,735)	903,616	2,733,161	3,430,947	3,430,947	3,430,947	3,390,947	3,694,760	3,694,760	3,694,760	3,694,760	650,000		
	Cumulative net cashflows (econ, w/o financing)				(6,400,735)	(5,497,119)	(2,763,958)	666,989	4,097,935	7,528,882	10,919,829	14,614,589	18,309,349	22,004,109	25,698,869	26,348,869		
	IRR (financial, 18% interest)		1.58															
	IRR (financial, 12% interest)		1.71															
	IRR (economic, w/o financing)		0.39															
	NPV (fin, 18%, r=15%)		7,754,291															
	NPV (fin,12%, r=15%)		8,432,514															
	NPV(econ r=15%)		7,427,068															
	Extra nut cost at a higher unit price ($0.13/nut)																	
	Net cashflows (fin, 18%)			1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738			
	Net cashflows (fin, 12%)				(640,074)	522,260	123,276	693,944	1,118,036	1,118,036	1,078,036	3,229,022	3,229,022	3,229,022	3,229,022	650,000		
	Net cashflows (econ, w/o fin)				(640,074)	522,260	390,851	961,518	1,385,610	1,385,610	1,345,610	3,229,022	3,229,022	3,229,022	3,229,022	650,000		
	IRR (fin, 18%), high nut price		0.90		(6,400,735)	522,260	1,970,449	2,541,116	2,965,209	2,965,209	2,925,209	3,229,022	3,229,022	3,229,022	3,229,022	650,000		
	IRR (fin, 12%), high nut price		1.04															
	IRR (econ, w/o fin), high nut price		0.31															
	NPV (fin, 18%, r=15%)		5,347,805															
	NPV (fin,12%, r=15%)		6,026,029															
	NPV(econ, r=15%)		5,020,583															

ANNEX z

COMPLETELY PROCESSED COCONUT CREAM (2500 LITERS/HR)
Solomon Islands (double shift, canned)
2-10-89

A. Assumptions

1. Product with fat content of 22.5%	
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of cream, liters/nut	0.24
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	169,492
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
16. Packaging materials, 340 ml lithographed cans	0.23
17. Daily production, liters/day (two shifts)	40,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Drying area	100	510,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,000
Aseptic tank	1	140,000
Can chillers	30	200,000
Buffing, drying equipment	5	100,000
Aseptic canning system	2	700,000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150,000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	304	4,983,850

ANNEX z

C. Buildings

Nut storage	520		
Nut preparation area	1450		
Sanitary line	300		
Drying for parings	400		
Drying for flakes	780		
Administrative	250		
Powerhouse	250		
Warehouse	500		
Warehouse for dry flakes	750		
	5,200	1,300,000	
D. Start-up costs, legal fees		20000	
E. Installation		498,385	
F. TOTAL CAPITAL COSTS		6,802,235	6,802,235

VARIABLE COSTS

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Coconuts	4,237,288												
Electricity	101,038												
Packaging materials for cream	6,764,706												
Packaging materials for flakes	250,847												
Packaging for parings	26,441												
Transport of cream ($3600/FCL)	2,178,000												
Transport of flakes	94,068												
Transport of parings	33,051												
Other supplies and materials	50,000												
Stabilizers, disinfectants, etc	50,000												
Labor	475,125												
Total	14,260,564	0	4,278,169	8,556,338	9,982,395	9,982,395	9,982,395	9,982,395	9,982,395	9,982,395	9,982,395	9,982,395	

FIXED COSTS

Land rent	60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor	11,336	0	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	
Night supervisor	4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	
Administrative expenses	80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	
Depreciation	568,385	0	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	
Maintenance	340,112	0	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	340,112	
Others	713,028	0	713,028	713,028	713,028	713,028	713,028	713,028	713,028	713,028	713,028	713,028	
Insurance	62,839	0	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	62,839	
Interest	1,017,984	0	0	1,017,984	1,017,984	1,017,984	1,017,984	1,017,984	0				
	2,858,652	0	1,840,669	2,858,652	2,858,652	2,858,652	2,858,652	2,858,652	1,840,669	1,840,669	1,840,669	1,840,669	0

ANNEX z

E. Total annual costs			17,119,216												
F. Sales of by products															
Dried paring	4.407	kg/day	146,525												
Low-fat coconut flakes	12.542		313,559												
			460,085	0	138,025	276,051	322,059	322,059	322,059	322,059	322,059	322,059	322,059	322,059	
G. Breakeven price of coconut cream			1.67												
Sales price			1.39												
Revenues from product (w/ 1% wastage)			19,602,000	0	5,880,600	11,761,200	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	13,721,400	0
Net revenues before taxes				(6,802,235)	(100,212)	622,260	1,202,412	1,202,412	1,202,412	1,202,412	2,220,396	2,220,396	2,220,396	2,220,396	0
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes				(6,802,235)	(100,212)	622,260	1,202,412	1,202,412	1,202,412	1,202,412	2,220,396	2,220,396	2,220,396	2,220,396	0
Other adjustments to cashflows (fin)															
Loan proceeds			6,122,012	6,122,012											
Repayment of principal			1,224,402	0	0	1,224,402	1,224,402	1,224,402	1,224,402	1,224,402	0	0	0	0	0
Exclusion of depreciation			568,385	0	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	568,385	
Replacement costs (vehicle)			40,000							40,000					
Salvage value			650,000												650,000
Net cashflows (financial, 18% interest rate)				(680,224)	468,173	(33,757)	546,395	546,395	546,395	506,395	2,788,781	2,788,781	2,788,781	2,788,781	650,000
Cumulative net cashflows (fin, 18% interest rate)				(680,224)	(212,051)	(245,808)	300,587	846,983	1,393,378	1,899,773	4,688,554	7,477,335	10,266,116	13,054,897	13,704,897
Interest at 12%			734,641	0	0	734,641	734,641	734,641	734,641	734,641	0	0	0	0	0
Net cashflows (fin, 12% interest)				(680,224)	468,173	249,585	829,737	829,737	829,737	789,737	2,788,781	2,788,781	2,788,781	2,788,781	650,000
Cumulative net cashflows (fin, 12% int)				(680,224)	(212,051)	37,535	867,272	1,697,010	2,526,747	3,316,484	6,105,266	8,894,047	11,682,828	14,471,609	15,121,609
Adjustments for economic analysis															
Exclusion of principal			1,224,402	0	0	1,224,402	1,224,402	1,224,402	1,224,402	1,224,402					
Exclusion of interest			734,641	0	0	427,466	427,466	427,466	427,466	427,466					
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds			6,122,012	6,122,012											
Net cashflows (econ, w/o financing)				(6,802,235)	468,173	1,901,454	2,481,606	2,481,606	2,481,606	2,441,606	2,788,781	2,788,781	2,788,781	2,788,781	650,000
Cumulative net cashflows (econ, w/o financing)				(6,802,235)	(6,334,062)	(4,432,609)	(1,951,003)	530,603	3,012,209	5,453,814	8,242,596	11,031,377	13,820,158	16,608,939	17,258,939
IRR (financial, 18% interest)	0.68														
IRR (financial, 12% interest)	0.83														
IRR (economic, w/o financing)	0.26														
NPV (fin, 18%, r=15%)	3,865,630														
NPV (fin,12%, r=15%)	4,583,821														
NPV(econ, r=15%)	3,447,341														
Extra nut cost at a higher unit price ($0.13/nut)			1,271,186	0	381,356	762,712	889,831	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)				(680,224)	86,817	(796,469)	(343,435)	80,657	80,657	40,657	2,323,043	2,323,043	2,323,043	2,323,043	650,000
Net cashflows (fin, 12%)				(680,224)	86,817	(513,127)	(60,093)	363,999	363,999	323,999	2,323,043	2,323,043	2,323,043	2,323,043	650,000
Net cashflows (econ, w/o fin)				(6,802,235)	86,817	1,138,742	1,591,775	2,015,868	2,015,868	1,975,868	2,323,043	2,323,043	2,323,043	2,323,043	650,000
IRR (fin, 18%), high nut price	0.28														
IRR (fin, 12%), high nut price	0.37														
IRR (econ, w/o fin), high nut price	0.18														
NPV (fin, 18%, r=15%)	1,459,145														
NPV (fin,12%, r=15%)	2,177,336														
NPV(econ, r=15%)	1,040,856														

ANNEX aa

VIRGIN OIL AND SKIM MILK PRODUCTION (HIGH CAPACITY)
Solomon Islands (double shift), Skim Milk Price $0.50/l
2-15-89

A. Assumptions

1. Production of virgin oil, kg/day	10,959
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of coconut skim milk, kg/nut	0.07
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	219,178
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
Packaging materials, 250 ml Tetrapak	0.14
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production of skimmed milk, kg/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18
Sale price of skimmed milk, $/250 ml Tetrapak	0.5

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Drying area	100	550,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
Virgin oil and skimmed milk plan	50	674800
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,600
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Tetrapak filling system	2	460000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	322	5,164,250

ANNEX aa

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	600													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5.500	1.375.000												
D. Start-up costs, legal fees		20000												
E. Installation		516,425												
F. TOTAL CAPITAL COSTS		7.075.675	7.075.675											
VARIABLE COSTS														
Coconuts		5.479.452												
Electricity		107.020												
Packaging materials for skimmed milk, Tetrapak		2.240.000												
Packaging materials for virgin oil, StarAsept		452.603												
Packaging materials for flakes		324.384												
Packaging for parings		34.192												
Transport of skimmed milk ($3600/FCL)		871.200												
Transport of virgin oil ($3600/FCL)		596.711												
Transport of flakes		121.644												
Transport of parings		42.740												
Other supplies and materials		50.000												
Stabilizers, disinfectants, etc		50.000												
Labor		609.732												
Total		10.979.678	0	3.293.903	6.587.807	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775
FIXED COSTS														
Land rent		60.000	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
Rent for starAsept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200
Indirect labor		11.336	0	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336
Night supervisor		4.294	0	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294
Administrative expenses		80.676	0	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676
Depreciation		590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175
Maintenance		353.784	0	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784
Others		548.984	0	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984
Insurance		65.393	0	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393
Interest		1.059.359	0	0	1.059.359	1.059.359	1.059.359	1.059.359	1.059.359	0				
		2.793.199	0	1.733.840	2.793.199	2.793.199	2.793.199	2.793.199	2.793.199	1.733.840	1.733.840	1.733.840	1.733.840	0
E. Total annual costs		13.772.877												

ANNEX aa

101															
102	F. Sales of byproducts														
103															
104	Dried paring	5.699	kg/day	189.475											
106	Low-fat coconut flakes	16.219		405.479											
108	Skimmed milk (w/ 1% wastage)	16.000		7.920.000											
	Subtotal			8.514.959	0	2.554.489	5.108.975	5.960.471	5.960.471	5.960.471	5.960.471	5.960.471	5.960.471	5.960.471	5.960.471	
109															
110	G. Breakeven price of virgin oil			1.92											
111	Sales price			1.87											
112															
113	Revenues from product (w/ 1% wastage)			5.072.055	0	1.521.616	3.043.233	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	0
114																
115	Net revenues before taxes				(7.075.675)	(951.640)	(1.228.797)	(968.064)	(968.064)	(968.064)	(968.064)	91.295	91.295	91.295	91.295	0
	Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
	Net revenues after taxes				(7.075.675)	(951.640)	(1.228.797)	(968.064)	(968.064)	(968.064)	(968.064)	91.295	91.295	91.295	91.295	0
	Other adjustments to cashflows (fin)															
	Loan proceeds			6.368.108	6.368.108											
	Repayment of principal			1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622	0	0	0	0	0
	Exclusion of depreciation			590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	
	Replacement costs (vehicle)			40.000							40.000					
	Salvage value			687.500												687.500
	Net cashflows (financial, 18% interest rate)				(707.568)	(361.465)	(1.912.244)	(1.651.510)	(1.651.510)	(1.651.510)	(1.691.510)	681.470	681.470	681.470	681.470	687.500
	Cumulative net cashflows (fin, 18% interest rate)				(707.568)	(1.069.032)	(2.981.276)	(4.632.786)	(6.284.297)	(7.935.807)	(9.627.318)	(8.945.848)	(8.264.379)	(7.582.909)	(6.901.439)	(6.213.939)
	Interest at 12%															
	Net cashflows (fin, 12% interest)			764.173	0	0	764.173	764.173	764.173	764.173	764.173	0	0	0	0	0
	Cumulative net cashflows (fin, 12% int)				(707.568)	(361.465)	(1.617.058)	(1.356.325)	(1.356.325)	(1.356.325)	(1.396.325)	681.470	681.470	681.470	681.470	687.500
					(707.568)	(1.069.032)	(2.686.090)	(4.042.415)	(5.398.740)	(6.755.065)	(8.151.390)	(7.469.920)	(6.788.451)	(6.106.981)	(5.425.511)	(4.738.011)
	Adjustments for economic analysis															
	Exclusion of principal			1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622					
	Exclusion of interest			764.173	0	0	427.466	427.466	427.466	427.466	427.466					
	Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
	Exclusion of loan proceeds			6.368.108	6.368.108											
	Net cashflows (econ, w/o financing)				(7.075.675)	(361.465)	84.029	344.763	344.763	344.763	304.763	681.470	681.470	681.470	681.470	687.500
	Cumulative net cashflows (econ, w/o financing)				(7.075.675)	(7.437.140)	(7.353.110)	(7.008.348)	(6.663.585)	(6.318.822)	(6.014.060)	(5.332.590)	(4.651.121)	(3.969.651)	(3.288.181)	(2.600.681)
	IRR (financial, 18% interest)	(0.18)														
	IRR (financial, 12% interest)	(0.15)														
	IRR (economic, w/o financing)	(0.05)														
	NPV (fin, 18%, r=15%)	(4.401.256)														
	NPV (fin,12%, r=15%)	(3.653.046)														
	NPV(econ, r=15%)	(4.878.766)														
	Extra nut cost at a higher unit price ($0.13/nut)			1.643.836	0	493.151	986.301	1.150.685	465.738	465.738	465.738	465.738	465.738	465.738	465.738	
	Net cashflows (fin, 18%)				(707.568)	(854.615)	(2.898.545)	(2.802.195)	(2.117.248)	(2.117.248)	(2.157.248)	215.732	215.732	215.732	215.732	687.500
	Net cashflows (fin, 12%)				(707.568)	(854.615)	(2.603.360)	(2.507.010)	(1.822.063)	(1.822.063)	(1.862.063)	215.732	215.732	215.732	215.732	687.500
	Net cashflows (econ, w/o fin)				(7.075.675)	(854.615)	(902.272)	(805.922)	(120.975)	(120.975)	(160.975)	215.732	215.732	215.732	215.732	687.500
	IRR (fin, 18%), high nut price	(0.30)														
	IRR (fin, 12%), high nut price	(0.29)														
	IRR (econ, w/o fin), high nut price	(0.19)														
	NPV (fin, 18%, r=15%)	(7.188.432)														
	NPV (fin,12%, r=15%)	(6.440.222)														
	NPV(econ, r=15%)	(7.665.942)														

ANNEX ab

VIRGIN OIL AND SKIM MILK PRODUCTION (HIGH CAPACITY)
Solomon Islands (double shift), skim milk price $0.55/l
2-15-89

A. Assumptions

1. Production of virgin oil, kg/day	10,959
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of coconut skim milk, kg/nut	0.07
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	219,178
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
Packaging materials, 250 ml Tetrapak	0.14
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production of skimmed milk, kg/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18
Sale price of skimmed milk, $/250 ml Tetrapak	0.55

B. Equipment

Nut opening	21 np	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Flakes dryer	100	550,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
Virgin oil and skimmed milk plan	50	674800
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,600
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Tetrapak filling system	2	460000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	322	5,164,250

ANNEX ab

53	C. Buildings													
54														
55	Nut storage	520												
56	Nut preparation area	1450												
57	Sanitary line	600												
58	Drying for parings	400												
59	Drying for flakes	780												
61	Administrative	250												
62	Powerhouse	250												
63	Warehouse	500												
64	Warehouse for dry flakes	750												

65		5.500	1.375.000											
66														
	D. Start-up costs, legal fees		20000											
68														
69	E. Installation		516.425											
70														
71	F. TOTAL CAPITAL COSTS		7.075.675	7.075.675										
72														
73														
74	VARIABLE COSTS													
75														
76	Coconuts		5.479.452											
77	Electricity		107.020											
	Packaging materials for skimmed milk, Tetrapak		2.240.000											
78	Packaging materials for virgin oil, StarAsept		452.603											
	Packaging materials for flakes		324.384											
	Packaging for parings		34.192											
	Transport of skimmed milk ($3600/FCL)		871.200											
	Transport of virgin oil ($3600/FCL)		596.712											
	Transport of flakes		121.644											
	Transport of parings		42.740											
79	Other supplies and materials		50.000											
80	Stabilizers, disinfectants, etc		50.000											
81	Labor		609.732											
82														
83	Total		10.979.678	0	3.293.903	6.587.807	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775
84														
85	FIXED COSTS													
86														
87	Land rent		60.000	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
	Rent for starAsept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200
89	Indirect labor		11.336	0	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336
	Night supervisor		4.294	0	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294
90	Administrative expenses		80.676	0	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676
91	Depreciation		590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175
92	Maintenance		353.784	0	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784
93	Others		548.984	0	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984
94	Insurance		65.393	0	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393
95	Interest		1.059.359	0	0	1.059.359	1.059.359	1.059.359	1.059.359	1.059.359	0			
96														
97			---											
98			2.793.199	0	1.733.840	2.793.199	2.793.199	2.793.199	2.793.199	2.793.199	1.733.840	1.733.840	1.733.840	1.733.840	0
99														
100	E. Total annual costs		13.772.877											
101														

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ANNEX ab

F. Sales of byproducts

Dried paring	5.699 kg/day	189.479												
Low-fat coconut flakes	16.219	405.479												
Skimmed milk (w/ 1% wastage)	16.000	8.712.000												
Subtotal		9.306.959	0	2.792.088	5.584.175	6.514.871	6.514.871	6.514.871	6.514.871	6.514.871	6.514.871	6.514.871	6.514.871	
G. Breakeven price of virgin oil		1.63												
Sales price		1.87												
Revenues from product (w/ 1% wastage)		5.072.055	0	1.521.616	3.043.233	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	0
Net revenues before taxes			(7.075.675)	(714.040)	(753.597)	(413.664)	(413.664)	(413.664)	(413.664)	645.695	645.695	645.695	645.695	0
Taxes and annual license fees		0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes			(7.075.675)	(714.040)	(753.597)	(413.664)	(413.664)	(413.664)	(413.664)	645.695	645.695	645.695	645.695	0
Other adjustments to cashflows (fin)														
Loan proceeds		6.368.108	6.368.108											
Repayment of principal		1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622	0	0	0	0	0
Exclusion of depreciation		590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	
Replacement costs (vehicle)		40.000							40.000					
Salvage value		687.500												
Net cashflows (financial, 18% interest rate)			(707.568)	(123.865)	(1.437.044)	(1.097.110)	(1.097.110)	(1.097.110)	(1.137.110)	1.235.870	1.235.870	1.235.870	1.235.870	687.500
Cumulative net cashflows (fin, 18% interest rate)			(707.568)	(831.432)	(2.268.476)	(3.365.586)	(4.462.697)	(5.559.807)	(6.696.918)	(5.461.048)	(4.225.179)	(2.989.309)	(1.753.439)	687.500 (1.065.939)
Interest at 12%		764.173	0	0	764.173	764.173	764.173	764.173	764.173	0	0	0	0	0
Net cashflows (fin, 12% interest)			(707.568)	(123.865)	(1.141.858)	(801.925)	(801.925)	(801.925)	(841.925)	1.235.870	1.235.870	1.235.870	1.235.870	687.500
Cumulative net cashflows (fin, 12% int)			(707.568)	(831.432)	(1.973.290)	(2.775.215)	(3.577.140)	(4.379.065)	(5.220.990)	(3.985.120)	(2.749.251)	(1.513.381)	(277.511)	409.989
Adjustments for economic analysis														
Exclusion of principal		1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622					
Exclusion of interest		764.173	0	0	427.466	427.466	427.466	427.466	427.466					
Exclusion of taxes		0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds		6.368.108	6.368.108											
Net cashflows (econ, w/o financing)			(7.075.675)	(123.865)	559.229	899.163	899.163	899.163	859.163	1.235.870	1.235.870	1.235.870	1.235.870	687.500
Cumulative net cashflows (econ, w/o financing)			(7.075.675)	(7.199.540)	(6.640.310)	(5.741.148)	(4.841.985)	(3.942.822)	(3.083.660)	(1.847 790)	(611.921)	623.949	1.859.819	2.547.319
IRR (financial, 18% interest)	(0.03)													
IRR (financial, 12% interest)	0.01													
IRR (economic, w/o financing)	0.05													
NPV (fin, 18%, r=15%)	(2.273.395)													
NPV (fin,12%, r=15%)	(1.525.185)													
NPV(econ, r=15%)	(2.750.904)													
Extra nut cost at a higher unit price ($0.13/nut)		1.643.836	0	493.151	986.301	1.150.685	465.738	465.738	465.738	465.738	465.738	465.738	465.738	
Net cashflows (fin, 18%)			(707.568)	(617.015)	(2.423.345)	(2.247.795)	(1.562.848)	(1.562.848)	(1.602.848)	770.132	770.132	770.132	770.132	687.500
Net cashflows (fin, 12%)			(707.568)	(617.015)	(2.128.160)	(1.952.610)	(1.267.663)	(1.267.663)	(1.307.663)	770.132	770.132	770.132	770.132	687.500
Net cashflows (econ, w/o fin)			(7.075.675)	(617.015)	(427.072)	(251.522)	433.425	433.425	393.425	770.132	770.132	770.132	770.132	687.500
IRR (fin, 18%), high nut price	(0.17)													
IRR (fin, 12%), high nut price	(0.15)													
IRR (econ, w/o fin), high nut price	(0.06)													
NPV (fin, 18%, r=15%)	(5.060.571)													
NPV (fin,12%, r=15%)	(4.312.361)													
NPV(econ, r=15%)	(5.538.081)													

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ANNEX ac

VIRGIN OIL AND SKIM MILK PRODUCTION (HIGH CAPACITY)
Solomon Islands (double shift).Skim milk price $0.60/l
2-15-89

A. Assumptions

1. Production of virgin oil, kg/day	10,959
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of coconut skim milk, kg/nut	0.07
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	219,178
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
Packaging materials, 250 ml Tetrapak	0.14
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production of skimmed milk, kg/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18
Sale price of skimmed milk, $/250 ml Tetrapak	0.6

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Flakes dryer	100	550,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
Virgin oil and skimmed milk plan	50	674800
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,600
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Tetrapak filling system	2	460000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIF	1	43,000
	327	5,164,250

ANNEX ac

C. Buildings

Nut storage	520													
Nut preparation area	1450													
Sanitary line	600													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5,500	1,375,000												
D. Start-up costs, legal fees		20000												
E. Installation		516,425												
F. TOTAL CAPITAL COSTS		7,075,675	7,075,675											
VARIABLE COSTS														
Coconuts		5,479,452												
Electricity		107,020												
Packaging materials for skimmed milk, Tetrapak		2,240,000												
Packaging materials for virgin oil, StarAsept		452,603												
Packaging materials for flakes		324,384												
Packaging for parings		34,192												
Transport of skimmed milk ($3600/FCL)		871,200												
Transport of virgin oil ($3600/FCL)		596,712												
Transport of flakes		121,644												
Transport of parings		42,740												
Other supplies and materials		50,000												
Stabilizers, disinfectants, etc		50,000												
Labor		609,732												
Total		10,979,678	0	3,293,902	6,587,807	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Rent for starAsept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	
Indirect labor		11,336	0	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	
Night supervisor		4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	
Administrative expenses		80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	
Depreciation		590,175	0	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	
Maintenance		353,784	0	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	
Others		548,984	0	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	
Insurance		65,393	0	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	
Interest		1,059,359	0	0	1,059,359	1,059,359	1,059,359	1,059,359	1,059,359	0				
		2,793,199	0	1,733,840	2,793,199	2,793,199	2,793,199	2,793,199	2,793,199	1,733,840	1,733,840	1,733,840	1,733,840	0
E. Total annual costs		13,772,877												

ANNEX ac

F. Sales of byproducts

Dried paring	5.699	kg/day
Low-fat coconut flakes	16.219	
Skimmed milk (w/ 1% wastage)	16.000	
Subtotal		

G. Breakeven price of virgin oil

Sales price	189.479												
	405.479												
	9.504.000												
	10.098.959	0	3.029.688	6.059.375	7.069.271	7.069.271	7.069.271	7.069.271	7.069 271	7.069.271	7.069.271	7.069.271	
	1.34												
	1.87												
Revenues from product (w/ 1% wastage)	5.072.055	0	1.521.616	3.043.233	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	0
Net revenues before taxes		(7.075.675)	(476.440)	(278.397)	140.736	140.736	140.736	140.736	1.200.095	1.200.095	1.200.095	1.200.095	(
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	(
Net revenues after taxes		(7.075.675)	(476.440)	(278.397)	140.736	140.736	140.736	140.736	1.200.095	1.200.095	1.200.095	1.200.095	(
Other adjustments to cashflows (fin)													
Loan proceeds	6.368.108	6.368.108											
Repayment of principal	1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622	0	0	0	0	0
Exclusion of depreciation	590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	
Replacement costs (vehicle)	40.000							40.000					
Salvage value	687.500												687.500
Net cashflows (financial, 18% interest rate)		(707.568)	113.735	(961.844)	(542.710)	(542.710)	(542.710)	(582.710)	1.790.270	1.790.270	1.790.270	1.790.270	687.500
Cumulative net cashflows (fin, 18% interest rate)		(707.568)	(593.832)	(1.555.676)	(2.098.386)	(2.641.097)	(3.183.807)	(3.766.518)	(1.976.248)	(185.979)	1.604.291	3.394.561	4.082.061
Interest at 12%	764.173	0	0	764.173	764.173	764.173	764.173	764.173	0	0	0	0	0
Net cashflows (fin, 12% interest)		(707.568)	113.735	(666.658)	(247.525)	(247.525)	(247.525)	(287.525)	1.790.270	1.790.270	1.790.270	1.790.270	687.500
Cumulative net cashflows (fin, 12% int)		(707.568)	(593.832)	(1.260.490)	(1.508.015)	(1.755.540)	(2.003.065)	(2.290.590)	(500.320)	1.289.949	3.080.219	4.870.489	5.557.989
Adjustments for economic analysis													
Exclusion of principal	1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622					
Exclusion of interest	764.173	0	0	427.466	427.466	427.466	427.466	427.466					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds	6.368.108	6.368.108											
Net cashflows (econ, w/o financing)		(7.075.675)	113.735	1.034.429	1.453.563	1.453.563	1.453.563	1.413.563	1.790.270	1.790.270	1.790.270	1.790.270	687.500
Cumulative net cashflows (econ, w/o financing)		(7.075.675)	(6.961.940)	(5.927.510)	(4.473.948)	(3.020.385)	(1.566.822)	(153.260)	1.637.010	3.427.279	5.217.549	7.007.819	7.695.319

IRR (financial, 18% interest)	0.14
IRR (financial, 12% interest)	0.21
IRR (economic, w/o financing)	0.13
NPV (fin, 18%, r=15%)	(145.533)
NPV (fin,12%, r=15%)	602.677
NPV(econ, r=15%)	(623.043)

Extra nut cost at a higher unit price ($C 13/nut)

Net cashflows (fin, 18%)	1.643.836	0	493.151	986.301	1.150.685	465.738	465.738	465.738	465.738	465.738	465.738	465.738	
Net cashflows (fin, 12%)		(707.568)	(379.415)	(1.948.145)	(1.693.395)	(1.008.448)	(1.008.448)	(1.048.448)	1.324.532	1.324.532	1.324.532	1.324.532	687.500
Net cashflows (econ, w/o fin)		(707.568)	(379.415)	(1.652.960)	(1.398.210)	(713.263)	(713.263)	(753.263)	1.324.532	1.324.532	1.324.532	1.324.532	687.500
		(7.075.675)	(379.415)	48.128	302.878	987.825	987.825	947.825	1.374.532	1.324.532	1.324.532	1.324.532	687.500

IRR (fin, 18%), high nut price	(0.05)
IRR (fin, 12%), high nut price	(0.01)
IRR (econ, w/o fin), high nut price	0.03
NPV (fin, 18%, r=15%)	(2.932.710)
NPV (fin,12%, r=15%)	(2.184.500)
NPV(econ, r=15%)	(3.410.220)

ANNEX ad

VIRGIN OIL AND SKIM MILK PRODUCTION (HIGH CAPACITY)
Solomon islands (double shift),skim milk price $0.65/l
2-15-89

A. Assumptions

1. Production of virgin oil, kg/day	10,959
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of coconut skim milk, kg/nut	0.07
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	219,178
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
Packaging materials, 250 ml Tetrapak	0.14
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production of skimmed milk, kg/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	17.18
Sale price of skimmed milk, $/250 ml Tetrapak	0.65

B. Equipment

Nut opening	21	hp	77,000
Washing and inspection	15		69,300
Grinding/blanching/pressing	96		476,000
Flakes dryer	100		550,000
Screening and packing	10		84,000
Pasteurizing	5		231,000
Virgin oil and skimmed milk plan	50		674800
FDA Standard extra	0		58,800
Aseptic processing plant	5		534,000
Homogenizer	60		117,600
Aseptic tank	1		140,000
StarAsept lease rights	3		55,000
Tetrapak filling system	2		460000
Lab equipment	2		50,000
Dryer for parings	50		280,000
Generator			93,750
Boiler	5		420,000
Office equipment	2		40,000
Truck scale	0		40,000
Land transport vehicle			50,000
Payloader			150000
Water treatment plant	5		70,000
Waste disposal system			400,000
CIP	1		43,000
	322		5,164,250

ANNEX ad

C. Buildings														
Nut storage	520													
Nut preparation area	1450													
Sanitary line	600													
Drying for parings	400													
Drying for flakes	780													
Administrative	250													
Powerhouse	250													
Warehouse	500													
Warehouse for dry flakes	750													
	5,500	1,375,000												
D. Start-up costs, legal fees		20000												
E. Installation		516,425												
F. TOTAL CAPITAL COSTS		7,075,675	7,075,675											
VARIABLE COSTS														
Coconuts		5,479,452												
Electricity		107,020												
Packaging materials for skimmed milk, Tetrapak		2,240,000												
Packaging materials for virgin oil, StarAsept		452,603												
Packaging materials for flakes		324,384												
Packaging for parings		34,192												
Transport of skimmed milk ($3600/FCL)		871,200												
Transport of virgin oil ($3600/FCL)		596,712												
Transport of flakes		121,644												
Transport of parings		42,740												
Other supplies and materials		50,000												
Stabilizers, disinfectants, etc		50,000												
Labor		609,732												
Total		10,979,678	0	3,293,903	6,587,807	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775	7,685,775
FIXED COSTS														
Land rent		60,000	0	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Rent for starAsept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200
Indirect labor		11,336	0	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336	11,336
Night supervisor		4,294	0	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294	4,294
Administrative expenses		80,676	0	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676	80,676
Depreciation		590,175	0	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175
Maintenance		353,784	0	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784	353,784
Others		548,984	0	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984	548,984
Insurance		65,393	0	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393	65,393
Interest		1,059,359	0	0	1,059,359	1,059,359	1,059,359	1,059,359	1,059,359	0				
		2,793,199	0	1,733,840	2,793,199	2,793,199	2,793,199	2,793,199	2,793,199	1,733,840	1,733,840	1,733,840	1,733,840	0
E. Total annual costs		13,772,877												

ANNEX ad

F. Sales of byproducts

Dried paring	5.699	kg/day	189,479												
Low-fat coconut flakes	16.219		405,479												
Skimmed milk (w/ 1% wastage)	16.000		10,296,000												
Subtotal			10,890,959	0	3,267,288	6,534,575	7,623,671	7,623,671	7,623,671	7,623,671	7,623,671	7,623,671	7,623,671	7,623,671	
G. Breakeven price of virgin oil			1.05												
Sales price			1.87												
Revenues from product (w/ 1% wastage)			5,072,055	0	1,521,616	3,043,233	3,550,438	3,550,438	3,550,438	3,550,438	3,550,438	3,550,438	3,550,438	3,550,438	0
Net revenues before taxes				(7,075,675)	(238,840)	196,803	695,136	695,136	695,136	695,136	1,754,495	1,754,495	1,754,495	1,754,495	0
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes				(7,075,675)	(238,840)	196,803	695,136	695,136	695,136	695,136	1,754,495	1,754,495	1,754,495	1,754,495	0
Other adjustments to cashflows (fin)															
Loan proceeds			6,368,108	6,368,108											
Repayment of principal			1,273,622	0	0	1,273,622	1,273,622	1,273,622	1,273,622	1,273,622	0	0	0	0	0
Exclusion of depreciation			590,175	0	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	590,175	
Replacement costs (vehicle)			40,000							40,000					
Salvage value			687,500												687,500
Net cashflows (financial, 18% interest rate)				(707,568)	351,335	(486,644)	11,690	11,690	11,690	(28,310)	2,344,670	2,344,670	2,344,670	2,344,670	687,500
Cumulative net cashflows (fin, 18% interest rate)				(707,568)	(356,232)	(842,876)	(831,186)	(819,497)	(807,807)	(836,118)	1,508,552	3,853,221	6,197,891	8,542,561	9,230,061
Interest at 12%			764,173	0	0	764,173	764,173	764,173	764,173	764,173	0	0	0	0	0
Net cashflows (fin, 12% interest)				(707,568)	351,335	(191,458)	306,875	306,875	306,875	266,875	2,344,670	2,344,670	2,344,670	2,344,670	687,500
Cumulative net cashflows (fin, 12% int)				(707,568)	(356,232)	(547,690)	(240,815)	66,060	372,935	639,810	2,984,480	5,329,149	7,673,819	10,018,489	10,705,989
Adjustments for economic analysis															
Exclusion of principal			1,273,622	0	0	1,273,622	1,273,622	1,273,622	1,273,622	1,273,622					
Exclusion of interest			764,173	0	0	427,466	427,466	427,466	427,466	427,466					
Exclusion of taxes			0	0	0	0	0	0	0	0					
Exclusion of loan proceeds			6,368,108	6,368,108							0	0	0	0	0
Net cashflows (econ, w/o financing)				(7,075,675)	351,335	1,509,629	2,007,963	2,007,963	2,007,963	1,967,963	2,344,670	2,344,670	2,344,670	2,344,670	687,500
Cumulative net cashflows (econ, w/o financing)				(7,075,675)	(6,724,340)	(5,214,710)	(3,206,748)	(1,198,785)	809,178	2,777,140	5,121,810	7,466,479	9,811,149	12,155,819	12,843,319
IRR (financial, 18% interest)	0.37														
IRR (financial, 12% interest)	0.50														
IRR (economic, w/o financing)	0.20														
NPV (fin, 18%, r=15%)	1,982,328														
NPV (fin,12%, r=15%)	2,730,538														
NPV(econ, r=15%)	1,504,818														
Extra nut cost at a higher unit price ($0.13/nut)			1,643,836	0	493,151	986,301	1,150,685	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)				(707,568)	(141,815)	(1,472,945)	(1,138,995)	(454,048)	(454,048)	(494,048)	1,878,932	1,878,932	1,878,932	1,878,932	687,500
Net cashflows (fin, 12%)				(707,568)	(141,815)	(1,177,760)	(843,810)	(158,863)	(158,863)	(198,863)	1,878,932	1,878,932	1,878,932	1,878,932	687,500
Net cashflows (econ, w/o fin)				(7,075,675)	(141,815)	523,328	857,278	1,542,225	1,542,225	1,502,225	1,878,932	1,878,932	1,878,932	1,878,932	687,500
IRR (fin, 18%), high nut price	0.09														
IRR (fin, 12%), high nut price	0.15														
IRR (econ, w/o fin), high nut price	0.11														
NPV (fin, 18%, r=15%)	(804,849)														
NPV (fin,12%, r=15%)	(56,638)														
NPV(econ, r=15%)	(1,282,358)														

ANNEX ae

VIRGIN OIL AND SKIM MILK PRODUCTION (HIGH CAPACITY)
Solomon Islands (double shift), skim milk price $0.70/l
2-15-89

A. Assumptions

1. Production of virgin oil, kg/day	10,959
2. Price of dehusked nuts, $/nut	0.10
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.78
4. Electricity, $/kw-hr	0.18
5. Building cost, $/sq.m.	250.00
6. Yield of coconut skim milk, kg/nut	0.07
7. Interest rates, %	0.18
8. Selling price of parings, $/kg	0.13
9. Selling price of low-fat flakes, $/kg	0.10
11. Maintenance costs	0.05
12. Raw material requirement, nuts per day (two shifts)	219,178
13. Shelling rate, nuts/day	750.00
14. Paring rate, nuts/day	750.00
15. Working days per year	250.00
Packaging materials, 250 ml Tetrapak	0.14
16. Packaging materials, 25 liter starAsept bags	4.13
17. Daily production of skimmed milk, kg/day (two shifts)	16,000.00
18. Depreciation of building	0.05
19. Depreciation of machinery	0.10
20. Depreciation of vehicle	0.2
21. Insurance	0.01
22. Fraction of capital investment loaned	0.90
23. Capacity use (yr 1--0% single shift; Yr. 2 --60% double shift, Yrs. 3 on --70% double shift)	
24. Skilled wage, $/day, (w/fringe benefits & leave)	.7.18
Sale price of skimmed milk, $/250 ml Tetrapak	0.7

B. Equipment

Nut opening	21 hp	77,000
Washing and inspection	15	69,300
Grinding/blanching/pressing	96	476,000
Flakes dryer	100	550,000
Screening and packing	10	84,000
Pasteurizing	5	231,000
Virgin oil and skimmed milk plan	50	674800
FDA Standard extra	0	58,800
Aseptic processing plant	5	534,000
Homogenizer	60	117,600
Aseptic tank	1	140,000
StarAsept lease rights	3	55,000
Tetrapak filling system	2	460000
Lab equipment	2	50,000
Dryer for parings	50	280,000
Generator		93,750
Boiler	5	420,000
Office equipment	2	40,000
Truck scale	0	40,000
Land transport vehicle		50,000
Payloader		150000
Water treatment plant	5	70,000
Waste disposal system		400,000
CIP	1	43,000
	322	5,164,250

ANNEX ae

53	C. Buildings													
54														
55	Nut storage	520												
56	Nut preparation area	1450												
57	Sanitary line	600												
58	Drying for parings	400												
59	Drying for flakes	780												
61	Administrative	250												
62	Powerhouse	250												
63	Warehouse	500												
64	Warehouse for dry flakes	750												

65		5.500	1.375.000											
66														
	D. Start-up costs, legal fees		20000											
68														
69	E. Installation		516.425											
70														
71	F. TOTAL CAPITAL COSTS		7.075.675	7.075.675										
72														
73														
74	VARIABLE COSTS													
75														
76	Coconuts		5.479.452											
77	Electricity		107.020											
	Packaging materials for skimmed milk, Tetrapak		2.240.000											
78	Packaging materials for virgin oil, Stasept		452.603											
	Packaging materials for flakes		324.384											
	Packaging for parings		34.192											
	Transport of skimmed milk ($3600/FCL)		871.200											
	Transport of virgin oil ($3600/FCL)		596.712											
	Transport of flakes		121.644											
	Transport of parings		42.740											
79	Other supplies and materials		50.000											
80	Stabilizers, disinfectants, etc		50.000											
81	Labor		609.732											
82														
83	Total		10.979.678	0	3.293.903	6.587.807	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775	7.685.775
84														
85	FIXED COSTS													
86														
87	Land rent		60.000	0	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000
	Rent for starksept filling system		19200	0	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200
89	Indirect labor		11.336	0	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336	11.336
	Night supervisor		4.294	0	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294	4.294
90	Administrative expenses		80.676	0	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676	80.676
91	Depreciation		590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175
92	Maintenance		353.784	0	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784	353.784
93	Others		548.984	0	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984	548.984
94	Insurance		65.393	0	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393	65.393
95	Interest		1.059.359	0	0	1.059.359	1.059.359	1.059.359	1.059.359	1.059.359	0			
96														
97			---											
98			2.793.199	0	1.733.840	2.793.199	2.793.199	2.793.199	2.793.199	2.793.199	1.733.840	1.733.840	1.733.840	1.733.840	0
99														
100	E. Total annual costs		13.772.877											
101														

ANNEX ae

F. Sales of byproducts

Dried paring	5.699	kg/day	189.479												
Low-fat coconut flakes	16.219		405.479												
Skimmed milk (w/1% wastage)	16.000		11.088.000												
Subtotal			11.682.959	0	3.504.888	7.009.775	8.178.071	8.178.071	8.178.071	8.178.071	8.178.071	8.178.071	8.178.071	8.178.071	
G. Breakeven price of virgin oil			0.76												
Sales price			1.87												
Revenues from product (w/ 1% wastage)			5.072.055	0	1.521.616	3.043.233	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	3.550.438	0
Net revenues before taxes				(7.075.675)	(1.240)	672.003	1.249.536	1.249.536	1.249.536	1.249.536	2.308 895	2.308.895	2.308.895	2.308.895	0
Taxes and annual license fees			0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes				(7.075.675)	(1.240)	672.003	1.249.536	1.249.536	1.249.536	1.249.536	2.308.895	2.308.895	2.308.895	2.308.895	0
Other adjustments to cashflows (fin)															
Loan proceeds			6.368.108	6.368.108											
Repayment of principal			1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622	0	0	0	0	0
Exclusion of depreciation			590.175	0	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	590.175	
Replacement costs (vehicle)			40.000							40.000					
Salvage value			687.500												687.500
Net cashflows (financial. 18% interest rate)				(707.568)	588.935	(11.444)	566.090	566.090	566.090	526.090	2.899.070	2.899.070	2.899.070	2.899.070	687.500
Cumulative net cashflows (fin. 18% interest rate)				(707.568)	(118.632)	(130.076)	436.014	1.002.103	1.568.193	2.094.282	4.993.352	7.892.421	10.791.491	13.690.561	14.378.061
Interest at 12%			764.173	0	0	764.173	764.173	764.173	764.173	764.173	0	0	0	0	0
Net cashflows (fin. 12% interest)				(707.568)	588.935	283.742	861.275	861.275	861.275	821.275	2.899.070	2.899.070	2.899.070	2.899.070	687.500
Cumulative net cashflows (fin. 12% int)				(707.568)	(118.632)	165.110	1.026.385	1.887.660	2.748.935	3.570.210	6.469.280	9.368.349	12.267.419	15.166.489	15.853.989
Adjustrents for economic analysis															
Exclusion of principal			1.273.622	0	0	1.273.622	1.273.622	1.273.622	1.273.622	1.273.622					
Exclusion of interest			764.173	0	0	427.466	427.466	427.466	427.466	427.466					
Exclusion of taxes			0	0	0	0	0	0	0	0	0	0	0	0	0
Exclusion of loan proceeds			6.368.108	6.368.108											
Net cashflows (econ. w/o financing)				(7.075.675)	588.935	1.984.829	2.562.363	2.562.363	2.562.363	2.522.363	2.899.070	2.899.070	2.899.070	2.899.070	687.500
Cumulative net cashflows (econ. w/o financing)				(7.075.675)	(6.486.740)	(4.501.910)	(1.939.548)	622.815	3.185.178	5.707.540	8.606.610	11.505.679	14.404.749	17.303.819	17.991.319
IRR (financial. 18% interest)	0.72														
IRR (financial. 12% interest)	0.89														
IRR (economic. w/o financing)	0.76														
NPV (fin. 18%. r=15%)	4.110.189														
NPV (fin.12%. r=15%)	4.858.399														
NPV(econ. r=15%)	3.632.679														
Extra nut cost at a higher unit price ($0.13/nut)			1.643.836	0	493.151	986.301	1.150.685	465.738	465.738	465.738	465.738	465.738	465.738	465.738	
Net cashflows (fin. 18%)				(707.568)	95.785	(997.745)	(584.595)	100.352	100.352	60.352	2.433.332	2.433.332	2.433.332	2.433.332	687.500
Net cashflows (fin. 12%)				(707.568)	95.785	(702.560)	(289.410)	395.537	395.537	355.537	2.433.332	2.433.332	2.433.332	2.433.332	687.500
Net cashflows (econ. w/o fin)				(7.075.675)	95.785	998.528	1.411.678	2.096.625	2.096.625	2.056.625	2.433.332	2.433.332	2.433.332	2.433.332	687.500
IRR (fin. 18%). high nut price	0.26														
IRR (fin. 12%). high nut price	0.34														
IRR (econ. w/o fin). high nut price	0.18														
NPV (fin. 18%. r=15%)	1.323.013														
NPV (fin.12%. r=15%)	2.071.223														
NPV(econ. r=15%)	845.503														

ANNEX af

SEMI-PROCESSED COCONUT CREAM, 1000 l/hr
Tonga (double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1. Product is frozen cream with fat content of 27%													
2. Price of dehusked nuts, $,nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	5.06												
4. Electricity, $/kwh	0.15												
5. Building cost, $/sq. m	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	81,218												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00									0	0	0	0
15. Working days per year	250.00									0	0	0	0
16. Packaging materials for cream, $ per 5 kg bag	0.40									0	0	0	0
17. Daily production, liters/day	16,000.00									0	0	0	0
18. Depreciation of building	0.05									0	0	0	0
19. Depreciation of vehicle	0.2									0	0	0	0
20. Depreciation of machinery	0.10									0	0	0	0
21. Insurance, % of equipment and buildings cost	0.01									0	0	0	0
22. Fraction of capital investment loannd	0.90									0	0	0	0
22. Capacity use (Yr 1--60% single shift; Yr 2--60%,										0	0	0	0
double shift, yrs 3-10 --70% double shift,										0	0	0	0
23. Skilled wage, $/day(w/fringe benefits & leave)	16.88									0	0	0	0
B. Equipment (duty-free)										0	0	0	0
										0	0	0	0
Nut opening	38,500	14 (hp)								0	0	0	0
Washing and inspection area	34,650	10								0	0	0	0
Grinding/blanching/pressing area	238,000	64								0	0	0	0
Flakes dryer	420000	50								0	0	0	0
Screening and packing area	42000	10											
Pasteurizing	240,000	5											
FDA Standard Extra	36000	0								0	0	0	0
Holding tank	30,000	1											
Blast freezers	60,000	40								0	0	0	0
Storage freezers (4 week capacity)	420,000	400								0	0	0	0
Dryer for parings	140,000	25								0	0	0	0
Lab equipment	30,000	2								0	0	0	0
Filling system	30,000	2								0	0	0	0
Generator	46,875									0	0	0	0
Boiler	210,000	5								0	0	0	0
Office equipment	40,000	2								0	0	0	0
Truck scale	40,000	0								0	0	0	0
Payloader	150000									0	0	0	0
Land transport vehicle	50,000												
Water supply/treatment system	70,000	5								0	0	0	0
Waste disposal system	100000									0	0	0	0
CIP	43,000	1								0	0	0	0
TOTAL	2,509,025	636								0	0	0	0
										0	0	0	0

ANNEX af

C. Buildings

Nut storage										0	0	0	0
Nut preparation area		260 sq. m.								0	0	0	0
Sanitary line		725								0	0	0	0
Freezer area (4 week's output)		150								0	0	0	0
Drying for parings		1250											
Drying for flakes		200											
Administrative		390								0	0	0	0
Powerhouse		125								0	0	0	0
Warehouse		125								0	0	0	0
Warehouse for dry flakes		250								0	0	0	0
Total building space	962,500	375								0	0	0	0
		3,850											
D. Installation (1% of equipment)	25,090									0	0	0	0
										0	0	0	0
E. Start-up costs, legal fees, etc.	20,000									0	0	0	0
										0	0	0	0
F. Total capital costs	3,516,615	3,516,615	0	0	0	0	0	0	0	0	0	0	0
										0	0	0	0
G. Variable costs										0	0	0	0
										0	0	0	0
Coconuts	2,030,457	0	609,137	1,218,274	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	0
Electricity	178,131									0	0	0	0
Packaging for frozen cream	320,000									0	0	0	0
Packaging for flakes	120,203									0	0	0	0
Packaging for parings	12,670									0	0	0	0
Other supplies and materials	20,000									0	0	0	0
Stabilizers, disinfectants, etc.	10,000									0	0	0	0
Unskilled labor	315,877									0	0	0	0
Transport of cream (paid by central)	0									0	0	0	0
Transport of parings	15,838									0	0	0	0
Transport of flakes	45,076									0	0	0	0
TOTAL	3,068,252	0	920,476	1,840,951	2,147,776	2,147,776	2,147,776	2,147,776	2,147,776	2,147,776	2,147,776	2,147,776	0
H. Fixed costs										0	0	0	0
Land rent	45,000	0	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	0
Indirect labor	10,631	0	10,631	10,631	10,631	10,631	10,631	10,631	10,631	10,631	10,631	10,631	0
Administrative, managerial, technical labor	77,681	0	77,681	77,681	77,681	77,681	77,681	77,681	77,681	77,681	77,681	77,681	0
Night supervisor	4,219	0	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	0
Depreciation	306,537	0	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	0
Insurance	34,715	0	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	0
Interest	569,692	0	0	569,692	569,692	569,692	569,692	569,692	0	0	0	0	0
Maintenance	173,576	0	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	
Other	153,413	0	153,413	153,413	153,413	153,413	153,413	153,413	153,413	153,413	153,413	153,413	
TOTAL	1,375,463	0	805,771	1,375,463	1,375,463	1,375,463	1,375,463	1,375,463	805,771	805,771	805,771	805,771	0
										0	0	0	0
I. Total annual costs	4,443,715									0	0	0	0
										0	0	0	0
J. Sales of byproducts										0	0	0	0
										0	0	0	0

ANNEX af

Dried parings	70,213									0	0	0	0
Low fat coconut flakes	199,838									0	0	0	0
TOTAL	270,051	0	81,015	162,030	189,036	189,036	189,036	189,036	189,036	189,036	189,036	189,036	0
										0	0	0	0
Breakeven price at 100% capacity use	1.04									0	0	0	0
Price w/ 15% margin	1.20									0	0	0	0
										0	0	0	0
Revenues from product (w/15% margin, 1% wastage)	4,751,717	0	1,425,515	2,851,030	3,326,202	3,326,202	3,326,202	3,326,202	3,326,202	3,326,202	3,326,202	3,326,202	0
										0	0	0	0
Net revenues before taxes		(3,516,615)	(219,7[illegible]	(203,354)	(8,002)	(8,002)	(8,002)	(8,002)	561,689	561,689	561,689	561,689	0
Taxes and annual license fees	50,218	0	15,0[illegible]	30,131	35,152	35,152	35,152	35,152	35,152	35,152	35,152	35,152	0
Net revenues after taxes		(3,516,615)	(234,[illegible])	(233,484)	(43,155)	(43,155)	(43,155)	(43,155)	526,537	526,537	526,537	526,537	0
										0	0	0	0
Other adjustments to cashflows (fin)										0	0	0	0
Loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of depreciation	306,537	0	306,537	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(351,662)	71,754	(634,932)	(386,030)	(386,030)	(386,030)	(436,030)	828,412	828,412	828,412	828,412	225,000
Cumulative net cashflows (fin, 18% interest rate)		(351,662)	(279,907)	(914,839)	(1,300,869)	(1,686,899)	(2,072,928)	(2,508,958)	(1,680,546)	(852,133)	(23,721)	804,691	1,029,691
										0	0	0	0
Interest (at 12%)	379,794	0	0	379,794	379,794	379,794	379,794	379,794	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(351,662)	71,754	(445,035)	(196,132)	(196,132)	(196,132)	(246,132)	828,412	828,412	828,412	828,412	225,000
Cumulative net cashflows (fin, 12% interest rate)		(351,662)	(279,907)	(724,942)	(921,075)	(1,117,207)	(1,313,339)	(1,559,472)	(731,059)	97,353	925,765	1,754,177	1,979,177
Adjustments for economic analysis													
Exclusion of loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of interest	379,794	0	0	379,794	348,165	348,165	348,165	348,165					
Exclusion of taxes	50,218	0	15,065	30,131	35,152	35,152	35,152	35,152	35,152	35,152	35,152	35,152	0
Net cashflows (economic, without financing)		(3,516,615)	86,820	668,213	831,935	831,935	831,935	781,935	863,564	863,564	863,564	863,564	225,000
Cumulative net cashflows (economic)		(3,516,615)	(3,429,795)	(2,761,583)	(1,929,647)	(1,097,712)	(265,777)	516,158	1,379,722	2,243,287	3,106,851	3,970,416	4,195,416
At listed nut price													
IRR (financial, 18% interest rate)	0.07												
IRR (financial, 12% interest rate)	0.15												
IRR (economic, without financing)	0.15												
NPV (fin, 18%, r=15%)	(481,281)												
NPV (fin, 12%, r=15%)	53												
NPV (econ,r=15%)	(41,099)												
Nut cost at a higher unit price ($.013/nut)	2,639,594	0	791,878	1,583,756	1,847,716	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(351,662)	(110,987)	(1,000,415)	(812,425)	(982,908)	(982,908)	(1,032,908)	231,534	231,534	231,534	231,534	225,000
Net cashflows (fin, 12%)		(351,662)	(110,987)	(810,517)	(622,528)	(793,011)	(793,011)	(843,011)	231,534	231,534	231,534	231,534	225,000
Net cashflows (econ, w/o fin)		(3,516,615)	(95,921)	302,731	405,539	235,057	235,057	185,057	266,686	266,686	266,686	266,686	225,000
IRR (fin, 18%, high nut price)	(0.26)												
IRR (fin, 12%, high nut price)	(0.22)												
IRR (econ, w/o fin)	(0.05)												
NPV (fin, 18%, r=15%)	(2,523,378)												
NPV (fin, 12%, r=15%)	(2,042,043)												
NPV (econ,r=15%)	(2,083,195)												

ANNEX ag

SEMI-PROCESSED COCONUT CREAM, 1000 l/hr
Vanuatu (double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1. Product is frozen cream with fat content of 27%													
2. Price of dehusked nuts, $.nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.31												
4. Electricity, $/kwh	0.21												
5. Building cost, $/sq. m	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	81,218												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, liters/day	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yr 1--60% single shift; Yr 2--60%, double shift, yrs 3-10 --70% double shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	15.38												
B. Equipment (duty-free)													
Nut opening	38,500		14 (hp)										
Washing and inspection area	34,650		10										
Grinding/blanching/pressing area	238,000		64										
Flakes dryer	420000		50										
Screening and packing area	42000		10										
Pasteurizing	240,000		5										
FDA Standard Extra	36000		0										
Holding tank	30,000		1										
Blast freezers	60,000		40										
Storage freezers (4 week capacity)	420,000		400										
Dryer for parings	140,000		25										
Lab equipment	30,000		2										
Filling system	30,000		2										
Generator	46,875												
Boiler	210,000		5										
Office equipment	40,000		2										
Truck scale	40,000		0										
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000		5										
Waste disposal system	100000												
CIP	43,000		1										
TOTAL	2,509,025		636										

ANNEX ag

C. Buildings										0	0	0	0
										0	0	0	0
Nut storage		260 sq. m.								0	0	0	0
Nut preparation area		725								0	0	0	0
Sanitary line		150											
Freezer area (4 week's output)		1250											
Drying for parings		200								0	0	0	0
Drying for flakes		390								0	0	0	0
Administrative		125								0	0	0	0
Powerhouse		125								0	0	0	0
Warehouse		250								0	0	0	0
Warehouse for dry flakes		375											
Total building space	962.500	3.850								0	0	0	0
										0	0	0	0
D. Installation (1% of equipment)	25.090									0	0	0	0
										0	0	0	0
E. Start-up costs, legal fees, etc.	20.000									0	0	0	0
										0	0	0	0
F. Total capital costs	3.516.615	3.516.615	0	0	0	0	0	0	0	0	0	0	0
										0	0	0	0
G. Variable costs										0	0	0	0
										0	0	0	0
Coconuts	2.030.457	0	609.137	1.218.274	1.421.320	1.421.320	1.421.320	1.421.320	1.421.320	1.421.320	1.421.320	1.421.320	0
Electricity	243.598									0	0	0	0
Packaging for frozen cream	320.000									0	0	0	0
Packaging for flakes	120.203									0	0	0	0
Packaging for parings	12.670									0	0	0	0
Other supplies and materials	20.000									0	0	0	0
Stabilizers, disinfectants, etc.	10.000									0	0	0	0
Unskilled labor	206.647									0	0	0	0
Transport of cream (paid by central)	0									0	0	0	0
Transport of parings	15.838									0	0	0	0
Transport of flakes	45.076									0	0	0	0
TOTAL	3.024.488	0	907.347	1.814.693	2.117.142	2.117.142	2.117.142	2.117.142	2.117.142	2.117.142	2.117.142	2.117.142	0
										0	0	0	0
H. Fixed costs										0	0	0	0
Land rent	45.000	0	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	45.000	0
Indirect labor	6.955	0	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	0
Administrative, managerial, technical labor	68.426	0	68.426	68.426	68.426	68.426	68.426	68.426	68.426	68.426	68.426	68.426	0
Night supervisor	3.846	0	3.846	3.846	3.846	3.846	3.846	3.846	3.846	3.846	3.846	3.846	0
Depreciation	306.537	0	306.537	306.537	306.537	306.537	306.537	306.537	306.537	306.537	306.537	306.537	0
Insurance	34.715	0	34.715	34.715	34.715	34.715	34.715	34.715	34.715	34.715	34.715	34.715	0
Interest	569.692	0	0	569.692	569.692	569.692	569.692	569.692	0	0	0	0	0
Maintenance	173.576	0	173.576	173.576	173.576	173.576	173.576	173.576	173.576	173.576	173.576	173.576	
Other	151.224	0	151.224	151.224	151.224	151.224	151.224	151.224	151.224	151.224	151.224	151.224	
TOTAL	1.359.972	0	790.280	1.359.972	1.359.972	1.359.972	1.359.972	1.359.972	790.280	790.280	790.280	790.280	0
										0	0	0	0
										0	0	0	0
I. Total annual costs	4.384.460									0	0	0	0
										0	0	0	0

ANNEX ag

J. Sales of byproducts													
										0	0	0	0
Dried parings	70.213									0	0	0	0
Low fat coconut flakes	199.838									0	0	0	0
TOTAL	270.051	0	81.015	162.030	189.036	189.036	189.036	189.036	189.036	189.036	189.036	189.036	0
										0	0	0	0
Breakeven price at 100% capacity use	1.03									0	0	0	0
Price w/ 15% margin	1.18									0	0	0	0
										0	0	0	0
Revenues from product (w/15% margin, 1% wastage)	4.684.255	0	1.405.276	2.810.553	3.278.978	3.278.978	3.278.978	3.278.978	3.278.978	3.278.978	3.278.978	3.278.978	0
										0	0	0	0
Net revenues before taxes		(3.516.615)	(211.335)	(202.081)	(9.099)	(9.099)	(9.099)	(9.099)	560.592	560.592	560.592	560.592	0
Taxes and annual license fees	41.187	12.356	24.712	28.831	28.831	28.831	28.831	28.831	28.831	28.831	28.831	28.831	0
Net revenues after taxes		(3.528.971)	(236.047)	(230.912)	(37.931)	(37.931)	(37.931)	(37.931)	531.761	531.761	531.761	531.761	0
										0	0	0	0
Other adjustments to cashflows (fin)										0	0	0	0
Loan proceeds	3.164.954	3.164.954	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	703.323	0	0	703.323	644.750	644.750	644.750	644.750	0	0	0	0	0
Exclusion of depreciation	306.537	0	306.537	301.875	301.875	301.875	301.875	301.875	301.875	301.875	301.875	301.875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481.250	0	0	0	0	0	0	0	0	0	0	0	225.000
Net cashflows (financial, 18% interest rate)		(364.018)	70.489	(632.360)	(380.806)	(380.806)	(380.806)	(430.806)	833.636	833.636	833.636	833.636	225.000
Cumulative net cashflows (fin, 18% interest rate)		(364.018)	(293.528)	(925.889)	(1.306.694)	(1.687.500)	(2.068.306)	(2.499.111)	(1.665.475)	(831.839)	1.797	835.433	1.060.433
										0	0	0	0
Interest (at 12%)	379.794	0	0	379.794	379.794	379.794	379.794	379.794	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(364.018)	70.489	(442.463)	(190.908)	(190.908)	(190.908)	(240.908)	833.636	833.636	833.636	833.636	225.000
Cumulative net cashflows (fin, 12% interest rate)		(364.018)	(293.528)	(735.991)	(926.900)	(1.117.808)	(1.308.717)	(1.549.625)	(715.989)	117.647	951.283	1.784.919	2.009.919
Adjustments for economic analysis													
Exclusion of loan proceeds	3.164.954	3.164.954	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	703.323	0	0	703.323	644.750	644.750	644.750	644.750	0	0	0	0	0
Exclusion of interest	379.794	0	0	379.794	348.165	348.165	348.165	348.165					
Exclusion of taxes	41.187	12.356	24.712	28.831	28.831	28.831	28.831	28.831	28.831	28.831	28.831	28.831	0
Net cashflows (economic, without financing)		(3.516.615)	95.202	669.485	830.838	830.838	830.838	780.838	862.467	862.467	862.467	862.467	225.000
Cumulative net cashflows (economic)		(3.516.615)	(3.421.413)	(2.751.928)	(1.921.090)	(1.090.253)	(259.415)	521.423	1.383.890	2.246.357	3.108.824	3.971.292	4.196.292
At listed nut price													
IRR (financial, 18% interest rate)	0 07												
IRR (financial, 12% interest rate)	0.15												
IRR (economic, without financing)	0.15												
NPV (fin, 18%, r=15%)	(475.878)												
NPV (fin, 12%, r=15%)	5.456												
NPV (econ,r=15%)	(37.162)												
Nut cost at a higher unit price ($.13/nut)	2.639.594	0	791.878	1.583.756	1.847.716	2.018.198	2.018.198	2.018.198	2.018.198	2.018.198	2.018.198	2.018.198	
Net cashflows (fin, 18%)		(364.018)	(112.252)	(997.843)	(807.202)	(977.684)	(977.684)	(1.027.684)	236.758	236.758	236.758	236.758	225.000
Net cashflows (fin, 12%)		(364.018)	(112.252)	(807.945)	(617.304)	(787.787)	(787.787)	(837.787)	236.758	236.758	236.758	236.758	225.000
Net cashflows (econ, w/o fin)		(3.516.615)	(87.539)	304.003	404.442	233.960	233.960	183.960	265.589	265.589	265.589	265.589	225.000
IRR (fin, 18%, high nut price)	(0.25)												
IRR (fin, 12%, high nut price)	(0.22)												
IRR (econ, w/o fin)	(0.05)												
NPV (fin, 18%, r=15%)	(2.517.975)												
NPV (fin, 12%, r=15%)	(2.036.640)												
NPV (econ,r=15%)	(2.073.258)												

ANNEX ah

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Vanuatu (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.31												
4. Electricity, $/kw-hr	0.21												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--50% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	15.53												

B. Equipment			
Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		420000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
StarAsept lease rights	3		55,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	232		2,793,025

52 ANNEX ah

53 C. Buildings

54

55	Nut storage	260													
56	Nut preparation area	725													
57	Sanitary line	150													
58	Drying for parings	200													
59	Drying for flakes	390													
61	Administrative	125													
62	Powerhouse	125													
63	Warehouse	250													
64	Warehouse for dry flakes	375													
65		2.600		650,000											
66															
67	D. Start-up costs, legal fees			20,000											
68															
69	E. Installation			279,303											
70															
71	F. TOTAL CAPITAL COSTS			3,742,328	3,742,328										
72															
73															
74	C. Variable Costs														
75															
76	Coconuts			1,694,915											
77	Electricity			88,804											
78	Packaging materials for cream			660,800											
	Packaging for flakes			100,339											
	Packaging for parings			10,576											
79	Other supplies and materials			20,000											
80	Stabilizers, disinfectants, etc			20,000											
81	Unskilled labor			176,794											
	Transport of cream ($5500/FCL)			971,200											
	Transport of parings			15,320											
	Transport of flakes			37,627											
82															
83	Total variable costs			3,694,276		0	1,108,283	2,216,566	2,585,994	2,585,994	2,585,994	2,585,994	2,585,994	2,585,994	2,585,994	2,585,994
84															
85	D. Fixed costs														
86															
87	Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
89	Indirect labor			6,946		0	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946
90	Administrative expenses			68,649		0	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649
	Night supervisor			3,882		0	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882
91	Depreciation			316,803		0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803
92	Maintenance			187,116		0	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116
93	Other			184,714		0	184,714	184,714	184,714	184,714	184,714	184,714	184,714	184,714	184,714	184,714
94	Insurance			34,430		0	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430
95	Interest			606,257		0	0	606,257	606,257	606,257	606,257	606,257	0	0	0	0	0
96																
97	Total			1,438,798		0	832,541	1,438,798	1,468,798	1,468,798	1,468,798	1,468,798	862,541	862,541	862,541	862,541	0
98																
99																
100	E. Total annual costs			5,133,074												
101																
102	F. Sales of byproducts															
103																
104	Dried paring	1,763	kg/day	58,610		0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
106	Low-fat coconut flakes	5,017		125,424		0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
107																	
108				184,034		0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

108	ANNEX ah												--- 824	0
109														
110	G. Breakeven price of coconut cream	1.24												
111	Sales price	1.54												
112														
113	Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,88	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
114														
115	Net revenues before taxes		(3,742,328)	(56,093)	114,097	342,913	342,913	342,913	342,913	949,170	949,170	949,170	949,170	0
	Taxes and annual license fees	36,119	0	10,836	21,671	25,283	25,283	25,283	25,283	25,283	25,283	25,283	25,283	0
	Net revenues after taxes		(3,742,328)	(66,929)	92,426	317,629	317,629	317,629	317,629	923,887	923,887	923,887	923,887	0
	Other adjustments to cashflows (fin)													
	Loan proceeds	3,368,095	3,368,095											
	Repayment of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619	0	0	0	0	0
	Exclusion of depreciation	316,803	0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	
	Replacement costs (vehicle)	40,000							40,000					
	Salvage value	325,000												325,000
	Net cashflows (financial, 18% interest rate)		(374,233)	249,874	(264,391)	(39,187)	(39,187)	(39,187)	(79,187)	1,240,689	1,240,689	1,240,689	1,240,689	325,000
	Cumulative net cashflows (fin, 18% interest rate)		(374,233)	(124,359)	(388,750)	(427,937)	(467,124)	(506,311)	(585,498)	655,191	1,895,880	3,136,569	4,377,258	4,702,258
	Interest at 12%	404,171	0	0	404,171	404,171	404,171	404,171	404,171	0	0	0	0	0
	Net cashflows (fin, 12% interest)		(374,233)	249,874	(62,305)	162,899	162,899	162,899	122,899	1,240,689	1,240,689	1,240,689	1,240,689	325,000
	Cumulative net cashflows (fin, 12% int)		(374,233)	(124,359)	(186,664)	(23,766)	139,133	302,032	424,930	1,665,619	2,906,308	4,146,998	5,387,687	5,712,687
	Adjustments for economic analysis													
	Exclusion of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619					
	Exclusion of interest	404,171	0	0	404,171	404,171	404,171	404,171	404,171					
	Exclusion of taxes	36,119	0	10,836	21,671	25,283	25,283	25,283	25,283	25,283	25,283	25,283	25,283	0
	Exclusion of loan proceeds	3,368,095	3,368,095											
	Net cashflows (econ, w/o financing)		(3,742,328)	260,709	1,037,156	1,265,972	1,265,972	1,265,972	1,225,972	1,265,972	1,265,972	1,265,972	1,265,972	325,000
	Cumulative net cashflows (econ, w/o financing)		(3,742,328)	(3,481,618)	(2,444,462)	(1,178,490)	87,482	1,353,454	2,579,426	3,845,398	5,111,370	6,377,343	7,643,315	7,968,315
	IRR (financial, 18% interest)	0.37												
	IRR (financial, 12% interest)	0.55												
	IRR (economic, w/o financing)	0.24												
	NPV(fin, 18%, r=15%)	993,447												
	NPV(fin, 12%,r=15%)	1,505,676												
	NPV(econ, r=15%)	1,405,824												
	Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
	Net cashflows (fin, 18%)		(374,233)	97,331	(569,476)	(395,119)	(504,925)	(504,925)	(544,925)	774,951	774,951	774,951	774,951	325,000
	Net cashflows (fin, 12%)		(374,233)	97,331	(367,390)	(193,033)	(302,839)	(302,839)	(342,839)	774,951	774,951	774,951	774,951	325,000
	Net cashflows (econ, w/o fin)		(3,742,328)	108,167	732,072	910,040	800,234	800,234	760,234	800,234	800,234	800,234	800,234	325,000
	IRR (fin, 18%), high nut price	0.04												
	IRR (fin, 12%), high nut price	0.12												
	IRR (econ, w/o fin), high nut price	0.13												
	NPV(fin, 18%, r=15%)	(633,867)												
	NPV(fin, 12%,r=15%)	(121,639)												
	NPV(econ, r=15%)	(221,490)												

ANNEX ai

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Vanuatu (double shtetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.31												
4. Electricity, $/kw-hr	0.21												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	15.53												

B. Equipment

Nut opening	14 hp	38,500
Washing and inspection area	10	34,650
Grinding/blanching/pressing	64	238,000
Flakes dryer	50	420000
Screening and packing area	10	42000
Pasteurizing	5	240,000
FDA Standard extra	0	36,000
Aseptic processing plant	5	504,000
Homogenizer	30	105,000
Aseptic tank	1	140,000
Aseptic filling system (tetrapak	2	635,000
Lab equipment	2	50000
Dryer for parings	25	140,000
Generator		46,875
Boiler	5	210,000
Office equipment	2	40 000
Truck scale	0	40,000
Payloader		150000
Land transport vehicle		50,000
Water treatment plant	5	70,000
Waste disposal system		100000
CIP	1	43,000
Total equipment cost	231	3,373,025

ANNEX ai

C. Buildings															
Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			337,303												
F. TOTAL CAPITAL COSTS			4,380,328	4,380,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			88,421												
Packaging materials for cream			2,240,000												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			176,794												
Transport of cream ($3600/FCL)			871,200												
Transport of parings			13,220												
Transport of flakes			37,627												
Total variable costs			5,273,094	0	1,581,928	3,163,856	3,691,166	3,691,166	3,691,166	3,691,166	3,691,166	3,691,166	3,691,166	3,691,166	
D. Fixed costs															
Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	
Indirect labor			6,946	0	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946	6,946	
Administrative expenses			68,649	0	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649	68,649	
Night supervisor			3,882	0	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882	3,882	
Depreciation			374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,303	374,803	374,803	374,803	
Maintenance			219,016	0	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	
Other			263,655	0	263,655	263,655	263,655	263,655	263,655	263,655	263,655	263,655	263,655	263,655	
Insurance			40,230	0	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	
Interest			709,613	0	0	709,613	709,613	709,613	709,613	709,613	0	0	0	0	0
Total			1,716,795	0	1,007,182	1,716,795	1,746,795	1,746,795	1,746,795	1,746,795	1,037,182	1,037,182	1,037,182	1,037,182	0
E. Total annual costs			6,989,888												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

ANNEX ai

G. Breakeven price of coconut cream	1.70												
Sales price	1.98												
Revenues from product (w/ 1% wastage)	7,840,800	0	2,352,240	4,704,480	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	5,488,560	0
Net revenues before taxes		(4,380,328)	(181,659)	(65,750)	179,424	179,424	179,424	179,424	889,037	889,037	889,037	889,037	0
Taxes and annual license fees	36,119	0	10,836	21,671	21,671	21,671	21,671	21,671	21,671	21,671	21,671	21,671	0
Net revenues after taxes		(4,380,328)	(192,495)	(87,422)	157,752	157,752	157,752	157,752	867,365	867,365	867,365	867,365	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,942,295	3,942,295											
Repayment of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459	0	0	0	0	0
Exclusion of depreciation	374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	
Replacement costs (vehicle)	40,000							40,000					
Salvage value	325,000												325,000
Net cashflows (financial, 18% interest rate)		(438,033)	182,307	(501,078)	(255,904)	(255,904)	(255,904)	(295,904)	1,242,168	1,242,168	1,242,168	1,242,168	325,000
Cumulative net cashflows (fin, 18% interest rate)		(438,033)	(255,725)	(756,803)	(1,012,707)	(1,268,611)	(1,524,515)	(1,820,419)	(578,251)	663,917	1,906,085	3,148,252	3,473,252
Interest at 12%	473,075	0	0	473,075	473,075	473,075	473,075	473,075	0	0	0	0	0
Net cashflows (fin, 12% interest)		(438,033)	182,307	(264,540)	(19,366)	(19,366)	(19,366)	(59,366)	1,242,168	1,242,168	1,242,168	1,242,168	325,000
Cumulative net cashflows (fin, 12% int)		(438,033)	(255,725)	(520,266)	(539,632)	(558,998)	(578,365)	(637,731)	604,437	1,846,605	3,088,773	4,330,941	4,655,941
Adjustments for economic analysis													
Exclusion of principal	788,459	0	0	788,459	788,459	788,459	788,459	788,459					
Exclusion of interest	473,075	0	0	473,075	473,075	473,075	473,075	473,075					
Exclusion of taxes	36,119	0	10,836	21,671	21,671	21,671	21,671	21,671	21,671	21,671	21,671	21,671	0
Exclusion of loan proceeds	3,942,295	3,942,295											
Net cashflows (econ, w/o financing)		(4,380,328)	193,143	1,018,665	1,263,839	1,263,839	1,263,839	1,223,839	1,263,839	1,263,839	1,263,839	1,263,839	325,000
Cumulative net cashflows (econ, w/o financing)		(4,380,328)	(4,187,184)	(3,168,519)	(1,904,680)	(640,841)	622,998	1,846,837	3,110,677	4,374,516	5,638,355	6,902,194	7,227,194

IRR (financial, 18% interest)	0.20
IRR (financial, 12% interest)	0.33
IRR (economic, w/o financing)	0.19
NPV(fin, 18%, r=15%)	326,020
NPV(fin, 12%,r=15%)	925,575
NPV(econ, r=15%)	781,500

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738	
Net cashflows (fin, 18%)		(438,033)	29,765	(806,163)	(611,836)	(721,642)	(721,642)	(761,642)	776,430	776,430	776,430	776,430	325,000
Net cashflows (fin, 12%)		(438,033)	29,765	(569,625)	(375,299)	(485,104)	(485,104)	(525,104)	776,430	776,430	776,430	776,430	325,000
Net cashflows (econ, w/o fin)		(4,380,328)	40,601	713,580	907,907	798,101	798,101	758,101	798,101	798,101	798,101	798,101	325,000

IRR (fin, 18%), high nut price	(0.03)
IRR (fin, 12%), high nut price	0.04
IRR (econ, w/o fin), high nut price	0.10
NPV(fin, 18%, r=15%)	*********
NPV(fin, 12%,r=15%)	(701,739)
NPV(econ, r=15%)	(845,814)

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ANNEX aj

Frozen Coconut Flakes (10,000 kg/day)
Vanuatu (single shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
2. Price of dehusked nuts, $.nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.31												
4. Electricity, $/kwh	0.21												
5. Building cost, $/sq. m	250.00												
6. Yield of flakes, kg/nut	0.28												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	35,689												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, kg/day	10,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yrs. 1 and 2 -- 60% single shift; yrs 3-10 --70% single shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	15.38												
B. Equipment (duty-free)													
Nut opening	38,500	14 (hp)											
Washing and inspection area	34,650	10											
Grinding/blanching	112,000	64											
Packing area	30000	5											
Blast freezers	60,000	30											
Storage freezers (4 week capacity)	420,000	400											
Dryer for parings	140,000	25											
Lab equipment	10,000	2											
Generator	46,875												
Boiler	70,000	3											
Office equipment	20,000	2											
Truck scale	40,000	0											
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000	5											
Waste disposal system	100000												
CIP	43,000	1											
TOTAL	1,435,025	561											

ANNEX aj

C. Buildings

Nut storage		260 sq. m.											
Nut preparation area		725											
Sanitary line		150											
Freezer area (4 week's output)		1250											
Drying for parings		200											
Drying for flakes		390											
Administrative		125											
Powerhouse		125											
Warehouse		250											
Warehouse for dry flakes		375											
Total building space	962,500	3,850											
D. Installation (1% of equipment)	14,350												
E. Start-up costs, legal fees, etc.	20,000												
F. Total capital costs	2,431,875	2,431,875	0	0	0	0	0	0	0	0	0	0	0
G. Variable costs													
Coconuts	892,220	0	267,666	267,666	312,277	312,277	312,277	312,277	312,277	312,277	312,277	312,277	0
Electricity	107,436												
Packaging for frozen flakes	200,000												
Packaging for parings	5,567												
Other supplies and materials	10,000												
Stabilizers, disinfectants, etc.	10,000												
Unskilled labor	92,874												
Transport of parings	6,959												
Transport of frozen flakes ($3600/FCL)	550,000												
TOTAL	1,875,056	0	1,125,034	1,125,034	1,312,539	1,312,539	1,312,539	1,312,539	1,312,539	1,312,539	1,312,539	1,312,539	0
H. Fixed costs										0	0	0	
Land rent	30,000	0	30,000	30,000	30,000	30,000	30,000	30,000	30,000	0	0	0	
Indirect labor	6,955	0	6,955	6,955	6,955	6,955	6,955	6,955	6,955	30,000	30,000	30,000	
Administrative, managerial, technical labor	53,886	0	53,886	53,886	53,886	53,886	53,886	53,886	53,886	6,955	6,955	6,955	
Depreciation	198,063	0	198,063	198,063	198,063	198,063	198,063	198,063	198,063	53,886	53,886	53,886	
Insurance	23,975	0	23,975	23,975	23,975	23,975	23,975	23,975	23,975	198,063	198,063	198,063	
Interest	393,964	0	0	393,964	393,964	393,964	393,964	393,964	0	23,975	23,975	23,975	
Maintenance	119,876	0	119,876	119,876	119,876	119,876	119,876	119,876	119,876	0	0	0	
Other	93,753	0	93,753	93,753	93,753	93,753	93,753	93,753	93,753	119,876	119,876	119,876	
TOTAL	920,472	0	526,508	920,472	920,472	920,472	920,472	920,472	526,508	93,753	93,753	93,753	
										526,508	526,508	526,508	0
I. Total annual costs	2,795,528									0	0	0	
J. Sales of byproducts										0	0	0	
Dried parings	30,853									0	0	0	
TOTAL	30,853	0	18,512	18,512	21,597	21,597	21,597	21,597	21,597	21,597	21,597	21,597	0

ANNEX aj

Breakeven price at 100% capacity use	1.11												
Price w/ 15% margin	1.27												
Revenues from product (w/15% margin, 1% wastage)	3,147,583	0	1,888,550	1,888,550	2,203,308	2,203,308	2,203,308	2,203,308	2,203,308	2,203,308	2,203,308	2,203,308	0
										0	0	0	0
Net revenues before taxes		(2,431,875)	255,519	(138,444)	(8,106)	(8,106)	(8,106)	(8,106)	385,857	385,857	385,857	385,857	0
Taxes and annual license fees	19,976	5,993	11,985	13,983	13,983	13,983	13,983	13,983	13,983	13,983	13,983	13,983	0
Net revenues after taxes		(2,437,868)	243,534	(152,427)	(22,089)	(22,089)	(22,089)	(22,089)	371,875	371,875	371,875	371,875	0
										0	0	0	0
Other adjustments to cashflows (fin)										0	0	0	0
Loan proceeds	2,188,688	2,188,688	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	486,375	0	0	486,375	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of depreciation	198,063	0	198,063	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(249,180)	441,597	(336,927)	(364,964)	(364,964)	(364,964)	(414,964)	673,750	673,750	673,750	673,750	225,000
Cumulative net cashflows (fin, 18% interest rate)		(249,180)	192,417	(144,511)	(509,475)	(874,439)	(1,239,403)	(1,654,368)	(980,618)	(306,868)	366,881	1,040,631	1,265,631
										0	0	0	0
Interest (at 12%)	262,643	0	0	262,643	262,643	262,643	262,643	262,643	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(249,180)	441,597	(205,606)	(233,643)	(233,643)	(233,643)	(283,643)	673,750	673,750	673,750	673,750	225,000
Cumulative net cashflows (fin, 12% interest rate)		(249,180)	192,417	(13,189)	(246,832)	(480,475)	(714,118)	(997,761)	(324,012)	349,738	1,023,487	1,697,237	1,922,237
Adjustments for economic analysis													
Exclusion of loan proceeds	2,188,688	2,188,688	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	486,375	0	0	486,375	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of interest	262,643	0	0	262,643	348,165	348,165	348,165	348,165					
Exclusion of taxes	19,976	5,993	11,985	13,983	13,983	13,983	13,983	13,983	13,983	13,983	13,983	13,983	0
Net cashflows (economic, without financing)		(2,431,875)	453,582	557,394	775,255	775,255	775,255	725,255	687,732	687,732	687,732	687,732	225,000
Cumulative net cashflows (economic)		(2,431,875)	(1,978,293)	(1,420,899)	(647,644)	125,611	898,866	1,622,121	2,309,853	2,997,586	3,685,318	4,373,051	4,598,051
At listed nut price													
IRR (financial, 18% interest rate)	0.14												
IRR (financial, 12% interest rate)	0.28												
IRR (economic, without financing)	0.24												
NPV (fin, 18%, r=15%)	(43,024)												
NPV (fin, 12%, r=15%)	289,837												
NPV (econ,r=15%)	807,740												
Nut cost at a higher unit price ($.13/nut)	1,159,886	0	347,966	695,931	811,920	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(249,180)	361,297	(765,193)	(864,607)	(2,070,885)	(2,070,885)	(2,120,885)	(1,032,171)	(1,032,171)	(1,032,171)	(1,032,171)	225,000
Net cashflows (fin, 12%)		(249,180)	361,297	(633,871)	(733,286)	(1,939,564)	(1,939,564)	(1,989,564)	(1,032,171)	(1,032,171)	(1,032,171)	(1,032,171)	225,000
Net cashflows (econ, w/o fin)		(2,431,875)	373,282	129,129	273,612	(932,666)	(932,666)	(982,666)	(1,018,189)	(1,018,189)	(1,018,189)	(1,018,189)	225,000
IRR (fin, 18%, high nut price)	(0.82)												
IRR (fin, 12%, high nut price)	(0.82)												
IRR (econ, w/o fin)	(0.82)												
NPV (fin, 18%, r=15%)	(4,728,938)												
NPV (fin, 12%, r=15%)	(4,396,077)												
NPV (econ,r=15%)	(3,878,174)												

ANNEX ak

Frozen Coconut Flakes (10,000 kg/day)
Vanuatu double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
2. Price of dehusked nuts, $.nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	3.31												
4. Electricity, $/kwh	0.21												
5. Building cost, $/sq. m	250.00												
6. Yield of flakes, kg/nut	0.28												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	71,378												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, kg/day	20,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yr. 1 60%, single shift; Yr. 2 -- 60% double shift; yrs 3-10 --70% double shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	15.38												
B. Equipment (duty-free)													
Nut opening	38,500		14 (hp)										
Washing and inspection area	34,650		10										
Grinding/blanching	112,000		64										
Packing area	30000		5										
Blast freezers	60,000		30										
Storage freezers (4 week capacity)	420,000		400										
Dryer for parings	140,000		25										
Lab equipment	10,000		2										
Generator	46,875												
Boiler	70,000		3										
Office equipment	20,000		2										
Truck scale	40,000		0										
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000		5										
Waste disposal system	100000												
CIP	43,000		1										
TOTAL	1,435,025		561										

ANNEX ak

C. Buildings

Nut storage		260 sq. m.											
Nut preparation area		725											
Sanitary line		150											
Freezer area (4 week's output)		1250											
Drying for parings		200											
Drying for flakes		390											
Administrative		125											
Powerhouse		125											
Warehouse		250											
Warehouse for dry flakes		375											
Total building space	962.500	3.850											
D. Installation (1% of equipment)	14.350												
E. Start-up costs, legal fees, etc.	20.000												
F. Total capital costs	2.431.875	2.431.875	0	0	0	0	0	0	0	0	0	0	0
										0	0	0	0
G. Variable costs										0	0	0	0
										0	0	0	0
Coconuts	1.784.440	0	535.332	535.332	624.554	624.554	624.554	624.554	624.554	624.554	624.554	624.554	0
Electricity	214.872									0	0	0	0
Packaging for frozen flakes	400.000									0	0	0	0
Packaging for parings	11.135									0	0	0	0
Other supplies and materials	20.000									0	0	0	0
Stabilizers, disinfectants, etc.	20.000									0	0	0	0
Unskilled labor	185.747									0	0	0	0
Transport of parings	13.919									0	0	0	0
Transport of frozen flakes ($3600/FCL)	1.100.000									0	0	0	0
TOTAL	3.750.112	0	1.125.034	2.250.067	2.625.079	2.625.079	2.625.079	2.625.079	2.625.079	2.625.079	2.625.079	2.625.079	0
										0	0	0	0
H. Fixed costs										0	0	0	0
Land rent	30.000	0	30.000	30.000	30.000	30.000	30.000	30.000	30.000	30.000	30.000	30.000	0
Indirect labor	6.955	0	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	6.955	0
Administrative, managerial, technical labor	53.886	0	53.886	53.886	53.886	53.886	53.886	53.886	53.886	53.886	53.886	53.886	0
Night supervisor	3.846												
Depreciation	198.063	0	198.063	198.063	198.063	198.063	198.063	198.063	198.063	198.063	198.063	198.063	0
Insurance	23.975	0	23.975	23.975	23.975	23.975	23.975	23.975	23.975	23.975	23.975	23.975	0
Interest	393.964	0	0	393.964	393.964	393.964	393.964	393.964	0	0	0	0	0
Maintenance	119.876	0	119.876	119.876	119.876	119.876	119.876	119.876	119.876	119.876	119.876	119.876	
Other	187.506	0	187.506	187.506	187.506	187.506	187.506	187.506	187.506	187.506	187.506	187.506	
TOTAL	1.018.071	0	620.261	1.014.225	1.014.225	1.014.225	1.014.225	1.014.225	620.261	620.261	620.261	620.261	0
										0	0	0	0
										0	0	0	0
I. Total annual costs	4.768.183									0	0	0	0
										0	0	0	0
J. Sales of byproducts										0	0	0	0
										0	0	0	0
Dried parings	61.706									0	0	0	0
TOTAL	61.706	0	18.512	37.024	43.194	43.194	43.194	43.194	43.194	43.194	43.194	43.194	0

ANNEX ak

Breakeven price at 100% capacity use	0.94												
Price w/ 15% margin	1.08												
Revenues from product (w/15% margin, 1% wastage)	5,358,325	0	1,607,497	3,214,995	3,750,827	3,750,827	3,750,827	3,750,827	3,750,827	3,750,827	3,750,827	3,750,827	0
Net revenues before taxes		(2,431,875)	(119,286)	(12,274)	154,718	154,718	154,718	154,718	548,682	548,682	548,682	548,682	0
Taxes and annual license fees	35,901	10,770	21,541	25,131	25,131	25,131	25,131	25,131	25,131	25,131	25,131	25,131	0
Net revenues after taxes		(2,442,646)	(140,826)	(37,405)	129,587	129,587	129,587	129,587	523,551	523,551	523,551	523,551	0
Other adjustments to cashflows (fin)										0	0	0	0
Loan proceeds	2,188,688	2,188,688	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	486,375	0	0	486,375	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of depreciation	198,063	0	198,063	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(253,958)	57,236	(221,905)	(213,288)	(213,288)	(213,288)	(263,288)	825,426	825,426	825,426	825,426	225,000
Cumulative net cashflows (fin, 18% interest rate)		(253,958)	(196,722)	(418,626)	(631,914)	(845,202)	(1,058,490)	(1,321,778)	(496,352)	329,074	1,154,500	1,979,926	2,204,926
Interest (at 12%)	262,643	0	0	262,643	262,643	262,643	262,643	262,643	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(253,958)	57,236	(90,583)	(81,967)	(81,967)	(81,967)	(131,967)	825,426	825,426	825,426	825,426	225,000
Cumulative net cashflows (fin, 12% interest rate)		(253,958)	(196,722)	(287,305)	(369,272)	(451,238)	(533,205)	(665,172)	160,254	985,680	1,811,106	2,636,532	2,861,532
Adjustments for economic analysis													
Exclusion of loan proceeds	2,188,688	2,188,688	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	486,375	0	0	486,375	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of interest	262,643	0	0	262,643	348,165	348,165	348,165	348,165					
Exclusion of taxes	35,901	10,770	21,541	25,131	25,131	25,131	25,131	25,131	25,131	25,131	25,131	25,131	0
Net cashflows (economic, without financing)		(2,431,875)	78,777	683,565	936,079	936,079	936,079	886,079	850,557	850,557	850,557	850,557	225,000
Cumulative net cashflows (economic)		(2,431,875)	(2,353,098)	(1,669,534)	(733,454)	202,625	1,138,704	2,024,783	2,875,339	3,725,896	4,576,453	5,427,009	5,652,009
At listed nut price													
IRR (financial, 18% interest rate)	0.20												
IRR (financial, 12% interest rate)	0.30												
IRR (economic, without financing)	0.25												
NPV (fin, 18%, r=15%)	185,337												
NPV (fin, 12%, r=15%)	518,199												
NPV (econ,r=15%)	1,087,703												
Nut cost at a higher unit price ($.13/nut)	2,319,772	0	695,931	1,391,863	1,623,840	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(253,958)	(103,363)	(1,078,436)	(1,212,574)	(1,606,932)	(1,606,932)	(1,656,932)	(568,218)	(568,218)	(568,218)	(568,218)	225,000
Net cashflows (fin, 12%)		(253,958)	(103,363)	(947,115)	(1,081,253)	(1,475,611)	(1,475,611)	(1,525,611)	(568,218)	(568,218)	(568,218)	(568,218)	225,000
Net cashflows (econ, w/o fin)		(2,431,875)	(81,823)	(172,966)	(63,207)	(457,565)	(457,565)	(507,565)	(543,087)	(543,087)	(543,087)	(543,087)	225,000
IRR (fin, 18%, high nut price)	(0.72)												
IRR (fin, 12%, high nut price)	(0.72)												
IRR (econ, w/o fin)	(0.71)												
NPV (fin, 18%, r=15%)	(4,385,735)												
NPV (fin, 12%, r=15%)	(4,052,874)												
NPV (econ,r=15%)	(3,483,369)												

ANNEX a1

SEMI-PROCESSED COCONUT CREAM, 1000 l/hr
Western Samoa (double shift, plastic bags)
2-10-89

A. Assumptions	Data	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11
1. Product is frozen cream with fat content of 27%													
2. Price of denusked nuts, $.nut, delivered	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	4.01												
4. Electricity, $/kwh	0.14												
5. Building cost, $/sq. m	250.00												
6. Yield of cream, liters/nut	0.20												
7. Interest rate, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11. Maintenance costs, % of capital equipment	0.05												
12. Coconuts required per day	81,218												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials for cream, $ per 5 kg bag	0.40												
17. Daily production, liters/day	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of vehicle	0.2												
20. Depreciation of machinery	0.10												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
22. Capacity use (Yr 1--60% single shift; Yr 2--60%, double shift, yrs 3-10 --70% double shift)													
23. Skilled wage, $/day(w/fringe benefits & leave)	16.88												
B. Equipment (duty-free)													
Nut opening	38,500		14 (hp)										
Washing and inspection area	34,650		10										
Grinding/blanching/pressing area	238,000		64										
Flakes dryer	420000		50										
Screening and packing area	42000		10										
Pasteurizing	240,000		5										
FDA Standard Extra	36000		0										
Holding tank	30,000		1										
Blast freezers	60,000		40										
Storage freezers (4 week capacity)	420,000		400										
Dryer for parings	140,000		25										
Lab equipment	30,000		2										
Filling system	30,000		2										
Generator	46,875												
Boiler	210,000		5										
Office equipment	40,000		2										
Truck scale	40,000		0										
Payloader	150000												
Land transport vehicle	50,000												
Water supply/treatment system	70,000		5										
Waste disposal system	100000												
CIP	43,000		1										
TOTAL	2,509,025		636										

ANNEX a1

C. Buildings

Nut storage		260 sq. m.											
Nut preparation area		725											
Sanitary line		150											
Freezer area (4 weeks output)		1250											
Drying for parings		200											
Drying for flakes		390											
Administrative		125											
Powerhouse		125											
Warehouse		250											
Warehouse for dry flakes		375											
Total building space	962,500	3,850											
D. Installation (1% of equipment)	25,090												
E. Start-up costs, legal fees, etc.	20,000												
F. Total capital costs	3,516,615	3,516,615	0	0	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0	0	0
G. Variable costs													
Coconuts	2,030,457	0	609,137	1,218,274	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	1,421,320	0
Electricity	166,255												
Packaging for frozen cream	320,000												
Packaging for flakes	120,203												
Packaging for parings	12,670												
Other supplies and materials	20,000												
Stabilizers, disinfectants, etc.	10,000												
Unskilled labor	249,894												
Transport of cream (paid by central)	0												
Transport of parings	15,838												
Transport of flakes	45,076												
TOTAL	2,990,393	0	897,118	1,794,236	2,093,275	2,093,275	2,093,275	2,093,275	2,093,275	2,093,275	2,093,275	2,093,275	0
H. Fixed costs													
Land rent	45,000	0	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	0
Indirect labor	8,411	0	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	0
Administrative, managerial, technical labor	78,904	0	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	0
Night supervisor	4,219	0	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	0
Depreciation	306,537	0	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	306,537	0
Insurance	34,715	0	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	34,715	0
Interest	569,692	0	0	569,692	569,692	569,692	569,692	569,692	0	0	0	0	0
Maintenance	173,576	0	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	173,576	
Other	149,520	0	149,520	149,520	149,520	149,520	149,520	149,520	149,520	149,520	149,520	149,520	
TOTAL	1,370,573	0	800,881	1,370,573	1,370,573	1,370,573	1,370,573	1,370,573	800,881	800,881	800,881	800,881	0
I. Total annual costs	4,360,966												

ANNEX a1

J. Sales of byproducts

Dried parings	70,213												
Low fat coconut flakes	199,838												
TOTAL	270,051	0	81,015	162,030	189,036	189,036	189,036	189,036	189,036	189,036	189,036	189,036	0
Breakeven price at 100% capacity use	1.02												
Price w/ 15% margin	1.18												
Revenues from product (w/15% margin, 1% wastage)	4,657,507	0	1,397,252	2,794,504	3,260,255	3,260,255	3,260,255	3,260,255	3,260,255	3,260,255	3,260,255	3,260,255	0
										0	0	0	0
Net revenues before taxes		(3,516,615)	(219,732)	(208,274)	(14,558)	(14,558)	(14,558)	(14,558)	555,134	555,134	555,134	555,134	0
Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
Net revenues after taxes		(3,516,615)	(219,732)	(208,274)	(14,558)	(14,558)	(14,558)	(14,558)	555,134	555,134	555,134	555,134	0
Other adjustments to cashflows (fin)													
Loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of depreciation	306,537	0	306,537	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	301,875	0
Replacement costs (vehicle)		0	0	0	0	0	0	50000	0	0	0	0	0
Salvage value	481,250	0	0	0	0	0	0	0	0	0	0	0	225,000
Net cashflows (financial, 18% interest rate)		(351,662)	86,805	(609,722)	(357,433)	(357,433)	(357,433)	(407,433)	857,009	857,009	857,009	857,009	225,000
Cumulative net cashflows (fin, 18% interest rate)		(351,662)	(264,857)	(874,579)	(1,232,012)	(1,589,444)	(1,946,877)	(2,354,309)	(1,497,300)	(640,291)	216,718	1,073,727	1,298,727
										0	0	0	0
Interest (at 12%)	379,794	0	0	379,794	379,794	379,794	379,794	379,794	0	0	0	0	0
Net cashflows (financial, 12% interest rate)		(351,662)	86,805	(419,825)	(167,535)	(167,535)	(167,535)	(217,535)	857,009	857,009	857,009	857,009	225,000
Cumulative net cashflows (fin, 12% interest rate)		(351,662)	(264,857)	(684,682)	(852,217)	(1,019,752)	(1,187,288)	(1,404,823)	(547,814)	309,195	1,166,204	2,023,213	2,248,213
Adjustments for economic analysis													
Exclusion of loan proceeds	3,164,954	3,164,954	0	0	0	0	0	0	0	0	0	0	0
Exclusion of principal	703,323	0	0	703,323	644,750	644,750	644,750	644,750	0	0	0	0	0
Exclusion of interest	379,794	0	0	379,794	348,165	348,165	348,165	348,165					
Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Net cashflows (economic, without financing)		(3,516,615)	86,805	663,293	825,380	825,380	825,380	775,380	857,009	857,009	857,009	857,009	225,000
Cumulative net cashflows (economic)		(3,516,615)	(3,429,811)	(2,766,518)	(1,941,138)	(1,115,759)	(290,379)	485,001	1,342,010	2,199,019	3,056,028	3,913,037	4,138,037
At listed nut price													
IRR (financial, 18% interest rate)	0.08												
IRR (financial, 12% interest rate)	0.17												
IRR (economic, without financing)	0.15												
NPV (fin, 18%, r=15%)	(368,950)												
NPV (fin, 12%, r=15%)	112,384												
NPV (econ,r=15%)	(63,687)												
Nut cost at a higher unit price ($.013/nut)	2,639,594	0	791,878	1,583,756	1,847,716	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	2,018,198	
Net cashflows (fin, 18%)		(351,662)	(95,936)	(975,204)	(783,829)	(954,311)	(954,311)	(1,004,311)	260,131	260,131	260,131	260,131	225,000
Net cashflows (fin, 12%)		(351,662)	(95,936)	(785,307)	(593,931)	(764,414)	(764,414)	(814,414)	260,131	260,131	260,131	260,131	225,000
Net cashflows (econ, w/o fin)		(3,516,615)	(95,936)	297,810	398,984	228,501	228,501	178,501	260,131	260,131	260,131	260,131	225,000
IRR (fin, 18%, high nut price)	(0.24)												
IRR (fin, 12%, high nut price)	(0.21)												
IRR (econ, w/o fin)	(0.05)												
NPV (fin, 18%, r=15%)	(2,411,047)												
NPV (fin, 12%, r=15%)	(1,929,712)												
NPV (econ,r=15%)	(2,105,784)												

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ANNEX ami

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Western Samoa (double shift, starAsept)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	4.01												
4. Electricity, $/kw-hr	0.14												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flaker, $/kg	0.10												
11. Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 25-l starAsept	4.13												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	16.89												

B. Equipment			
Nut opening	14	hr	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		420000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
StarAsept lease rights	3		55,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	232		2,793,025

ANNEX am

C. Buildings															
Nut storage	260														
Nut preparation area	725														
Sanitary line	150														
Drying for parings	200														
Drying for flakes	390														
Administrative	125														
Powerhouse	125														
Warehouse	250														
Warehouse for dry flakes	375														
	2,600		650,000												
D. Start-up costs, legal fees			20,000												
E. Installation			279,303												
F. TOTAL CAPITAL COSTS			3,742,328	3,742,328											
C. Variable Costs															
Coconuts			1,694,915												
Electricity			60,647												
Packaging materials for cream			660,800												
Packaging for flakes			100,339												
Packaging for parings			10,576												
Other supplies and materials			20,000												
Stabilizers, disinfectants, etc			20,000												
Unskilled labor			214,058												
Transport of cream ($3200/FCL)			774,400												
Transport of parings			15,220												
Transport of flakes			37,622												
Total variable costs			3,608,583		0	1,081,975	2,163,950	2,524,608	2,524,608	2,524,608	2,524,608	2,524,608	2,524,608	2,524,608	2,524,608
D. Fixed costs															
Land rent			30,000		0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Indirect labor			8,411		0	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411
Administrative expenses			78,904		0	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904
Night supervisor			4,219		0	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219
Depreciation			316,803		0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803
Maintenance			187,116		0	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116	187,116
Other			180,329		0	180,329	180,329	180,329	180,329	180,329	180,329	180,329	180,329	180,329	180,329
Insurance			34,430		0	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430	34,430
Interest			606,257		0	0	606,257	606,257	606,257	606,257	606,257	0	0	0	0	0
Total			1,446,469		0	840,212	1,446,469	1,476,469	1,476,469	1,476,469	1,476,469	870,212	870,212	870,212	870,212	0
E. Total annual costs			5,053,052												
F. Sales of byproducts															
Dried paring	1,763	kg/day	58,610		0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296	
Low-fat coconut flakes	5,017		125,424		0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855	
			184,034		0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

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109 ANNEX am

110	G. Breakeven price of coconut cream	1.22												
111	Sales price	1.54												
112														
113	Revenues from product (w/ 1% wastage)	6,098,400	0	1,829,520	3,659,040	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	4,268,880	0
114														
115	Net revenues before taxes		(3,742,328)	(37,456)	159,042	396,627	396,627	396,627	396,627	1,002,884	1,002,884	1,002,884	1,002,884	0
	Taxes and annual license fees	0	0	0	0	0	0	0	0	0	0	0	0	0
	Net revenues after taxes		(3,742,328)	(37,456)	159,042	396,627	396,627	396,627	396,627	1,002,884	1,002,884	1,002,884	1,002,884	0
	Other adjustments to cashflows (fin)													
	Loan proceeds	3,368,095	3,368,095											
	Repayment of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619	0	0	0	0	0
	Exclusion of depreciation	316,803	0	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	316,803	
	Replacement costs (vehicle)	40,000							40,000					
	Salvage value	325,000												325,000
	Net cashflows (financial, 18% interest rate)		(374,233)	279,346	(197,775)	39,811	39,811	39,811	(189)	1,319,687	1,319,687	1,319,687	1,319,687	325,000
	Cumulative net cashflows (fin, 18% interest rate)		(374,233)	(94,887)	(292,661)	(252,851)	(213,040)	(173,230)	(173,419)	1,146,267	2,465,954	3,785,640	5,105,327	5,430,327
	Interest at 12%	404,171	0	0	404,171	404,171	404,171	404,171	404,171	0	0	0	0	0
	Net cashflows (fin, 12% interest)		(374,233)	279,345	4,311	241,896	241,896	241,896	201,896	1,319,687	1,319,687	1,319,687	1,319,687	325,000
	Cumulative net cashflows (fin, 12% int)		(374,233)	(94,887)	(90,576)	151,321	393,217	635,113	837,009	2,156,696	3,476,382	4,796,069	6,115,755	6,440,755
	Adjustments for economic analysis													
	Exclusion of principal	673,619	0	0	673,619	673,619	673,619	673,619	673,619					
	Exclusion of interest	404,171	0	0	404,171	404,171	404,171	404,171	404,171					
	Exclusion of taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
	Exclusion of loan proceeds	3,368,095	3,368,095											
	Net cashflows (econ, w/o financing)		(3,742,328)	279,346	1,082,101	1,319,687	1,319,687	1,319,687	1,279,687	1,319,687	1,319,687	1,319,687	1,319,687	325,000
	Cumulative net cashflows (econ, w/o financing)		(3,742,328)	(3,462,981)	(2,380,880)	(1,061,193)	258,493	1,578,180	2,857,868	4,177,553	5,497,239	6,816,926	8,136,612	8,461,612

IRR (financial, 18% interest)	0.45
IRR (financial, 12% interest)	0.65
IRR (economic, w/o financing)	0.25
NPV(fin, 18%, r=15%)	1,292,615
NPV(fin, 12%,r=15%)	1,804,843
NPV(econ, r=15%)	1,607,952

Extra nut cost at a higher unit price ($0.13/nut)	508,475	0	152,542	305,085	355,932	465,738	465,738	465,738	465,738	465,738	465,738	465,738		
Net cashflows (fin, 18%)		(374,233)	126,804	(502,859)	(316,122)	(425,927)	(425,927)	(465,927)	853,949	853,949	853,949	853,949	325,000	
Net cashflows (fin, 12%)		(374,233)	126,804	(300,774)	(114,036)	(223,842)	(223,842)	(263,842)	853,949	853,949	853,949	853,949	325,000	
Net cashflows (econ, w/o fin)		(3,742,328)	126,804	777,017	963,754	853,949	853,949	813,949	853,949	853,949	853,949	853,949	325,000	

IRR (fin, 18%), high nut price	0.09
IRR (fin, 12%), high nut price	0.19
IRR (econ, w/o fin), high nut price	0.15
NPV(fin, 18%, r=15%)	(334,700)
NPV(fin, 12%,r=15%)	177,529
NPV(econ, r=15%)	(19,362)

ANNEX an

COMPLETELY PROCESSED COCONUT CREAM (1000 LITERS/HR)
Western Samoa (doutetrapak)
2-10-89

A. Assumptions	DATA	YR 0	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11
1. Product with fat content of 22.5%.													
2. Price of dehusked nuts, $/nut	0.10												
3. Unskilled wage, $/day(w/fringe benefits, leave)	4.01												
4. Electricity, $/kw-hr	0.14												
5. Building cost, $/sq.m.	250.00												
6. Yield of cream, liters/nut	0.24												
7. Interest rates, %	0.18												
8. Selling price of parings, $/kg	0.13												
9. Selling price of low-fat flakes, $/kg	0.10												
11 Maintenance costs	0.05												
12. Raw material requirement, nuts per day (two shifts)	67,797												
13. Shelling rate, nuts/day	750.00												
14. Paring rate, nuts/day	750.00												
15. Working days per year	250.00												
16. Packaging materials, 250 ml tetrapak	0.14												
17. Daily production, liters/day (two shifts)	16,000.00												
18. Depreciation of building	0.05												
19. Depreciation of machinery	0.10												
20. Depreciation of vehicle	0.2												
21. Insurance, % of equipment and buildings cost	0.01												
22. Fraction of capital investment loaned	0.90												
23. Capacity use (Yr 1--70% single shift; Yr 2--60% double shift, Yrs 3-10--70% double shift)													
24. Skilled wage, $/day(w/ fringe benefits & leave)	16.88												

B. Equipment

Nut opening	14	hp	38,500
Washing and inspection area	10		34,650
Grinding/blanching/pressing	64		238,000
Flakes dryer	50		420000
Screening and packing area	10		42000
Pasteurizing	5		240,000
FDA Standard extra	0		36,000
Aseptic processing plant	5		504,000
Homogenizer	30		105,000
Aseptic tank	1		140,000
Aseptic filling system (tetrapak	2		635,000
Lab equipment	2		50000
Dryer for parings	25		140,000
Generator			46,875
Boiler	5		210,000
Office equipment	2		40,000
Truck scale	0		40,000
Payloader			150000
Land transport vehicle			50,000
Water treatment plant	5		70,000
Waste disposal system			100000
CIP	1		43,000
Total equipment cost	231		3,373,025

52 ANNEX an

53	C. Buildings														
54															
55	Nut storage	260													
56	Nut preparation area	725													
57	Sanitary line	150													
58	Drying for parings	200													
59	Drying for flakes	390													
61	Administrative	125													
62	Powerhouse	125													
63	Warehouse	250													
64	Warehouse for dry flakes	375													
65		2,600		650,000											
66															
67	D. Start-up costs, legal fees			20,000											
68															
69	E. Installation			337,303											
70															
71	F. TOTAL CAPITAL COSTS			4,380,328	4,380,328										
72															
73															
74	C. Variable Costs														
75															
76	Coconuts			1,694,915											
77	Electricity			60,385											
78	Packaging materials for cream			2,240,000											
	Packaging for flakes			100,339											
	Packaging for parings			10,576											
79	Other supplies and materials			20,000											
80	Stabilizers, disinfectants, etc			20,000											
81	Unskilled labor			214,058											
	Transport of cream ($3200/FCL)			774,400											
	Transport of parings			13,220											
	Transport of flakes			37,627											
82															
83	Total variable costs			5,185,521	0	1,555,656	3,111,313	3,629,865	3,629,865	3,629,865	3,629,865	3,629,865	3,629,865	3,629,865	3,629,865
84															
85	D. Fixed costs														
86															
87	Land rent			30,000	0	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
89	Indirect labor			8,411	0	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411	8,411
90	Administrative expenses			78,904	0	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904	78,904
	Night supervisor			4,219	0	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219	4,219
91	Depreciation			374,803	0	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803	374,803
92	Maintenance			219,016	0	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016	219,016
93	Other			259,276	0	259,276	259,276	259,276	259,276	259,276	259,276	259,276	259,276	259,276	259,276
94	Insurance			40,230	0	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230	40,230
95	Interest			709,613	0	0	709,613	709,613	709,613	709,613	709,613	0	0	0	0	0
96															
97	Total			1,724,472	0	1,014,859	1,724,472	1,754,472	1,754,472	1,754,472	1,754,472	1,044,859	1,044,859	1,044,859	1,044,859	0
98															
99															
100	E. Total annual costs			6,909,993											
101															
102	F. Sales of byproducts														
103															
104	Dried paring	1,763	kg/day	58,610	0	17,583	35,166	41,027	37,296	37,296	37,296	37,296	37,296	37,296	37,296
106	Low-fat coconut flakes	5,017		125,424	0	37,627	75,254	87,797	107,855	107,855	107,855	107,855	107,855	107,855	107,855
107															
108				184,034	0	55,210	110,420	128,824	128,824	128,824	128,824	128,824	128,824	128,824	128,824	0

108
109 ANNEX an
110 G. Breakeven price of coconut cream 1.68
111 Sales price 1.98
112
113 Revenues from product (w/ 1% wastage) 7,840,800 0 2,352,240 4,704,480 5,488,560 5,488,560 5,488,560 5,488,560 5,488,560 5,438,560 5,488,560 5,488,560 0
114
115 Net revenues before taxes (4,380,328) (163,065) (20,884) 233,047 233,047 233,047 233,047 942,660 942,660 942,660 942,650 0
Taxes and annual license fees 0 0 0 0 0 0 0 0 0 0 0 0 0
Net revenues after taxes (4,380,328) (163,065) (20,884) 233,047 233,047 233,047 233,047 942,660 942,660 942,660 942,660 0

Other adjustments to cashflows (fin)
Loan proceeds 3,942,295 3,942,295
Repayment of principal 788,459 0 0 788,459 788,459 788,459 788,459 788,459 0 0 0 0 0
Exclusion of depreciation 374,803 0 374,803 374,803 374,803 374,803 374,803 374,803 374,803 374,803 374,803 374,803
Replacement costs (vehicle) 40,000 40,000
Salvage value 325,000 325,000
Net cashflows (financial, 18% interest rate) (438,033) 211,738 (434,541) (180,609) (180,609) (180,6[illegible] (220,609) 1,317,463 1,317,463 1,317,463 1,317,463 325,000
Cumulative net cashflows (fin, 18% interest rate) (438,033) (226,295) (660,836) (841,445) (1,022,055) (1,202,664) (1,423,274) (105,811) 1,211,652 2,529,114 3,846,577 4,171,577

Interest at 12% 473,075 0 0 473,075 473,075 473,075 473,075 473,075 0 0 0 0 0
Net cashflows (fin, 12% interest) (438,033) 211,738 (198,003) 55,928 55,928 55,928 15,928 1,317,463 1,317,463 1,317,463 1,317,463 325,000
Cumulative net cashflows (fin, 12% int) (438,033) (226,295) (424,298) (368,370) (312,442) (256,513) (240,585) 1,076,877 2,394,340 3,711,803 5,029,265 5,354,265

Adjustments for economic analysis
Exclusion of principal 788,459 0 0 788,459 788,459 788,459 788,459 788,459
Exclusion of interest 473,075 0 0 473,075 473,075 473,075 473,075 473,075 0 0 0 0 0
Exclusion of taxes 0 0 0 0 0 0 0 0
Exclusion of loan proceeds 3,942,295 3,942,295
Net cashflows (econ, w/o financing) (4,380,328) 211,738 1,063,531 1,317,463 1,317,463 1,317,463 1,277,463 1,317,463 1,317,463 1,317,463 1,317,463 325,000
Cumulative net cashflows (econ, w/o financing) (4,380,328) (4,168,590) (3,105,059) (1,787,596) (470,133) 847,329 2,124,792 3,442,254 4,759,717 6,077,179 7,394,642 7,719,642

IRR (financial, 18% interest)	0.25
IRR (financial, 12% interest)	0.40
IRR (economic, w/o financing)	0.20
NPV(fin, 18%, r=15%)	614,179
NPV(fin, 12%,r=15%)	*********
NPV(econ, r=15%)	983,276

Extra nut cost at a higher unit price ($0.13/nut) 508,475 0 152,542 305,085 355,932 465,738 465,738 465,738 465,738 465,738 465,738 465,738
Net cashflows (fin, 18%) (438,033) 59,195 (739,625) (536,542) (646,347) (646,347) (686,347) 851,725 851,725 851,725 851,725 325,000
Net cashflows (fin, 12%) (438,033) 59,195 (503,088) (300,004) (409,810) (409,810) (449,810) 851,725 851,725 851,725 851,725 325,000
Net cashflows (econ, w/o fin) (4,380,328) 59,195 758,447 961,530 851,725 851,725 811,725 851,725 851,725 851,725 851,725 325,000

IRR (fin, 18%), high nut price	0.01
IRR (fin, 12%), high nut price	0.08
IRR (econ, w/o fin), high nut price	0.11
NPV(fin, 18%, r=15%)	*********
NPV(fin, 12%,r=15%)	(413,581)
NPV(econ, r=15%)	(644,038)

POTENTIAL FOR PRODUCTION AND MARKETING HIGH VALUE SOUTH PACIFIC COCONUT PRODUCTS

VOLUME IV

ANNEX IV - EQUIPMENT SUPPLIER INFORMATION AND QUOTES

ANNEX V - QUALITY ASSURANCE REQUIREMENTS AND NEW PRODUCT CONCEPTS

POTENTIAL FOR PRODUCTION AND
MARKETING HIGH VALUE
SOUTH PACIFIC COCONUT
PRODUCTS

ANNEX IV

EQUIPMENT SUPPLIER INFORMATION AND QUOTES

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QUALITY ASSURANCE REQUIREMENTS AND NEW PRODUCT CONCEPTS

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Scholle Corporation

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IRVINE, CA 92713

P.O. BOX 19277
PHONE: (714) 955-1750
TELEX: 692-455

March 10, 1989

Mr. George Patterson
A.T. INTERNATIONAL
1331 H Street NW
Washington, D.C. 20005

Dear Mr. Patterson,

Thank you for your phone call regarding an interest in our low acid filler for coconut cream and coconut milk. Enclosed please find a full quotation covering this twin-head low acid aseptic bag filler. Should you have any comments or questions please feel free to contact either Mr. George McFarlin or myself.

Very truly yours,

Jody Hitchcock
Customer Service

JH/ee
Enclosure

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GENERAL DESCRIPTION

The AUTO-FILL 10-2 LA is a dual headed, low acid, aseptic filling machine that fills presterilized plastic bags to a predetermined volume. Successful aseptic filling requires that the proper sterile conditions be achieved and maintained CONTINUOUSLY.

Your Scholle AUTO-FILL 10-2 LA is equipped with a system of monitors and controls interfaced to a programmable controller to ensure that the proper operating conditions are being maintained during filling operations. If one or more of the process conditions varies beyond the parameters necessary for safe aseptic filling, this system of monitors will alert the operator with a warning light, print a message listing the fault condition(s) and, if necessary, stop the filling operation.

In addition, product will be automatically diverted away from the filler and the upstream processing control will be informed of this action.

A system for automatic sterilization of the filler has been designed into the AUTO-FILL 10-2 LA. After this system has been setup and started, it does not require any further operator attention. This system also automates the flush/CIP cycles.

Sterility of the filling chamber is maintained by a positive sterile air supply coming from a microfilter system. The air supply is delivered into the chamber through an atomizing spray head which drives a chlorine solution into the chamber in a very fine particle spray. The chamber is maintained at a temperature of 150 deg. F ±5 deg. F (88 deg. C ±2.7 deg. C) by steam injection to increase the effectiveness of the chlorine solution.

The filling chamber is not opened directly to the atmosphere when the presterilizing spout cup is in place over the bottom opening of the chamber. Sterilizing steam is released into the cup when a spout is locked into place in the cup. The cup is removed from over the spout at the end of the preset time period.

The filler control then removes the cap from the spout, inserts the filling head into the spout, evacuates excess air, fills the bag to a predetermined volume, closes the filling valve, puffs in a small volume of inert gas, and then recaps the spout for bag removal.

LOW ACID PACKAGING REQUIREMENTS

The packaging of low acid food in the United States is under the regulation of the Food and Drug Administration (USFDA) and the Department of Agriculture (USDA) for meat and poultry. The Federal Register Title 21 Part 113 contains the rules and regulations that are required, and must be understood and followed.

The following are excerpts from these rules and regulations and are in no way complete.

PERSONNEL

The operators of your Scholle AUTO-FILL shall be under the operating supervision of a person who fully understands the technology of Aseptic packaging and has gone through the training supplied by Scholle Corporation and fully understands the SCHEDULED PROCESSES that are outlined in the Service Manual.

MAINTENANCE AND RECORDS OF INSTRUMENTATION

All measurement and recording devices of critical factors should have a tag, seal, or other means of identity that includes the date on which it was last tested for accuracy. Records of accuracy checks which specify date, standard used, method used and person performing the test should be kept.

All temperature recording charts, printers and other production records must be reviewed by a qualified representative of management and signed or initialed by him within one working day and before release or shipment of such product. All charts and records must be kept on file for a period of three years.

DEFINITIONS OF TERMS USED IN THIS MANUAL

COMMERCIAL STERILITY

COMMERCIAL STERILITY of equipment and containers used for aseptic processing and packaging of food means the condition achieved by application of heat, chemical sterilant(s), or other appropriate treatment that renders the equipment and containers free of viable microorganisms of having public health significance, as well as microorganisms of nonhealth significance, capable of reproducing in the food under normal non-refrigerated conditions of storage and distribution.

CRITICAL FACTOR (SEVERITY WARNING LEVEL 3)

CRITICAL FACTOR means any property, characteristic, condition, aspect, or other parameter, variation of which may affect the scheduled process and the attainment of commercial sterility. Critical factors specified in the scheduled process shall be measured and recorded on the processing record at intervals of sufficient frequency to ensure that the factors are within the limits specified in the scheduled process. All measurements and recordings of critical factors should be made at intervals not to exceed 15 minutes.

SCHEDULED PROCESS

SCHEDULED PROCESS means the process selected by the processor that equals or exceeds the minimum requirements set forth in the scheduled process.

LOW ACID

LOW ACID means any food, other than alcoholic beverages with a finished equilibrium pH greater than 4.6 and a water activity greater than 0.85. Tomatoes and tomato products having a finished equilibrium pH less than 4.7 are not classified as low-acid foods.

SHALL

SHALL is used to state mandatory requirements.

SHOULD

SHOULD is used to state recommended or advisory procedures or to identify recommended equipment.

ADDITIONAL DEFINITIONS AND TERMS USED IN THIS MANUAL

WARNING

WARNING is used to denote that damage to filling equipment is possible.

IMPORTANT

IMPORTANT is used to state information that is necessary for the operation of the equipment.

DANGER

DANGER is used to denote that injury to operating personnel is possible.

AUTO-FILL LOCATION

1. It is important that your SCHOLLE Aseptic Filler be located in as clean an environment as possible. In a clean environment the filler has a lower microbacteriological load to deal with.

2. The location, where the bags to be filled are held, should be protected. The distance between the filler and where the bags are located before filling should be as short as possible.

3. Bags come to you packed in an overwrap bag. Tear the overwrap across the end and reach in for each bag only before it is to be filled. If you have a web filler, completely open the overwrap so the bags will feed freely and attach the tail of the web to the next box of bags. Place the bag-box cover over the open box of bags to protect the bags from airborne dust and contamination. Do not leave bags out in ambient air. Attempt to use up all bags in an overwrap before closing down production. If bags are left over, be sure to securely close the overwrap.

4. The operator should avoid handling or touching the spout and cap before insertion into the spout holder. It is recommended that rubber gloves be used and that they be periodically dipped into a chlorine solution.

SERVICE CONNECTION & POWER REQUIREMENTS

1. COMPRESSED AIR

   100 PSI (690 KPa) at 10 CFM (283 l/min.) 1/4" pipe, no more than 25' long (7.6 meters). If longer, use 3/4" pipe.

2. INERT GAS (NITROGEN)

   Connected to valve V-9, regulator R-4 is adjusted between 40-90 PSI (276-621 KPa) at 10 cu ft/hr (280 l/hr. with production of 150 bags/hr.).

3. ELECTRICAL

   230/380/415/460 volts, 50/60 Hertz; 1 phase; 1 KVA service.

4. PRODUCT LINE

   Connections are as shown in flow diagram #1380763. The by-pass valve is controlled by the filler.

   NOTE: It is recommended by the SCHOLLE corporation that the filler be separated from the processing equipment by a bypass valve (furnished by customer). The process equipment and the interfacing piping is sterilized separately from the filler.

   IMPORTANT: To obtain maximum accuracy of fill, there must be a section of straight pipe immediately upstream of the flowmeter. This straight pipe must be at least 10 times the inside diameter of the flowmeter in length.

5. Product line pressure shall not exceed 150 PSI (1035 KPa).

6. CHLORINE TANK

Use to supply chlorine solution to the filling chamber spray head. Connect the inert gas supply to the tank by the "G" quick-disconnect fitting. Connect the "L" quick-disconnect fitting to the liquid side of the tank for removal of the chlorine solution to spray head. The chlorine solution tank should be filled with 5 gallons of 150 ppm chlorine solution.

NOTE: See the manual section STERILANT SOLUTION PREPARATION AND TESTING for instructions on preparation and testing of the 150 ppm chlorine solution.

Pressure on the tank is set at approximately 10 PSI (69 KPa). V-42 and V-43 control valves are adjusted for a flow rate of 10 ml/minute for each spray head, with a new filter element.

7. VACUUM SUPPLY

18" Hg (-61 KPa) of vacuum is supplied to the filler thru a vacuum tank system. The purpose of the tank system is to supply an instant reserve of vacuum for the removal of excess air from the bag before filling and to collect any product that may travel up the vacuum system. Vacuum is generated by an air powered jet vacuum pump that is set at 18" Hg (-61 KPa). Setting vacuum above 18" Hg (-61 KPa) can cause damage to the inside liner of the bag.

Regulated vacuum may be supplied to the tank from a plant vacuum supply.

Quick disconnects are used for easy removal for cleaning and service. (See manufacturers manual for instructions.)

8. STEAM SUPPLY

Connect to valve V-13 (1/2 pipe minimum). Clean, good quality steam such as is used for culinary purposes must be used. The quantity of steam required is 20 lb/hr (9 kg/hr) for sterilizing and 10 lb/hr (4.5 kg/hr) for filling.

Steam regulator R-5 is for the heating of the filling chambers, product line sterilization, F-1 filter sterilization, and steam flushing of F-2 and F-3 filters; set at 20 PSI (138 KPa).

Steam regulator R-12 is used for all of the steam seals; set at 20 PSI (138 KPa).

Steam regulator R-16 is used as the steam source for the presterilizing spout cup; set at 70 PSI (483 KPa).

AUTOMATIC STERILIZATION CYCLE AUTO FILL 10-2 LOW ACID

PRIOR TO START OF AUTOMATIC STERILIZATION CYCLE THE FOLLOWING CONDITIONS EXIST:

SOL-102	RIGHT STEAM SEALS DRAIN	CLOSED (OFF)
SOL-103	CHAMBERS DRAIN	OPEN (ON)
SOL-104	PRODUCT LINE STEAM HEAT	CLOSED (OFF)
SOL-105	STEAM SEALS STEAM HEAT	CLOSED (OFF)
SOL-106	LEFT CHAMBER STERILIZING HEAT	CLOSED (OFF)
SOL-107	LEFT PUFF VALVE	CLOSED (OFF)
SOL-108	RIGHT CHAMBER STERILIZING HEAT	CLOSED (OFF)
SOL-110	RIGHT PUFF VALVE	CLOSED (OFF)
SOL-111	PRODUCT MANIFOLD DRAIN	CLOSED (OFF)
SOL-112	LEFT STEAM SEALS DRAIN	CLOSED (OFF)
SOL-8	LEFT PRODUCT VALVE	CLOSED (OFF)
SOL-9	RIGHT PRODUCT VALVE	CLOSED (OFF)
SOL-124	LEFT STEAM FLUSH VALVE	CLOSED (OFF)
SOL-125	RIGHT STEAM FLUSH VALVE	CLOSED (OFF)
SOL-126	CHAMBER HEAT	CLOSED (OFF)

TO START THE AUTOMATIC STERILIZATION CYCLE THE FOLLOWING CONDITIONS MUST BE MET:

FLUSH/CIP CYCLE OFF
EMERGENCY STOPS PULLED OUT
ALL MANUAL OPERATIONS OFF
ALL AUTOMATIC CYCLES OFF
KEY SWITCHES IN "NO" POSITION
CHAMBER HEAT OFF
TEMPERATURE RECORDERS ON

COMPRESSED AIR PRESSURE CORRECT
NITROGEN PRESSURE CORRECT
VACUUM SUPPLY CORRECT
STEAM PRESSURE CORRECT
CHAMBER CHLORINE LEVEL CORRECT
CHAMBER CHLORINE FLOW CORRECT

AUTOMATIC STERILIZATION STARTED BY PUSHING MEMBRANE SWITCH MS-E,3 "AUTOMATIC STERILIZATION CYCLE START". THE SPOUT COVERS AND FILLING CHAMBERS WILL MOVE UP AUTOMATICALLY, THEN:

SOL-103	CHAMBERS DRAIN	CLOSES (OFF)
SOL-8	LEFT PRODUCT VALVE	OPENS (ON)
SOL-9	RIGHT PRODUCT VALVE	OPENS (ON)
SOL-126	CHAMBER HEAT	OPENS (ON)
SOL-105	STEAM SEALS STEAM HEAT	OPENS (ON)
SOL-102	RIGHT STEAM SEALS DRAIN	OPENS (ON)
SOL-112	LEFT STEAM SEALS DRAIN	OPENS (ON)
SOL-104	PRODUCT LINE STEAM HEAT	OPENS (ON)
SOL-106	LEFT CHAMBER STERILIZE HEAT	OPENS (ON)
SOL-108	RIGHT CHAMBER HEAT	OPENS (ON)

WHEN TP-9 REACHES 250 F THEN:

SOL-111	PRODUCT MANIFOLD DRAIN	OPENS (ON)

WHEN TP-4 & 14 REACH 250 F AND
TP-5, 6, 7, 8, 10, AND 11 = 225 F THEN:

FIRST STAGE STERILIZATION CYCLE IS STARTED (30 MINUTES)

WHEN FIRST STAGE STERILIZATION IS COMPLETE THEN:

SOL-103 CHAMBERS DRAIN	OPENS (ON)
SOL-104 PRODUCT LINE STEAM HEAT	CLOSES (OFF)
SOL-106 LEFT CHAMBER HEAT	
SOL-108 RIGHT CHAMBER HEAT	
SOL-112 LEFT STEAM SEALS DRAIN	
SOL-102 RIGHT STEAM SEALS DRAIN	

WHEN THE CHAMBER AIR FLOW SENSOR SENSES FLOW THEN:

FILLING CHAMBERS DROP	
SOL-111 PRODUCT MANIFOLD DRAIN	CLOSES (OFF)
THE 10 MINUTE COOLING TIME STARTS	

WHEN THE 10 MINUTE COOLING TIME IS COMPLETE THEN:

FILLING CHAMBERS MOVE UP	
SOL-8 LEFT PRODUCT VALVE	CLOSES (OFF)
SOL-9 RIGHT PRODUCT VALVE	CLOSES (OFF)
SOL-124 LEFT STEAM FLUSH VALVE	OPENS (ON)
SOL-125 RIGHT STEAM FLUSH VALVE	OPENS (ON)

WHEN TP-9 & TP-14 REACH 250 F AND TP-5 & TP-6 = 225 F THEN:

SECOND STAGE STERILIZATION CYCLE IS STARTED (30 MINUTES)

WHEN SECOND STAGE STERILIZATION IS COMPLETE THEN:

SOL-124 LEFT STEAM FLUSH VALVE	CLOSES (OFF)
SOL-125 RIGHT STEAM FLUSH VALVE	CLOSES (OFF)
SOL-107 LEFT PUFF VALVE	OPEN (ON)
SOL-110 RIGHT PUFF VALVE	OPEN (ON)

AT THIS TIME THE 2 MINUTE WAITING TIME IS STARTED

WHEN THE 2 MINUTE WAITING TIME IS COMPLETE THEN:

SOL-107 LEFT PUFF VALVE	CLOSES (OFF)
SOL-110 RIGHT PUFF VALVE	CLOSES (OFF)

THE AUTOMATIC STERILIZATION CYCLE IS COMPLETE.
THE FILLING CHAMBERS MOVE DOWN, AND THE SPOUT CUPS MOVE DOWN.

STERIL_2

Scholle Corporation

19500 JAMBOREE BLVD P.O. BOX 19277
IRVINE, CA 92713 PHONE: (714) 955-1750
TELEX: 692-455

Date 3/10/89

AGREEMENT

FOR: A.T. INTERNATIONAL
1331 H Street NW
Washington, D.C. 20005

ACCEPTANCE AND AGREEMENT

This Proposal is subject to confirmation of price and approval by Scholle Corporation at Irvine, California, as stated in the General Terms of Sale, this Proposal shall not be binding until acceptance by an officer or other authorized employee of Scholle Corporation.

F.O.B. POINT - Ex Factory

ESTIMATED SHIP DATE: 24 ~~XX~~ ____ weeks from receipt of approved order at factory, complete with all specifications, approvals, executed documents and payments due with order. Due to fluctuation in engineering and manufacturing schedules, estimate is subject to confirmation or revision when order is accepted.

Prices quoted herein will be firm for a period of sixty (60) days from the date of this Proposal.

Please sign and return the original and duplicate of this Proposal. The duplicate will be returned when approved.

If, for record keeping purposes, you wish to submit a purchase order based on this Proposal, please sign this Proposal and attach your Purchase Order to it. The terms of this Proposal shall apply.

The General Terms of Sale and the Specifications and Pricing attached are an integral part of this Proposal.

The statements and information contained herein are believed to be reliable but are not to be construed as a warranty or guarantee for which we assume legal responsibility. Users should not rely on the information absolutely for specific applications and should undertake sufficient verification and testing to determine its validity and suitability for their own particular purpose. No warranty or fitness for a particular purpose is made.

Submitted By _____

525

_____	SCHOLLE CORPORATION
_____ Full Name of Buyer/User (Corporation, Partnership, or other)	
BY _____ (Print Name)	BY _____ (Print Name)
_____ (Signature)	_____ (Signature)
Title _____	Title _____
Date Accepted _____	Date Accepted_____

If Buyer/User is a corporation, a qualified officer must sign and the Secretary or other qualified officer should attest and affix the corporate seal. If Buyer/User is a partnership, a general partner must sign. Show full partnership name. An individual doing business under an assumed or trade name must sign his own name. Add "dba" (doing business as) and the assumed or trade name.

Scholle Corporation

19500 JAMBOREE BLVD
IRVINE, CA 92713

P.O. BOX 19277
PHONE: (714) 955-1750
TELEX: 692-455

December 1, 1988

EQUIPMENT PRICE LIST

AUTO FILL 10-2LA (LOW ACID) BASIC MACHINE . . . U.S. $184,600.00

OPTIONAL ITEMS:

ROLLER TABLE FOR 1-6 GALLON SIZE BAGS . . . . U.S. $ 4,060.00

ROLLER TABLE FOR 55/60 GALLON SIZE BAGS . . . U.S. $ 13,800.00

COMPREHENSIVE SPARE PARTS KIT . . . .Domestic U.S. $ 6,100.00
Overseas U.S. $ 16,000.00

Prices are quoted F.O.B. Irvine, California U.S.A.

Terms are 30% with order, 70% irrevocable letter of credit.

A Service Technician will be supplied for 40 hours at No Charge for his time. All time on site over 40 hours plus travel hours will be charged at current rates. All travel and living expenses at cost are for the buyer's account.

Scholle Corporation

19500 JAMBOREE BLVD
IRVINE, CA 92713

P.O. BOX 19277
PHONE: (714) 955-1750
TELEX: 692-455

February 10, 1989

Mr. John Slavics
A.T. INTERNATIONAL
1331 H Street
Washington D.C. 20005

Dear Mr. Slavics,

Thank you for your recent telephone call regarding your project in Samoa for packaging coconut milk and coconut cream. You are interested in our aseptic bag filler suitable for these two products for filling into bags ranging in size from 5 litre to 1,000 litre. As I mentioned our standard high acid bag filler is perfectly suited for coconut cream since the water activity is below .85 however the coconut milk would have to be called an extended shelf life product and stored at refrigerated temperatures throughout distribution. Attached you will find a complete quotation covering our Auto-Fill 10-2E including options. For the 1,000 litre bag in corrugated bin, you would need the expanded frame. Approximate pricing for our various size bags is as follows:

5 litre - $.60 each
5 gallon - $1.10 each
55 gallon for open head steel drum - USD $5.09 each
1,000 litre with 2" or 3" drain spout USD $30.00

These prices are quoted ex-factory Irvine California USA.

After you have evaluated this information I hope to hear from you with any further questions or comments you may have.

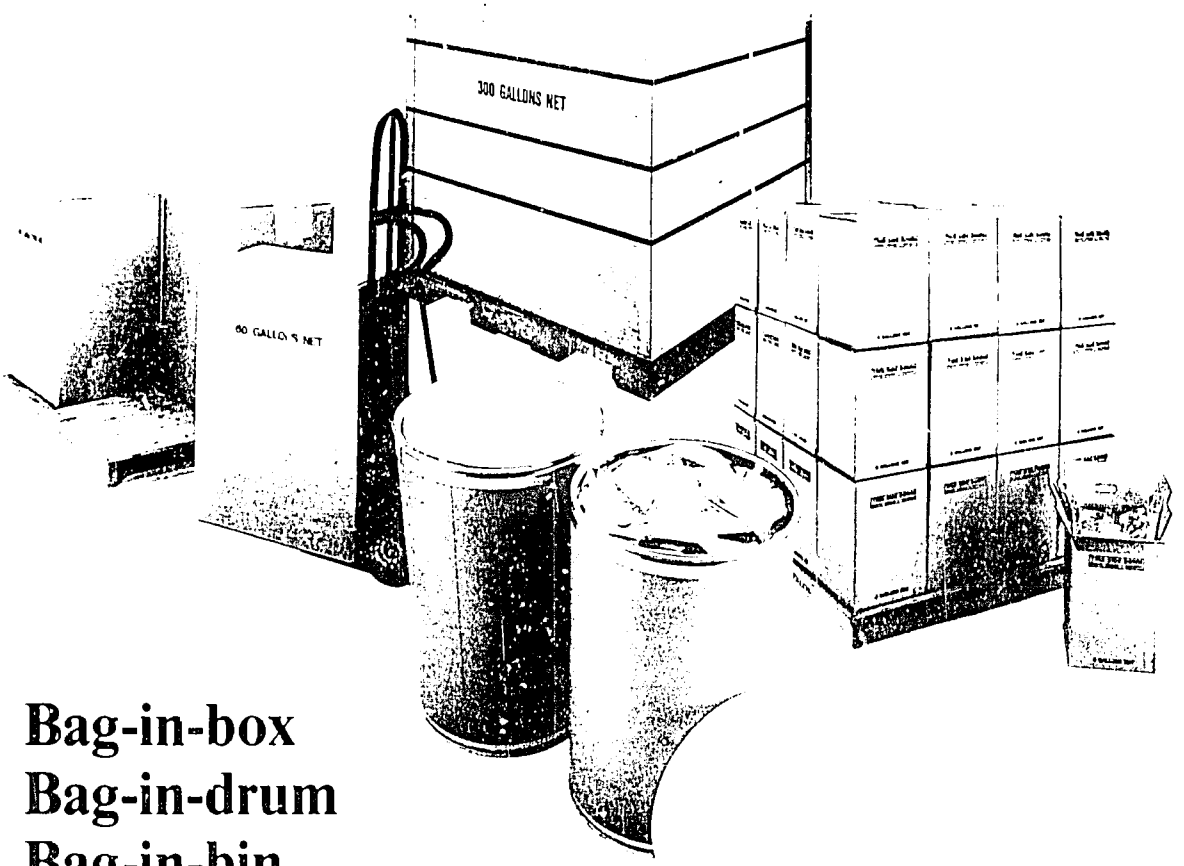
Very truly yours,

George McFarlin
Manager
New Product Development

GM/ee
Enclosure

Scholle
Aseptic system

PERFECT FOR EXPORT



Bag-in-box
Bag-in-drum
Bag-in-bin

Scholle Corporation originated the bag-in-box packaging system over 30 years ago and remains the number 1 bag supplier worldwide. To complement this business we offer a full line of filling equipment ranging from our single head manual non-aseptic bag filler to our completely automatic high speed aseptic bag fillers. Our bags range in size from 2 liter to 1,250 liters.

SCHOLLE
CORPORATION
19500 Jamboree Blvd.
Irvine, California, U.S.A. 92715
Telephone: 714-955-1750 Telex: 692-455 FAX: 714-476-2967

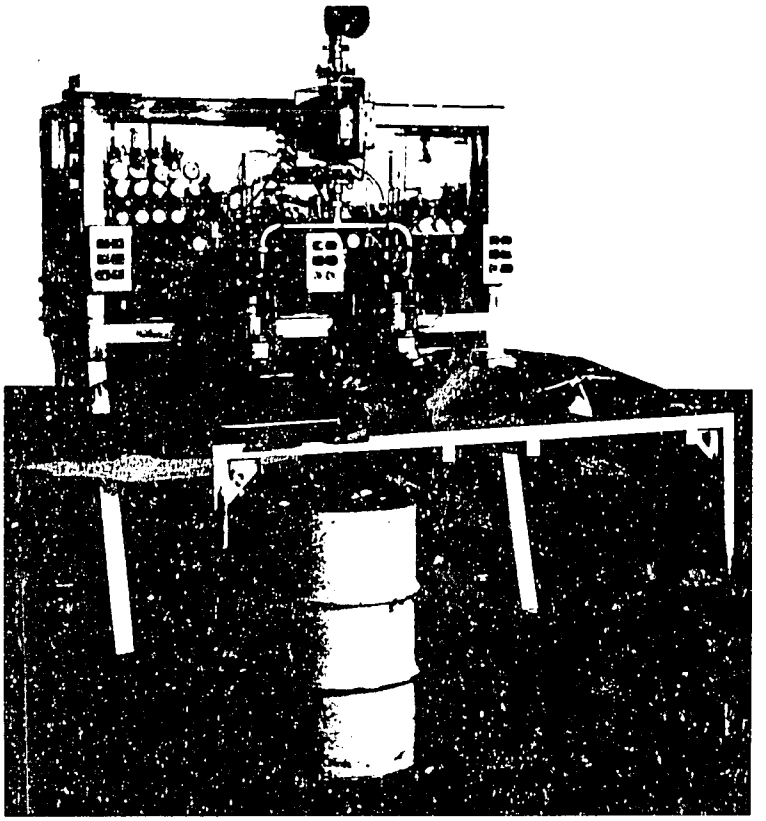
COMPARE COSTS!	
6 Gallon Bag-in-Box U.S.	$ .06 kg
60 Gallon Bag-in-Box	.04 kg
55 Gallon Bag-in-Drum	.08 kg
300 Gallon Bag-in-Bin, 1 way	.076/kg
5 Trips	.03 kg

The Scholle bag-in-box bag-in-drum package is the ideal export package for a number of reasons:

- lower cost than traditional packaging such as cans and drums
- light weight, thus lower shipping costs
- easy to dispose of after emptying
- reduces warehouse space by 80% on empty units and 33% on filled units
- aseptic processing and packaging give a better product quality

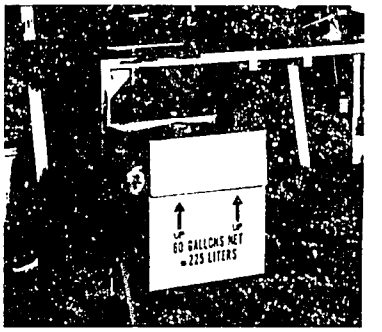
NOW WITH AUTO-STERILE

SCHOLLE AUTO-FILL 10-2E

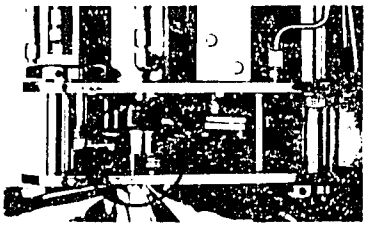


Shown filling aseptic bags for 55-gallon drums

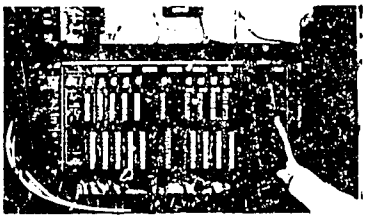
. . . With filling table for 1 to 6 gallon bags



. . . With 60-gallon Bag- In-Box Container



Automatic spout cap pre-sterilization cup.



Modular-design microprocessor controller.

THE VERSATILE, ASEPTIC FILLING SYSTEM FOR BAG-IN-BOX & DRUM FILLING

This aseptic bag filler can handle a wide range of container sizes and products. Using advanced engineering with state-of-the-art microprocessor controls, the Auto-Fill 10-2E is fast — capable of filling up to 60 drum bags per hour. Self-lubricating bearings allow long time, continuous operation. It's ideal for filling of tomato pastes and sauces, fruit purees, and other foods such as crushed pineapple and concentrates. With an optional pre-sterilization cup, single-strength juices, particulates and other sensitive foods can be handled effectively.

For 55-gallon drums or 60-gallon boxes, a wide frame accommodates two lines, and a smaller table attachment is available for filling bags up to 6-gallon size. Other features include a post-fill nitrogen puff to provide an inert gas blanket over the product before capping, and an optional vacuum/puff system to evacuate all air from the bag before filling.

SCHOLLE
CORPORATION

-520

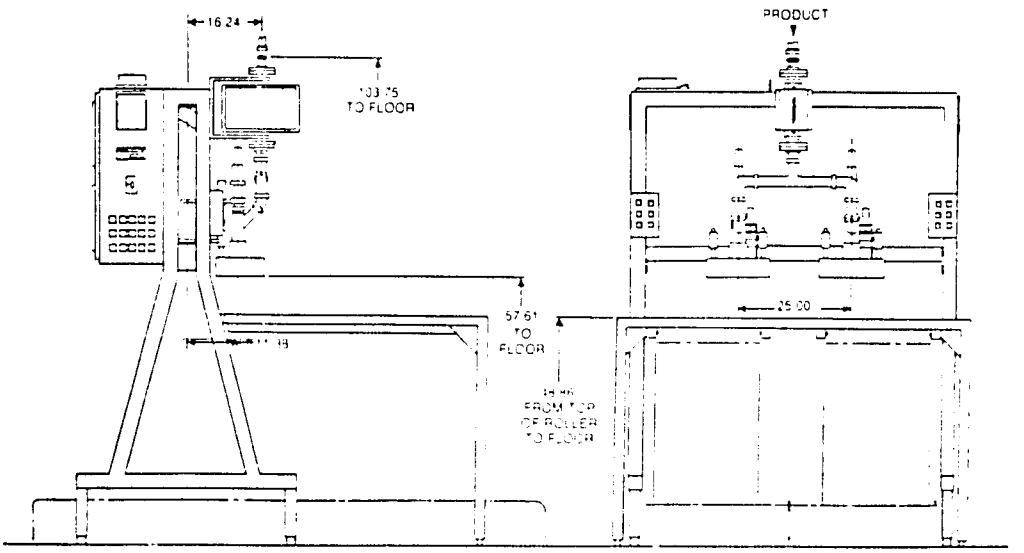
SCHOLLE AUTO-FILL 10-2E

The Auto-Fill 10-2E is designed for a continuous filling operation. This latest design is equipped with a fully automatic pre-startup sterilizing system. Before use, both filling chambers, piping and all steam seals are sterilized with steam. Sterility during filling is maintained in the chamber by steam and the positive pressure of a constant atomized chlorine spray.

In use, the capped spout of a pre-sterilized bag is inserted into one of the chambers which are completely airtight during filling. * The AF 10-2E removes the cap, inserts a filling valve into the spout, fills the bag to a pre-set volume of product, recaps the spout, drops it out of the chamber and loads it into the waiting drum or large carton — *all automatically!*

With the twin filling chambers, product can flow continuously, as it is instantly diverted from the filled bag to the pre-set empty bag.

** With the optional pre-sterilization cup, the spout/cap is isolated from the chamber (after insertion) until it is sprayed with a concentrated sterilizing solution.*



GENERAL SPECIFICATIONS

CONTAINER SIZE: One to 220 gallons.

FILLING SPEED: 300 to 480 containers per hour 1-6 gallon size. 35 to 60 containers per hour 55-60 gallon size.

POWER REQUIREMENTS:

Air — operation 100 psi — ¾" pipe at filler 10 cfm (including sterile air system)

Steam for sterilization — ½" pipe at filler — regulated to 40-45 lbs. Must be culinary quality steam.

Valves — sterile seal — 12 lbs. psi — ¼" pipe at filler min.

Electrical — 3 phase electrical supply — 1.5 K.V.A. Voltage and cycles to customer requirements.

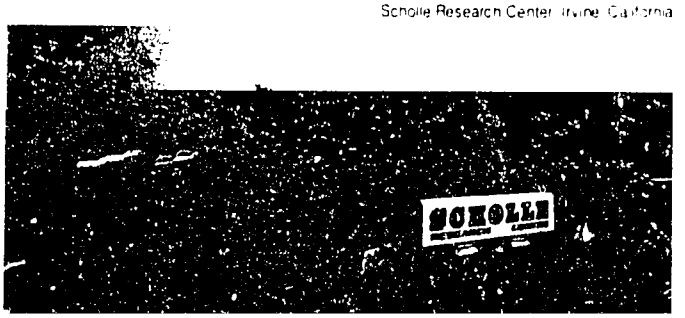
Nitrogen — .75 cfm

WEIGHT: 3000 pounds

SIZE: 81" x 108" x 61" (l x w x h) crated

CONSTRUCTION: U.S.P.H.S. Approved. All product surfaces 304, 316 stainless. Roller table to provide dry operation.

Scholle Research Center, Irvine, California



SCHOLLE
CORPORATION

220 West North Avenue, Northlake, Illinois 60164
Telephone: (312) 562-7290
Telex: 728 323 • FAX. (312) 562-6569

PLANTS: Rancho Dominguez, CA; Irvine, CA; Ridgefield, NJ; Atlanta, GA; Dallas, TX; Kansas City, MO; Minneapolis, MN; Newark, CA; Oskaloosa, IA; Charleston, IL; Ravenna, OH; Scarborough, Ont. Canada; Adelaide, Australia; Breda, Netherlands

March 9, 1989

Mr. Glenn Patterson
A. T. INTERNATIONAL
1331 H Street, N. W.
Washington, D.C. 20005

Subject: Proposal Number: 5205-8831-LE

Dear Mr. Patterson:

In response to your inquiry, we are providing the enclosed information regarding our (M.A.P.S.) Mobile Aseptic Processing System, and a copy of our Equipment Rental Agreement.

I am also including information regarding other systems and components offered by FR Mfg. Corporation - FranRica.

With regards to your anticipated application on coconut product, we suggest you direct any questions to Glenna Matthews, our staff Food Technologist.

Sincerely,

Michael H. Delucchi
Chief Estimator
FR Mfg. Corporation

yc
Enclosure

P.O. Box 30127, Stockton, California 95213-0127 (209) 948-2811 Telex 359419

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FR MFG. CORPORATION (FRANRICA)

REFERENCE NUMBER 4537

FAX ROUTING SHEET

FR MFG. CORPORATION (FRANRICA)
PO BOX 30127
STOCKTON, CALIFORNIA 95213-0127

OFFICE PHONE: (209) 948-2811
FAX NUMBER: (209) 948-5198

TO: AT. INTERNATIONAL

FAX NUMBER: 202-628-4627

ATTN: GLEN PATTERSON

FROM: MIKE DELUCCHI

DATE: 3/13/89 SENT BY: MD TIME: 5:05

DISTRIBUTION: QF # 5205

NUMBER OF PAGES, INCLUDING FAX ROUTING SHEET: One

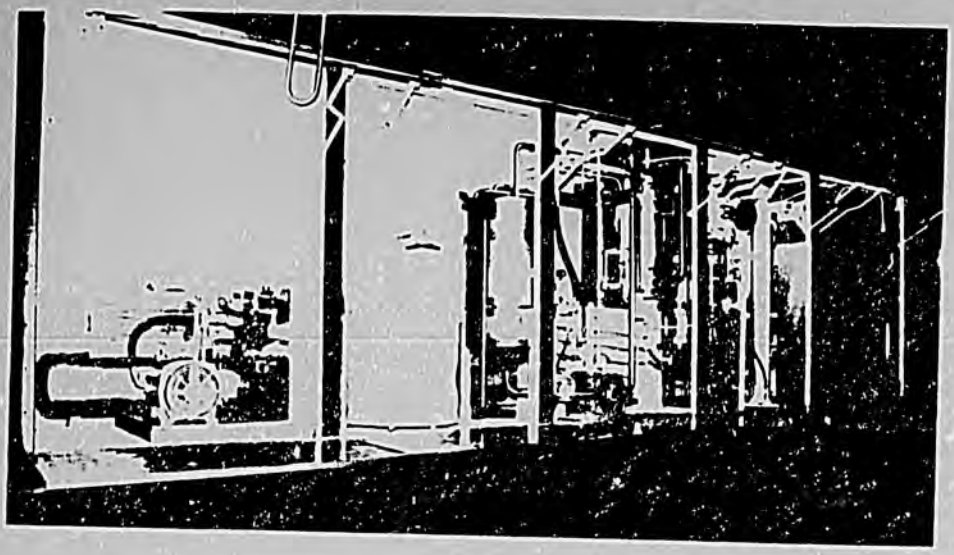
PLEASE ADVISE IF TRANSMISSION IS NOT RECEIVED COMPLETE OR CLEAR.

SUBJECT: Our Proposal Was Mailed on March 9.
Budgetary Prices For Our Low Acid Fillers Are As Follows:

LABF.0200, 55 GAL BAGS price Ex Factory. $225,000

LABF 1200, 300 GAL BAG price Ex Factory. $240,000

[redacted]



PROBLEM

For years, the food processing and packaging industry has been confronted with an ongoing problem: the high cost of processing and packaging equipment which is utilized for short periods of time in a given geographical location for a single product. And as the costs of processing and packaging equipment and technologies continue to rise, it becomes increasingly difficult to justify these expenditures.

SOLUTION

In an effort to assist processors and packagers, FranRica is proud to introduce its new Mobile Aseptic Processing Systems (MAPS). These systems have been designed to bring to local plant sites the capabilities for processing, sterilizing, and packaging a full range of fruit, vegetables, and dairy products. The systems are available in a number of configurations and capacities, ranging from small pilot laboratory scale, the MAPS-500, (capable of sterilizing and packaging aproximately 500 kg./hr. of product) to the MAPS-3000 (capable of handling approximately 3,000 kg./hr. of product).

The MAPS systems have been designed to provide ultimate flexibility to the customer, bringing the highest level of aseptic processing and packaging technology directly to the existing processing facility. Only steam, water, electricity, and prepared product must be provided to these systems in order for operations to begin immediately.

The MAPS systems incorporate the following components for processing and packaging:

- Stainless steel, covered product feed tank with optional agitation
- Positive displacement type system feed pump with hydraulic, variable speed control
- Scraped surface heat exchanger for heating the product to the proper sterilization temperatures
- Insulated hot product holding tube to hold the product for a proper amount of time to cause sterilization
- Scraped surface heat exchanger for aseptically cooling the product to ambient temperature prior to filling
- Aseptic product surge tank with discharge pump for transferring the product to the aseptic flexible bag filler. (Optional item for specific products and applications.)
- FranRica Model ABF-SH-0.200 or ABF-1000 aseptic flexible bag filler
- Complete system instrumentation and control panel for the operation of the processing system and flexible bag filler
- Water chilling system for cooling water to the scraped surface cooler
- Hydraulic power system required for the rotors on the scraped surface heat exchangers and the product pumps
- Motor control center for the proper distribution of the electrical power throughout the system
- Overhead lift assembly for the removal of the rotors from the scraped surface heat exchangers and the fill tube assembly from the flexible bag filler
- Air compressor required for the operation of all instrumentation and controls on the system
- Required access platforms and stairs
- Enclosed, secured storage area with lockable cabinets
- Spare parts and lubricants
- Interconnecting piping, wiring and conduit, fittings, valves and required controls

The entire system is pre-assembled within a specially modified 40-foot transport container. The entire enclosure when completed is waterproof and can be handled by any standard container export truck or ocean carrier.

The setup time for this system at the facility is less than 24 hours from time of arrival to the start of production.

The system has been designed with utmost simplicity for ease of operator training, maintenance, service, and product application. Detailed graphics are provided throughout the system to remind operators of specific procedures, techniques, and process applications.

The MAPS systems have been designed to be located adjacent to a packaging facility. The main processing equipment remains outdoors within the confines of the container bordering the packaging facility without the introduction of a "wet environment" into the "dry environment" of the warehouse.

The design conditions for heating, holding, and cooling the product and product flowrates can be easily adjusted to the specific product requirements. The use of hydraulic, variable speed drive motors throughout the system provides maximum flexibility and the ability to easily change the setting from one product to another.

The system has been designed to utilize either saturated steam or recirculated hot water sterilization techniques, based on the requirements of the specific product processed.

Products which may be processed on this system include tomato sauce, tomato ketchup, tomato paste, applesauce, tropical fruit purees, nectars, fruit concentrates, banana puree, yogurt fruits, jams, preserves, meat purees and paste concentrates of dairy products, ice cream mixes, and more. For certain low acid products (those with a pH greater than 4.5), the specially designed MAPS-LA system is available. This system has been designed exclusively for low acid products and does require specific controls and modifications to the processing and piping systems, heat exchangers, pumps, and aseptic filler.

For applications which may require the processing of fluid products of a low viscosity such as juices, nectars, light purees, and beverage bases, the scraped surface heat exchangers may be replaced with a tubular heat exchange system of suitable production capacity.

For facilities that do not have the proper preparation systems for the product, or steam supply, similar design techniques may be utilized to prepare the product's washing, sorting, and preparation system as well as the steam generating equipment.

The MAPS systems are unique to the processing industry, and for the first time offer truly mobile aseptic processing capabilities for the food processor.

SCHEDULE "A"

EQUIPMENT DESCRIPTION

MOBILE ASEPTIC PROCESSING SYSTEM

The MAPS 500 system includes the following items:

1. One (1) 100 gallon, type 304 stainless steel product feed tank with hinged, removable cover, overflow, inlet and outlet piping.

2. One (1) Waukesha Model 60 positive displacement pump with manually controlled hydraulic variable speed drive.

3. One (1) lot interconnecting product piping from the system feed pump to the product heater, including drain valves, sanitary pressure indicator and thermometer.

4. One (1) FranRica Model 9 scraped surface heat exchanger with type 410 stainless steel exchange surface and manually controlled hydraulic variable speed drive. Unit is further provided with required air operated steam control valve, pressure indicating gauges and condensate trap.

5. One (1) lot interconnecting product piping/holding tube, insulated, between the product heater and product cooler, including required thermowells for temperature recorders and controllers, vent and drain valves, thermometer and required support brackets.

6. One (1) FranRica Model 12 scraped surface heat exchanger for product cooling, with type 410 stainless steel heat exchange surface, manually controlled hydraulic variable speed drive, inlet and outlet supply and return chilled water piping, including drain and bleed valves, thermometers and connection to chilled water system.

7. One (1) Dunham Bush 20 ton packaged chilled water system, including water cooled condenser, shell-in-tube heat exchanger, 200 gallon chilled water make-up tank and 5 h.p. chilled water recirculating pump.

8. One (1) lot interconnecting product piping from the discharge of the scraped surface product cooler to the inlet of the Model ABF-SH-0.200 aseptic flexible bag filler, including

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required thermometer, sanitary pressure gauge, aseptic surge tank transition section, aseptic manually operated product line isolation valves, steam and quench water supply valve assemblies, bleed and vent valves, supports, interconnecting clamps and gaskets.

9. One (1) FranRica Model ABF-SH-0.200 aseptic flexible bag filling system, complete with control panel, utility supply rack and sterile air/nitrogen counter pressure filtration system. Also included is one (1) bag-in-drum placement unit for the filling of 55 gallon bags.

10. One (1) lot interconnecting return product piping from the ABF-SH-0.200 aseptic flexible bag filler to the 140 gallon product system feed tank, including air operated product divert valve, manually operated drain, bleed and vent valves and sanitary pressure gauge.

11. One (1) instrument control panel for the operation of the ABF-SH-0.200 aseptic flexible bag filler and the process system.

12. One (1) hydraulic power system, including interconnecting valves, gauges and piping. The hydraulic power system is used to drive the system feed pump, scraped surface heater, scraped surface cooler and the aseptic flexible bag filler.

13. One (1) motor control center and transformer to provide proper electrical supply for the hydraulic power system, instrument panel and aseptic flexible bag filler.

14. One (1) removable overhead left assembly required for the removal of the rotors and cylinders from the scraped surface heat exchangers and to mount the surge tank above the product piping prior to the filler.

15. One (1) air compressor capable of accommodating all air operated equipment in the system. Compressor specifications include a 7.5 h.p. drive, produces 20 cfm and has an 80 gallon receiving capacity.

16. One (1) lot access platform and stairs integrally mounted to the container enclosure.

17. One (1) enclosed, secured storage area with lockable metal cabinets.

18. One (1) bag to drum handling system of manual nature.

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19. All equipment is operational within a 40' Sealand container.

20. The container has been structurally modified for the convenience of handling and access to machinery.

21. One (1) lot of spare parts for normal wear items to be drawn from and purchased separately as previously described.

UTILITIES

Based upon a flowrate of 2,500 lbs/hr (maximum capacity of system), the estimated utilities will be as follows:

System Maximum Steam Pressure: (During Sterilization)	1 kg/cm^2 (14.7 psig)
Maximum Steam Supply Pressure:	8.75 kg/cm^2 (125 psig)
Maximum Steam Flow:	563 kg/hr (1,240 lbs/hr)
Maximum Fresh Water Supply: (To Fill Chiller)	379 liters/min (110 gpm) at 24°C, 8.8 Kg/cm^2 (40 psig)
Fresh Water for Pump: Seals/Heliflows:	102 Liters/min (27 gpm) at 24°C (75°F).
Electricity:	225 amps, 380/460 volts, 50/60 Hertz, 3 Phase.

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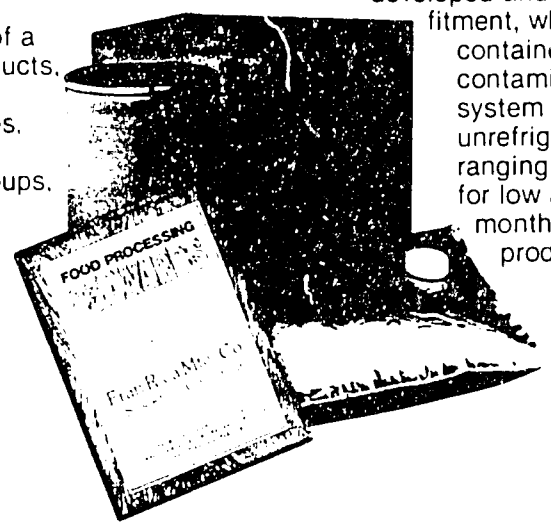
Aseptic flexible bag fillers for the bulk packaging of low and high acid purees, pulps, pastes, nectars and sauces

The FranRica aseptic bag filling systems offer the food processing industry a highly effective aseptic method of bulk packaging high and low acid food products. The systems, developed by FranRica provide processors with a reliable solution for the aseptic bulk packaging of a wide variety of food products, including tomato paste, vegetable and fruit purees, fruit particulates, concentrates, sauces, soups, tropical fruit purees, and dairy and many other delicate products.



Aseptic flexible bag

The packages consist of flexible plastic bags of various types and sizes, which are "housed" in boxes, bins or drums. The key feature of the system is the specially developed and patented membrane fitment, which ensures that the container is at all times contamination-free. The system provides an unrefrigerated shelf stability, ranging from a few months for low acid products to 9-12 months for high acid products.

Salient features

The system, designed by FranRica in conjunction with CTI, Container Technologies, Inc., offers a number of unique features, including:

1 63 mm membrane fitment and hermetic fill tube connection.

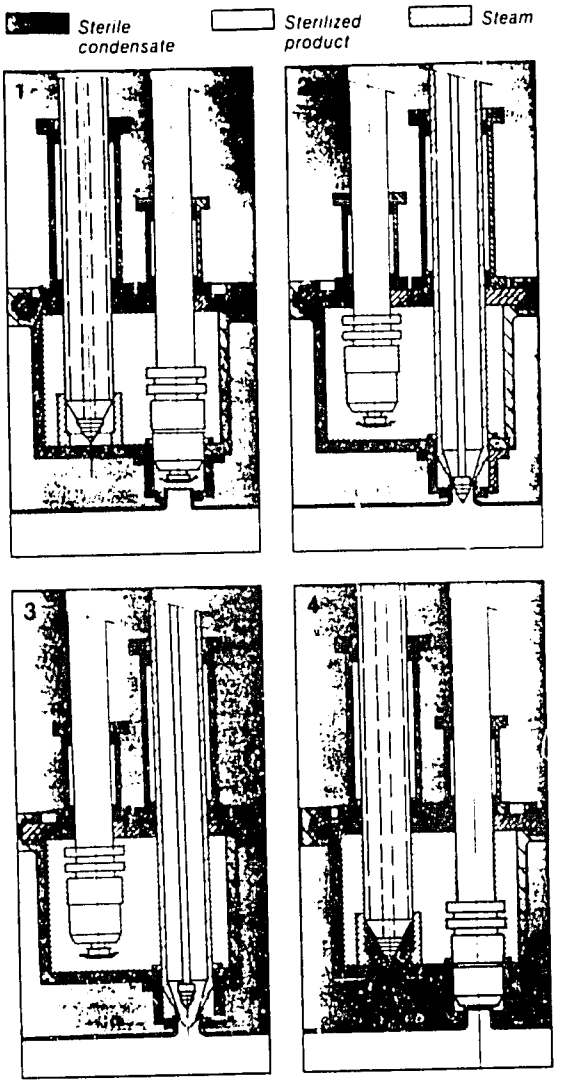
2 Saturated steam sterilization (eliminating the need for chemicals) of fitment, cap and fill chamber with each filling cycle.

3 Hermetic sealing of bag opening after filling.

4 Rinsing of fill tube with sterile condensate at the end of each filling cycle.

5 Maximum aseptic integrity. Fill rates of up to 13,000 l/h. Sustained operating periods of up to several weeks.

The filling cycle explained



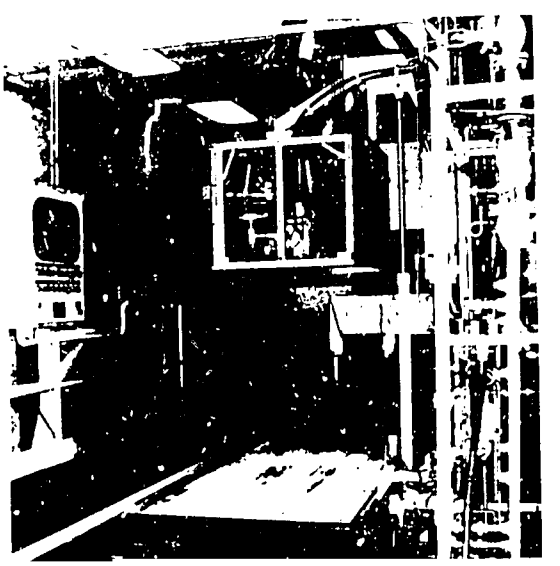
1 • The fitment is sealed against the bottom of the fill chamber and the foil/PE cap is lifted from the fitment. The area in the chamber closure is vented to remove air, and is then steam sterilized. After the chamber closure, fitment and cap have been sterilized, the chamber closure and cap are raised and moved away from the fitment. The fitment now serves as the seal, isolating the interior of the fill chamber from ambient conditions.

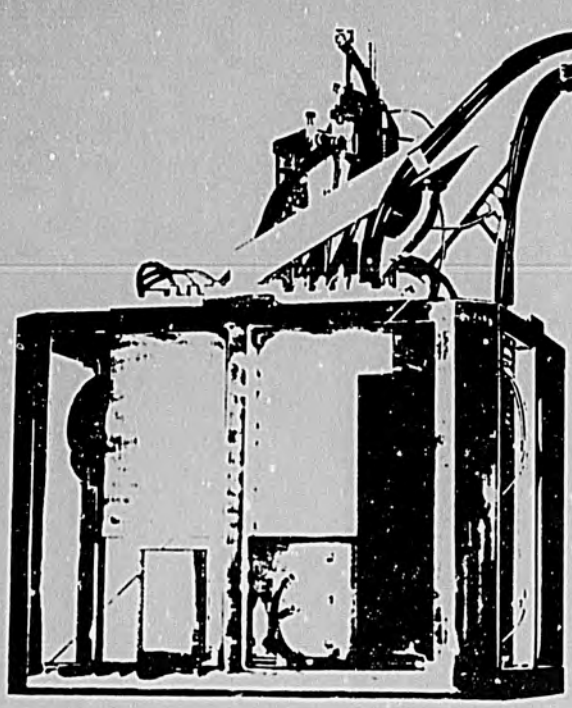
2 • The fill tube rotates into position, then lowers and pierces the fitment membrane to expose the pre-sterilized bag interior to the sterile atmosphere inside the fill chamber. The slight positive pressure in the fill chamber 'puffs' the bag to separate the interior bottom plies from the fitment. The fill tube seals to an interior surface of the fitment to prevent damage to the cap sealing area.

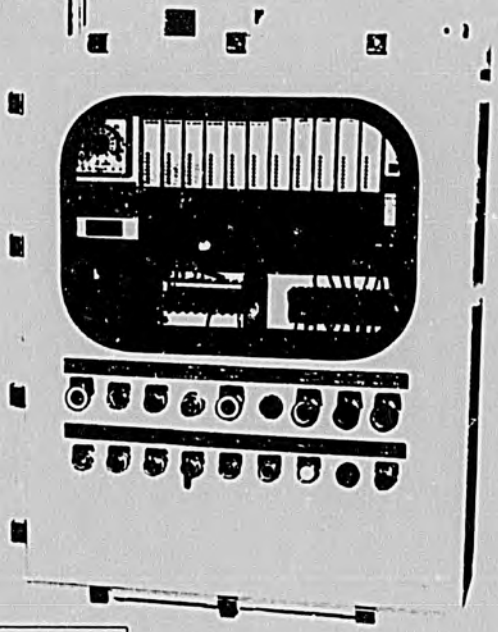
3 • The fill valve opens and the product flows into the bag. The piercing action of the fill tube holds the ruptured segments aside to maximize the fill opening. Product flow into the bag is controlled by volume, weight, or time.

4 • Upon cor ion of the filling cycle, the fill valve closes, raises slightly, and rotates to the rinse position. The end of the fill tube which is exposed to the product is rinsed with cool, sterile condensate in preparation for filling the next bag. As the fill tube moves to this position, the chamber closure simultaneously returns to its original position above the fitment and seals against the fill chamber opening. The foil/PE cap is placed on the fitment and heat-sealed to provide a tamper-proof, hermetically sealed bag opening.

The FranRica aseptic flexible bag fillers can be hooked up to the FranRica scraped-surface heat exchanger, Stork - FranRica Sterideal UHT-system, or Stork - FranRica SteriJuice plant.







e FranRica aseptic flexible bag filling system is available in three basic types:

	ABF-MH-0.200	ABF-300	ABF-1000	
			Aseptic	Non-aseptic
team	227 kg/h at 8.5 bar, Average 364 kg/h, intermittent	540 kg/h at 8.5 bar intermittent 230 kg/h at 8.5 bar Est. average consumption	227 kg/h 8.5 bar, Average 364 kg/h, intermittent	36 kg/h at 8.5 bar
r	0.07 m³/min. at 5.4 bar	0.2 m³/min. at 5.4 bar	0.14 m³/min. at 5.4 bar	0.06 m³/min. at 5.4 bar
ater	38 l/min. at 20°C	None required	38 l/min. at 20°C	38 l/min. at 20°C
ectrical	5 kW, 220/240 VAC, 3 phase, 50/60 Hz; 110 V, 20 Amps	5 Kw, 220/240 VAC, 3 phase, 50/60 Hz; 110 V, 20 Amps	8 kW, 220/240 V, 3 phase, 50/60 Hz; 1 kW, 110 VAC, 1 phase, 50/60 Hz	8 kW, 220/240 V, 3 phase, 50/60 Hz; 1 kW, 110 VAC, 1 phase, 50/60 Hz
illing ight	3.2 m. Allow for fill tube removal 4.1 m.	4.4 m. Allow for fill tube removal 5.7 m.	4.57	4.57
oor area	1.9 x 1.0 m	3.2 x 4.4 m	2.9 x 2.7 m	2.9 x 2.7

ates are dependent upon bag sizes and product. Bag sizes are 11 - 1,140 litres for ABF-300, 4 - 230 litres for -MH-0.200, and 3.8 - 1,325 litres for ABF-1000.

Fitm With ..ase

Fitm The oxyg

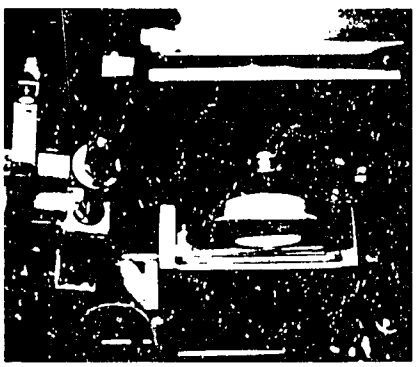
Fill c Fran a tar

Free flexi syst

Fitment membrane pierced by the fill tube. With the FranRica system there is no "aseptic" risk

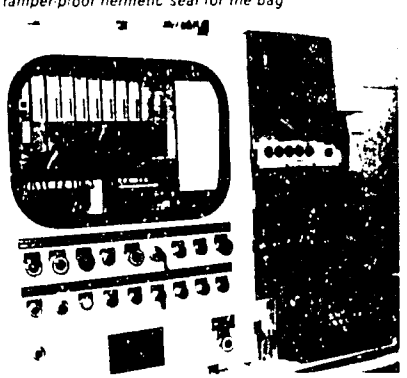
Increased production capacity, reduced operating costs, greater flexibility of container size and configuration, and reduced floor area are but a few of the many benefits offered by the FranRica ABF-1000 flexible bag filling system.

The ABF-1000 is capable of aseptic or non-aseptic operation, filling flexible containers ranging in size from 3.8 litres to 1,325 litres, while utilizing a minimum number of changeable parts. Product flow may be controlled by volume, weight, time, or any combination of these methods. The ABF-1000 is ideally suited to fill homogeneous liquids and paste products. It may be readily adapted to fill particulate products with a liquid medium such as diced fruit and vegetables.

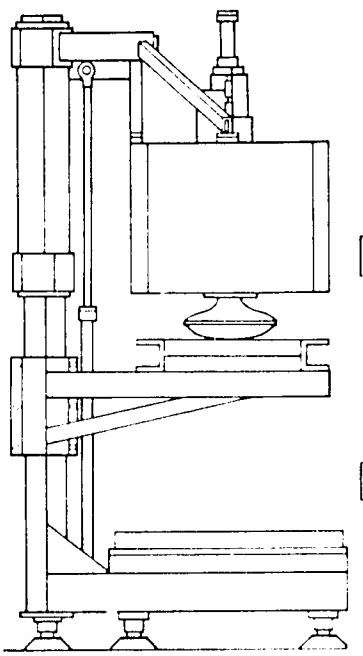


Fitment under bottom of fill chamber. The fitment incorporates an integrated oxygen barrier cap after sealing

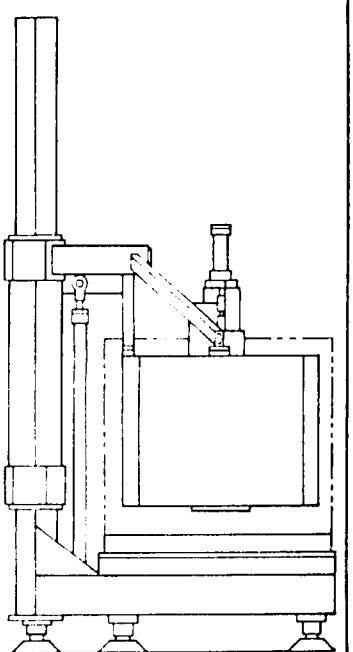
Fill chamber with sight glass. Only FranRica heat seals the fitment, creating a tamper-proof hermetic seal for the bag



Free-standing control panel allows greater flexibility of installation and conveying system layouts



For flexible bags up to 250 litres



For flexible bags up to 1,325 litres

ABF-1000 filler features

- Innovative design eliminates costly lift table;
- Fewer mechanical motions reduce filling cycle times;
- Smaller overall size, reduced ceiling height, easier installation;
- No special foundations required;
- Simplified automation and electrical circuitry;
- Minimal wear/replacement parts;
- Wider range of bag sizes;
- Free-standing control panel, incorporating a PLC, and utility rack allow greater flexibility of installation and conveying system layouts;
- Fill tube wash after each cycle;
- Easily adapted to aseptic or non-aseptic operation;
- Easily adapted to handle dry particulate products such as nuts and raisins;
- Full stainless steel construction

REPRINTED FROM AUGUST 1988 Food Processing

First aseptic filler in U.S. for low-acid products in flexible bags

Unique system packs 2¼-gal to 55-gal bags with reclosable spouts

DANIEL E. GREEN, *General Manager*
ROBERT BECKER, *Quality Control Manager*
RON HILLISON, *Director of Engineering*
KEVIN GALLAGHER, *Special Projects Engineer*
Amboy Specialty Foods, Div. of Dean Foods Company

ROBERT J. SWIENTEK, *Executive Editor*

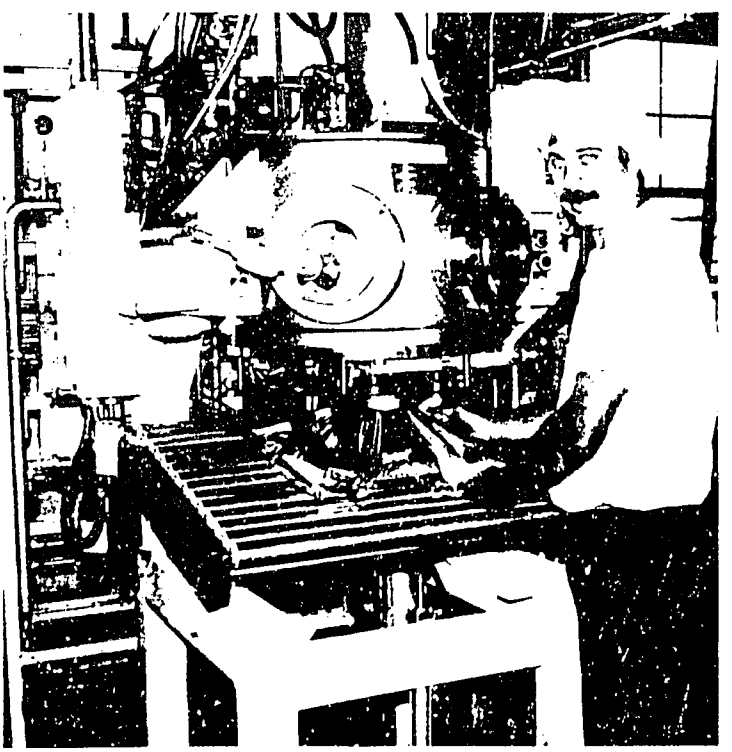
Without fanfare or publicity, a "first" occurred in the U.S. food processing industry on May 26, 1988. On that day, Amboy Specialty Foods received acceptance from the FDA on its process filing to produce low-acid aseptic products in flexible bags with reclosable spouts.

Initially, the company will pack aseptic cheese sauces and puddings in 2.25-gal bags and 55-gal bag-in-drums. Designed for the foodservice trade, the 2.25-gal bag equals three No. 10 cans. The 55-gal size is intended for use by large commissaries and food processors.

The flexible bags are preformed with the fitment (opening) in place and presterilized using gamma irradiation prior to shipment to Amboy. Each bag features an inner ply of 4 mil low-density polyethylene (LDPE) and an outer 3-ply laminate of 2 mil LDPE, 0.5 mil metallized polyester, and 2 mil LDPE. The 63-mil O.D. fitment is constructed of high-density PE and is threaded for reclosing. The fitment includes an integrally molded membrane, which provides a hermetically sealed empty bag. An aluminum foil lid is laminated with LDPE for heat sealing to the fitment following filling. This heat-sealed lid furnishes a hermetically sealed final closure. A threaded overcap is applied to the sealed fitment.

As part of its services, Amboy will work with food companies on developing both low-acid and high-acid foods for the new filler. The aseptic processor also will co-pack for interested parties.

Aseptic products in flexible bags furnish benefits to both Amboy and its customers. The aseptic filler can handle different bag sizes with minimal changeover requirements. One operator can run two fillers. Flexible bags offer a 10% weight savings compared to a No.



Director of Engineering Ron Hillison inserts fitment into bag holder

10 can case equivalent.

For the institutional user, the flexible bags occupy 20% less space than a No. 10 can case equivalent. The shelf-stable bags are easier and safer to handle, store, and dispose. They present opportunities for minimizing product waste and their reclosable spouts provide enhanced sanitation during storage and disposal.

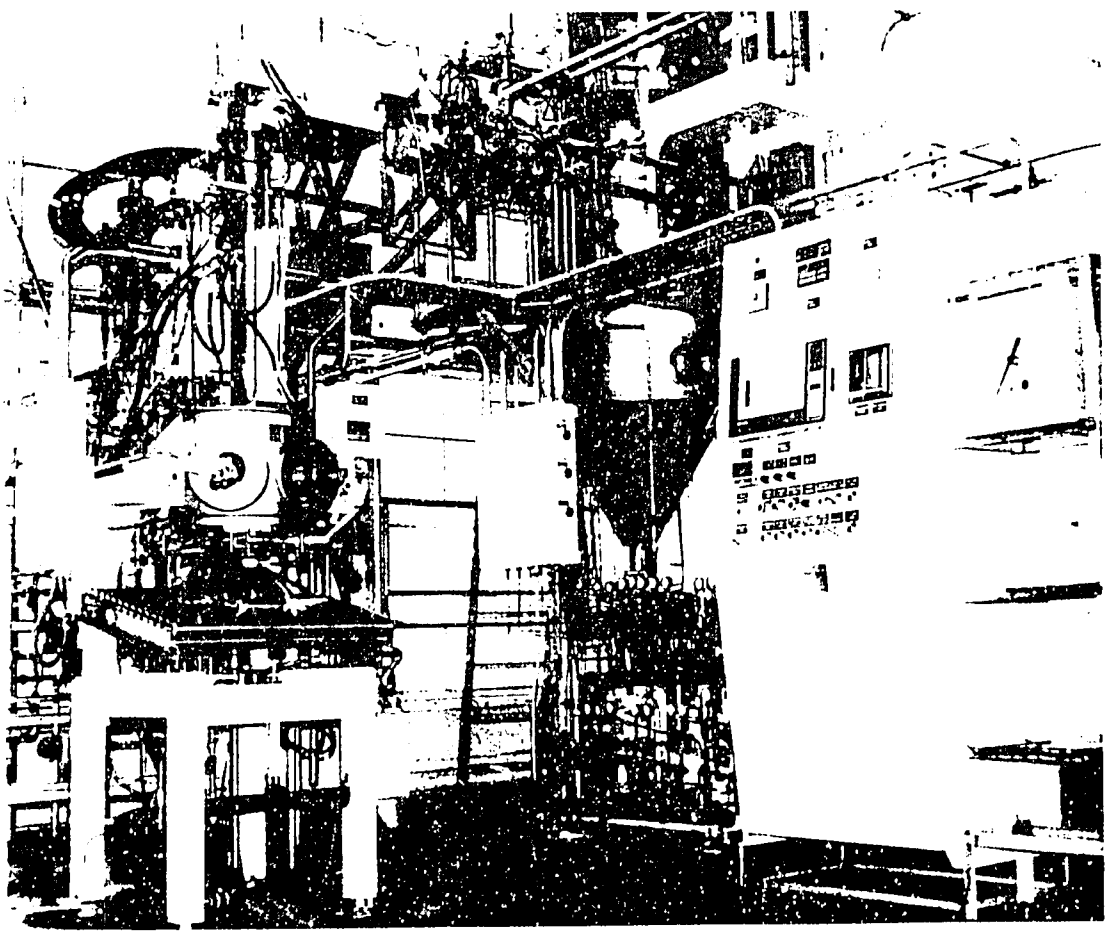
To remove product from the bags, users can break the membrane seal on the fitment and pour product out of the spout or they can cut off a corner of the bag. The reclosable spout with overcap allows users to store unused portions of product in the bags under refrigeration.

System features & operation

The FranRica aseptic packaging system consists of a 400-gal sterile surge tank and aseptic filler. Prior to operation, the sterile surge tank and filler are sterilized with saturated steam 245°F for 60 min. The flexible filling machine can fill a variety of bag sizes from 2.25 gal to 55 gal. For bag sizes above 15 gal, the machine requires a special lift table under the fill head. The filler can handle liquids and viscous products containing particulates up to 1/4". Both low-acid and high-acid aseptic foods—such as frozen dessert mixes, gravies, sauces, soups, fruit & vegetable purees, and glazes—could be packed by the machine. For high-acid foods (e.g., ketchup), the bags can incorporate dual fitments for bag-in-box dispensing. The system incorporates 30 temperature sensors, Honeywell recorder/controller, and Allen-Bradley programmable logic controller to insure that sterilization temperatures are maintained throughout the heating cycle.

Following steam sterilization, the surge tank is kept under a positive pressure using sterile nitrogen. A positive pressure is maintained in the bag filler by low-pressure steam in the main chamber and sterile air in the fill tube housing.

The aseptic filler incorporates a fill tube housing, main chamber, mini chamber, condensate gener-



Aseptic packaging system consists of aseptic filler (left), 400-gal sterile surge tank (center), and control panel

ating system, and a gas incinerator.

The packaging machine operates in a batch cycle mode. First, an operator places a presterilized bag onto the platform table below the fill head. Next, the operator positions the aluminum foil/PE lid over the fitment, manually inserts the fitment into the bag holder, and depresses the start button. The remainder of the filling cycle is automatic.

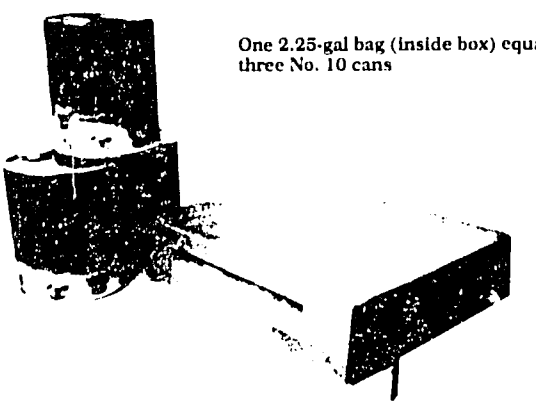
At the start of the filling cycle, two bag holders lock into position and seal the fitment up against the bottom of the mini chamber. A pick-up head lifts (by vacuum) the foil/PE lid from the fitment. Introduced into the mini chamber, saturated dry steam sterilizes the chamber, lid, and membrane fitment. When the mini chamber maintains a temperature of 280°F for 7.5 sec, the sterilizing steam valve closes. Next, the pick-up head with lid moves upward into the main chamber and away from the fitment.

The fill tube housing valve opens and the fill tube enters the mini chamber. As the fill tube lowers into the mini chamber, it pierces the membrane fitment and forms a seal against the bag fitment. The fill valve opens and the proper amount of product is metered into the bag. During filling, the tube holds the membrane segment aside to maximize the fill opening.

After the bag is filled with the proper amount of product, the fill valve closes and the fill tube retracts into the fill tube housing. Then the fill tube housing valve closes, initiating a sterile condensate rinse of the fill tube and valve to remove any residual product. Sterile air is introduced into the fill tube housing to provide a positive pressure.

The pick-up head with foil/PE lid returns to its position atop the fitment opening. The lid is heat sealed onto the bag fitment, providing a tamper-evident, hermetic seal on the bag opening. Following sealing, the bag is released from the mini chamber and the fill cycle

Users of the flexible bags can remove product by cutting off a corner of the bag or via the reclosable spout



One 2.25-gal bag (inside box) equals three No. 10 cans

Amboy—Pioneer in aseptic foods

Located in Dixon, IL, Amboy Specialty Foods produces 1-2 million cases annually of low-acid aseptic canned products for institutional and retail markets. The plant houses approximately 30,000 sq ft of production area, 7,500 sq ft of refrigerated space, and 90,000 sq ft of dry warehousing.

Five aseptic canning lines pack a variety of cheese sauces and puddings in No. 10 cans, specialty products in 46-oz cans, cheese & Mexican-style dips and puddings in 9-oz containers, and cheese sauces and puddings in 17-oz cans. A pilot plant unit is available for new product development. More than 50 scraped-surface heat exchangers heat and cool product.

Amboy was established in 1959 to perform R&D and pilot plant work on aseptic canning for interested companies. Work was done on a per hour fee basis. Soon the company started to offer contract packaging or co-packing services.

Amboy's initial contract packaging work involved the production of liquid diet foods. One of Amboy's early packaging accounts was Dean Foods, or Dean Milk as it was known then. The liquid diet food fad lasted only 4-5 years; however, the relationship with Dean Foods continued when Amboy was purchased by Dean in 1969.

With the demise of the diet food business, Amboy switched its production to the manufacture of an aseptically canned cheddar cheese spread product used in the military's combat rations. During the Vietnam War, the aseptic processor packed hundreds of millions of cans of the cheese spread.

Prior to the end of the production of the cheese spread, Amboy began packing pudding products in No. 10 cans for the foodservice trade. In the early 1970s, more than one million cases of pudding were produced annually. During this period, a distribution system was established with major institutional food distributors throughout the U.S.

In 1973, Amboy began packing cheddar cheese sauce in No. 10 cans. In the mid-70s, entrepreneurs in the Southwest mixed the cheese sauce with jalapeno peppers to create a finger food called Nachos. Today, Amboy markets Nacho cheese sauce and dip in No. 10 cans and 9-oz containers.

This year, Amboy Specialty Foods launched Pudding Plus—a 9-oz convenient ready-to-serve pudding. The product is marketed under the Dean Foods label in retail outlets in Illinois and Wisconsin.

Amboy's latest innovation is low-acid aseptic foods in presterilized flexible bags. In addition to being a "first" in the U.S. food industry, the low-acid aseptic filler is the first "U.S. designed and built" packaging machine to be accepted by the FDA since the first Dole aseptic canning system became commercially operational in the late 1940s. All other low-acid aseptic packaging developments have been based on European technology.

is completed. An operator manually affixes a protective overcap onto the bag fitment. The filling procedure is then repeated.

Fill times are dependent on bag size. A typical 2.25-gal bag can be cycled in about 40-50 sec.

Presterilization of the aseptic system and filler operating sequences are monitored and controlled by a Honeywell recorder controller, Allen-Bradley programmable logic controller, and Taylor Mod 30 instrumentation. The system is equipped with numerous safety interlocks; if any part of the aseptic system loses sterility, the filler is automatically shut down.

Background

The commercial production of low-acid foods in aseptic flexible bags is a culmination of nearly two years of painstaking research by personnel from Amboy, FR Mfg—FranRica aseptic filler, the R&D group of Amboy's parent company Dean Foods, the Eastern and Western research labs of the National Food Processors Association (NFPA), and Scholle—presterilized flexible bags.

In the fall of 1985, Amboy acquired a high-acid bag filler from FranRica. Working together for several months, Amboy and FR Mfg redesigned the prototype filler for low-acid foods. Acting as a process authority, the NFPA was called in to perform heat distribution studies and inoculation tests.

Based on the results of the tests and studies, the filler and bags were modified. Additional thermocouples and RTDs were incorporated into the system. Sterilization procedures for the mini chamber, heat sealable lid, and bag fitment were revised. The bag fitment was modified to withstand greater temperatures and pressures. All in all, development of the low-acid aseptic filling system required three periods of testing and design modification, which were carefully documented for future reference.

In March 1987, the NFPA performed final inoculation testing. Amboy submitted its process filing on the production of low-acid foods in aseptic flexible bags to the FDA in June 1987. The FDA accepted the process filing on May 26, 1988.

Additional information on FranRica LABF-0 200 bag filler for low-acid aseptic foods is available from FR Mfg Corp., P.O. Box 30127, Stockton, CA 95213-0127.

More information on presterilized flexible bags for low-acid and high-acid aseptic foods is available from Scholle Corp., P.O. Box 19277, Irvine, CA 92713.

Further information on co-packing capabilities for low-acid aseptic foods in flexible bags is available from Amboy Specialty Foods, Div. of Dean Foods Company, P.O. Box 529, Dixon, IL 61021.

ALFA-LAVAL

ANNEX
II-6-3-c

LATEST DEVELOPMENT IN ALFA-LAVAL FOR WET PROCESSING OF COCONUTS AND COCONUT PRODUCTS

INTRODUCTION:

Basically the utilization of coconuts can be divided into two major categories:

1. Industrial production of coconut-oil from copra and desiccated coconut.

2. Local consumption of either fresh products like coconut water, etc. or in sweet/savory types of food preparation using coconut milk as the main ingredient.

The enormous number of local dishes containing coconut reflects its importance in the tropics. However, disregarding coconut oil and desiccated coconut, very few new coconut products of commercial importance have been introduced. During the last decade, only spray dried coconut cream powder is worth mentioning, but still with limited success. There are many brands of canned coconut cream in the market, but the quantities are small due to poor quality.

The fast spoilage of unprocessed coconuts products together with heat sensitive flavour has created the biggest problem in the past. However, by introducing hygienic processing, Alfa-Laval has developed processes for a new range of high quality products with long shelf life.

NEW COCONUT PRODUCTS:

With stiffer competition in the edible oil market, the coconut industry is looking for alternative products to coconut oil. The industry is today very specialized in one product. Improved utilization of the whole nut as well as a wider range of products is highly desired.

In addition to full utilization of the coconut, the new products shall have an "added value" according to the following:

* High quality products with retained coconut flavour
* Long shelf life at ambient temperature

2/

ALFA-LAVAL

By starting from whole matured nuts, Alfa-Laval has developed processes for the following end products:

* Virgin oil:	A clear coconut oil extracted from fresh coconut meat with retained coconut flavour and colourless. The level of free fatty acid is below 0.07%. No refining is needed so the vitamin E content is maintained at the original high level. No chemicals are added during processing.
* Aseptic coconut cream:	A white, smooth liquid cream with excellent coconut flavour and 20-30% fat, aseptically packed. The product is easily pourable and ready for direct serving or to be used in other food preparation.
* Aseptic coconut skimmilk:	A white, protein-rich drink with good coconut flavour. As a drink, protein content of 1-3% and fat content 0.5-3% are recommended.
* Aseptic coconut water:	An almost clear drink from pure coconut water. To enhance the sweetness, some sugar can be added to reach a total Brix of 7-7.5. The pH of about 6 in the fresh coconut water is not altered.
* "Low fat" desiccated coconut:	After extraction of the milk from the coconut meat, the fiber residue is dried to white flakes similar to desiccated coconut but lower in fat content.

The taste evaluation of the products scored amazingly high and was commented to be almost the same as fresh products. Samples of the above products are available on request for your own evaluation at Alfa-Laval's R&D Centre in Singapore.

SINGLE PROCESS LINES:

By upgrading the existing coconut industry, most of these new products are possible to go into commercial production. In Appendix 1, the integration of the following process lines is shown in a block diagram:

- *PASTEURIZATION OF COCONUT WATER*

The coconut water is collected directly at the cutting point of the coconut. The water is clarified and the small fraction of oil is removed. Pasteurization and chilling down to 5-8 deg C is included in the process line. The chilled coconut water has now a shelf life up to a couple of days.

- *PASTEURIZATION OF COCONUT MILK*

The coconut milk is collected directly after extraction and continously filtered, pasteurized and chilled to 5-8 deg C. The chilled coconut milk has after pasteurization a shelf life up to a couple of days. This "pretreatment" will secure consistent product quality in frozen coconut milk as well as in aseptic products.

- *VIRGIN OIL PROCESS LINE*

The coconut milk is converted into so called virgin oil and skimmilk in a centrifugal process including purification, drying and polishing of the oil and chilling down of the skimmilk.

- *STERILIZATION*

The low acid products:- coconut milk, -water and -skimmilk are sterilized at 140 deg C/4 sec after formulation. The aseptically packed products have a shelf life of 3-12 months at ambient temperature depending on the chemical composition and storage conditions.

- *ASEPTIC PACKAGING*

The sterilized products are then packed aseptically at ambient temperature in either Bag-in-Box for bulk distribution (10L - 1400L) or in paper cartons 200-1000 cc for the consumer market. Note, the aseptic packaging machines have to be designed for *low* acid products for long shelf life at ambient temperature.

All parts of the equipment which come in contact with the products are in stainless steel. Cleaning-in-place is integrated in the continous and hygieric process lines.

COMPLETE PLANT FOR COCONUT PRODUCTS:

By adding pretreatment and an extraction line, Alfa-Laval can supply a complete plant for the previous mentioned products according to the block diagram in Appendix 2.

The pretreatment includes shelling, paring, washing, etc. of the dehusked, matured coconuts. In addition to what has been mentioned for "SINGLE PROCESS LINES", the wet extraction of the coconut meat can be described according to the following:

- *EXTRACTION:*

The coconut meat is ground to a slurry and separated to the three intermediate products cream, skimmilk and fiber residue in a centrifugal process. The cream has 70-80% fat content and can easily be converted into virgin oil. Most of the protein end up in the skimmilk containing 1-3% protein and 0.1-0.5% fat. The "low fat" fiber residue is dried to "low fat desiccated coconut".

This integrated plant of a new range of high quality coconut products has a built in production flexibility between virgin oil and aseptic coconut cream and can be extended to optimise the utilization of the by-products like the shell, etc.

With small alterations, it is possible to tailor the plant for spray-dried products like coconut cream powder. The virgin oil line in Appendix 2 is then replaced by spray-drying.

As mentioned before, all equipment are in stainless steel and cleaning-in-place is an integrated part of the plant. Alfa-Laval has long experience in designing complete plants and is prepared to take the full responsibility for "turnkey" projects also including building, service media, training, etc.

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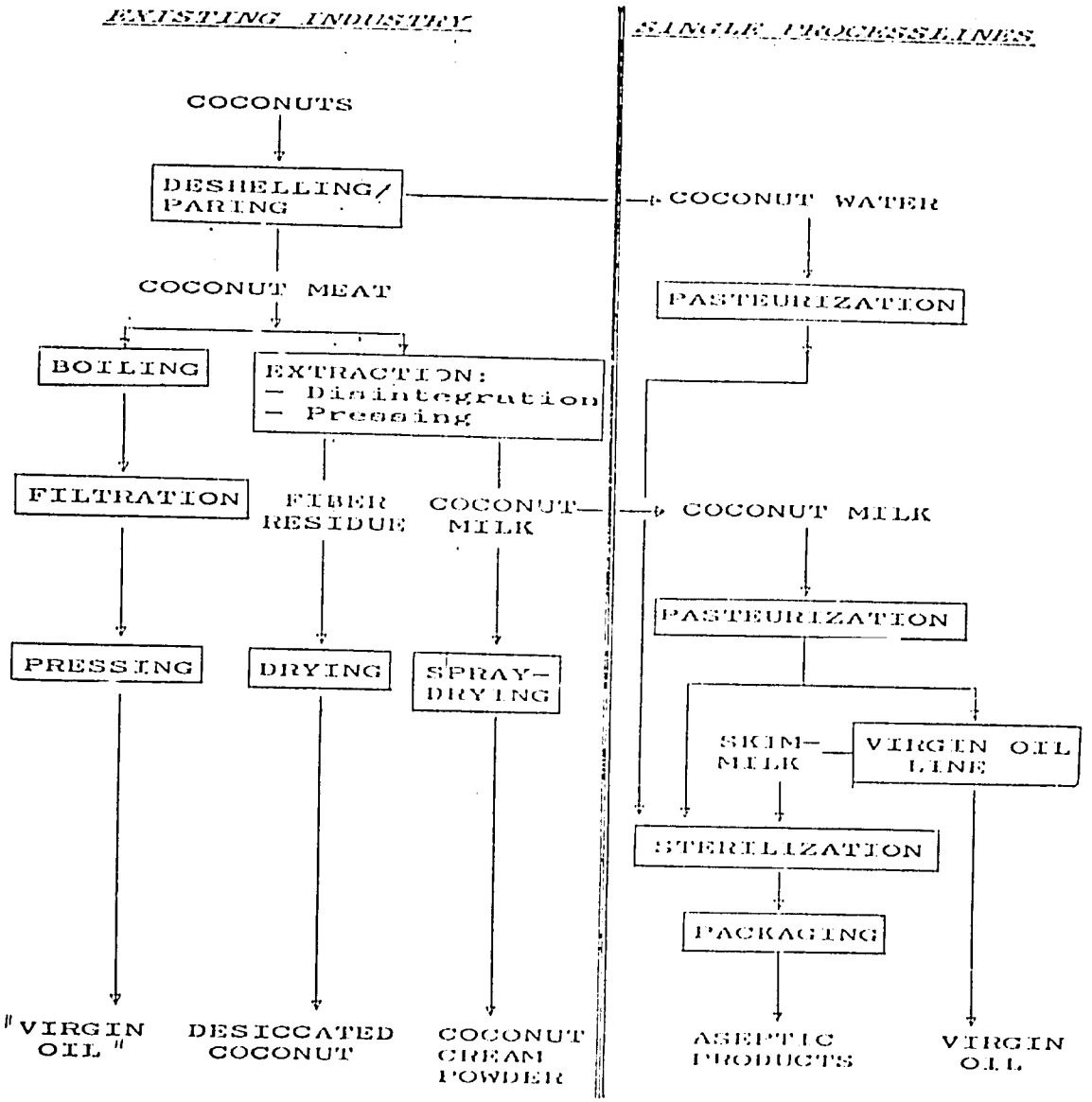
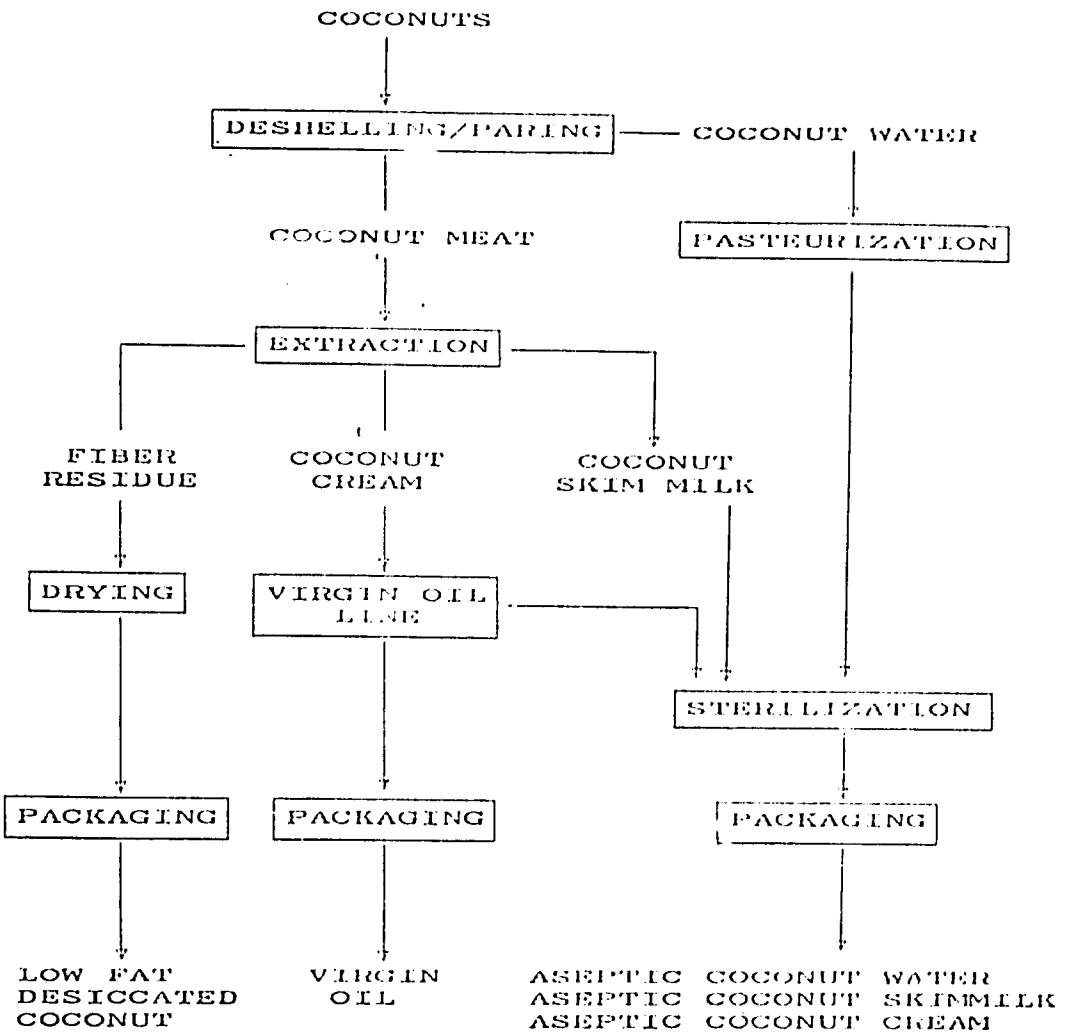
ALFA-LAVAL'S SINGLE PROCESSLINES FOR COCONUT PRODUCTS



ALFA-LAVAL'S COCONUT PLANT FOR WET PRODUCTS



SOUTH EAST ASIA PTE. LTD.
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TELEFAX TRANSMISSION

TO : A.T. International, USA

DATE : 1989-02-24

ATTN : Mr Glenn Patterson

REF : F 2321

FAX : 005-1-202-628 4622

FROM : G Leufstedt

NO OF PAGES INCLUDING THIS COVER : One

SUBJ : Your faxes Feb 14 and 22.

MESSAGE :

1. Starasept

To add one Starasept unit in an aseptic system will cost about 22% extra on the price for the equipment for installation and commissioning.

Note:- The sterilizer has to be designed for coconut products.
- The Starasept unit is operating as the only packaging machine.
- We recommend to install either aseptic tank + one Starasept or two Starasept units.

2. Since some time back, we have been working on FDA/USDA-approval for Starasept but still not finalized. When we will get the approval is very hard to state, but we hope to finalize this within a year's time.

Is the idea to locate a plant outside USA?

3. Normally, the Tetar-Brik machine is setting the capacity. However, the Starasept has variable capacity. The capacity of the processing equipment has, in principle, no minimum capacity but according to our judgement capacity below will be hard to justify.

4. To product the requested samples will cost 2 x 2900 SGD = 5800 SGD. Raw material, ingredients, transportation are not included.

Sorry for the late reply.

Best Regards

Goran Leufstedt

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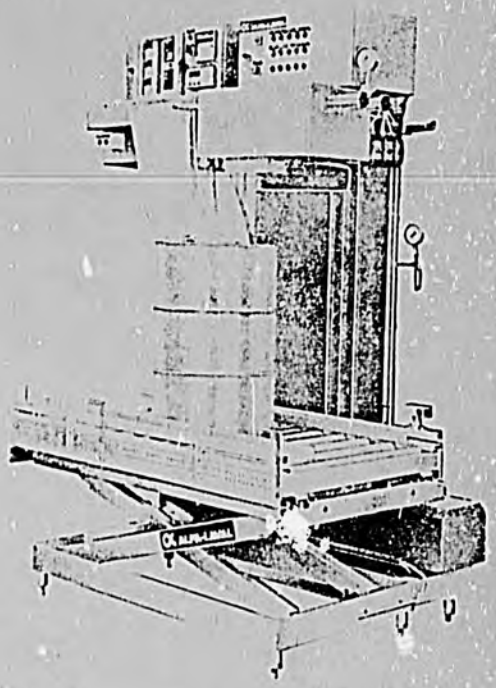
AL-010

Application

Filling of bulk-size packages with liquids of high as well as low acidity, under aseptic conditions. High-acid liquids may even contain solid or semi-solid particles. The filler is designed for CIP.



Working Principle

Package. The packages are manufactured from a variety of laminates to match the product and required shelf-life. The packages are provided with patented spouts designed for aseptic filling. The inside of the packages is sterilized before delivery; the packages are supplied flat and contain no air or gas. Thery are available in volumes from catering size up to sizes intended for shipping of product from manufacturer/grower to processor/packer/distributor. All packages are intended to be supported, when filled, by an outer container, for instance a barrel or heavy-duty cardboard box.

Filler. The main sections are:
Roller conveyor on hydraulic lifting table
Filling head with package manipulation and filling devices
Control and operator panels
Service units including electrical gear, steam and pneumatic valves, lifting table hydraulics, etc
Machine frame

The filler is normally installed together with barrel (or box) feed and discharge conveyors. In front of the filler, an operator's bridge should be placed (bridge and ancillary conveyors are not included in the standard aseptic bulk packaging system equipment).

Filling cycle. The filling cycle is divided into a manual preparatory part and an automatic filling part:

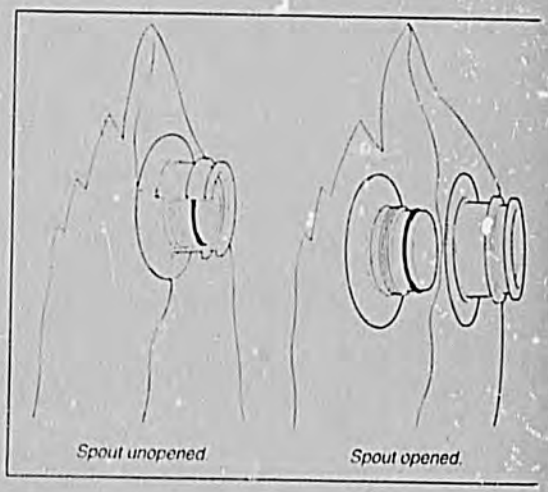
Manual preparation

1 The operator takes a flat and sterile package from its wrapping and places it inside a barrel arriving on the feed conveyor (most common production set-up for large packages). The operator pushes a button to start the conveyors and initiate the filling cycle. A barrel moves into position underneath the filling head. The lifting table ascends to prefilling level, and the spout bung gripper moves to engage the bung.

2 The package now in filling position, the operator pushes a pair (for safety) of buttons. The still unopened spout is brought to the filling valve.

Automatic filling

3 The spout is pressed tightly against the filling valve outlet.
4 Steam is admitted to the filling valve chamber, sterilizing it and the spout including its exposed bung face. Air and condensate are expelled.
5 Sterilization takes place at setpoint temperature and time, monitored by the fail-safe control system of the filler.
6 After sterilization, the filling valve opens and simultaneously the spout bung is withdrawn. Product enters the package.
7 Prefilling, main filling, and topping-up take place at different lifting table levels until the load cells sense the preset weight.
8 The filling valve closes, and steam enters the filling valve chamber, forcing remaining product into the package. Steam then enters and inflates the top of the package.



9 The inflated package triggers a sensor, causing the spout to be closed while still in a sterile environment.
10 With no air or gas headspace, the completely filled package is released and descends on the lifting table to be taken away by the discharge conveyor.

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StarAsept™
Aseptic bulk filling machine

Application

Filling of bulk-size packages with liquids of high as well as low acidity, under aseptic conditions. High-acid liquids may even contain solid or semi-solid particles. The filler is designed for CIP.

Working Principle

Package. The packages are manufactured from a variety of laminates to match the product and required shelf-life. The packages are provided with patented spouts designed for aseptic filling. The inside of the packages is sterilized before delivery; the packages are supplied flat and contain no air or gas. Thery are available in volumes from catering size up to sizes intended for shipping of product from manufacturer/grower to processor/packer/distributor. All packages are intended to be supported, when filled, by an outer container, for instance a barrel or heavy-duty cardboard box

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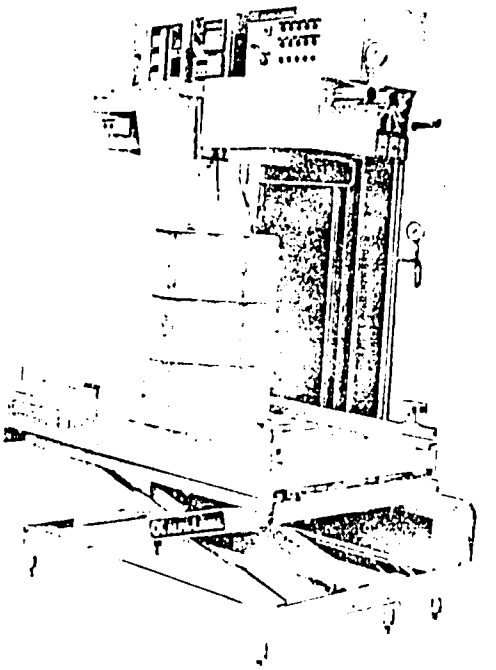
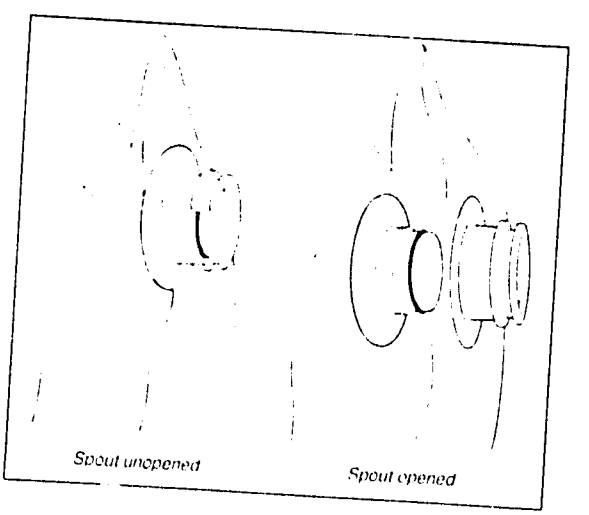




9 The inflated package triggers a sensor, causing the spout to be closed while still in a sterile environment.
10 With no air or gas headspace, the completely filled package is released and descends on the lifting table to be taken away by the discharge conveyor.

StarAsept™ aseptic bulk filling machine

Operation. The lifting table is hydraulic, and the package manipulation devices are operated by pneumatic cylinders. The steam and filling valves are pneumatic and solenoid operated.

Control system. The control system features an Alert 05 microcomputer process control unit. The package positions on the conveyors are marshalled by photocells and the lifting table levels by proximity switches. Prefilling is time-controlled, and main filling and topping-up are weight-controlled by means of load cells. Sterilization is safe-guarded by a timer and temperature monitor, and both are recorded on a chart. Should the temperature drop below setpoint, the sterilization procedure is automatically restarted from the beginning.

Sampling. Facilities are provided to draw small samples of product in the course of production.

Cleaning. The filler is designed for CIP. During cleaning, a dummy spout is placed in the filling valve outlet.

Capacity. The capacity depends on package volume, product characteristics, product supply facilities and pressure, and operator dexterity. A twin filler installation more than doubles the capacity and improves utilization of the operator's time by allowing him to prepare and sterilize one package while the other one is being filled; initial and concluding filling (when flow rate is reduced) of the two packages can also overlap.

Basic Unit

Standard equipment. The filler is a self-contained unit, ready to be sited and connected to electric, pneumatic, and steam services and the product supply line, and the feed and discharge conveyors. The latter are not included; nor is the operator's bridge.

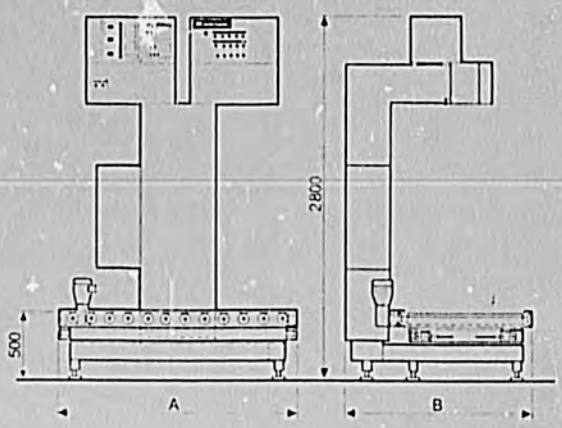
Material. All parts in contact with product as well as the upper framework, panels, and spout mechanism are of stainless steel. The lower framework, lifting table, and roller conveyor are of galvanized mild steel.

Versions. Single filler with 920 mm or 1300 mm wide lifting table and roller conveyor. Twin filler consisting of two identical single fillers.

Optional Equipment

Lower framework, lifting table, and roller conveyor made of stainless steel instead of mild steel.
Filter for culinary steam.
Operator's bridge.

Dimensions



Conveyor width, mm	A mm	B mm
920	1920	1500
1300	1960	1900

Technical Data

Steam supply. 400 kPa (4 bar); culinary quality steam recommended, max. 2 kg/h

Compressed air. 600 kPa (6 bar), 20 Nl per package

Electric power. 220/380 V 50 Hz 3-phase AC (other voltages on request), 5 kW

Product supply. 50–200 kPa (0.5–2.0 bar) depending on product viscosity

Shipping Data

	920 mm conveyor	*1300 mm conveyor*
Net weight	1240 kg	1400 kg
Gross weight	1800 kg	2000 kg
Volume	9.5 m³	11.5 m³

Proctor & Schwartz, Inc.
251 GIBRALTAR ROAD, HORSHAM, PENNSYLVANIA 19044
PHONE: (215) 443-5200 TELEX 6851098 CABLE "PROCTOR"

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PROPOSAL—CONTRACT TO: [redacted]

DATE: [redacted] Feb 2, 1989

Ref. Model 2000

Mr. John Slavics

DESCRIPTION OF EQUIPMENT:

One (1) "Proctor" 10'6" (3200mm) wide Conveyor, SCF Two Stage Single Conveyor Steam Heated Coconut Dehydrator and Cooler including Temperature Controls, Pin Levellers, Fines Recovery System, Cam Operated Doffer and Dry Brushes.

Approximate Dimensions

Overall Length	76' - 5 1/4"	(23,298mm)
Overall Width	14' - 7 1/2"	(4,458mm)
Height of Housing	7' - 9 5/8"	(2,378mm)
Height over Exhaust Fan	13' - 7 5/8"	(4,156mm)
Preliminary Drawing No.	CP28538-1A (Model 2000)	

PRICE.....U.S. $299,500.00

One (1) Set of Spare Parts for two (2) years operation.

PRICE.....U.S. $ 18,200.00

One (1) Power Control Cubicle with starters.

PRICE.....U.S. $ 24,160.00

One (1) "Proctor" Wiper Feed.

PRICE.....U.S. $ 24,080.00

All prices are in U.S. Dollars, F.O.B. our U.S.A. Factory, suitably packed for containerized sea shipment, pier delivery prepaid to an East Coast U.S.A. port of Proctor's option.

NOTE: The equipment can also be offered in Pounds Sterling, F.O.B. our U.K. Factory, suitably packed for containerized sea shipment, pier delivery prepaid to a U.K. port of Proctor's option.

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QUOTATION SUBJECT TO WITHDRAWAL WITHOUT NOTICE

TERMS OF PAYMENT

Thirty percent (30%) Downpayment with the order.

Balance: Irrevocable Confirmed Letter of Credit.

(Other terms must be negotiated.)

Financing up to five years is available for qualified buyers.

All terms are subject to credit approval.

DELIVERY

It is estimated that shipment of the above equipment can be made in approximately 4 to 5 months. Shipping date as stated is contingent upon the receipt of all require information to proceed with the order without delay and all financial matters satisfactorily settled.

Prices firm - 30 days

CABLE ADDRESS
"PROCTOR" HORSHAM PA

(FORM 2274)

QUOTATION SUBJECT TO
WITHDRAWAL WITHOUT NOTICE

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PERFORMANCE SPECIFICATIONS

Note that the performance of this dessicated coconut dehydrator is dependent upon variety of product, moisture content and other factors, and the following figures are, therefore, estimates based on past experiences.

1.	Capacity Output	2200 lbs/hr.	(1000 kgs/hr.)
2.	Initial moisture content	55% WWB	(122% BDB)
3.	Final moisture content	2.5% CDB	(2.5% BDB)
4.	Utilities required:		
	A) Electric current (Customer to Confirm)	380 Voltage/ 3 Phase/ 60 Hertz	
	B) Installed HP (KW)	91.75 HP	(68.41 KW)
	C) Steam pressure at dryer	100 Psig	(6.8 ATM)
	D) Estimated steam consumption Dryer	4650 lbs/hr.	(2108 kgs/hr.)

GENERAL ARRANGEMENT

1.	Feed End Extension	8' - 0"	(2438mm)
2.	Stage "A" Compartment No. 1 (Air Up)	10' -10"	(3302mm)
3.	State "A" Compartment No. 2 (Air Down)	10' -10"	(3302mm)
4.	Transfer Zone - Stage "A" t "B"	10'- 2 3/4"	(3118mm)
5.	Stage "B" Compartment No. 1 (Air Down)	10'-10"	(3302mm)
6.	Stage "B" Compartment No. 2 (Air Down)	10'-10"	(3302mm)
7.	Jog	2'- 0"	(609mm)
8.	Cooler	7'- 2"	(2184mm)
9.	Delivery End Extension	5' - 0"	(1524mm)

HAND OF MACHINE

Machine is to be a right hand machine. When facing the machine at the feed end, the circulating fans will be on the right.

CABLE ADDRESS
PROCTOR, HORSHAM, PA
(FORM 2274)

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WIPER FEED (Option)

Located above the feed end of the conveyor is an automatic feed consisting of a neoprene cross belt conveyor and a stainless steel wiper blade. The feed can be arranged to receive the product on either side (the left or the right) of the machine, and is driven through a totally enclosed worm gear by an electric motor.

CONSTRUCTION OF MACHINE

1. Structural framework - heavy gauge, 2" (50mm) square, plain steel tubing and angle iron, welded into modules and frames.

2. Housing - panels insulated with fiberglass, 2 1/2" (63.5mm) thick, between aluminized steel sheets. Inside panel sheets will have welded corners and will be vapor tight from the inside of the machine. All side panels, where possible, will be doors that can be opened by means of special latches.

3. Internal Sheet Metal - partitions, baffles, etc. 16 gauge and lighter will be aluminized steel. Sheet metal heavier than 16 guage will be plain steel painted. Sheet metal heavier than 16 gauge will be plain steel painted.

4. Side doors and panels will be provided with silicone rubber seals.

CONVEYOR

1. Interlocking sectional type, 8' - 5 7/8" (2587mm) wide between traveling guards.

2. Conveyor sections, 8" (203mm) pitch, type 304 stainless steel, perforated.

3. Conveyor Chain - 8" (203mm) pitch, plain steel roller chain attached to both sides of converyo sections.

4. Traveling Guards - overlapping 4" (102mm) high, type 304 stainless steel.

5. Stationary Guards - aluminized steel spring loaded with non-metallic air seals.

6. Conveyor Shafts - plain steel.

7. Conveyor Sprockets - cast iron.

8. Conveyor Tracks - plain steel.

9. Conveyor Drive - complete with motor, gear reducer, variable speed drive and chain drive.

CABLE ADDRESS
PROCTOR HORSHAM PA
(FORM 22741)

Proctor & Schwartz

QUOTATION SUBJECT TO
WITHDRAWAL WITHOUT NOTICE

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HEATING COILS

Heating coils will be of the extended surface type.

TEMPERATURE CONTROLS

Honeywell or equal, electric operated, recording, dry bulb, limited throttling, manual reset type controls will be furnished with floor mounted control stands and necessary flow control valves. Controls will have electric chart drives for 380 volts, 3 phase, 50 Hertz, single phase current, and charts are for 24 hour operating day.

CIRCULATION FANS

Centrifugal type, non-overloading fans of iron and steel construction arranged for V-belt drive. Proctor furnishes complete fan drives and safety guards.

COOLER CIRCULATING FAN

Circulating fan of iron and steel construction provided with V-belt drive guards and volume control disc.

EXHAUST FAN

Centrifugal type, of iron and steel construction mounted on the roof of the dryer to remove moisture laden air. Fan is arranged for V-belt drive and is provided with the necessary drive and motor and OSHA approved guards. Aluminized steel ductwork supplied from dryer to exhaust fan located on dryer roof.

MOTORS

Totally enclosed fan cooled motors are included for operation on 380 volts, 3 phase, 50 Hertz and are inclusive of tropical windings. (Customer to confirm.)

POWER CONTROL CUBICLE (Option)

Power Control Cubicle - dust tight construction, including disconnect switch, indicating lights, pushbuttons, nameplates, mounting of the above described temperature controllers, and motor starters. All of the above components are completely wired, piped and installed on control cubicle prior to shipment. "Square D" components are standard. Other supplied at additional cost.

Purchaser to furnish all electric power wiring from the motors to the control cubicle and control wiring from the components to the control cubicle.

ROTARY LEVELLERS

Two (2) pin levellers will be furnished for levelling matted product at the feed point of each stage.

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CABLE ADDRESS
"PROCTOR" HORSHAM PA

(FORM 2274)

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DOFFER

One (1) at the discharge point of Stage "A", a special cam operated doffer will be provided to assist in removing product from the Stage "A" conveyor and transferring it to the Stage "B" conveyor. Parts in cotnact with product, except for the neoprene blade, will be of type 304 stainless steel. This unit is driven by a gearmotor and chain drive.

FINES RECOVERY SYSTEM

One (1) to recover product thatmight sift through the Stage "B" conveyor at the discharge point. Proctor will provide a fines recovery drum mounted on the delivery end shaft. The fines recovery system also includes a screw conveyor to carry the fines to the side of the machine. All parts in contact with the product will be of 304 stainless steel.

DRY BRUSHES

Two (2) located underneath the return run of the drying conveyors to assist in removing fines which stick to the conveyor surfaces.

Brushes will consist of a rotating shaft with brush blades. The unit will be provided with gearmotor and chain drive.

MACHINERY GUARDS

All exposed belts or chain drives will be guarded in accordance with OSHA requirements.

TRIM

TRim and exterior steel parts will be coated with "Proctor" Food White Epoxy.

STEEL PROTECTION

Parts of aluminized steel and/or stainless steel will be uncoated. Steel parts within the machine will be coated with one (1) coat of high temperature aluminum epoxy.

BUILDING LAYOUT

Purchaser is to furnish the Company with a building layout indicating principal dimensions and location in the building where the machine will be installed.

SPECIAL MATERIALS CLAUSE

The Pur 'aser has approved the kind of materials to be used in the various parts of this machine as above identified. If, after the equipment is installed, it develops that materials other than those specified are necessary, then such matorial replacements will be made at an adjusted price.

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CABLE ADDRESS
PROCTOR HORSHAM PA

FORM 2274

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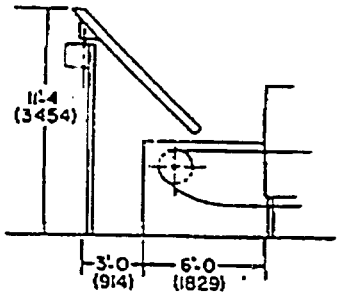
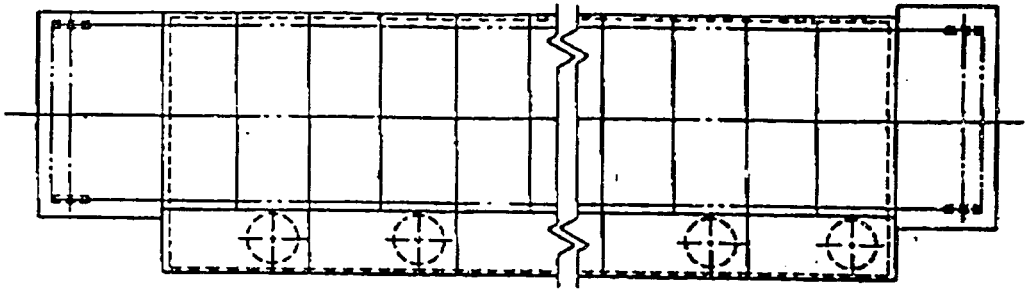
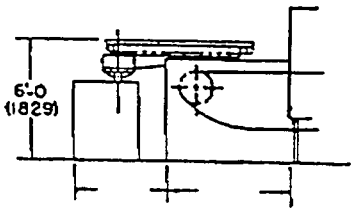


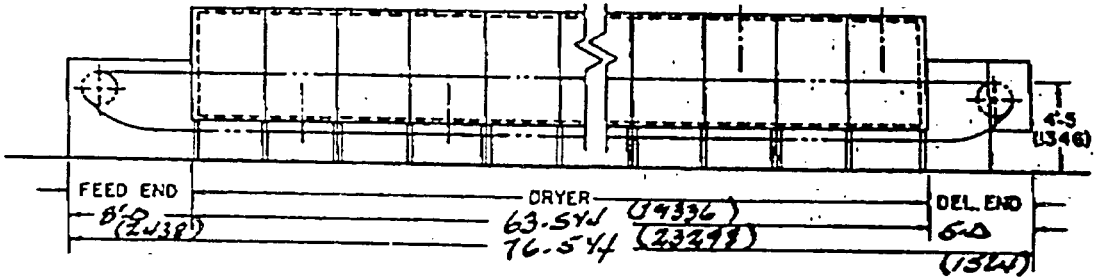
SWINGING SPOUT



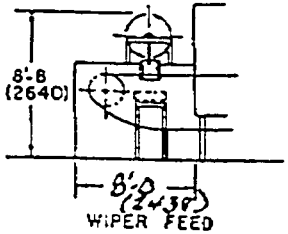
PLAN VIEW



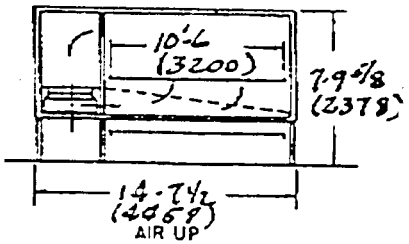
OSCILLATING SPREADER



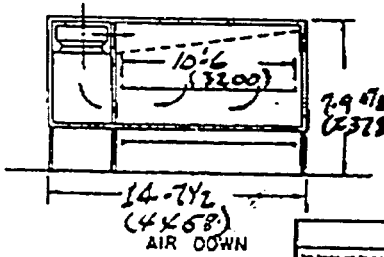
SIDE VIEW



WIPER FEED



AIR UP



AIR DOWN

CROSS SECTIONS

COMP'T	LENGTH	DIRECTION
A1, A2	10-10 (3302)	DOWN
TRANSITION	10-2½ (3118)	—
B1, B2	10-10 (3302)	DOWN
JOG.	2-0 (610)	—
COOLER	7-2 (2187)	DOWN.

MODEL 3000
COC JET DEHYDRATOR

CP28538-1A

PROCTOR & SCHWARTZ

PHILADELPHIA PA. U.S.A.

SCHWARTZ PROCTOR

02. 02. 89 02:06 PM

PURCHASER TO FURNISH

1. Freight from shipping points.

2. Unload and move to clear erection site.

3. Building alterations and foundations as required.

4. Labor to erect the machine.

5. Steam piping and connections including traps and hand valves.

6. Electrical wiring and connections including motor starters and disconnect switches.

7. Make-up air connection from out-of-doors if desired.

8. Exhaust ductwork from the dryer to out-of-doors.

9. Permits and approvals such as may be required by governmental or insuring agencies.

10. Water piping, valves, strainers, sumps, pumps, drains, etc. for conveyor washing equipment.

11. Equipment to bring the product to the dryer at a continuous and uniform rate and remove it as it is discharged from the dryer conveyor.

THE O'BRIEN MACHINERY CO.

"THE POWERHOUSE" SINCE 1915

Washington & Green Sts., Downingtown, PA 19335 • (215) 269-6600 • PHILA. TELEX 835319

QUOTATION TO:

Appropriate Technology International
1331 H Street N.W.
Washington, DC 20005

Attention: Russ Reed

MANUFACTURING PLANTS IN:
Wilmington, Delaware
Downingtown, Pennsylvania
Houston, Texas
Miami, Florida
Ash, Canterbury, England
Sandwich, Kent, England

Quote Number BS289-55
February 21, 1989

Gentlemen:

We offer for your consideration, subject to prior sale and conditions stated below

TERMS: Our regular terms are one-third deposit with order, balance C.O.D. or sight draft attached to bill of lading, unless otherwise arranged. It is understood that there are no conditions or agreements outside this proposal. For immediate acceptance and subject to change without notice. Not subject to cancellation.

GUARANTEE: All NEW machinery carries standard guarantee of the manufacturer of the item offered. All machinery offered RECONDITIONED bears our warranty as enclosed. No guarantee applied to equipment offered in "as is" condition

DESCRIPTION	PRICE
G-3850	Prices are NET F.O.B. Shipping Point
Unused O'Brien Model OB195V-DW63 engine/generator set consisting of a Volvo TD120GG diesel engine directly coupled to an EC generator. The engine speed is 1800 RPM with the following standard equipment:	
Fabricated steel base; precision governor; unit mounted radiator cooled, lube oil, fuel oil, and jacket water pumps; lube oil, fuel oil, and intake air filters; 24 VDC electric start; high water temperature, low oil pressure, overspeed safety shutdown system and an engine instrument panel consisting of running time meter, DC voltmeter, jacket water temperature and lube oil pressure gauges.	
The brushless generator set is standby rated at 195 KW, 243.7 KVA, 3 phase, 60 hertz, 127/220 volts with an automatic voltage regulator. The following accessories are also included:	
* Generator control and monitoring panel, unit mounted with vibration isolators; complete with ammeter, voltmeter, combination phase selector switch, frequency meter, fault shutdown indication lights, running time meter, and voltage adjusting rheostat; * Lead-acid, heavy duty, engine starting battery system complete with battery cables and battery rack; * Radiator core and fan guards; * Flexible fuel line; * Stainless steel flexible exhaust connection; * Industrial grade exhaust silencer;	

All agreements are contingent upon strikes, accidents or any cause beyond our control and are not binding unless signed by an officer of this corporation. Quotations for prompt acceptance, subject to change without notice and prior sale.

* 800 Ampere molded case main line circuit breaker sized for rated capacity of generator set at rated voltage. Adjustable solid state trip included;
* Initial pre-shipment fill of antifreeze solution and lube oil;
* Pre-shipment, full load test;
* Operation and maintenance manual.

NET PRICE: F.O.B. Our Shops. $1.,352.00

G-3851

Unused O'Brien Model OB240V-DW63 engine/generator set consisting of a Volvo TID120FG diesel engine directly coupled to an EC generator. The engine speed is 1800 RPM with the following standard equipment:

Fabricated steel base; precision governor; unit mounted radiator cooled, lube oil, fuel oil, and jacket water pumps; lube oil, fuel oil, and intake air filters; 24 VDC electric start; high water temperature, low oil pressure, overspeed safety shutdown system and an engine instrument panel consisting of running time meter, DC voltmeter, jacket water temperature and lube oil pressure gauges.

The brushless generator set is standby rated at 240 KW, 300 KVA, 3 phase, 60 hertz, 127/220 volts with an automatic voltage regulator. The following accessories are also included:

* Generator control and monitoring panel, unit mounted with vibration isolators; complete with ammeter, voltmeter, combination phase selector switch, frequency meter, fault shutdown indication lights, running time meter, and voltage adjusting rheostat;
* Lead-acid, heavy duty, engine starting battery system complete with battery cables and battery rack;
* Radiator core and fan guards;
* Flexible fuel line;
* Stainless steel flexible exhaust connection;
* Industrial grade exhaust silencer;
* 800 Ampere molded case main line circuit breaker sized for rated capacity of generator set at rated voltage. Adjustable solid state trip included;
* Initial pre-shipment fill of antifreeze solution and lube oil;
* Pre-shipment, full load test;
* Operation and maintenance manual.

NET PRICE: F.O.B. Our Shops. $17,679.00

G-3882

Reconditioned O'Brien Model OB350K-DW63 engine/generator set consisting of a Cummins VT-1710 diesel engine directly coupled to a generator. The engine speed is 1800 RPM with the following standard equipment:

Fabricated steel base; Woodward hydraulic governor; unit mounted radiator cooled, lube oil, fuel oil, and jacket water pumps; lube oil, fuel oil, and intake air filters; 24 VDC electric start; high water temperature, low oil pressure, overspeed safety shutdown system and an engine instrument panel consisting of jacket water temperature and lube oil pressure gauges, DC ammeter, and engine hour meter.

The generator set is standby rated at 350 KW, 438 KVA, 3 phase, 60 hertz, 208/480 volts with an automatic voltage regulator. The following accessories are also included:

* Generator control and monitoring panel, unit mounted with vibration isolators; complete with ammeter, voltmeter, combination phase selector switch, frequency meter, fault shutdown indication lights, running time meter, and voltage adjusting rheostat;
* Lead-acid, heavy duty, engine starting battery system complete with battery cables and battery rack;
* Flexible fuel line;
* Flexible exhaust connection;
* Industrial grade exhaust silencer;
* Molded case main line circuit breaker sized for rated capacity of generator set at rated voltage. Adjustable solid state trip included;
* Pre-shipment, full load test;
* Operation and maintenance manual.

NET PRICE: F.O.B. Our Shops. $23,000.00

Delivery: 4-6 Weeks A.R.O.

Subject to Prior Sale

G-1481

Reconditioned O'Brien Model OB300GM-DM63 engine/generator set consisting of a General Motors EMD6-567 diesel engine directly coupled to an Electric Machinery generator. The engine speed is 720 RPM with the following standard equipment:

Fabricated steel base; Woodward hydraulic governor; remote radiator cooled, lube oil, fuel oil, and jacket water pumps; lube oil, fuel oil, and intake air filters; 64 VDC electric start; high water temperature, low oil pressure, overspeed safety shutdown system and an engine instrument panel consisting of exhaust pyrometer, lube oil pressure and jacket water temperature gauges.

The generator set is continuous rated at 300 KW, 375 KVA, 3 phase, 60 hertz, 416 volts with an automatic voltage regulator. The following accessories are also included:

* Free standing generator control and monitor panel complete with ammeter, voltmeter, combination phase selector switch, frequency meter, fault shutdown indication lights, running time meter and voltage adjusting rheostat;
* Lead-acid, heavy duty, engine starting battery system complete with battery cables and battery rack;
* Flexible fuel line;
* Stainless steel flexible exhaust connection;
* Industrial grade exhaust silencer;
* 600 Ampere molded case main line circuit breaker sized for rated capacity of generator set at rated voltage. Adjustable solid state trip included;
* Initial pre-shipment fill of antifreeze solution and lube oil;
* Pre-shipment, full load test;
* Operation and maintenance manual.

NET PRICE: F.O.B. Our Shops. $17,500.00

Very truly yours,

THE O'BRIEN MACHINERY COMPANY

Robert J. Squitieri

RJS:bss

SHORTFORM FACSIMILE TRANSMITTAL

PAGE: 1 OF 1 PAGES

DATE: 01 FEBRUARY89

REF : US SAMOA STEAMPLANT SOLID FUEL COGEN

TO

APPROPRIATE TECHNOLOGY INTERNATIONAL
1331 H STREET, NW
WASHINGTON, DC 20005

ATTN:
(1) MR. RUSS READ
(2) MR. JOHN SLAVICS
(202) 879-2900

(202) 628-4622
RECIPIENT'S TELECOPIER NO

MESSAGE

PER OUR TELCONS OF 30 JAN & 1 FEB 1989, RE EQPT PRICING I PROVIDE THE FOLLOWING PER YOUR REQUEST.

ESTIMATED SOLID FUEL BOILER PLANT EQUIPMENT COSTS:

FOR BOILER, SOLID FUEL FEED SYSTEM, BREECHING, STACK & MECHANICAL COLLECTOR, FEEDWATER RECEIVER, FW PUMP SET, FEEDWATER QUALITY CONTROL SYSTEM, TURBINE & SWITCHGEAR, BOILER AND GENERATOR CONTROL SYSTEM, FOB WORKS USA:

SYS	ELEC CAP	STEAM PRODUCTION @ 50 PSIGSAT	APPX COST
A)	150 KW_E	APPX 6,600 LBM/HR	$ 385,000
B)	200 KW_E	APPX 8,800 LBM/HR	$ 415,000
C)	250 KW_E	APPX 11,000 LBM/HR	$ 450,000
D)	300 KW_E	APPX 13,200 LBM/HR	$ 490,000

RUSS, THESE NUMBERS ARE VALID BUDGET ESTIMATES; WE NEED COMPLETE SYS RQMTS/SPECS TO GIVE FIRM QUOTE. GOOD LUCK WE LOOK FORWARD TO WORKING WITH YOU ON ATI'S PROJECTS.

FROM: PARKER ENGINEERING AND CHEMICALS, INC.
P.O.DRAWER 81226 ATLANTA GA 30366

PARKER FAX NO: (404) 451-7365

ORIGINATOR: FRANK D. PARKER, JR. (404) 458-9131

PAGES: NUMBER OF PAGES BEING SENT INCLUDING THIS SHEET: 1

MEMORANDUM

TO: Glenn Patterson, TRG
cc: John Slavics, TRG

FROM: Russ Read, TRG RS.

DATE: January 27, 1989

RE: Coconut processing equipment, as per request dated 1/23/89

==========

This data is preliminary and will require verification when more specifics become available. I have made several assumptions for each piece of equipment because I have been unable to contact Ernesto Lozado. I have listed the assumptions, and I hope they are consistent with each other and your needs. Technical data is being sent to my attention, but will not reach here until late next week.

Boilers:

I have lumped the boilers and turbines together into a cogeneration facility to provide power as well as steam. The boiler portion has been sized to provide not only the steam, but also power (150 - 300 kW, 3 phase, 220 V) from the coconut husks. I have been told that 24 hour use is much better than start/stop operation and will increase the life substantially. Using your data and information from John, I have assumed that using 5,000 - 10,000 lb/hr. of 250 ^{o}F, 2 bar, saturated culinary grade steam is sufficient for your needs.

Because of the highly site-specific nature of the technology, the quotes take some time to develop. I have requested quotes from Midwesco Corp. (Illinois, (312) 966-2150 contact: Chuck Tyberg), Lancaster Distral Corp. (Florida, (305) 920-8100, contact: Mr. Tomayo), and Parker Engineering (Georgia, (404) 458-9131, contact: Frank Parker, Jr.). Parker has been the only interested party, but it is taking some time to develop the information. John will pass along any information not included here.

Boiler (including: feed bin, firebox, boiler, and water treatment facility for feed water (which will include some amines for scale reduction)):

150 kW operations (PE)	$ 170,000
300 kW operations (PE)	$ 300,000

Truck Scale

The truck scales were more straight forward. Two types exist, pit (requiring less equipment, but more concrete and foundation work), and above ground (where water tables are a problem, requiring more equipment, and less concrete and foundation work). All have a steel, as opposed to a concrete deck, measuring 60' x 10'. Pits have to be about

5′ deep. Can be run from single or three phase source and all are rated up to 100 ton (US). All are electronic and do not provide logging capability. None felt that special work needed to be done for the marine/island environment.
Fairbanks Scales (Maryland, (301) 574-0650, contact: Mike Linnehan) and Weightronix (Maryland, (301) 682-2800, contact Frank Murphy at American Scale) both quoted:

Pit scale: 100 ton, including deck, electronics hook-up, and readout.

(FS)	$ 20,000 + $15,000 (concrete, etc.)
(WT)	$ 22,000 + $15,000 (concrete, etc.)

Above ground: 100 ton, including deck, electronics, and read-out.

(FS)	$ 31,000 + $10,000 (concrete, etc.)
(WT)	$ 28,000 + $8,000 (concrete, etc.)

Diesel fired generators:

In this case, I have assumed that the generator will serve as a back-up to the main steam plant. I have no real reason to believe this, but what the heck. I have also assumed that the generator will provide power at 3 phase, 220 volts, which seemed to be a good industrial standard. None of the units quoted include a power filter, nor is any special adaptation made for the marine/island environment. All have a manual start-up switch rather than a auto-start to save a few thousand dollars. I also tried to stick with major manufacturing firms to guarantee parts and service. Footprints are roughly L112" x W39" x H59".

Penske (New Jersey, (201) 489-5800, contact: Jay O'Neil), and O'Brien (Pennsylvania, (215) 269-6600, contact: Bob Squitieri)

Generator sets:

150 kW (O'B)	$ 25,000
200 kW (P)	$ 24,000
300 kW (O'B)	$ 30,000 - $ 32,000
300 kW (P)	$ 28,000

Steam turbines and power generation:

As mentioned under boilers, the steam turbines will be part of a cogeneration facility. The specifics are given above as I have assumed them. The same organizations are quoting on the turbines/generators.

ANNEX V-a

SUSTAIN Notes

A JOINT PUBLICATION OF PROJECT SUSTAIN AND THE LEAGUE FOR INTERNATIONAL FOOD EDUCATION
915 FIFTEENTH STREET, N.W., SUITE 915, WASHINGTON, D.C. USA • TELEPHONE (202) 331-1658

VOLUME 1, NUMBER 2, FALL 1986

QUALITY ASSURANCE REQUIREMENTS FOR FOODS INTENDED FOR EXPORT TO THE USA

John J. Slavics

John J. Slavics is with Appropriate Technology International. He has extensive experience in the design and development of quality assurance systems for companies both in the U.S. and overseas. He was Quality Assurance Manager for the Technology Commercialization Department of the Pillsbury Company and was involved in the development of the Hazard Analysis and Critical Control Point (HACCP) system for maintaining food safety. He has also served as Chief of the Quality Assurance Branch, Food Safety and Quality Service, U.S. Department of Agriculture. He has taught and written on many aspects of Quality Assurance.

Introduction

A number of food processing companies are attracted by the seemingly limitless North American Market for processed food, and are attempting to export to the USA. They are finding, however, that frequently their products are seized or embargoed at US ports of entry due to evidence of filth or contamination of the product, an event that causes a tremendous waste of food, labor, packaging materials, and capital. The cause of this contamination and failure to gain entry usually is traced back to processors' inadequate quality control programs. Many processors, it appears, rely solely on laboratory analysis of food lots as a means of control. The fact is that only a well-functioning quality assurance program that conforms to FDA (Food and Drug Administration) laws will ensure successful exportation of foods to the United States.

SUSTAIN Notes Newsletter is published four times a year and is funded by the Agency for International Development. the views expressed are not necessarily those of Project SUSTAIN or AID.

> processors should develop quality assurance programs

Meeting FDA Standards

FDA laws (The Federal Food, Drug, and Cosmetic Act) (Section 201) clearly prohibit the "delivery or introduction into interstate commerce of any food ... that is adulterated or misbranded ..." Section 402 of the Act states that, "... a food shall be deemed adulterated ... if it consists in whole or in part of any filthy, putrid, or decomposed substance ... or if it has been prepared, packed, or held under insanitary conditions whereby it **may** have become contaminated with filth ..." (Emphasis added.)

In order to meet these requirements and increase their chances of getting products into US markets, processors should develop quality assurance programs to protect against spoilage and assure that contamination of the food by filthy, putrid, or decomposed substances cannot occur.

Protecting against these two hazards requires sanitary conditions in the controlled environment called the "product zone" (the area in which cleaned ingredients, the processing techniques, and packaging come together to produce the finished product.) The product zone must be protected against contamination from flying insects, and can be achieved with the use of screening, air curtains, insect electrocutors, and periodic applications of registered fog or spray insecticides applied by licensed technicians. Populations of these insects can also be limited by keeping the outside of the plant sanitary, covering garbage, and frequently removing trash.

Plant location, too is an important factor in sanitation: one should not site the plant near a feed lot, abattoir (slaughterhouse), sewage plant, or other operation which breeds many flying insects. Bird control is similarly effected, and the plant and ingredients warehouse must be screened completely so as to exclude any vertebrate pests. Entry by crawl-

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ing insects and rodents is made more difficult if the concrete foundation of the plant is built several feet above the surrounding terrain and if strict grounds sanitation is practiced. The groundline of the building must be completely free of weeds and landscaping plants for at least 50 feet around its periphery. Landscaping, although attractive, can harbor rodents and other pests.

Prevention of insect contamination by **sanitary practices** is less costly than spraying, and avoids the risk that residual pesticide will be carried over into the final product and later cause it to be detained.

Frequent clean-up of accumulated and spilled ingredients, reworked scrap, and products awaiting further processing also will guard against infestation and contamination. Also essential to insect control are frequent clean-up of spillage and leaks from equipment and specific treatment with approved residual pesticides of elevator boot pits, bins, and other cereal conveyors and containers.

A **strict rodent control program,** which includes patrol and inspection, trapping, and baiting using only approved materials, is vital to protecting food supplies. **Contamination** from **rodents** is **easily detected** by **FDA analysis** through ultraviolet lamp examination of containers for rodent urine stains. United States courts have held that the presence of urine stains is evidence that the food has been held under insanitary conditions, and this is a clear violation of the Act. Such food packages are seized or embargoed, without exception. Rodent hairs, which are almost microscopic, easily detected in food, and undeniably characteristic of defilement, also are considered "filth" by the FDA. Their presence in foods in any amount is evidence of violation of the Act. The various bacteria and their toxins are considered adulterants and also are easily detected. They may enter the food system through environmental contamination, improper handling, and uncontrolled storage conditions. Insects, birds, rodents and unsanitary or improper practices in the food plant can introduce adulterants into foods.

If you, as a food processor, would like to export to US markets, the foregoing should give you some idea of the standards for sanitation and assured good-quality of the product that the FDA requires. It is not enough simply to attempt to pass goods with your own laboratory analyses as the indicator of quality. In order to **guarantee** that a product meets FDA standards, safeguards for sanitary products must begin at the processing plant.

safeguards for sanitary products must begin at the processing plant

It should be apparent that:

1. Any adulterant (pests or their products, trash, filth, and contaminants from people) in the product zone can enter the food.

2. An inadequately controlled environment or process is a violation of the Act, and, in addition, can allow the growth of microorganisms resulting in detectable adulteration.

3. Insanitary and unhygienic practices by plant personnel can contribute to adulteration through shed hair, nasal secretions, wound exudates, and fecal contamination.

4. Contamination of food can result from improper maintenance and engineering practices. For example, unprotected fluorescent tubes and incandescent bulbs, if broken, could dangerously contaminate an entire batch of ingredients and go undetected during further processing. Leaking pipes, binding wire, wood, moisture condensate, and dust in the product zone all risk contaminating foods during processing.

5. Final testing of packaged food products *alone* will not satisfy the requirements of the US Federal Food, Drug and Cosmetic Act, nor the sanitary standards of the Codex Alimentarius. To the contrary, any strategy aimed at "certifying" solely through a final **laboratory examination** is worse than useless, because it **fails to correct** dangerous and unethical practices at the plant level. A clear, well-defined quality assurance program that is strictly enforced saves the processor tremendous export losses due to contaminated products.

Improving Quality Assurance with the HACCP System

Meeting FDA standards by avoiding contamination as outlined above can be facilitated by using the **HACCP** (Hazard Analysis and Critical Control Point) System of Food Safety and Quality Control that was developed in 1972 by the Pillsbury Company under contract to the FDA, and was used as an aid to FDA in enforcing regulations governing low-acid canned foods.

The HACCP system identifies sensitive ingredients, establishes critical control points (those process parameters that, when out of control, create an unacceptable food safety risk), and controls relevant human factors which affect product safety. FDA found the HACCP program particularly well suited to the production of low-acid and acidified foods in hermetically sealed containers, and adopted parts of it which assist in the inspection of critical control points for those kinds of foods. These principles now are contained in Title 21, Code of Federal Regulations, 113 and 144, and are now called **critical factors.**

The HACCP program, therefore, can be applied advantageously to

any food processing operation, whether a small single-parent firm, a large firm with many plants, or a transnational company. HACCP can be applied to artesanal operations such as bakeries, dairies, restaurants, or to large-scale high-speed processing plants for high-risk foods such as low-acid hermetically sealed foods.

In 1980, in Geneva, the WHO International Commission on Microbiological Specifications for Foods endorsed use of the HACCP system in food hygiene (National Academy of Sciences, 1985, *An Evaluation of the Role of Microbiological Criteria for Food and Food Ingredients*, Washington, D.C.), and great emphasis was placed upon the control of contamination by microorganisms. Not only does HACCP control microorganisms, but also other agents such as aflatoxins and other mycotoxins, heavy metals, and pesticides, as well as adulterants such as filth, pests and their products, and extraneous materials. When HACCP is properly installed in a plant

the HACCP program . . . can be applied advantageously to any food processing operation

quality assurance program, it is invaluable in generating personnel awareness, controlling risks, and affording great economies of operation because there is increased employee morale and increased efficiency as the plant becomes a model for the industry. For processors already in operation, HACCP has an extremely rapid course for upgrading and bringing into compliance those parts of the operation which need immediate attention in a step-wise, orderly fashion. Processors can request further information from the US FDA, FAO (Food and Agriculture Organization), WHO (World Health Organization), or PAHO (Pan American Health Organization.)

When assisted by an experienced HACCP consultant, a project can be established in stages to assure a minimum of disruption to processing and operations with an absolute minimum of new capital invested. In this way, a plant can be brought into compliance with a minimum expenditure of time and resources. The gross margin improvement would soon offset the expense of upgrading.

The following 11 points, constitute a model quality assurance program which can assure compliance with US FDA laws and regulations if diligently applied, and, therefore, assure that a food process will meet all FDA requirements for importation.

1. *An Organizational Chart* diagram showing the place of the quality assurance organization in the company management structure. It would indicate function, communications, and should specify **who in authority can stop production** or hold or reject products.

2. *Process Flow Diagram* — a diagram for each product showing step-by-step processing operations. It shows ingredient testing, flow of materials, and operations, and identifies critical control points and product protection devices (magnets, sifters, metal detectors, thermometers, and other control devices and instruments.)

3. *Analytical Methods* — a file containing or identifying physical, chemical and microbiological methods of analysis for all tests done in the plant; the name and address of contract laboratories; and the schedule of calibration of all measuring instruments used for quality assurance and metering in the plant.

4. *Incoming Materials Control* — a chart listing all ingredients, packaging materials, and regulated food additives, and gives sampling plans, test methods, attributes and limits (specifications), and accept/reject criteria.

5. *In-Process Control* — a chart showing each critical control and quality check points with attributes, limits, sampling plan, and accept/reject criteria.

6. *Packaging Operations Control* — a chart listing each packaging critical control and quality check point showing attribute, limit, sampling plan, and accept/reject action. Includes label quality control, all coding requirements, and definition of a "lot" for recall purposes.

7. *Storage Requirements* — a chart and instruction book for maintaining the integrity of ingredients, packaging materials, and finished products with specifications for warehouse layout. Categories of stored products, sequestering and disposal of defective goods, salvage and repack operations, lot accounting, and maintenance, sanitation and pest control procedures should also be included here.

8. *Finished Product Evaluation* — a chart showing in-process control format, attributes, limits, sampling plan and accept reject action levels.

9. *Sanitation and Personal Hygiene Monitoring* — to protect the product, it is necessary to prescribe the sanitation of the facility and the hygienic practices required of plant personnel. A book containing cleaning methods and schedules, grounds maintenance, refuse handling, pest control program, inspection schedule, and detailed hygienic practices for employees, shall be maintained.

10. *Sample Standard Forms File* — a file containing copies of all recorded and

reported tests and observations should be sited in one place.

11. *Recall Plan* — a booklet defining conditions and detailed procedures to be followed in recovering from commercial channels all non-conforming products, whether for public health or commercial reasons. This plan specifies an executive and staff who coordinate all activities, and includes progress reporting procedures.

Questions Concerning Quality Assurance may be directed to:

Mr. John J. Slavics
Technical Officer
Appropriate Technology International
1331 H Street N.W.
Washington, D.C. 20005
U.S.A.

Mr. Robert Lake
Acting Director, Office of Compliance
U.S. Food and Drug Administration
Center for Food Safety and Applied Nutrition
200 C Street S.W.
Washington, D.C. 20204
U.S.A.

Mr. Richard R. Klug
Director, Import Operations
Food and Drug Administration
HFC 131 Room 1218
5600 Fishers Lane
Rockville, Maryland 20850
U.S.A.

Suggested Further Reading

1. *Codes of Federal Regulations of the United States:*
   a. **Title 7** — Agriculture. Chapter I. Agricultural Marketing Service (Standards, Inspection, Marketing Practice) Parts 26-209. (Abbreviated, "7 CFR 26-209.")
   b. **Title 9** — Animals and Animal Products. Chapter I. Animal and Plant Health Inspection Service Parts 1-199. (Abbreviated, "9 CFR 1-199.")
   c. **Title 9** — Animals and Animal Products. Chapter III. Food Safety and Inspection Service. Meat and Poultry Inspection. Parts 300-399. (Abbreviated, "9 CFR 300-399.")
   d. **Title 21** — Food and Drugs. Chapter I. Food and Drug Administration Parts 1-1299. (Abbreviated, "21 CFR 1-1299.")

   The Code of Federal Regulations is published in sections that must be ordered separately by abbreviated code. They may be obtained from the US Government Printing Office (see address below.)

2. *Requirements of Laws and Regulations Enforced by the U.S. Food and Drug Administration*, US Department of Health and Human Services, Public Health Service, Food and Drug Administration. For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Order HHS Publication No. (FDA) 85-1115.

3. *Importing Foods Into the United States: A Summary of the Procedures The U.S. Importer Must Follow When Handling Food Products.* Department of Health and Human Services, Public Health Service, Food and Drug Administration, 200 "C" Street, SW, Washington, DC 20204, USA.

4. *Laws Enforced by the U.S. Food and Drug Administration.* US Department of Health and Human Services, Public Health Service, Food and Drug Administration, 5600 Fishers Lane, Rockville, MD 20857, USA. Also available through the US Government Printing Office (see address above). Order HHS Publication No. (FDA) 80-1051.

5. The "Codex Alimentarius" of the Food and Agriculture Organization (FAO) of the United Nations.
   a. The "General Principles of Food Hygiene"

6. Manual of Food Quality Control: FAO, Rome.
   a. Food control laboratory
   b. Chemical analysis; ingredients contaminants, techniques
   c. Chemical analysis: commodities
   d. Microbiological analysis
   e. Food inspection
   f. Food for export

7. "Guidelines for the Establishment of an Effective National Food Control System." FAO, Rome.

The FAO Technical Papers are available through the authorized FAO Sales Agents or directly from Distribution and Sales Section, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

Mini-workshop on Coconut Water and Sap Utilization

PROCEEDINGS

Jointly Organized By:

Philippine Coconut Research and Development Foundation

And

Philippine Council for Agriculture and Resources
Research and Development

Manila Peninsula Hotel
Makati, Metro Manila
20 September 1983

ANNEX
IV-8

MINI-WORKSHOP ON COCONUT WATER AND SAP UTILIZATION

OBJECTIVES

1. To assess the state-of-the-art of coconut water and sap utilization
2. To identify researchable areas along coconut water and sap utilization

EXPECTED OUTPUT

1. Assessment of the status of research and development on coconut water and sap utilization
2. List of researchable areas or gaps along coconut water and sap utilization

OPENING CEREMONIES

WELCOME REMARKS

ERNESTO P. LOZADA
Executive Director
Philippine Coconut Research and Development
Foundation, Inc. (PCRDF)
Pasig, Metro Manila

Administrator Dueñas, Dr. Gapasin, Dr. Madamba, colleagues in coconut research, friends:

Last year at about the same time we had a Mini-Workshop on Coconut By-Products Utilization and Socio-Economics Research at PCARRD. The output of that workshop had been very useful to PCRDF and PCARRD in identifying and prioritizing research areas. Two major projects have been funded for 1983 and four more are being considered for 1984 funding. Today we are having another Mini-Workshop on Coconut Water and Sap Utilization, which is part of the PCRDF eighth year founding anniversary celebration. This workshop is again a joint undertaking with PCARRD, our favorite co-sponsor. We feel that it has a good system. This Mini-Workshop is a small step like the previous ones we had. But these small steps when done deliberately and persistently will add up through the years to a significant contribution in making the coconut industry more progressive and more equitable. In behalf therefore of PCRDF and our co-sponsor, PCARRD, we welcome you all.

Thank you

BRIEF REMARKS

FELIX V. DUEÑAS, JR.
Administrator
Philippine Coconut Authority (PCA)
Diliman, Quezon City

Dr. Lozada, Dr. Gapasin, Dr. Banzon, Dr. Madamba, Dr. Padolina, Dr. Cruz, Deputy Administrator Aldaba, Ladies and Gentlemen:

The PCA, as its fundamental policy, encourages research on coconut by-product and waste-resource utilization, through the inter-agency approach. That is, the pooled expertise and resources of competent agencies and the private sector are harnessed and managed, to maximize the research effort, and ultimately enhance the welfare of our coconut farmers. It has been my privilege in the last six years as PCA Administrator to implement this policy and I am happy to inform you that the PCA inter-agency set-up with the University of the Philippines at Los Baños (UPLB), the Philippine Coconut Research and Development Foundation (PCRDF), the Philippine Council for Agriculture and Resources Research and Development (PCARRD) and the Private Sector has been very successful. Today's workshop is an embodiment of this success.

While we have a wealth of scientific minds to focus on any area of new product utilization for coconut, we are not correspondingly endowed with the financial capacity to pursue all research possibilities. It is for this very reason that researches in the Philippine setting should focus on utilizing our resources very efficiently and effectively. One approach to this end which I would like to suggest at the risk of sounding simplistic, is to strengthen and rationalize the linkages between the entrepreneur and the scientific community. In a free market society, it is a truism that consumer need determines new product priorities. The entrepreneur fills this need, but he cannot do so unless the scientist creates what is needed. On the converse side, the utility of what the scientist creates is significantly a function of consumer need as identified by the entrepreneur. What I am really trying to say is that research prioritization should be governed among major considerations, by the functional inter-action of the scientist and the entrepreneur; otherwise, the danger of wasteful research which we can ill afford, exists. Science and commerce are not incompatible. Each reinforces the other.

PCA has started to forge this linkage. It is my justified expectation that only with your cooperation can it be fully strengthened and exploited.

WORKSHOP RATIONALE AND GUIDELINES

DELY P. GAPASIN
Director
Crops Research Division
Philippine Council for Agriculture and Resources
Research and Development
Los Baños, Laguna

Col. Dueñas, Dr. Lozada, participants to this Mini-Workshop on Coconut Water and Sap Utilization:

We are here today to talk about an important aspect of the coconut industry. We produce approximately 5 B liters of coconut water in the production of copra annually. About 1 M liters of coconut water a day are thrown away by 6 desiccated coconut factories in Laguna. Tapping this by-product would not only mean utilization of an important untapped resource but also prevention of pollution in our rivers and creeks. On the other hand, we produce 1.4 liters of coconut sap per palm per day, on the average. Excellent utilization of sap has been found in alcoholic beverages called "tuba" in the Visayas or "lambanog" in the Tagalog regions. Having a high commercial value, an average annual income of ₱7,000 is generated from the alcoholic beverage as compared to ₱1,000 from copra. If we can improve utilization of sap and water, we can increase support for the coconut industry at these times when prices of copra and coconut oil are not stable.

The objectives of this workshop are: to assess the status of coconut water and sap utilization in terms of research and actual use, and to identify researchable areas or gaps that we need to pay attention at this time. A total of nine technical papers will be presented today by high-caliber coconut researchers from various agencies. These will be the bases for discussion in the workshop sessions. We will divide the session into two groups this afternoon: Group I, chaired by Dr. Priscilla C. Sanchez, will discuss coconut water utilization and Group II, chaired by Dr. William G. Padolina, will discuss coconut sap utilization. Each group will come up with a list of prioritized researchable areas which will be used in developing an integrated program on this aspect of coconut research and development. Then, during the Plenary Session we will discuss the output of both groups. Recommendations for funding for specific projects will be sent to PCARRD and PCRDF for consideration.

We hope that your contribution will enable us to come up with an inter-agency program which we will implement in the near future.

571.

COCONUT WATER AND COCONUT SAP: SUGGESTIONS FOR RESEARCH AND DEVELOPMENT

WILLIAM G. PADOLINA
Associate Professor of Chemistry and
Deputy Executive Director
Institutes of Biotechnology and Applied Microbiology
University of the Philippines at Los Baños
College, Laguna

Introduction

In 1981, the area planted to coconut was 3.1 M hectares with a total of 411 M trees, 338 M of which were bearing. These trees produced a total of 16 B nuts most of which were processed into copra (Coconuts Today, 1983).

The above figures give an indication of the amount of coconut water that is generated as processing waste and the volume of coconut sap that could be derived even if only one per cent of the bearing trees are tapped. There is no doubt that both coconut water and coconut sap can be obtained in volumes that will give some economic use for these resources.

If we assume that 0.3 l of coconut water can be derived from each nut, the total nut production in 1981 could have yielded 4.8 B liters of coconut water. However, if we assume that the recoverable quantities would come from the operations of desiccated coconut factories which processed a total of 471,731,000 nuts in 1981, the total volume of coconut water would amount to 141,519,300 l or 141,519.30 metric tons for the whole year.

In the operations of a desiccated coconut factory and even in copra processing coconut water may be considered a processing waste.

The situation is a little different in the case of coconut sap, because once a tree is tapped for the sap, nut production is completely stopped. Thus coconut sap can be considered only if the tradeoff shows a clear advantage towards product diversification. Available data show that in 1971, 4 M trees were tapped to yield 112 M l of tuba, or an average of 28 l tree/year. Taking a conservative sap yield of 0.65 l tree/day or 237.25 l tree/year (Gibbs, 1911), one could calculate a yield of 800 M liters/year if 1% of the bearing trees in 1981 were tapped. In the accounts of Gibbs (1911) we are told that in 1909, 5.7 M liters of coconut sap were processed into 705,000 liters of distilled beverage (37% ethanol) by 28 distilleries. Furthermore, there are reports that selling sap products could give more income than copra or buko (Cordova, 1963). It is clear that the further use of coconut sap must demonstrate that it will still make good business even if copra production is completely lost. Thus, coconut sap can be considered a primary product, in contrast to coconut water which is a processing waste.

Nature and Composition of Coconut Water

Coconut water which is also the liquid endosperm, constitutes 21.6% of the whole nut and the amount of coconut water that can be derived from each nut varies from 133 ml/nut for the Catigan (dwarf) populations to 524 ml/nut

for the Tagnanan (tall) populations (Santos, et al., 1981). However, the usual value of recoverable coconut water from each nut is 0.3 l (Sison, 1977).

The composition of coconut water is given in Table 1. With total solids content of 4.71% and total sugars of 2.56%, coconut water is a relatively dilute system. The sugar content gradually increases as the nut matures with the maximum being reached at nine months (Anzaldo, 1973). In young coconuts, glucose and fructose are the main sugar fractions while sucrose predominates in the mature nuts (Nathanael, 1952; Eiseman, 1954). Aside from the sugars, coconut water contains inorganic ions, mostly potassium, amino acids, vitamins, and growth hormones. It has a pH of 5.6 and a specific gravity of 1.02.

Table 1. Composition of coconut water

CONSTITUENT	PERCENTAGE
Total Solids	4.71
Total Sugar	2.56
Ash	0.46
Oil	0.74
Protein	0.55
Chlorides	0.17

Source: Sison, 1977

Nature and Composition of Coconut Sap

Coconut sap is a sweet, oyster white, translucent liquid that exudes from the young spadix of the coconut (Fernandez, 1978). Ten spadices are produced every year and each spadix will produce sap for two months (Gibbs, 1911). There is variation in the yield of the sap depending on the spadix, the palm, the time of tapping and the season (Fernandez, 1978). But the reasonable figure for the yield seems to be the one supplied by Gibbs (1911) after studying 5785 trees in Quezon Province — 0.65 l/tree/day.

The composition of coconut sap is given in Table 2. It is more concentrated than coconut water with total solids of 17.5% and a sucrose content of 16.5%. This sucrose content is comparable to that of sugar cane juice, and the palm saps of nipa (*Nipa fruticans*, Wurmb.), buri (*Croypha elata* Roxb)

Table 2. Composition of coconut sap

CONSTITUENT	PERCENTAGE
Total Solids	17.5
Acidity	trace
Ash	0.40
Sucrose	16.5
Invert Sugar	trace
Nitrogenous Compound	0.60

Source: Gibbs, 1911

and kaong (*Arenga saccharifera* Labill) (Gibbs, 1911). Coconut sap ferments rapidly as the sucrose is converted to glucose and fructose by the enzyme invertase and subsequently fermented into alcohol (Gibbs, 1911). The specific gravity of the sap is 1.07 (Gibbs, 1911) and the pH of fresh sap ranges from 6.2 – 6.7 (Fernandez, 1978).

An injurious effect of tapping has been noted among the Laguna-type coconuts (Soliven, 1929) where the weight of the oil per nut and the percentage of oil, dry basis, progressively decreased in the years after tapping is stopped but the effect is temporary (Soliven, 1929). Furthermore, as mentioned earlier, the yield of copra is forfeited when a coconut tree is tapped for its sap.

Current Use of Coconut Water and Coconut Sap

At present, most of the coconut water from copra production and desiccated coconut factories is dumped into the rivers or the sea. However, vinegar and *nata de coco* are products that are currently manufactured from sugar-fortified coconut water. There are no available figures on the volume of coconut water presently used for these purposes. Some research laboratories use coconut water, pure and in various degrees of fortification, for tissue culture and as substrate for microbial growth.

On the other hand, coconut sap is currently used in the manufacture of beverages – tuba and lambanog. In 1971, 4 M trees were tapped for this purpose.

Directions for Research and Development

We must continue to exploit the use of coconut water and coconut sap for food. However, with the advent of the new field of biotechnology we must also explore both coconut water and coconut sap as substrates for the production of high valued products like antibiotics, enzymes and organic acids. There is enough proof that they are excellent media for fermentation.

Coconut Water

There are many important studies being conducted now on the utilization of coconut water. Some need further work in the laboratory but some are ready for the pilot plant stage.

Single Cell Protein (SCP). Yeast strains are being selected for optimum growth in coconut water. Although some yeast strains have been identified, their production into SCP has to be optimized using novel fermenter designs such as the continuous flow fermenter.

Coconut Water Beverage. The production of natural beverages from coconut has been an area of interest in recent years. There are now product formulations that will need further testing and improvement.

Intravenous Fluid Replacement. The successful experiments done in 1973 to 1975 on the use of coconut water as intravenous fluid replacements should be pursued further especially in the light of our efforts to improve primary health care systems.

Dextran Production. Patent No. 8189 has been issued to Dr. Benjamin G. Nolasco and his co-workers for the production of gum-dextran using sugar fortified coconut water and a locally isolated strain of *Leuconostoc mesenteroides*. This project was piloted in a desiccated coconut factory but could not progress due to minor technical problems. The Philippines is importing a lot of gums for textiles, foods, adhesives, lacquers, etc.

Culture Medium for Microorganisms and Plant Tissues. Coconut water has been found to be effective in plant tissue cultures because of the presence of growth factors. Recently work has been done at UPLB where coconut water proved suitable for mammalian tissue culture. The mass production of nitrogen-fixing Rhizobial inoculants using coconut water is now being studied at BIOTECH-UPLB. Initial results show that coconut water (pure) is a better medium for growth than the traditional imported media.

Coconut Water as Fertilizer. There have been attempts to use coconut water as fertilizer but the growth factors seem to complicate the study. This needs further investigation.

Concentration of Coconut Water. Coconut water is a dilute substrate and may be concentrated for other uses. E.J. del Rosario and co-workers at UPLB have some interesting results that show coconut water could be concentrated using reverse osmosis. Both protein and sugar levels increased significantly after hyperfiltration.

Biogas from Coconut Water. A project is now being developed involving BIOTECH, NIST, Energy Research and Development Center and UP College of Engineering. Initial results from BIOTECH indicate that it is possible to generate biogas from diluted coconut water with a relatively short retention time.

Coconut Sap

Alcoholic Beverage Production. The studies by Gibbs and W.L. Fernandez have provided much of the basic information specially on the microbiology of coconut sap. Large-scale lambanog production must be explored for export purposes. Lambanog has on several occasions been compared to vodka.

Non-alcoholic Beverage Production. Coconut sap is good material for natural drinks because it contains significant amounts of proteins, sugars, and vitamins. The development of a nutritious beverage must be explored.

Fuel Alcohol. Banzon (1983) has calculated that under high coconut sap yields of 1.38 l tree/day enough alcohol can be derived per month that will equal the energy of coconut oil from a 20 nut fruit bunch. However, the use of coconut sap for fuel alcohol production may not be feasible in areas where beverage alcohol is produced because of the high price that beverage alcohol commands. Palm saps can be used to augment the molasses-based production of fuel alcohol to reach the national target of 268 M liters of absolute ethanol by 1990 for a 20% blend with gasoline. This requires a daily output of 1 M liters ethanol.

Long-Term Goals

Both coconut water and coconut sap are renewable substrates which

are produced in adequate volumes to serve as carbon sources for the production of fuels, drugs and chemicals using efficient biotechnological processes. The following (in addition to those previously stated) may be considered for the long-term use of both substrates: a) Antibiotics — penicillin and derivatives, b) Enzymes — amylases, glycoamylases; c) Organic Acids — citric acid, lactic acid; d) Solvents — glacial acetic acid, acetone, butanol; e) Microbial Polysaccharide — dextrans, xanthrans; f) Amino Acids — lysine; and g) Other Pharmaceuticals — steroids.

We may concentrate on low-volume — high valued products in order to reduce capital costs.

Summary

A draft program for the utilization of coconut sap and coconut water has been presented. There is no doubt that under the present circumstances, priority attention must be given to coconut water because it is currently being produced in volumes which can cause serious problems if not disposed of properly.

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COCONUT WATER BEVERAGE

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Abstract

A study on the development of beverage from coconut water was undertaken involving nuts of different maturities.

Results showed that the use of certain additives could transform the water from mature nuts close to those of the young nuts. The coconut water could be bottled and processed to give a stable product. The addition of pulp is feasible in young coconut water or formulated water from mature coconut which could be processed into a stable product.

PROCESS FOR PREPARING NON-CARBONATED AND CARBONATED COCONUT WATER

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Introduction

The Philippines produced 98,563 metric tons (MT) of desiccated coconut for export in 1977 valued at $[illegible]88,680 FOB. Canned and powdered coconut milk and coconut chips are likewise produced by several small and medium scale food processors. All these commercial products generate voluminous quantities of coconut water estimated at 10^{10} liters annually. A typical desiccated coconut factory throws away about 90,000 liters of coconut water a day from about 300,000 mature nuts (Sison, 1977). The average composition of this water is as follows: protein — 0.55%; oil — 0.74%; total sugars — 2.56%; ash — 0.46%, chlorides — 0.17%; specific gravity — 1.02% and total solids — 4.71%. It has an unusual growth promoting factor on plant cells.

Extensive works have been done on the industrialization of coconut water and a number of products have been developed locally among which are yeast, alcohol, wine, ethyl acetate, food jelly, dextran, *nata de coco* and beverages. Vinegar and *nata de coco* are now being produced commercially on a small scale.

The utilization of coconut water into beverage type of drinks has been explored. Water from the immature nuts *(buko)* has a pleasant, sweetish coconut flavor and has gained popularity as a refreshing drink mixed with the meat of the young coconut. On the other hand, water from the mature nuts such as those generated in desiccated coconut factories though less sweet in taste has likewise the pleasant characteristic flavor of coconut. Properly processed, it can be made stable into a ready-to-drink beverage. Del Rosario and Rubico (1979) formulated a beverage type of drink from coconut water of matured nuts. They experimented on malic acid, ascorbic acid, citric acid and combinations of acidulants, and also on varied sugar concentrations to increase total soluble solid content. The formulation found most acceptable was that with total soluble solids adjusted to 10-12%, and pH adjusted to 4.2 using an acidulant plus 0.1 to 0.15% sodium citrate.

This study, on the other hand, which also made use of the water of the mature coconuts treated with an acidulant and preservative, has the main objective of preparing carbonated and non-carbonated drinks that could be packed in suitable containers, and of such quality that they could be stored at room temperature. Water from immature nuts may also be used.

Materials, Methods and Results

In the development of the products, several factors affecting the organoleptic, microbial and storage qualities of the beverages were considered, namely: immediate pasteurization of the fresh coconut water, adjustment of Total

Soluble Solids (TSS) and pH with sugar and suitable acid respectively, addition of a permitted chemical preservative, centrifuging and sterilization of the bottled or canned products at controlled temperature. Commercial samples of carbonated and non-carbonated beverages, namely, a cola-type of soft drink and an artificial fruit drink were tested for pH, total soluble solids content and microbiological properties.

After a series of trials, the following procedure was adopted (Fig. 1): Coconut water free from off-flavor and odor, obtained from mature nuts, as those generated in desiccated coconut factories is filtered immediately thru a clean cheese cloth, or mechanically thru a suitable filter machine, or passed thru a basket centrifuge to separate coarse suspended particles. Coconut water from *buko* may also be used. Immediately, pH is adjusted to 4.2 with food

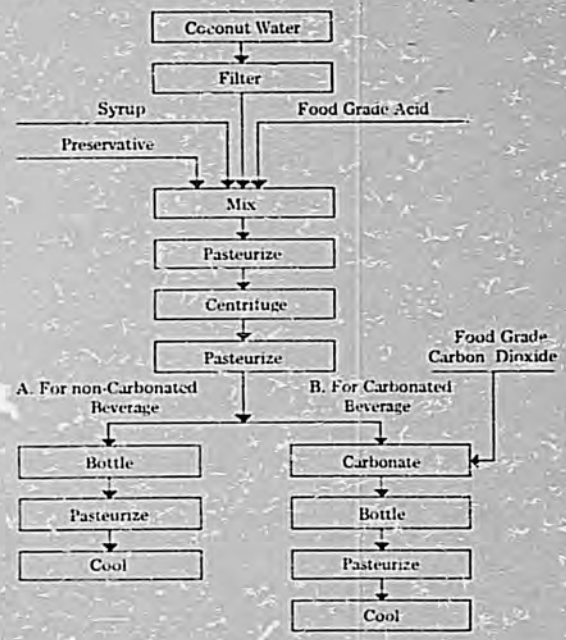

Fig. 1 Flow process for the preparation of carbonated and non-carbonated coconut water

grade phosphoric acid, and total soluble solids to 12-14% with refined sugar. Sodium benzoate is added as preservative in concentration of 0.05%. The prepared solution is pasteurized, passed in a three way centrifuge to give a clear non-oily solution, and repasteurized further. Repasteurization may also be accomplished by passing through a High Temperature Short Time (HTST) heating unit. In such case then, addition of preservative is not necessary. Also, pH and total soluble solids content need not be adjusted. This will result to a natural product sometimes referred to as a "health food".

For Non-Carbonated Beverage. The hot repasteurized coconut water is packed aseptically in clean containers such as beverage bottles, tin cans, laminated pouches, or tetra brics, and then sealed immediately. In non-aseptic conditions of packing such as in bottles or metal containers, process further over steam at atmospheric pressure for 15 to 30 min depending upon the size of the cans or bottles.

For Carbonated Beverage. The repasteurized coconut water is cooled, carbonated and packed aseptically in suitable sterile containers such as beverage bottles. In non-aseptic conditions of packing, coconut water is processed further in water bath at 60° to 65°C for 30 min. The carbonator used in this study was fabricated at the National Institute of Science and Technology.

Heating the formulation is a very important step to destroy microorganisms and also to coagulate heat-coagulable substances in the coconut water. Coconut water is higher in nutrients compared with other soft drink or fruit-based drink products hence would allow easy growth of microbes if not checked. Centrifuging is important to get a clear and non-oily product. Hermetic sealing is a must for long shelf-life at ambient conditions.

Table 1 shows the physico-chemical, microbiological and organoleptic

Table 1. Physico-chemical, microbiological and organoleptic properties of the coconut water beverages, cola-type of soft drink and artificial fruit drink

Properties	Carbonated	Non-Carbonated	Artificial Fruit Drink*	Cola Type of Soft Drink
pH	4.2	4.2	[illegible]	2.7
Total soluble solids (TSS) °Brix	14.0	14.0	14.0	10.0
Acidity, %	0.14	0.14	0.24	0.04
Total Plate Count	negative	negative	negative	negative
Yeast and Mold Count	negative	negative	negative	negative
Coliform Count	negative	negative	negative	negative
**Organoleptic Scores				
Odor	6.75	6.86	5.56	7.19
Color	7.29	6.86	6.25	6.19
Taste	6.75	6.93	5.71	7.31
General Acceptability	6.97	6.93	5.96	7.18

* Packed in Aluminum Polyethylene Laminate

** based on the Hedonic Rating Scale of 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like or dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely

properties of the newly prepared product. Results of physico-chemical and microbiological tests conducted on cola-type of soft drink and the artificial fruit drink packed in aluminum/polyethylene laminate are also given.

The non-carbonated and carbonated products still possess the characteristic coconut water flavor though slightly masked by the slightly acid-sweetish taste of the final products. Both products received high rating scores for all the organoleptic qualities tested, indicating them to be highly acceptable. Microbial analysis showed that they are negative for total plate count, yeasts and molds, and coliforms indicating that the heat treatments received were sufficient to destroy the microorganisms.

The physico-chemical properties of the cola-type of soft drink and the artificial fruit drink did not differ with the experimental products. In terms of volume of carbonation, it is apparent that the volume of CO_2 dissolved in carbonated coconut water which is 2.4 as determined using Zahm and Nagel CO_2 Tester, is within the range of those obtained from commercial cola and uncola types of soft drinks, that is 2.1 to 3.2 (Table 2). The tests were all conducted at a constant temperature of 30°C.

Table 2. Physical properties and volume of carbonation of the various carbonated beverages

PROPERTIES	CARBONATED BEVERAGE SAMPLES				
	Cola-type	Uncola Type 1	Uncola Type 2	Orange	Coco Water
Net Content (ml)	355	355	355	207	210
Air Pressure (psi)	42	36	33	26	40
CO_2 Pressure (psi)	50	10	56	31.5	42
Temperature (°C)	30	39	30	30	30
Volume CO_2 dissolved	2.9	2.1	3.2	2.1	2.4

Stability of Carbonated and Non-Carbonated Coconut Water Packed in Beverage Bottles

Samples were packed in beverage bottles and then sealed with bottle crowns as those used in cola-type of soft drinks. Both the bottled non-carbonated and carbonated products were stored at room temperature (28°-32°C) to simulate storage conditions as practiced commercially. Representative samples were examined for a period of 6 months. Examinations conducted were on pH, total solable solids, titratable acidity, optical density, organoleptic qualities for odor, color, taste and general acceptability using the Hedonic Rating Scale of 1-9 and microbial load for total plate count (TPC), yeasts and molds, and coliforms.

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Shown in Table 3 are the results of the acceptability tests. Both products were found to be acceptable in all the qualities tested. Statistical analysis showed no significant difference between the 2 samples initially and during storage for 6 months at room temperature. Acceptability scores ranged from 6.28 to 7.28 during this period. They remained clear without noticeable discoloration or turbidity. Previous [illegible] showed that insufficient pasteurization treatment generally caused t[illegible], in the products within 2 days with correspondingly high mold and y[illegible] counts. It is apparent that the experimental products are commercialy sterile with no signs of deterioration during the 6 month storage period.

Table 3. Mean acceptability scores* of carbonated and non-carbonated coconut water during storage at room temperature (28-32°C)

PERIOD OF STORAGE IN MONTHS	COLOR		ODOR		TASTE		GEN. ACCEPTABILITY	
	A	B	A	B	A	B	A	B
0	7.28	6.86	6.78	6.86	6.75	6.93	6.97	6.93
0.5	6.93	6.50	6.57	6.50	6.66	6.57	6.66	6.61
1.0	6.71	6.71	6.57	6.64	6.64	6.64	6.54	6.57
1.5	6.50	6.57	6.64	6.43	6.61	6.28	6.60	6.28
2.0	6.50	7.00	6.29	7.00	6.64	6.78	6.71	6.78
2.5	6.64	7.00	6.61	6.71	6.43	7.00	6.43	6.86
3.0	6.78	6.64	6.57	6.36	6.50	6.78	6.50	6.78
4.0	7.00	7.14	6.86	6.64	6.36	6.64	6.57	6.78
5.0	6.75	6.71	6.64	6.71	6.64	6.71	6.75	6.71
6.0	6.57	6.43	6.71	6.57	6.57	6.71	6.57	6.64

* — Hedonic Rating Scale of : 9 — like extremely; 8 — like very much; 7 — like moderately; 6 — like slightly; 5 — neither like nor dislike; 4 — dislike slightly; 3 — dislike moderately; 2 — dislike very much; 1 — dislike extremely.

A — Carbonated coconut water

B — Non-carbonated coconut water

This observation is further confirmed by results of microbial load and physico-chemical tests. Results were negative for yeasts and molds, TPC and coliforms (Table 4). This indicates that the products were hermetically sealed.

Table 4. Physico-chemical and microbial properties of carbonated and non-carbonated coconut water during storage

[illegible]	pH		[illegible]		[illegible] ACIDITY		[illegible]	
[illegible]	A	B	A	B	A	B	A	B
0	4.2	4.2	14	14	0.14	0.14	[illegible]	[illegible]
0.5	4.2	4.2	14	14	0.14	0.14	do	do
1.0	4.2	4.2	14	14	0.14	0.14	do	do
1.5	4.2	4.2	14	14	0.14	0.14	do	do
2.0	4.2	4.2	14	14	0.14	0.14	do	do
2.5	4.2	4.2	14	14	0.14	0.14	do	do
3.0	4.2	4.15	14	14	0.14	0.14	do	do
4.0	4.2	4.15	14	14	0.14	0.14	do	do
5.0	4.2	4.15	14	14	0.14	0.14	do	do
6.0	4.2	4.15	14	14	0.14	0.14	do	do

* Microbial analysis for total plate count, coliform, yeast and mold

The stability of the products was shown by the almost constant values for titratable acidity and total soluble solids. Only a very slight change was observed on the third month for pH, and for titratable acidity on the fifth month. This showed that no fermentation occurred in the product. They were still acceptable even with these very slight changes.

It is of interest to note at this point of the results of a consumer acceptance test conducted by a marketing research company which showed good acceptance for both types of coconut water drinks though the carbonated beverage was better preferred by most of the respondents (Data, Inc., 1983).

Stability of Non-Carbonated Coconut Water Packed in Aluminum (Al)/Polyethylene (PE) Laminate

As shown in the study, the use of Al/PE laminate as packaging material for carbonated drinks is not advisable since the packaged beverage can break up during storage due to the possible building up of CO_2 in the package.

Packaging was done using the facilities of a fruit-drink manufacturer. Nitrogen gas was flushed into the container prior to filling and hermetic sealing. Nitrogen gas is inert and is conventionally used for products that are easily affected by the presence of air in the package.

Representative samples were stored in A at 28° to 32°C (room temperature); B at 3° to 5°C (refrigerated temperature), C at 37°C; and D at 55°C. The latter temperature was also used to test for presence of thermophiles. They were examined initially and periodically thereafter for pH, total soluble solids, optical density, microbial load and organoleptic properties. Results of initial tests showed the product to have an orange odor/flavor and tint which masked somewhat the characteristic flavor of coconut water. The orange flavor can be attributed to the fact that the facilities used have just been utilized in the processing of an orange-flavored drink. Somehow, the panelist also perceived an off-flavor quite distinct from that of coconut water. Thus, no attempt was made to present formally the newly produced product for organoleptic evaluation. However, 10 weeks after production, the products (A, B, C and D) were removed from the containers, coded and evaluated for acceptability. The samples stored at 55°C were not evaluated due to its intense dark brown discoloration. The high temperature condition of storage favored the occurrence of Maillard reaction (non-enzymatic browning) of the product.

Interestingly, mean score ratings for samples A & B were high, ranging from 6.2 to 6.75. According to the Hedonic Rating Scale, products receiving scores of 6.2 and above are considered highly acceptable (Pilgrim, 1958). On the third month, products A and B stored at room and refrigerated temperatures respectively got higher acceptability scores ranging from 6.8 to 7.1 (Table 5). The orange flavor was slightly perceived by only two of the panelists but did not consider it undesirable. Sample C (stored at 37°C) decreased in acceptability scores on its third month of storage. However, in terms of acceptability, this product which received a rating score of 6.19 can still be considered as acceptable.

As regards their microbial properties, initial analyses showed very low TPC (3 per ml) for the products. It was negative for yeasts, molds and coli-

Table 5. Mean acceptability scores of non-carbonated coconut water packed in AL/PE laminates stored at varied temperatures

TRIAL QUALITIES	STORAGE PERIOD (MONTHS) 2.5	3
A (28° – 32°C)		
Color	6.55	6.94
Odor	6.20	7.0
Taste	6.55	6.8
Gen. Acceptability	6.20	6.86
B (3° – 5°C)		
Color	6.75	7.0
Odor	6.42	7.1
Taste	6.42	7.0
Gen. Acceptability	6.57	7.0
C (37°C)		
Color	6.42	6.31
Odor	6.42	6.31
Taste	6.0	5.88
Gen. Acceptability	6.42	6.19

• – No formal acceptability testing made initially up to the 2nd month due to the off orange flavor odor highly perceived by the panelists.

forms (Table 6). After 15 days, those stored at room and refrigerated temperatures had TPC of 2 per ml. That stored at 37°C gave negative counts. On the first month of storage and up to the third month all samples showed negative counts. The very low counts obtained earlier can be considered insignificant. Any microorganisms that had survived the processing treatment were finally destroyed on storage. The low pH (4.2), high TSS (14°Brix) and lack of oxygen became unfavorable for the growth of these organisms. These environmental factors had been reported to cause adverse effects on growth of viable organisms that may have survived processing treatments in preserved products (Tanner, 1944).

Table 6. Microbial counts of non-carbonated coconut water packed in AL/PE laminates stored at varied temperatures

STORAGE PERIOD IN MONTHS	A			B			C			D		
	TPC	YMC	C	TPC	YMC	C	TPC	YMC	C	TPC	YMC	C
0	3	0	0	3	0	0	3	0	0	3	0	0
0.5	2	0	0	2	0	0	0	0	0	0	0	0
1.0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	0	0	0	0	0	0	0	0	0	Products discarded due to intense discoloration		
2.0	0	0	0	0	0	0	0	0	0			
2.5	0	0	0	0	0	0	0	0	0			
3.0	0	0	0	0	0	0	0	0	0			

A – Stored at room temperature (28°–32°C)
B – Stored at refrigerated temperature (3-5°C)
C – Stored at 37°C
D – Stored at 55°C

TPC – Total Plate Count
YM – Yeast & Mold Count
C – Coliform

Results of physico-chemical tests indicate slight insignificant change of pH during storage (Table 7). It was 4.4 initially and stabilized to 4.2 on the second month. TSS did not change. Optical density readings were almost constant for the refrigerated and the room-stored samples and increased markedly for the 37°C stored product (Fig. 2). However, it may be noted that visually, there was almost no noticeable color difference between these products. As indicated earlier, the 55°C-stored products have to be discarded after 10 weeks due to its intense dark brown discoloration.

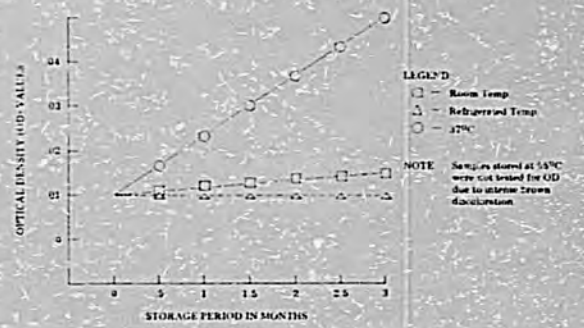
The products are still under storage studies for 6 months.

Table 7. pH and total soluble solids content of non-carbonated coconut water packed in AL/PE laminate during storage

STORAGE PERIOD IN MONTHS	pH				TSS (°Bx)			
	A	B	C	D	A	B	C	D
0	4.4	4.4	4.4	4.4	14	14	14	14
0.5	4.29	4.29	4.29	4.29	14	14	14	14
1.0	4.28	4.28	4.28	4.10	14	14	14	14
1.5	4.28	4.28	4.28	3.9	14	14	14	14
2.0	4.2	4.2	4.2	3.8	14	14	Products discarded	
2.5	4.2	4.2	4.2	3.8	14	14	due to intense	
3.0	4.2	4.2	4.2	3.8	14	14	discoloration	

A – Stored at room temperature (28°–32°C)
B – Stored at refrigerated temperature (3° – 5°C)
C – Stored at 37°C
D – Stored at 55°C

Fig. 2. Color change of non carbonated coconut water packed in flexiloll laminates and stored at different temperature conditions



Conclusions and Recommendations

1. Centrifuging is important to get a clear non-oily product.
2. The products must undergo sufficient heat treatment to kill viable organisms which if not destroyed can cause turbidity and deterioration of the products on storage.
3. Hermetic sealing of the product is important for long shelf-life. Non-carbonated coconut water subjected to HTST process and packed at aseptic conditions in appropriate containers (flexible laminate pouches, tetra brics, bottles or metal containers) does not have to be treated with preservative, sugar or acid if desired.
4. Under the conditions of this study, beverage bottle was the only one found best suited for carbonated coconut water.
5. Coconut water from mature and immature nuts *(buko)* can be utilized in the preparation of a stable and highly acceptable carbonated and non-carbonated coco-beverage.
6. Pilot-scale production should be undertaken in cooperation with the industry to cost the product as well as for market study.

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MODIFIED COCONUT WATER FOR ORAL REHYDRATION

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Introduction

Despite the notable progress made in infant care in the past years, diarrhea ranks high among the causes of pediatric mortality in the Philippines. Fluid and electrolyte therapy constitute the major aspect of the therapeutic armamentarium in the management of diarrhea. In view of this, a number of researches to find a simple, practical, inexpensive fluid for use in the management of diarrhea have been conducted. This study made use of coconut water, an indigenous material and a waste product of certain industries, as the basic fluid for oral rehydration therapy to replace the expensive, commercially prepared fluids. In a previous study, eight to nine month old nuts were found to have the highest volume (500-600 ml) of coconut water and a relatively high glucose content. However, coconut water was found to be very low in sodium and exceedingly high in potassium, a combination which is not ideal for safe and effective oral rehydration therapy. There is, therefore, a need to modify the composition of coconut water to attain the main objective of this study which is to determine the suitability, safety, and utility of the modified coconut water as a fluid for oral replacement therapy.

Modification Procedure

Eight to nine month old nuts were used in the experiment. The coconut water was collected in clean beakers and filtered through clean muslin cloth to remove suspended particles. The clear fluid was analyzed for electrolyte and glucose content and its pH was measured. These served as baseline values for subsequent modification of the coconut water.

The clear coconut water was diluted with distilled water in 1:1 ratio to reduce the potassium concentration by one-half. To every liter of the diluted coconut water, 1 gram sodium chloride, 2.5 grams sodium bicarbonate and 15 grams glucose were added.

The modified coconut water was stored in the refrigerator at 40°C for further chemical studies and for human experiments. Storage time was for a maximum of 7 days after which it was no longer considered suitable for use.

Every batch of coconut water prepared was subjected to determination of pH, glucose and electrolyte content. The electrolyte pattern of coconut water resembles that of intracellular fluid, the main cation concentration being made up of potassium. Its Ca^{++}, Mg^{++}, Cl^{-} concentration, osmolarity and pH are close enough to that of mammalian body fluids.

Clinical Trials of Modified Coconut Water

Fifty-eight infants and children admitted to the UP-PGH Medical Center for acute diarrhea with varying degrees of dehydration ranging from mild to moderate were chosen as subjects of this study. Detailed clinical histories and physical examinations were done on the patients. Modified coconut water was given orally to the patients at a dose of 150-200 ml/kg/24 hr for infants less than one year and 100-150 ml/kg/24 hr for those from one to six years. No food or other therapeutic aid was given except for the modified coconut water.

Seven to ten cc of blood was extracted from the femoral artery of the patients upon admission and 24 hours after the ingestion of coconut water. Blood chemistry was done on the serum samples to determine Na^+ and K^+, Ca^{++}, Cl^-, CO_2, glucose and blood urea nitrogen content. Total protein A/G ratio, hematocrit and osmolarity were also determined.

The patients were observed 24 hours while on rehydration therapy using coconut water administered orally. The effectiveness of the fluid therapy was measured using the following criteria: weight change, state of hydration, frequency of diarrhea, acceptance and side effects.

Results

The chemical composition of a typical batch of modified coconut water as compared to pure coconut water is shown in Table 1.

Table 1. Chemical composition of pure and modified coconut water

	Pure Coconut Water	Modified Coconut Water
Na^+	2.6 mEq/l	47 mEq/l
K^+	38.0	19
Cl^-	32.7	34
Ca^{++}	8.7	1.4
Mg^{++}	6.8	3.4
Glucose	26.0 g/l	30.0 g/l
pH	4.9	approx. 7.0

On modification, Na^+ content was considerably increased and the potassium content reduced to approximately one half the original value while essentially maintaining the glucose content and raising the pH to neutrality.

The clinical profile of the patients is seen in Table 2.

Out of 58 patients studied, 39 were males and 19 were females. Their ages ranged from 3 months to 6 years with a mean age of one year.

Distribution of the patients based on degree of dehydration is as follows: 43 patients with mild dehydration, 6 with mild to moderate dehydration and 9 with moderate dehydration.

Table 2. Clinical profile of patient population

Total No. of Patients	58
Male	39
Female	19
Mean Age	12.46 mo
Range of Ages	3 mo to 6 yr
Degree of Dehydration	
mild dehydration	43 patients
mild to moderate	6
moderate	9

Evaluation of the clinical and chemical data for the responders (Table 3) gave a pre-treatment mean weight of 7.14 kg and a post-treatment mean weight of 7.51 kg. The weight increase of 0.37 was found to be statistically significant.

Comparison of the pre-treatment and post-treatment values of the mean frequency of diarrhea per 24 hours during therapy was not statistically significant. This indicated that the group of responders did not develop more diarrhea during therapy.

Table 3. Clinical and chemical data of responders

	PRE-TREATMENT	POST-TREATMENT
Mean Weight	7.14	7.52 kg*
Mean Frequency of Diarrhea	7.6 x	7.7 x**
Mean Serum Na^+	134.6 mEq/l	138.9 mEq/l*
Mean Serum K^+	4.4 mEq/l	4.9 mEq/l*
Mean CO_2 Content	20.9 mEq/l	23.9 mEq/l*
Mean Blood Glucose	89 mg%	79.9 mg%*

*Significant

**Not Significant

Serum Na^+ mean level increased from 134.6 mEq/l (pre-treatment) to 138.9 mEq/l (post-treatment). The serum K^+ concentration also increased. These increases were also significant. Serum CO_2 mean values similarly showed a modest but significant increase. The blood glucose showed a significant decline from a pre-treatment level of 89 mg % to a post-treatment level of 79.9 mg %.

The group of non-responders was evaluated separately. Results are shown in Table 4.

This group showed a slight decrease in the mean weight which was not statistically significant. The mean frequency of diarrhea showed a marked increase from a pre-treatment mean frequency of 7.7 times/24 hours to 15.5 times/24 hours during therapy. Even if these patients had adequate intake of modified coconut water, this could not offset the continued fluid loss.

Table 4. Clinical and chemical data of non-responders

	PRE-TREATMENT	POST-TREATMENT
Mean Weight	7.03 kg	6.97 kg**
Mean Frequency of Diarrhea	7.7 x	15.5 x*
Mean Serum Na^+	135.7 mEq/l	138.2 mEq/l**
Mean Serum K^+	4.4 mEq/l	4.6 mEq/l**
Mean CO_2 Content	17.6 mEq/l	21.9 mEq/l*
Blood Glucose	95.9 mg%	90.8 mg%

*Significant

**Not Significant

There was no significant change in their serum Na^+ and K^+ levels but there was a significant increase in their serum CO_2 content. This increase in CO_2 content indicates correction of the mild metabolic acidosis in the group of non-responders. A modest fall in the blood glucose was observed in this group of patients.

Pre-treatment and post-treatment levels of Na^+, K^+, CO_2 and blood glucose as well as weight and frequency of diarrhea for responders and non responders were compared. Results of these comparisons are given in Table 5.

Table 5. Comparison between responders and non-responders

	PRE-TREATMENT		POST-TREATMENT	
	Responders	Non-Responders	Responders	Non-Responders
Mean Weight	7.11	7.03	7.52	6.97
Mean Frequency of Diarrhea	7.6 x	7.7 x	7.7 x	15.5x*
Mean Serum Na^+ (mEq/l)	134.6	135.7	138.9	138.2
Mean Serum K^+ (mEq/l)	4.1	4.1	4.9	4.6
CO_2 Content (mEq/l)	20.9	17.6*	23.5	21.9*
Blood Glucose (mg%)	89.0	95.9	79.9	90.8

*Significant

Only the CO_2 pre-treatment level was found to be significantly lower in the group of non-responders as compared to the responders indicating that there were more patients in this group with metabolic acidosis. All other pre-treatment values of parametets measured for both groups showed no significant differences. However, comparison of post-treatment values between the two groups showed significant differences not only in the CO_2 content but also in the frequency of diarrhea. The post-treatment serum Na^+ and weight levels were not significantly different for the two groups.

To explain why the group of non-responders developed more diarrhea while on therapy, a comparison was made of the Na^+, K^+ and glucose concentration as well as the volume of modified coconut water ingested by both groups.

Table 6 revealed no significant difference in the intake of modified coconut water by both groups. Likewise, there were no significant differences in the Na^+, K^+ and glucose content of modified coconut water ingested by responders and non-responders.

Table 6. Comparison of modified coconut water ingested by responders and non-responders

	Responders (13 pts.)	Non-Responders (15 pts.)
Glucose Concentration of Coco H_2O	14.15 g/l	13.35 g/l NS
Na^+ Concentration of Coco H_2O	46.8 mEq/l	46.3 mEq/l NS
K^+ Concentration of Coco H_2O	27.72 mEq/l	28.04 mEq/l NS
Volume of Coco H_2O ingested (cc/kg)	216	238 NS

NS = Not Significant

These results imply that the increase in stool frequency in the group of non-responders was not related to intake nor to the composition of the coconut water in so far as the Na, K, and glucose contents are concerned.

The modified coconut water used in this study was well accepted and tolerated by all the patients. The volume ingested by the patients ranged from 96-545 ml/kg/24 hours with a mean of 223.7 ml/kg/24 hours. The only side effect noted in addition to increase in stool frequency in 15 patients was the occurrence of electrolyte, mainly sodium, disturbances in three patients.

Discussion

Since it is chiefly the extra-cellular fluid that is rapidly depleted in acute dehydration, rehydration fluids for oral use should contain a substantial concentration of sodium and a low concentration of potassium. For the treatment of non-cholera diarrhea, an oral dehydration fluid containing approximately 50 mEq/l of sodium is suitable. In this study on the use of modified coconut water for oral rehydration, the Na^+ and K^+ concentrations as well as the pH and glucose content was adjusted to conform to the desired composition.

Based on clinical and chemical criteria, it has been shown that modified coconut water is effective in correcting significant dehydration in 43 out of 58 patients (74.14%). Significant mean weight increases and clinical improvement in their state of dehydration were observed for this group of responders. In addition, there was improvement of the serum electrolyte in this group particularly in their mean sodium concentration which rose from a pre-treatment level of 134.6 mEq/l to a post-treatment level of 138.94 mEq/l.

Treatment failures were noted in 15 out of 58 patients (25.86%) whose state of dehydration deteriorated. This group of non-responders developed

profuse watery stools while on therapy which would explain the absence of weight increase and an overall dismal response. While it was initially thought that the diarrhea might have been induced by the volume ingested, comparison of the intake of the group of responders and non-responders did not disclose any significant differences. Evaluation of the glucose content and Na/K concentration of the coconut water ingested did not provide any answer either as there were no differences seen.

Summary and Conclusion

A modified formulation of coconut water was tried in 58 pediatric patients suffering from diarrhea with mild to moderate dehydration. Clinical improvement of their state of dehydration accompanied by weight increase and improved electrolyte composition was observed in 43 out of 58 patients.

Modified coconut water was found safe for oral rehydration provided that the sodium concentration is kept below 60 mEq/l and the amount ingested does not exceed the recommended dosage particularly in infants less than 6 months. Treatment is extremely simple and excludes other therapeutic aids. The time required for normalization of stools is much lower than in conventional treatment. This is attributed to the increased glucose content in the modified formulation since glucose is a monosaccharide which is rapidly absorbed

The reason for the failure of some patients (25.86%) to respond to oral administration of modified coconut water was not elucidated in this study. However, it is very possible that there may be other substances in coconut water not measured or analyzed that can provoke diarrhea in persons who may have an idiosyncrasy to coconut water.

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SINGLE CELL PROTEIN PRODUCTION FROM COCONUT WATER

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Introduction

Malnutrition afflicts more than half of the population of the world. One factor which brought about this problem is the unavailability of rich protein sources for the populace because of the high cost of feeds for livestock and poultry, two of the main sources of protein for man. This situation prompted scientists to find new sources of protein. The production of single cell protein (SCP) by microbial fermentation from agricultural and industrial wastes was recommended as one solution to alleviate this problem. Single cell protein refers to the protein obtained from bodies of unicellular or multicellular microorganisms such as bacteria, yeasts, fungi and algae. Several advantages of this process are: microbial fermentation can be carried out indoors under controlled conditions; microorganisms cultured for SCP have protein composition comparable to that of animal protein; under the right conditions microorganisms can grow quite rapidly and can be obtained anytime; and production of SCP does not require as much space as that for production of plant or animal proteins.

With the proper technology, it can be produced at a much lower cost than any of the conventional sources of protein, using agricultural wastes as the fermenting substrate.

Coconut water is one of the substrates being tapped for single cell protein production. In the Philippines it is estimated to be produced at a rate of about 2×10^9 liters annually (Banzon, 1980). Of this, a minimal undetermined amount is utilized as vinegar, *nata de coco* and lately as beverage.

Status

The potential of coconut water as a substrate for single cell protein is realized with its chemical composition, amino acid and vitamin contents. With its nutritional values as seen in Tables 1 and 2 the growth of numerous organisms could be supported by this substrate. This was previously tested as a substitute for nutrient broth successfully by Gonzales (1975) and Alejar (1974).

Yeasts, which belong to the natural microflora of coconut water grow rapidly on it. They usually predominate the microflora thus preventing proliferation of other microorganisms. Lantin (1977) studied the production of yeasts on this substrate.

Of the twenty-seven yeasts tested, *Candida utilis* and *Candida tropicalis* had the highest growth rate in 24 hr. Smith and Bull (1976) studied the utilization of coconut water wastes for the production of the food yeast *Saccharomyces fragilis*. The specific growth rates were found to be consistently higher in

Table 1. Composition of coconut water

Constituent	Percentage
Total solids	4.71
Total sugars	2.08
Ash	0.62
Potassium	3.12
Sodium	1.5
Calcium	2.9
Magnesium	3.0
Iron	0.01
Copper	0.004
Phosphorus	3.7
Sulfur	3.4
Protein	0.55

Source: SUBRAHMANYAN, V. and D. SWAMINATHAN. 1959.

Table 2. Vitamins and amino acids present in coconut water

Ascorbic acid	2.2-3.7 mg/100 ml
Nicotinic acid	0.64 ug/ml
Pantothenic acid	0.52 ug/ml
Riboflavin	0.01 ug/ml
Folic acid	0.003 ug/ml
Glutamic acid	14.50*
Arginine	12.75*
Leucine	4.18*
Lysine	4.51*
Proline	4.12*
Aspartic acid	3.60*
Tyrosine	2.83*
Alanine	2.41*
Histidine	2.05*
Phenylalanine	1.23*
Serine	0.91*
Cystine	1.17*

*Percentage of total amino acids

Source: SISON, B.C. JR. 1977.

coconut water than in defined medium. Caday (1979) and del Rosario (1980) also studied these three yeasts on shake-flask cultures and continuous air-lift fermentation.

At the NSRI, studies on production of SCP by batch culture on a New Brunswick Microferm fermentor MF-114 are being conducted using *Candida utilis* var. thermophila (UPCC 2074), *Candida tropicalis* (UPCC 2049) and *Saccharomyces fragilis* (UPCC 2095). Coconut water was supplemented with the following: $(NH_4)_2SO_4$, 4.0 g/l; KH_2PO_4, 2.0 g/l; $MgSO_4$, 1.0 g/l; Ca pantothenate, 4.5 mg/l. Temperature was maintained at 28°-30°C and the pH was regulated at 4.5 by addition of ammonium hydroxide.

Table 3. Summary of results of studies on batch cultivation of yeasts on coconut water

ORGANISM	PEAK OF GROWTH*	DRY WEIGHT	CRUDE PROTEIN (DRY BASIS)
Candida utilis UPCC 2074	17 hr	4.21 g/l	57.24%
Candida tropicalis UPCC 2049	14 hr	3.20 g/l	48.58%
Saccharomyces fragilis UPCC 2095	14 hr	8.23 g/l	39.41%

*Approximately 96% of the available sugars utilized

The results of the studies are summarized in Table 3. In terms of fermentation time and biomass yield (by dry weight) *Saccharomyces fragilis* is the most effective microorganism having a dry weight of 8.23 g/l in 14 hrs. However, *Candida utilis* is more favorable in terms of Kjeldahl protein, with 57.24% protein. Although the dry weight yield for *Candida tropicalis* is lowest, it may also be considered an effective microorganism for SCP production. The low yield obtained for this particular fermentation run may have been due to the low initial sugar content of the coconut water. This varies accordingly with the age of the coconut itself. The total reducing sugar consumption of the yeasts were in the range of 96-98% as analyzed by the Somogyi-Nelson method. The most efficient consumer of sugar was *Candida utilis*, based on the rate of sugar consumption as shown in Fig. 1.

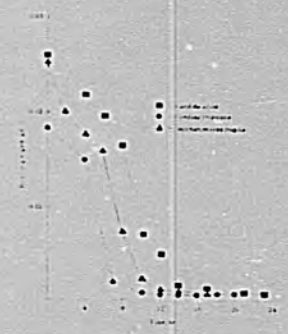

Fig. 1. Sugar utilization by *Candida utilis* UPCC 2074, *Candida tropicalis* UPCC 2049 and *Saccharomyces fragilis* UPCC 2095 on supplemented coconut water.

Conclusion

The preceding discussions have shown the feasibility of single cell protein production from coconut water on laboratory scale by microbial fermentation. There is no doubt that this could be stepped up to an industrial scale, as supported by the chemical analyses of coconut water showing its nutritional value for microorganisms. The main problem now lies in the economic feasibility of this process. There would be two main points to be considered for this process: the capital involved for the equipment and the energy costs for operation and maintenance. Considerable amount of energy would be needed in the sterilization and in the drying processes of the product as well as in the aeration and agitation of the fermentors. Capital costs for equipment may be reduced by tapping our local engineering resources and doing away with foreign-based technologies. Coordination among our microbiologists, chemists, engineers and economists would render this process feasible.

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ALCOHOLIC BEVERAGES FROM COCONUT SAP

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Three alcoholic beverages prepared from coconut sap are *tubâ* (coconut sap to which is added powdered tanbark of *Ceriops tagal* (Perr.) C.B. Robinson), *bahalina* (an aged *tubâ*), and *lambanog* (an alcohol distillate from fermented coconut sap). The *tubâ* and *lambanog* industry involves a rural-based food fermentation process.

Coconut sap is obtained from unopened spadix or inflorescence of the coconut palm (*Cocos nucifera* Linn.). The spadix is gradually bent downward and later cut open at the distal end. The cut is kept open by daily morning and afternoon trimming to encourage continuous flow of the sap. The number of spadices on any one palm seldom exceeds three. Each spadix will produce sap for about 2 months. Ten spadices are produced yearly.

The sap yield varies from day to day, season to season, palm to palm and spadix to spadix. The highest yield occurs in August and the lowest in April. The average sap yield per spadix was 49.5 liters (l) with a range of 17 to 68.8 l for tall palm, and 8.5 l with a range of 0.01 to 15.4 l for the dwarf type. A single tall palm could be expected to produce a daily yield of about 0.9 l of sap. An annual yield for tall palm was reported at 370.5 and 400 l in Iloilo and Quezon, respectively.

The sap gatherer can handle daily 30-40 palms in *tubâ* collection or 100 palms in *lambanog* sap collection.

The freshly exuded sap (unfermented) is sweet, oyster white and translucent. Its pH ranges from 6.2 to 7.2 and averages 6.7. Its chemical analyses are shown in Tables 1 to 3. The nutrients it contains are readily utilized by different microorganisms.

The theoretical yield of ethyl alcohol from the sugars in the sap is computed first by converting its sucrose content to reducing sugars by multiplying with the factor 1.0526. The total reducing sugars are then multiplied by 0.511, the conversion factor of reducing sugars to ethyl alcohol by weight. The alcohol by weight is changed to volume by the factor 0.79389, the specific

Table 1. Chemical analyses of the coconut sap and *tabad* by Gibbs (G) and Fandialan (F)

	COCONUT SAP				WASH	TABAD
	PRESERVED		FRESHLY GATHERED			
	(G)	(F)	(G)	(F)	(F)	(F)
Samples analyzed	–	23		33	24	24
Total solids (% w/w)	17.5	17.9	22	[illegible]	14	5.7
Sucrose (% w/w)	16.3	16.6	0.5	0.6	0	0
Reducing sugars (% w/w)	trace	0.2	7.0	5.7	1.2	1.4
Nitrogen free extract (other than sugar) (% w/w)		0.5	–	1.9	2.7	3.6
Crude protein (% w/w)	0.6	0.2	–	0.2	0.2	0.3
Ash (% w/w)	0.4	0.3	0.4	0.3	0.3	0.4
Fat	–	0	–	0	0	0
pH		6.4	–	3.6	3.4	4.4
Titratable acidity (% w/w)	trace	0.09	0.7	0.58	1.4	1.7
Specific gravity	1.070	1.070	1.010	1.019	0.9[illegible]	1.019
Alcohol (% w/w)	–	0	6.0	5.2	6.8	0.4

Table 2. Amino acid content (g/100 g) of freshly gathered coconut sap and *tubá* as compared with saké (Kozaki)

AMINO ACIDS	SAP	TUBA	SAKÉ
Tryptophan	1.27	–	0.00
Lysine	0.30	0.12	0.01
Histidine	1.19	–	0.01
Arginine	0.35	–	0.02
Aspartic acid	11.22	0.05	0.02
Threonine	15.36	0.05	0.01
Serine	8.24	0.04	0.01
Glutamic acid	34.20	0.57	0.03
Proline	3.52	trace	0.01
Glycine	0.47	0.04	0.01
Alanine	2.56	0.24	0.02
Cystine	–	–	0.00
Valine	2.11	trace	0.01
Methionine	trace	trace	0.00
Isoleucine	0.38	trace	0.01
Leucine	0.48	trace	0.01
Tyrosine	0.31	–	0.02
Phenylalanine	0.78	–	0.01

Table 3. Vitamin content of freshly gathered coconut sap and *tubá* (Kozaki)

VITAMIN	SAP	TUBA
	ug/dl	ug/dl
Thiamine	77.0	23.3
Riboflavin	12.2	28.5
Pyridoxine	38.4	8.9
Pyridoxal	38.4	8.9
Pantothenic acid	5.2	47.0
Nicotinic acid	40.6	218.0
PABA	47.1	134.8
Biotin	0.17	0.16
Folic acid	0.24	0.65
Inositol	127.7 mg/dl	5.6
Choline	9.0	0.93
Vitamin B_{12}	trace	trace

gravity of ethyl alcohol. With the total sugars in Table 1, the theoretical yield of ethyl alcohol will be 11.4% by volume.

On Tubá (coconut wine). *Tubá* is coconut palm wine. The addition of a pinch of powdered tanbark of *Ceriops tagal* (Perr.) C.B. Robinson (locally called *tungog* in Visayan) to the sap results in a product that is colored terra cotta to feuville morte and is astringent in taste. The *tubá*, collected once a day and sieved through *guinit*, is drank without further treatment.

The percent efficiency of alcohol conversion ranged from 48.2 to 88.6 with an average of 66.7 (Table 4). This low average percent efficiency is due mainly to different microorganisms. It is possible to raise the average from 66.7 to 88.6 as one sample had shown in Table 4.

Table 4. The pH and alcohol content by volume of freshly gathered *tubá* and *lambanog* sap

THESIS ADVISEES	YEAR COMPLETED	NUMBER OF SAMPLES	pH range	pH ave	ALCOHOL CONTENT % BY VOLUME range	ALCOHOL CONTENT % BY VOLUME ave
ON TUBA						
4	1974	4	4.6-4.8	4.7	6.6-8.0	7.3
2	1975	10	4.0-5.0	4.6	5.5-10.1	7.6
2	1976	10	4.4-5.0	4.6	5.6-9.3	7.8
1	1982	1		3.5		7.1
				Ave. of 25 samples		7.6

Efficiency of alcohol conversion (%): range, 48.2-88.6; ave., 66.7

ON LAMBANOG SAP						
4	1974	4	3.6-3.8	3.8	7.3-8.8	7.9
2	1975	10	3.0-5.0	4.1	5.4-6.7	6.0
2	1976	10	3.6-4.0	3.8	4.3-6.6	5.7
1	1978	33	3.5-3.7	3.6	4.4-6.1	5.2
1	1982	1		3.5		6.8
				Ave. of 58 samples		5.6

Efficiency of alcohol conversion (%): range, 37.7-77.2; ave., 49.1

The average microbial plate count of freshly gathered *tuba* is shown in Table 5. The total counts were made on TGYA. Yeasts were present in greater

Table 5. Average microbial plate count of freshly gathered *tubá* and *lambanog* sap grown on TGYA (tryptone glucose yeast extract agar), TGYRBSA (tryptone glucose yeast extract rose bengal streptomycin agar), and TGYBGAA (tryptone glucose yeast extract bromcresol green actidione agar).

Trials	TGYA	TGYRBSA	TGYBGAA
ON TUBA (X 10^3 per ml)			
CULTURE MEDIA			
4	18,290	–	–
10	29,320	15,999	146.56
10	7,994	4,090	162.9
ON LAMBANOG SAP (X 10^3 per ml)			
4	2,706	–	–
10	15,951	12,696	32.55
10	2,229	2,631	292

number as shown in TGYRBSA than bacteria grown in TGYBGAA. No fungi were observed.

The yeasts in *tubâ* were identified as: *Saccharomyces cerevisiae* making up 22.7 to 46.9%, *S. chevalieri*, 53.1 to 71.2%, and an unknown, 3.1 to 6.1%. A taxonomic study on yeasts identified 39 genera and 349 species.

The acetic acid bacteria were identified as *Acetobacter aceti* subsp. *xylinum*, *A. peroxydans* and *Gluconobacter oxydans* (the predominating species).

Among the lactic acid bacteria present in *tubâ* and *lambanog* sap were: *Lactobacillus hilgardii* (the predominating species), *L. fermentum* and *Leuconostoc mesenteroides*.

No bacterial isolates from tuba and lambanog sap produced more than 1.59% alcohol by weight or 2.52% by volume in 72 hr fermentation.

With these different kinds of yeasts and bacteria in *tubâ* in varying proportions, the fermentation products will also vary and so a standardized *tubâ* count could not be expected if left alone to nature. In addition to the variable alcohol yield, analysis of the freshly gathered *tubâ* showed on a mg/100 ml basis the following:

total titratable acidity	257
volatile acidity (as acetic)	21
lactic acid	1600
tartaric acid	189
laevo-malic acid	178
citric acid (anhydrous)	16
glycerol	903

Where do these microorganisms come from? Initially and continuously, they come into the sahod (receptacle for collecting the sap) by wind, rain, insects, from *tungog* and the *tubâ* gatherer; and also by the residual build-up of microorganisms in the *sahod* used continuously.

One can really imagine the large number of microorganisms that will come in contact with the sap and cause the sap to ferment rapidly whether it be alcoholic, acetic or lactic fermentation. These high counts from the *sahod* (Table 6) served as inocula to the freshly exuded sap, and the collection of the sap is on a 24 hr basis.

Table 6. Average microbial plate count of *sahod* wherein 100 ml rinse water was used per *sahod*. No fungi were observed.

	IN TUBA SAHOD (X 10^3 per ml)			
	CULTURE MEDIA			
Trials	TGYA	TGYRBSA	TGYBGAA	pH
10	6,301	4,329	190	4.75
10	97,320	14,203	340	4.5
	IN LAMBANOG SAP SAHOD (X 10^3 per ml)			
10	119,875	86,450	841	4.10
10	65,533	67,400	62,198	3.50

Powdered tanbark or tungog. The powdered tanbark of *Ceriops* turns the oyster white and translucent sap reddish brown or brownish pink, adds its astringent taste characteristic to tuba, and increases the fermentation rate and alcohol yield. An analogous practice in beer making is the use of hops.

Fungi were present in *tungog* but none was recovered from *tubâ* and *sahod*.

The addition of *Ceriops tagal* and *Rhizophora mucronata* Lam. at 0.5 to 3.0% to coconut sap increased the fermentation rate and alcohol yield over that without *tungog* in 24 and 48 hr fermentation. *Rhizophora* serves as a substitute for *Ceriops*. The tanbark contains polyphenols or tannins which inhibit bacteria but not the yeasts.

Tannic acid at 0.01 to 0.05% yielded the largest amount of alcohol but at 0.5% it decreased alcohol yield.

Coir dust was tried as a source of tannin. The 0.5% coir dust appeared to be optimal. The problem with dry coir dust was that it absorbed the sap, thus, reducing the volume of *tubâ*.

Oenologists recommend the addition of tannins to inhibit the growth of undesirable yeasts and bacteria. Excessive tannin concentrations, however, are inhibitory to desirable yeasts.

Tubâ is a wine that is not aged before consumption. Regular *tubâ* drinkers prefer the *bahal*, which is at least a day old *tubâ*. The *bahal* does not have the sweetish tinge present in freshly gathered *tubâ*. Their preference is justified by the fact that the highest alcohol content occurs in a one day old *tuba* or *bahal*.

In a one week storage study on *tubâ*, the average alcohol content increased in one day storage at 27°C and ambient room temperature and in three days storage at 17°C and 37°C; and decreased thereafter. *Bahal*, therefore, has a higher alcohol content than the freshly gathered *tubâ*.

On Bahalina (coconut wine). *Bahalina* is aged coconut wine. The freshly gathered *tubâ* is allowed to stand for one day. The *tubâ* is siphoned to another container (preferably glass) leaving behind the sediment. The container is filled to the top and stoppered tightly. Two days later, the *tubâ* is again siphoned to a clean, clear glass container, leaving behind the sediment. This procedure of transfer of two days interval is done four times. Precaution should be taken that the container is filled to the top and stoppered tightly.

When the *tubâ* appears to be very clear, it is again transferred to another container and buried in the ground. The duration of storage may last from seven weeks to one year. The longer the storage the better is the quality of the *bahalina*. Because of the demand for *bahalina*, the storage of *bahalina* is shortened to one week.

On Lambanog (coconut brandy). The problems on *lambanog* production are more on the sap collection and fermentation than on distillation. With the simple distillation used by the *lambanog* distiller, the slop waste showed:

	% alcohol by volume	
	range	average
in 21 samples	0.3-0.5	0.4
in 31 samples	0.3-0.9	0.6

The percent efficiency of alcohol conversion in *lambanog* sap ranged from 37.7-77.2 with 49.1 average. This is much lower than *tubā* which showed a range of 48.2-88.6 and an average of 66.7% (Table 4).

Microbial plate counts of freshly gathered *lambanog* sap were relatively lower in total counts than *tubā* (Table 5).

The microorganisms involved in the fermentation are yeasts and bacteria. Sap from three localities differed in yeast ecology. The yeast flora in freshly gathered sap were:

	Range %	Total %
Saccharomyces cerevisiae	20.0-34.2	29.5
S. chevalieri	21.8-46.5	37.9
S. rosei	0 - 8.1	2.0
S. capensis	0 -13.6	6.4
Candida diddensi	0 -12.7	4.9
C. langeronii	1.6-12.7	5.6
C. mogii	0 - 8.2	2.6
C. rhagii	2.2-16.4	6.3
Torulopsis colliculosa	1.1- 6.4	3.3
Unknown	1.0- 1.8	1.5

The bacteria were the same as in *tubā*. They do not produce alcohol higher than 2.52% by volume.

In addition to the alcohol, the freshly gathered *lambanog* sap showed 4.5 times titratable acidity, 3.1 times volatile acidity, 13 times lactic acid and 2.8 times tartaric acid than that of *tubā*.

The sources of microorganisms in *lambanog* sap are the same as in *tubā* except for *tungog*, which is not added to the former. The residual inocula of microorganisms in the former are much higher than the latter (Table 6).

The *tubā sahod* is cleaned with a bamboo brush after pouring out the *tubā*. In *lambanog* sap collection, the sap in the *sahod* is stirred with a bamboo stick and poured out. The *sahod* is then returned to the spadix. This allows more microorganisms to remain in the latter *sahod*. The sediment in the former *sahod* ranged from 0.01 to 0.55 g/ml of rinse water and in the latter *sahod*, 0.22 to 0.25 g/ml.

The pH of the rinse water from *tubā sahod* ranged from 4.5 to 4.8 and in sap *sahod*, 3.5 to 4.1. The lower pH in the latter does not favor desirable yeasts growth.

In a one week storage study on *lambanog* sap, the average alcohol content at 17°C, 27°C, 37°C and ambient room temperature (ART) increased on the first day of storage and decreased rapidly at 27°C and ART but gradually at 17°C and 37°C. In one sample stored at 27°C, no alcohol was recovered on the seventh day of storage.

Selection of High Alcohol Producing Yeasts

Yeasts were isolated from *tubā* and *lambanog* sap and tested for alcohol production in comparison with known yeast cultures. The inoculum rate was one percent and the fermentation time was 50 hr at ambient room temperature

(ART). The result showed the following:

Yeasts	Sterilized sap	Sterilized sap with tungog
Tubā and sap isolates	4.46- 7.97	4.71-8.04
S. cerevisiae (Baker's)	7.67	7.12
S. cerevisiae distillery	7.20	7.30
S. cerevisiae Champagne	5.59	4.11
S. carlsbergensis	2.43	6.20
C. utilis BMA	1.89	2.63
C. utilis var *thermophila*	1.66	0.86
C. utilis	1.5	1.83

In another study, sterilized sap inoculated with 1% yeast and fermented for 48 hr at ART, showed the following result:

Yeasts	% Alcohol by Volume
Saccharomyces cerevisiae NRRL Y-134	9.77
S. bayanus	9.02
Tubā isolate	8.94
S. cerevisiae (Baker's 2)	8.78
S. saki Kykai N. 7	8.70
S. cerevisiae E	8.60
S. cerevisiae F	8.14
S. cerevisiae (Baker's 1)	7.43
S. cerevisiae C	7.19
S. carlsbergensis	6.33
S. cerevisiae TUA No. 6215	5.66
Schizosaccharomyces pombe	5.10
Saccharomyces formosensis	1.41

One thing though that has to be mentioned here is that the taste and aroma have not been considered in these studies.

In the testing of bacterial isolates from *tubā* and *lambanog* sap for alcohol production, *Zymomonas mobilis* was included. This bacterium was not found in *tubā* or *lambanog* sap but it produced 6.55% by weight or 8.23% alcohol by volume in sterilized coconut sap in 72 hr fermentation.

A study was conducted wherein new *sahods* inoculated with 50, 100 and 200 ml of yeasts, used *tubā sahods*, and used *lambanog* sap *sahods*, were used in collecting the sap. Ranked from the highest to the lowest alcohol content was the 200 ml inoculum, followed by 100 ml inoculum, 50 ml inoculum, *tubā sahod*, and *lambanog* sap *sahod*.

The Business of the Lambanog Industry

A study made on the "Bottling and Marketing of *Lambanog*" (coconut brandy) in 1979 revealed that labor constituted the biggest item of expense — 69.77% of the total operating expenses. Tapping accounted for 81.16% of the labor expenses or 56.62% of the total operating expenses. Distillation was tagged at 11.29% of the labor expenses or 7.88% of the total operating expenses.

Supplies and materials cost 13.94% of the total expenses. Bamboo constituted 99.86%. Rental on coconut palm was 5.47% of total expenses (1978).

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PRODUCTION OF FUEL ALCOHOL FROM COCONUT SAP

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ABSTRACT

The utilization of the sugars in coconut sap for fuel alcohol production is a promising alternative to the traditional copra process. The technology for the alcohol process is simple and is, in fact, indigenous for 'lambanog' (distilled alcoholic beverage) production. However, the economics of producing ethyl alcohol for use as fuel, instead of as beverage, is presently not favorable in small scale. Additional problems for the fuel alcohol process, especially the high labor cost, are discussed.

UTILIZATION OF FUEL ALCOHOL IN INTERNAL COMBUSTION ENGINES

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Introduction

Man's mobility when he became erect and when he abandoned his forelegs for locomotion, was somewhat limited by the modest length of his hind legs. He could sprint briefly for a few hundred yards after a deer, or he might extend his radius to a dozen miles by jogging or walking. Early Greek story-tellers, with wish-fulfillment fantasy, invented the centaur, combining a horsey speed and range with a human torso and the capacity to enjoy travel.

This need for better personal transportation was achieved, after a gestation of several millenia, in the motor bike and the automobile. It is difficult to imagine that man will now lay down his new love-objects on demand, only because the price of fuel is going up. Rather, it would be easier for man to search for alternative sources of fuel, one of which is alcohol.

The use of alcohol in motor vehicles is neither a new technology nor a new concept. There is extensive literature on the subject dating back into the 20's. Alcohol has often been used in both war and peace times. In recent years, particularly after the 1973 oil crisis, alcohol has been acknowledged as one of the most promising near-term options as fuel for internal combustion engines.

Alcohol as Fuel for Gasoline Engines

Two types of alcohol are commonly used as fuel, either by themselves, or blended with gasoline: METHANOL and ETHANOL. More complex forms of alcohol, such as propyl alcohol, butyl alcohol and pentyl alcohol can also be used; however, they are presently utilized in small amounts to help keep blends mixed, or to improve the performance of straight ethanol or methanol fuels.

Alcohol-gasoline blends have been given different names when used in different countries. Gasohol as used in the United States is a blend of 10% ethanol and 90% gasoline. Blends used in Brazil's PROALCOOL programme are usually 20% ethanol and 80% gasoline. The ALCOGAS used in Negros is a blend of 15% ethanol and 85% gasoline.

During the 1970's critics of alcohol-gasoline blends listed a number of problems that they said could arise when modified gasoline engines were run on gasoline containing 10 to 20% alcohol:

1. If a blend of anhydrous alcohol and gasoline was exposed to more than 0.25% water, phase separation would occur. The gasoline and alcohol could separate into different layers in the fuel tank, causing serious driving problems such as surging and loss of power.
2. Vapor lock could occur when the alcohol, with higher vapor pressure than gasoline, began evaporating. Bubbles of vapor could accumulate in fuel lines, block fuel pumps and prevent cars from starting.
3. Fuel tanks and carburator gaskets could corrode with alcohol blends, since they were not built to resist alcohol.
4. Starting difficulties, particularly in cold weather, could occur.
5. The lower heat content of alcohol fuels would mean mileage would suffer.

When several experiments were conducted by noted researchers, it was found out that none of these problems was serious enough to prohibit the use of alcohol-gasoline blends. Results of the experiments, particularly those conducted by Dr. Richard Pefley of the University of Sta. Clara, California and by the West German government, Shell and Volkswagen, showed the following:

1. Adding alcohols to pure gasoline increases the octane rating. A 10% blend of ethanol with 80-octane gasoline will produce an 83- or 84-octane fuel; adding 15% ethanol will make an 86-octane fuel. Alcohol can therefore be used as an alternative to lead additives to boost the octane of gasoline.
2. Alcohols have a lower heat value than gasoline. Methanol has only 49% and ethanol has only 66% of the heat content of a comparable amount of gasoline. The higher octane rating of alcohols and their more complete, carbon-free burning partly makes up for this difference. Thus, with pure ethanol, mileage tends to be only 15-20% lower; with methanol, about 30-35%.
3. Alcohol burns cooler than gasoline so less nitrogen oxides (NO_x) are produced.
4. Alcohol fuels burn cleaner than gasoline, an emission advantage; and the cooling effect of alcohols provide a greater density so power is increased. At lower combustion temperatures, thermal efficiency increases to 8 to 10% more.
5. Annydrous alcohol is not necessary for pure alcohol engines. Alcohol can burn at a minimum of 50% purity; however, it is recommended that 80% purity be set as minimum for straight alcohol operation.

The only potentially serious problem confirmed was a tendency for carburator and fuel pump gaskets to swell. Experts recommended that all new cars be built with alcohol-resistant gaskets.

A. The Brazilian Experience: Alcohol Cars

The president of Brazil had been impressed by research on blends and straight alcohol at Brazil's Center for Aerospace Technology that he ordered a massive campaign to blend sugarcane ethanol with gasoline. This alcohol

program-called Proalcool-proved that as much 20% ethanol had no ill-effects on automobiles.

In 1979, Brazil's program went even further. The Brazilian automakers association ANFAVEA signed an agreement with the government to manufacture cars which run on pure ethanol. By March 1980, General Motors, Volkswagen, Ford, Fiat and other manufacturers in Brazil began offering the pure ethanol cars to the public. By the end of 1980, over one-quarter of the automobiles sold in Brazil were designed to run on pure hydrated alcohol.

Brazil's ethanol cars are different in several respects from conventional gasoline automobiles. Some of their features are as follows:

1. Their carburator have slightly wider inlet nozzles, to allow more fuel to enter the cylinder.
2. They have auxiliary fuel tanks containing gasoline, to allow starting under cold weather conditions.
3. They have increased compression ratios to obtain better mileage.

In terms of power and performance, they are equal to gasoline-fueled cars. Mileage per Btu is higher with alcohol, but kilometers per liter is lower. A consumer survey showed that:

- The VW 1300 gets 10.3 km/l with ethanol, compared with 12.8/l with a standard gasoline engine.
- Ford Landau gets 5.0 km/l with ethanol, compared to 5.79/l with gasoline.
- GM's Opala gets about 8 km/l with alcohol, compared to the gasoline model's 10.7 km/l.
- The Fiat-L gets 10.9 km/l with alcohol, 12.4 km/l with gasoline.

B. The Philippine Alcohol Program

The Philippines recently embarked on an alcohol program similar to that of Brazil and targets gasoline displacement of some 3 million barrels yearly by 1988. The island of Negros is the first pilot consumer: gasoline sold in Negros now has 15% anhydrous alcohol.

A number of devices which enable ordinary alcohol (about 95% purity) to be used as gasoline-alcohol mixtures have also surfaced. One such invention is the "alco-tipid" which is claimed to separate water in the alcohol as it is used in the engine. This is achieved by "aspirating" air through the alcohol thereby evaporating it, resulting in a thoroughly-mixed fuel-air blend that is then introduced into the engine intake manifold either before the throttle valve of the carburator or directly to the carburator itself. The engine vacuum provides the aspiratory effect. With this system, alcohol is stored in a separate vessel and is mixed only with gasoline at the moment of use. A dynamometer test conducted on this device showed gasoline savings of 10 to 20%.

Operating on a slightly different principle but also enabling the use of ordinary alcohol-gasoline mixtures is the Dyna-mix. This device, it is claimed, allows the operator to select over a continuous range of mixture concentration through a dial installed in the console.

These devices, as well as other systems, had been put in the market.

Alcohol as Fuel for Diesel Engines

Two approaches are currently being studied to utilize alcohol in diesel engines: (1) Fuel modification and (2) Engine modification.

1. Fuel Modification

The process is to blend alcohol with diesel fuel or diesel substitutes and inject this in the normal manner into the engine without any major modifications to the engine.

a. Blends of diesel and alcohol

Anhydrous alcohol is miscible with diesel. However, the presence of even 0.50% v/v water in the mixture causes phase separation. One way of overcoming this problem is to use chemical emulsifiers to form an emulsion of the ternary system alcohol/distillate/water. One such chemical emulsifier is a proprietary A.R.L. surfactant trademarked "DALCO" developed by the Space Laboratories in Australia. Total surfactant concentration ranges from 2 to 5 grams per liter of diesohol. Engine performance with blends containing 20% ethanol is considered satisfactory, while performance on 30% blend is characterized by excessive ignition delay with consequent knock, quench and poor starting. No cetane improver was added to any of the blends. Other performance results:

(1) Exhaust smoke and NO_x emissions are reduced.
(2) CO emissions decreased with increasing hydrated ethanol concentration for loads above 50%, but increased for loads below 50%.
(3) Aldehydes and total hydrocarbons increased with increasing ethanol concentration.

b. Blends of alcohol, diesel and castor oil

Castor oil is miscible either with alcohol alone or with both alcohol and diesel oil. Engine tests in Japan using Yanmar diesel engines (CR-21, pre-combustion chamber) run on binary mixtures of ethanol and castor oil, with ethanol content ranging from 20% to 80%, showed the following results:

(1) There was an appreciable increase in maximum power as compared to the normal diesel operation.
(2) Smoke decreased with increase in ethanol and turned invisible at over 60% ethanol content except for the vicinity of the point where maximum power was produced.
(3) NO_x emissions decreased with increase in ethanol while HC and CO levels increased.
(4) Problems, however, were encountered with increase in ethanol (up to 80%) and these are engine knock under high load conditions, and misfire under low load conditions.
(5) The problem of misfire was corrected by the use of a glow plug in the engine cylinders; the problem of engine knock was diminished with the use of an ignition improver (Hexyl nitrate, 5%) with the blends. The electrical glow plug also improved the startability of the engine.

To minimize the hard starting problems of small diesel engines which cannot be fitted with glow plugs, the ethanol content in the blends was limited to below 50% and a portion of castor oil was replaced with diesel oil. A typical blend is 20% castor oil, 30% diesel fuel, and 50% ethanol which is stable if

water content in the ethanol is small enough. If this approaches 5% level, then castor oil will have to be increased up to approximately 35% and a corresponding reduction of diesel fuel to 15%.

Results of the engine tests on a blend of 50% ethanol, 30% diesel fuel showed gaseous emissions and engine knock levels comparable to those in normal diesel engine operation.

2. Engine Modification

Several schemes under engine modification were tried by several researchers. Some of these are described below.

a. Ignition-assisted combustion

Pure alcohol can be injected in a diesel engine in lieu of diesel oil. The problem is the markedly low ignition quality of alcohol which results either in misfire or in engine knock. One approach to overcome this problem is offered by the MAN-FM (German) spark assisted combustion system. The features of this system are: diesel-type compression ratio, direct injection, wall deposition of the fuel in the combustion chamber, and a largely conventional ignition system.

Direct injection of straight alcohol avoids the mixing of alcohol with conventional fuel which poses the problem of poor miscibility. Additives to stabilize mixtures can be quite expensive.

The problem of poor ignitability is solved without the use of ignition improvers by injecting alcohol so that the greater proportion of the fuel is deposited on the walls of the spherical combustion chamber in the piston. The fuel evaporating from the film forming on the combustion chamber wall is successively fed into the flames with the greater part of the heat necessary for evaporation being supplied by flame radiation. This prevents the existence before the start of combustion of greater amounts of ignition mixture than is necessary for ignition. This leads to a more controlled rate of combustion and therefore prevents engine knock.

b. Dual-fuel, twin injection system

Instead of a spark plug used for ignition, another injector could be used using diesel for pilot injection that initiates ignition. Once combustion starts, a second injector injects the main fuel which is alcohol (90% at full load and 50% at idling of total energy supplied). The pilot fuel used could be alcohol itself with an ignition improver (Kerobrisol, Alkylnitrates such as cyclohexyl nitrate or amyl nitrate in proportions from 10 to 20% vol). The quantity of ignition improver required is 3 to 10 times higher to single injection compared to twin injection.

One advantage of the twin injection system is the suitability of using cheap ethanol with high water content (up to 40%).

c. Dual-fuel carburation system

This is the simplest approach to engine modification to utilize alcohol as the main fuel since it involves only the addition of an alcohol carburation system external to the engine. The alcohol is mixed with air in the carburation system and introduced into the air intake of the diesel engine. A pilot injection of diesel fuel in the normal way initiates ignition and combustion of the alcohol. The percentage of the total energy contributed by alcohol can be as high as 90% in stationary engines at full load and up to 50% in vehicle engines operating at variable loads. Again, cheap ethanol with high water content (up

to 60% can be used). Also, vegetable oils like coconut oil can be used as ignition fuel. When used as a pilot spray with alcohol operation, the disadvantages of higher energy consumption and emissions encountered when using vegetable oils in conventional diesel engines do not exist.

Conclusions

1. The use of alcohol in gasoline engines is neither a new technology nor a new concept. There is an extensive literature on the subject dating back into the 20's. In recent years, particularly after the 1973 oil crisis, alcohol has again been acknowledged as one of the most promising near-term options as fuel for gasoline.

2. The prospect and potential for the utilization of alcohol in the diesel engine is bright. Supply of diesel fuel is far more critical than that of gasoline and acute shortage of diesel in the near future is most likely to happen. Alcohol, a renewable indigenous fuel, is technically found to be a most feasible substitute. When the economics of its utilization becomes acceptable, alcohol can in fact become the logical substitute for diesel.

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REVERSE OSMOSIS OF COCONUT WATER

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Introduction

The Philippine coconut industry produces coconut water in excess of 2×10^9 liters annually. Approximately, 10% of the coconut water is discharged by the six dessicated coconut factories in the country, namely Franklin Baker Company of the Philippines, Medina Coconut Products, Peter Paul (Phils.) Corporation, Blue Bar Coconut Phils., Inc., Red V Coconut Products, and Sun Ripe Coconut Products which operate mainly in the Laguna and Quezon areas. These factories throw away *daily* a total volume of 6×10^5 liters or an average for each factory of 10^5 liters of coconut water whose Biochemical Oxygen Demand (B.O.D.) is about 40 g/l.

The greatest potential and need for coconut water utilization exists in dessicated coconut factories due to centralized nut processing. Each factory processes more than 200,000 freshly opened coconuts daily. The coconut water can be recovered with minimal contamination and utilized immediately. Utilization of this high B.O.D. waste is expected to reduce the environmental pollution caused by dessicated coconut factories. On the other hand, only limited utilization of coconut water could be obtained in small copra dryers or 'tapahan' due to the small number of coconuts processed and the highly perishable nature of coconut water. Furthermore, the pollution caused by coconut water in the small copra processing units is not significant.

Aside from the control of environmental pollution, utilization of coconut water allows the recovery and use of its nutrients as food or fermentation substrate. The main constituents of coconut water are carbohydrates. These include the simple sugars, glucose, fructose and sucrose, as well as sugar alcohols, mainly sorbitol (glucitol). The concentration of sugars and sugar alcohol in coconut water are 20-40 and 9-15 g/l, respectively. The corresponding protein content is generally less than 5 g/l. Several growth factors are also present in small amounts.

A promising approach to the utilization of waste coconut water involves preliminary concentration of this waste by reverse osmosis. This process, which is also called hyperfiltration, involves filtration through a semipermeable membrane under high pressure ($>$ 15 bars). The use of a very dense membrane allows only water to pass through the membrane and concentrates carbohydrates, salts and proteins in the retentate. By using this technique a concentrated coconut water may be prepared which could be suitable as a beverage or concentrated fermentation substrate. Unlike concentrating by vaporization, reverse osmosis does not involve phase changes and is, therefore,

less energy-intensive. Furthermore, the use of ambient temperature during reverse osmosis avoids thermal degradation of the processed material.

Principles of Reverse Osmosis

Normal osmosis is defined as diffusion or permeation across a membrane along a (decreasing) concentration gradient. The solvent molecules diffuse across the semi-permeable membrane, which is permeable only to solvents, towards the solution. The driving pressure for this process is known as osmotic pressure, which is approximately proportional to the concentration of the solution. Normal osmosis proceeds until equilibrium is attained, i.e., when the hydrostatic pressure of the column of solution equals the osmotic pressure.

On the other hand, reverse osmosis is diffusion of solvent molecules across a membrane from the solution to the solvent side, i.e. along an increasing concentration gradient of solvent. In order to accomplish this, pressure has to be applied on the more concentrated side which is greater than the osmotic pressure of the concentrated solution. Application of such a high pressure forces the solvent molecules across the membrane in a direction which is in reverse to that of normal osmosis.

Reverse osmosis (RO) is one of several related membrane processes. It is similar to ultrafiltration (UF) in that both start with a feed stream which is split into the concentrated product stream (retentate) and the product-poor stream (permeate) However, UF membranes only retain large molecules or polymers with molecular weights (MW) greater than about 5000 daltons while RO membranes can be used to concentrate small molecules (MW > 50 daltons). Because RO membranes retain essentially all dissolved substances in water, the feed and permeate solutions have a different osmotic pressure. This osmotic pressure difference must be exceeded before water can be forced through the membrane.

There are four RO modular designs in use namely: plate-and-frame, tubular, spiral-wound and hollow fiber modules. The relative merits, costs and operational characteristics of the different designs are discussed in the literature (Lonsdale, 1980).

Materials and Methods

Sample and Equipment Preparation

Coconut water. Dehusked, shelled and pared coconuts were obtained from the Blue Bar Coconut Phils, Inc. factory, Tiaong, Quezon. The nuts were opened with a knife and the coconut water was collected in plastic pails. The coconut water was passed through a 2-mm (10 mesh) wire screen and then through a 75-micron (200 mesh) screen of Liquatex separator (Model L 44.10) before introduction into the reservoir of the reverse osmosis equipment.

Deionization of coconut water. For the reverse osmosis run at 40 bars, the fresh coconut water was centrifuged at 8,000 rpm in a Westfalia separator for two hours. The deionized coconut water was then passed through an ion-exchange resin (Barnstead High Capacity D0803) prior to ultrafiltration. However, for the 20 and 50 bar runs, only deionization but no centrifugation of coconut water was done.

Reverse osmosis equipment. A DDS Lab-Unit HF 30-4.5 Reverse Osmosis (RO) module, was used for the experiments at the Blue Bar coconut factory. A flow sheet of the RO equipment is given in Fig. 1. Assembly of the membrane module was modified such that only 30 (instead of 90) membranes were used. The membrane type is made of cellulose acetate cast directly on filter paper (DDS Type 995 PPI) and has a molecular weight cut-off of less than 500 daltons. It has a maximum recommended operating pressure of 60 bars (870 psi).

Experimental Techniques

Reverse osmosis runs were conducted at 20, 30, 40 and 50 bars module inlet pressure for 3-5 hours at 36-42°C. Samples of retentate (concentrate) and permeate were collected and permeate flow rate was determined every half hour. The volume of concentrate was maintained at 38-40 liters by continuously replacing the lost permeate with fresh prefiltered coconut water. The samples for later analysis were frozen in order to prevent deterioration. The electrical conductivity, density and pH of the samples were determined. The samples were also analyzed in terms of the concentration of total sugars, sugar alcohol and protein. Electrical conductivity was measured using portable conductivity meters (Kurita Model TS-3, Japan and YSI Model 33-S-C-T meter, U.S.A.). Density was determined with a pycnometer and pH was measured with a Cole-Parmer pH Monitor Model 5653.

Results and Discussion

The time profiles of the flux of distilled water and coconut water through the reverse osmosis membranes (cellulose acetate DDS Type 995 PPI), whose total area is 1.5 m^2, are presented in Fig. 2a and 2b respectively. The flow rate of distilled water increased with increasing inlet pressure and was constant after 3.5 hr. The flow rate of coconut water decreased rapidly during the first two hours of continuous hyperfiltration and leveled to a constant value after about 3 hr. The flux at 50 bars was 7.6 l/m^2 /hr after 5 hr while the corresponding flow rate at 20 bars was 4.8 l/m^2/hr. The differences in flow rates between 20 and 30 bars were greater specially after one hour of operation than at 30, 40, and 50 bars. This indicates that the flow rate shows a hyperbolic dependence on operating pressure.

Reverse osmosis data for both fresh and deionized coconut water at 20, 40 and 50 bars operating pressure are presented in Figs. 3-5. The data are shown in terms of the concentrations of total sugar, sugar alcohol and protein. It can be seen in the figures that the concentration of the above-mentioned solutes was greatly improved, specially at 50 bars, by preliminary deionization of coconut water. This is explained by the absence of membrane polarization after removal of the dissolved ions. It is seen in Fig. 5 that the final concentrations of total sugars and sugar alcohol in the retentate of deionized coconut water were approximately 14 and 7%, respectively, after 5 hr of reverse osmosis at 50 bars. These numbers correspond to concentration factors of about 11 and 5 for total sugars and sugar alcohol, respectively.

For fresh coconut water the final concentrations of total sugars and sugar

alcohol at 50 bars were 5.6 and 2.3%, respectively, corresponding to a concentration factor of about 3.4. The lower concentration factor observed for fresh coconut water shows the effect of dissolved ions in interfering with the free passage of neutral molecules across the membrane through the phonemenon of membrane polarization.

The effect of the inlet pressures on the retention of total carbohydrates (total sugars and sugar alcohol) in fresh and deionized coconut water is shown in Fig. 6. At 50 bars inlet pressure the total carbohydrates in fresh and deionized samples after 5 hr of reverse osmosis were 7.6 and 21.5% respectively. With the initial concentration of total carbohydrates in the range 2.3-3.6%, the extents of concentrating the carbohydrate solute were roughly 3.3 and 7.7 for fresh and deionized coconut water respectively. At 20 bars the concentration factor (CF) values were 2.1 and 2.9 for fresh and deionized coconut water, while at 40 bars the corresponding CF values were 3.3 and 6.0.

In conclusion, hyperfiltration of coconut water using DDS plate-and frame equipment and cellulose acetate membrane showed promising results. The concentrations of sugars and sugar alcohol of coconut water could be increased by a factor of almost eight after 5 hrs. of continuous retentate recirculation at 50 bars operating pressure. At this pressure the final carbohydrate concentration in the retentate was 21% yielding a syrupy product which could be used as a beverage concentrate, sugar syrup or concentrated fermentation substrate. At 40 bars, the final carbohydrate concentration was 12.9% which would make the retentate a potential beverage product. Because of the sweet, pleasant coconut flavor and not salty taste of the product, the prospects are bright for its large-scale food applications. Needless to say, further research and development, as well as consumer acceptability tests, are needed in order to fully tap the potential of concentrated coconut water as a food or fermentation substrate.

Acknowledgment

The present study was financed by the NSTA-ASEAN Project on the Management and Utilization of Food Waste Materials. The generous support of the Australian Government and the National Science and Technology Authority (NSTA) is acknowledged. The author acknowledges the skillful technical assistance of Gabriel M. Papa, Julita R. Fabilitante and Hector A. Bergonia, research assistants and associate, respectively in the project. The author also wishes to thank Mr. Venuso Bibit and Engr. Napoleon Garcia of Blue Bar Coconut Phils. and Mrs. Olympia Gonzalez of NIST for their kind assistance. The award of a PCRDF professorial chair to the author is also gratefully acknowledged.

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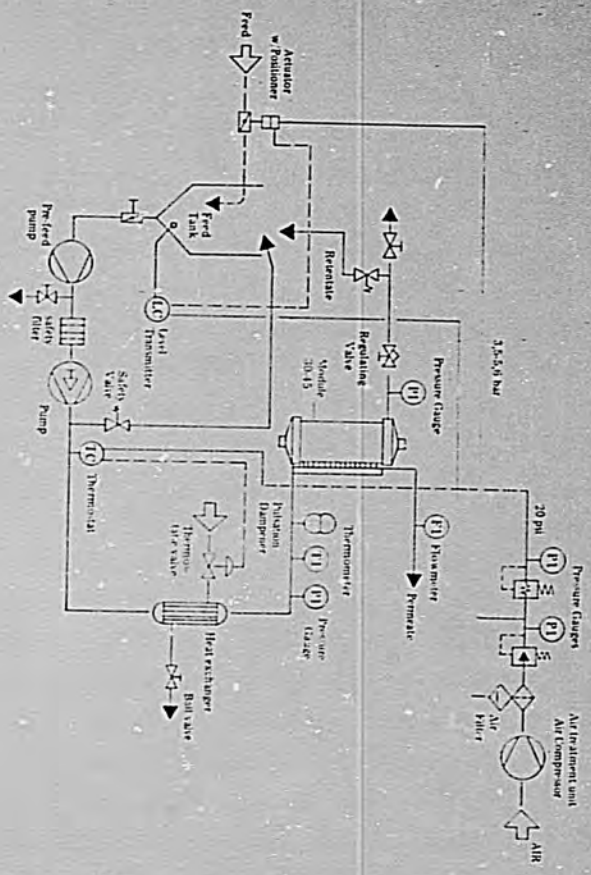

Fig. 1. Flow sheet of reverse osmosis equipment (DDS Module 30-4.5 Lab).

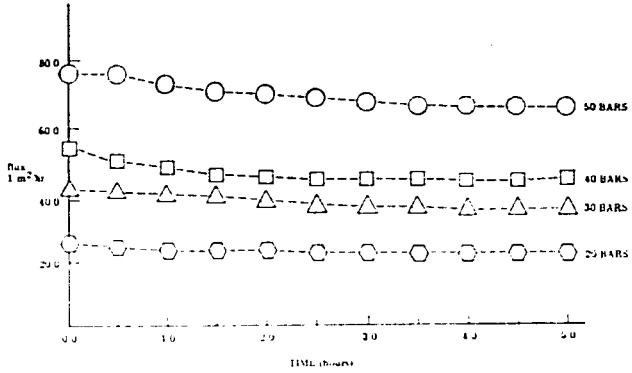

Fig. 2a. Reverse osmosis water flux at different module inlet pressures using cellulose acetate membrane

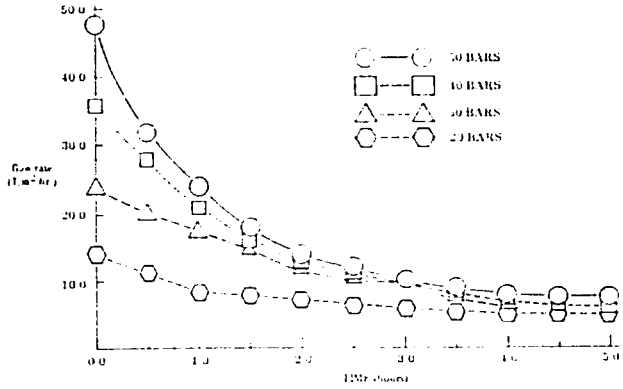

Fig. 2b. Flow rate of coconut water at different module inlet pressures

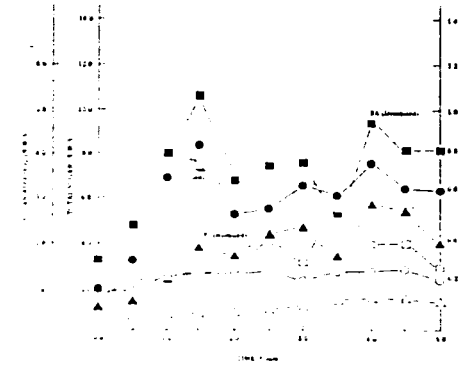

Fig. 3. Concentrations of sugar, sugar alcohol and protein for fresh and deionized coconut water at 20 bars.

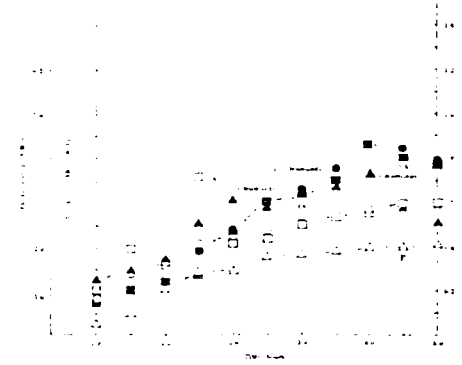

Fig. 4. Concentrations of sugar, sugar alcohol and protein for fresh and deionized coconut water at 40 bars.

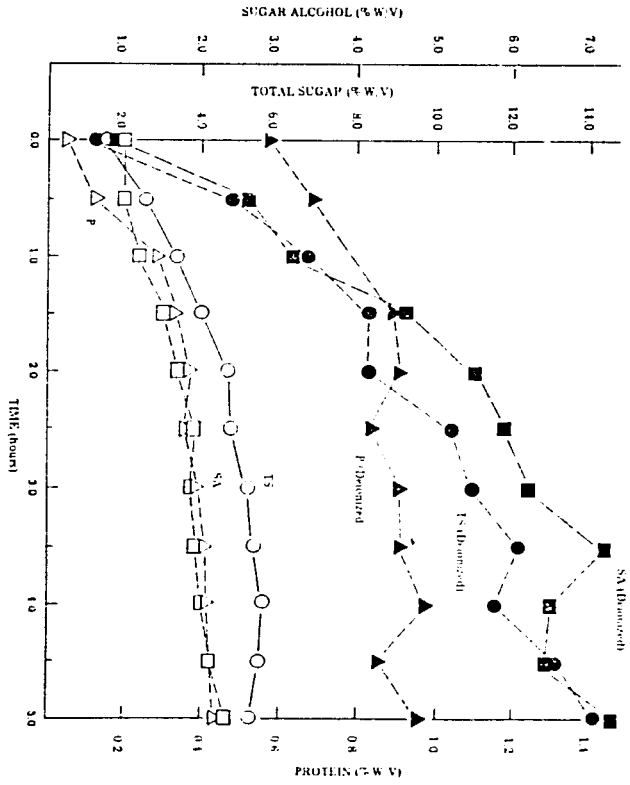

Fig. 5. Concentrations of sugar, sugar alcohol and protein for fresh and deionized coconut water at 50 bars.

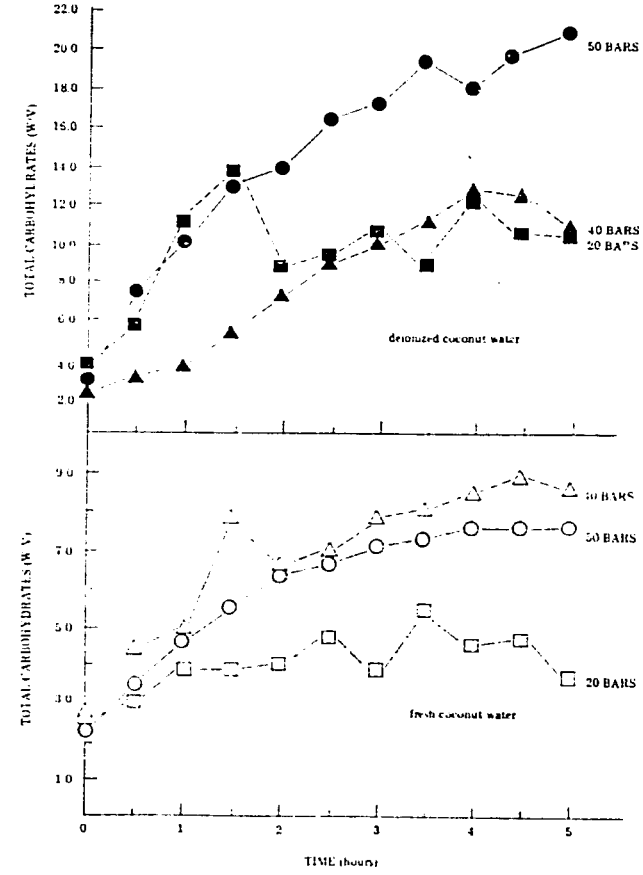

Fig. 6. Total carbohydrate concentrations at different inlet pressures.

PLENARY SESSION

WORKSHOP OUTPUT

Two workshop sessions were organized: the Coconut Water workshop chaired by Dr. Priscilla C. Sanchez of the University of the Philippines at Los Baños and the Coconut Sap workshop chaired by Dr. William G. Padolina, also of the University of the Philippines at Los Baños. Each group identified the high priority researchable areas along the fields of coconut water and sap utilization that would serve as bases in developing and packaging programs along these fields.

Research Areas

A. Coconut Water Utilization

1. Single cell protein
   a. cost minimization and optimization of process
   b. verify technology in reducing nucleic acid
   c. dissemination of selected suitable strains
   d. generation of food and feed products
   e. microbiological medium generation
   f. technology generation in utilization of nucleic acid

2. Coconut water beverage (young and mature nuts)

   – piloting of existing beverage studies

3. Antibiotics

   – technology generation from nutrient-supplemented coconut water

4. Pharmaceutical and other uses (diuretics, amino acids, vitamins)

   a. technology generation of growth promoting factors
   b. dissemination of oral rehydration fluid

5. Reverse osmosis (RO) coconut water concentrate

   a. explore other areas of utilization
   b. cost minimization and optimization of process

6. Vinegar

   – improvement of fermentation technology (shorten/hasten)

7. Nata de Coco

   – verification of stability of mother liquor

8. Biogas

   – optimization of process

9. Fertilizer

   a. selection of plants that would favorably respond to coconut water
   b. dosage determination

10. Intravenous fluid

   – implementation plan

B. Coconut Sap Utilization

1. Develop efficient technology for collecting sap

2. Products

   a. lambanog
      – improve alcohol production
   b. vinegar
      – profit maximization
   c. non-alcoholic drinks
   d. substrate

3. Socio-economic study

   a. copra displacement
   b. baseline data on marketing of lambanog
   c. social issues towards improvement of technology

CLOSING CEREMONIES

WORKSHOP SUMMARY

Dr. Julian A. Banzon
Professor Emeritus
University of the Philippines at Los Baños
College, Laguna

The presentation of papers started with Dr. William Padolina's overview of the status of coconut water and coconut sap utilization. He also gave a draft R & D program on coconut water and sap utilization. The next speaker, Dr. Ricardo del Rosario described in detail his experiments at UPLB on coconut water as a beverage and the problems that he encountered. Ms. Julieta Alejo brought samples of NIST coconut water beverage, both carbonated and non-carbonated. She discussed the procedures for their products. Dr. Felicidad Anzaldo explained her simple methods for the oral rehydration fluid as backed-up by clinical trials. The importance of her work is not realized much in the Philippine setting, but in Australia, this is a major project of the Ministry of Health in the outbacks. The UP-NSRI study on single cell protein was reported by Dr. Flordeliz Uyenco. She emphasized that in her project no sugar is added to coconut water. Prof. William Fernandez presented his paper on alcoholic beverages from coconut sap. Dr. Ernesto del Rosario showed his unusual versatility by discussing two papers, one on concentration of coconut water by reverse osmosis and the other on their efforts at BIOTECH to improve fuel alcohol production at an economically optimum level. Dr. Ibarra Cruz of PNOC-ERDC gave us an insight on the use of alcohol in diesel fuel because of the present shortage in diesel fuel and glut in gasoline. The papers have covered a very wide area. We have learned a lot from these presentations.

CLOSING REMARKS

JOSEPH C. MADAMBA
Director, Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna and
Vice-Chairman, Board of Trustees, Philippine Coconut Research and Development Foundation, Inc. (PCRDF)
Pasig, Metro Manila

Colleagues in the Research and Development Community, Distinguished Guests, Friends, Ladies and Gentlemen:

We wind up this afternoon another workshop on an important, but relatively less attended to, aspect of the coconut industry. In your invitation for me to participate in these closing ceremonies, you have described this meeting of scientific minds as a mini-workshop. Be that as it may, I am certain that it can turn out to be a giant step toward the accelerated development of coconut water and coconut sap-based industries that could boost the efforts of rural people in coconut-producing regions to improve their farm incomes and hopefully the quality of their lives.

In recent years, symposia, workshops and conferences on the coconut industry most often brought to mind the fateful year of 1980 to mid-1980 to be exact when the price of copra nose-dived due to the drop in the worldwide demand for coconut oil brought about by a glut in other vegetable oils. In the case of the Philippines, this unfavorable development in the international coconut oil market spoke eloquently about the unbalanced growth of her coconut-based industries.

Those keeping a close watch on the coconut industry, most especially members of the research and development sector, now say that those depending on this prime commodity for their livelihood would not have been adversely affected by the price decline if the coconut-based industries were fully developed. The hundreds of millions of coconut trees that mantle the countrysides can easily provide raw materials for such industries. After all, the coconut has been dubbed as the "Tree of Life" considering that all its parts have some economic value.

Indeed, what appears as a lopsided development of the various aspects of the industry is rather unfortunate, especially when we consider that massive coconut planting in the country began some 341 years ago. That was in 1642 when then Spanish Governor General Sebastian Hurtado de Corcuera issued a decree ordering each village chief to plant 200 coconut trees, and each serf, 100. The program sought to provide food for the Filipino and Spanish soldiers engaged in the galleon trade and also for providing coir for rigging the Spanish galleons.

In 1906 the first modern coconut mill was established in Manila. By 1911, about 210,000 hectares were already planted to some 42 million coconut trees.

The First World War directly stimulated the industry's growth since coconut products were needed in the manufacture of explosives.

By 1969, the number of coconut trees totalled 264 million, increasing further to 388 million in 1978. Of this total 42% was in Mindanao, 31% in Luzon and 27% in the Visayas.

The Philippines harvested 11 billion nuts from its 2.8 million hectares of coconut farms in 1978. In the same year, it supplied 84% of the world's total requirements for coconut products.

At present the total area planted to coconut represents about 23% of the country's total agricultural land. This constitutes about one-fourth of the world's coconut hectarage.

As members of the research and development community, you are well aware of these historical as well as statistical data on the coconut industry. But I took this occasion to bring them to the limelight primarily to drive home the point that, considering the vast potential that the coconut industry offers, care and attention should be given to a balanced and full development of the various segments of the coconut industry.

Of course, there are reasons to justify the pouring in of so much resources for the development of some aspects of the industry, particularly coconut oil, copra, copra meal and desiccated coconut. At the forefront of those reasons is the need to generate enough foreign exchange badly needed by the country to bolster its national economy as a whole. Moreover, the technologies already generated in these particular aspects are more advanced than those of the rest.

But recent developments in the international coconut business now underline the urgency of accelerating the development of the other components of the industry. And, fortunately enough, we have, through science and technology, already acquired an initial critical mass of the necessary skills to do so.

The main issue covered by this workshop — which is coconut water and sap utilization — is a case in point.

Anyone who has gone over the topics tackled by this conference will be more than convinced that it is but a matter of time before coconut water and sap products as well as by-products will hopefully become a substantial source of income of the people in coconut-producing areas in the country. But to realize this goal at the soonest time possible, viable mechanisms on how to transfer already available technologies to the intended beneficiaries should be devised. We are all too aware that research results are meaningless if these are not made use of by the very people for whom the scientific endeavor has been intended.

We have, indeed, come to a point wherein the potential of coconut water and sap as income-generating resources for our rural people need not be over-emphasized.

Among the various brilliant ideas that have surfaced in todays's discussions, the following general observations deserve careful attention and emphasis:

1) In the operations of a desiccated coconut factory and even in copra processing, coconut water may be considered a processing waste and may even cause serious problems if not disposed of properly.

2) Coconut sap can be considered only if the *trade-off* shows a *clear advantage* toward product diversification.

3) We must continue to exploit the use of coconut water and coconut sap for *food uses*.

4) Both coconut water and coconut sap are renewable substrates which are produced in adequate volumes to serve as carbon sources for the production of fuels, drugs, and chemicals using efficient biotechnological processes.

5) There is a need for more realistic studies on the social, economic, and business viabilities of current as well as potential technologies vis-a-vis coconut water and sap utilization in the coconut industry.

6) Current available R&D resources dictate that we should concentrate in low-volume/high-value products in order to reduce capital costs.

These and similarly encouraging developments indicate that some viable technologies in coconut water and sap utilization are indeed available and may very well be ready for piloting by industry entrepreneurs. The state-of-the-art of this component of the coconut industry has been shaped and brought about by pragmatic and down-to-earth scientists and researchers like you who have been dedicating their talent toward the development of the coconut industry.

May I also take this opportunity to commend our scientists and researchers who have been burning the midnight candle to record the strides of the coconut research sector.

The past few years saw the publication of important books, bulletins, research reports, dissertations and reference materials about the coconut industry.

Only last year, two among you — Dr. Julian Banzon and Dr. Jose Velasco — came out with a book, *Coconut Production and Utilization* with the financial support of PCRDF. The book has been described as a "valuable reference material for scientists, researchers, students and policy makers not only in the Philippines but also in other developing countries where coconut has the potential to be a major crop." Extensive and exhaustive in its coverage, the book, I am certain, will become — if it has not yet become — one of the "Bibles" of the coconut industry in our country.

At this juncture, may I stress that the development of the country's capability in agriculture and resources research, including that in coconut, can be attributed to the government's having mustered the necessary political will to backstop efforts aimed at welding research into a potent instrument for national development.

You have played a key role in this regard and it gladdens me no end that you have continued to devote your time and talent toward the growth of our agricultural economy. And, encouragingly enough, the government leadership has been trying its best to match your dedication with whatever available support it could muster.

In behalf, therefore, of PCRDF and PCARRD (the co-sponsors of this workshop) may I say that this meeting of minds in the coconut R&D sector has more than served the purpose for which it has been convened. But this action certainly deserves sustained interest and meaningful follow-ups. I am quite confident that the significant strides in coconut research and development options projected by this meeting will generate appropriate national programs intended to further develop coconut-producing communities across the length and breadth of our country. We look forward to the not too distant future when the results of your endeavors will make our rural people realize meaningful increases in income from farming the coconut.

Thank you.

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Alcoholic Beverages from Coconut Sap[1/]

William L. Fernandez[2/]

I know of three alcoholic beverages prepared from coconut sap: namely, **tuba** (coconut sap to which is added powdered tanbark of *Ceriops tagal (Perr).* C. B. Robinson), **bahalina** (an aged **tuba**), and **lambanog** (an alcohol distillate from fermented coconut sap). The **tuba** and **lambanog** industry involves a rural-based food fermentation process.

Coconut sap is obtained from unopened spadix or inflorescence of the coconut palm (**Cocos nucifera** Linn.). The spadix is gradually bent downward and later cut open at the distal end. The cut is kept open by daily morning and afternoon trimming to encourage continuous flow of the sap. The number of spadices on any one palm seldom exceeds three. Each spadix will produce sap for about 2 months. Ten spadices are produced yearly.

The sap yield varies from day to day, season to season, palm to palm and spadix to spadix. The highest yield occurs in August and the lowest in April. The average sap yield per spadix was 49.5 liters (l) with a range of 17 to 68.8 l for tall palm, and 8.5 l with a range of 0.01 to 15.4 l for the dwarf type. A single tall palm could be expected to produce a daily yield of about 0.9 l of sap. An annual yield for tall palm was reported at 370.5 and 400 l in Iloilo and Quezon, respectively.

The sap gatherer can handle daily 30-40 palms in tuba collection or 100 palms in **lambanog** sap collection.

The freshly exuded sap (unfermented) is sweet, oyster white and translucent. Its pH ranges from 6.2 to 7.2 and averages 6.7. Its chemical analyses are shown in Tables 1 to 3. The nutrients it contains are readily utilized by different microorganisms.

The theoretical yield of ethyl alcohol from the sugars in the sap is computed first by converting its sucrose content to reducing sugars by multiplying with the factor 1.0526. The total reducing sugars are then multiplied by 0.511, the conversion factor of reducing sugars to ethyl alcohol by weight. The alcohol by weight is changed to volume by dividing it with the factor 0.79389, the specific gravity of ethyl alcohol. With the total sugars in Table 1, the theoretical yield of ethyl alcohol will be 11.4% volume.

On Tuba (Coconut Wine)

Tuba is coconut palm wine. The addition of a pinch of powdered tanbark of *Ceriops tagal* (Perr.) C.B. Robinson (locally called **tungog** in Visayan) to the sap results in a product that is colored terra cotta to feuville morte and is astringent in taste. The tuba, collected once a day and sieved through **guinit**, is drank without further treatment.

The % efficiency of alcohol conversion ranged from 48.2 to 88.6 with an average of 66.7 (Table 4). This low average % efficiency is due mainly to different microorganisms. It is possible to raise the average from 66.7 to 88.6 as one sample had shown in Table 4.

The average microbial plate counts of freshly gathered **tuba** are shown in Table 5. The total counts were made on tryptone glucose yeast extract agar (TGYA). Yeasts were present in greater number as shown in tryptone glucose yeast extract rose bengal streptomycin agar (TGYRBSA) than bacteria grown in tryptone glucose yeast extract bromcresol green actidione agar (TGYBGAA). No fungi were observed.

The yeasts in tuba were identified as: *Saccharomyces cerevisiae* making up 22.7 to 46.9%, *S. chevalieri*, 53.1 to 71.2%, and an unknown, 3.1 to 6.1%. A taxonomic study on yeasts identified 39 genera and 349 species.

The acetic acid bacteria were identified as *Acetobacter aceti* subsp. *xylinum* *A. peroxydans* and *Gluconobacter oxydans* (the predominating species).

Among the lactic acid bacteria present in **tuba** and **lambanog** sap were: *Lactobacillus hilgardii* (the predominating species), *L. fermentum* and *Leuconostoc mesenteroides*.

No bacterial isolates from **tuba** and **lambanog** sap produced more than 1.59% alcohol by weight or 2.52% by volume

1/ Read in the Miniworkshop on Coconut Water and Sap Utilization sponsored by PCDRF and PCARRD on September 20, 1983, in Makati, Metro Manila.

2/ PCRDF Professor of Microbiology and Chairman, Department of Life Sciences, College of Arts and Sciences, University of the Philippines at Los Baños, College, Laguna, 3720, Philippines.

- 6060'

in 72 hr fermentation.

With these different kinds of yeasts and bacteria in tuba in varying proportions, the fermentation products will also vary and so a standardized tuba could not be expected if left alone to Nature. In addition to the variable alcohol yield, analysis of the freshly gathered tuba showed a mg/100 ml basis:

total titratable acidity of	257
volatile acidity (as acetic) of	21
lactic acid of	1600
tartaric acid of	189
laevo-malic acid of	178
citric acid (anhydrous), and	16
glycerol of	903

Where do these microorganisms come from? Initially and continuously, they come into the sahod (receptacle for collecting the sap) by wind, rain, insects, tungog and the tuba gatherer; and the residual build-up of microorganisms in the sahod used continuously.

One can really imagine the large number of microorganisms that will come in contact, with the dripping sap and cause the sap to ferment rapidly, whether it be alcoholic, acetic or lactic fermentation.

These high counts from the sahod (Table 6) served as inocula to the freshly exuded sap, and the collection of the sap is on a 24 hr basis.

Powdered tanbark or tungog.

The powdered tanbark of *Ceriops* turns the oyster white and translucent sap reddish brown or brownish pink, adds its astringent taste characteristic of tuba, and increases the fermentation rate and alcohol yield. An analogous practice in beer making is the use of hops.

Fungi were present in tungog but none was recovered from tuba and sahod.

The addition of *Ceriops tagal* and *Rhizophora mucronata* Lam. at 0.5 to 3.0% to coconut sap increased the fermentation rate and alcohol yield over that without tungog in 24 and 48 hr fermentation. *Rhizophora* serves as a substitute for *Ceriops*. The tanbark contains polyphenols or tannins which inhibit bacteria but not the yeasts.

Tannic acid at 0.01 to 0.05% yielded the largest amount of alcohol but at 0.5% decreased alcohol yield.

Coir dust was tried as a source of tannin. The 0.5% coir dust appeared to be optimal. The problem with dry coir dust was that it absorbed the sap, thus, reducing the volume of tuba.

Oenologists recommend the addition of tannins to inhibit the growth of undesirable yeasts and bacteria. Excessive

Table 1. Chemical analyses of the coconut sap and tabad (Gibbs and Fandialan).

	Coconut sap					Tabad
	Preserved		Freshly gathered		Wash	
	(G)	(F)	(G)	(F)	(F)	(F)
Samples analyzed	–	33	–	33	24	24
Total solids (% w/w)	17.5	17.9	3.7	8.7	4.4	5.7
Sucrose (% w/w)	16.5	16.6	0.3	0.6	0	0
Reducing sugars (% w/w)	trace	0.3	2.0	5.7	1.2	1.4
Nitrogen-free extract other than sugar (% w/w)	–	0.5	–	1.9	2.7	3.6
Crude protein (% w/w)	0.6	0.2	–	0.2	0.2	0.3
Ash (% w/w)	0.4	0.3	0.4	0.3	0.3	0.4
Fat	–	0	–	0	0	0
pH	–	6.4	–	3.6	3.4	3.4
Titratable acidity (% w/w)	trace	0.09	0.7	0.88	1.4	1.7
Specific gravity	1.070	1.070	1.010	1.019	0.996	1.019
Alcohol (% w/w)	–	0	6.0	5.2	6.8	0.4

Table 2. Amino acids content (grams/100 g) of freshly gathered coconut sap and tuba as compared with sake (Kozaki).

Amino acids	Sap	Tuba	Sake
Tryptophan	1.27	–	0.00
Lysine	0.30	0.12	0.01
Histidine	1.19	–	0.01
Arginine	0.35	–	0.02
Aspartic acid	11.22	0.05	0.02
Threonine	15.36	0.05	0.01
Serine	8.24	0.04	0.01
Glutamic acid	34.20	0.57	0.03
Proline	3.52	trace	0.01
Glycine	0.47	0.04	0.01
Alanine	2.56	0.24	0.02
Cystine	–	–	0.00
Valine	2.11	trace	0.01
Methionine	trace	trace	0.00
Isoleucine	0.38	trace	0.01
Leucine	0.48	trace	0.01
Tyrosine	0.31	–	0.02
Phenylalanine	0.78	–	0.01

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tannin concentrations, however, are inhibitory to desirable yeasts.

Tuba is a wine that is not aged before consumption. Regular **tuba** drinkers prefer the **bahal**, which is at least a day old **tuba**. The **bahal** does not have the sweetish tinge present in freshly gathered **tuba**. Their preference is justified by the fact that the highest alcohol content occurs in a one day old **tuba** or **bahal**.

In a one week storage study on **tuba**, the average alcohol content increased in one day storage at 27°C and ambient room temperature and in three days storage at 17°C and 37°C; and decreased thereafter. **Bahal**, therefore, has a higher alcohol content than the freshly gathered **tuba**.

Table 3. Vitamin content of freshly gathered coconut sap and tuba (Kozaki).

Vitamin	Sap ug/dl	Tuba ug/dl
Thiamine	77.0	23.3
Riboflavin	12.2	28.5
Pyridoxine	38.4	8.9
Pyridoxal	38.4	8.9
Pantothenic acid	5.2	47.0
Nicotinic acid	40.6	248.0
P A B A	47.1	134.8
Biotin	0.17	0.16
Folic Acid	0.24	0.65
Inositol	127.7*	5.6
Choline	9.0	0.93
Vitamin B_{12}	trace	trace

On Bahalina (Coconut Wine)

Bahalina is aged coconut wine. The freshly gathered **tuba** is allowed to stand for one day. The **tuba** is siphoned to another container (preferably glass) leaving behind the sediment. The container is filled to the top and stopped tightly. Two days later, the **tuba** is again siphoned to a clean, clear glass container, leaving behind the sediment. This procedure of transfer of two days interval is done four times. Precaution should be taken that the container is filled to the top and stoppered tightly.

When the **tuba** appears to be very clear, it is again transferred to another container and buried in the ground. The duration of storage may last from seven weeks to one year. The longer the storage the better is the quality of the **Bahalina**. Because of the demand for **bahalina**, the storage of **bahalina** is shortened to one week.

On Lambanog (Coconut Brandy)

The problems on **lambanog** are more on the sap collection and fermentation than on distillation. With the simple distillation used by the **lambanog** distiller, the slop waste showed:

	% alcohol by volume	
	range	average
1. in 24 samples	0.3-0.5	0.4
2. in 31 samples	0.3-0.9	0.6

The % efficiency of alcohol conversion in **lambanog** sap ranged from 37.7–77.2 with 49.1 average. This is much lower than **tuba** which showed a range of 48.2–88.6 and an average of 66.7% (Table 4).

Microbial plate counts of freshly gathered **lambanog** sap were relatively lower in total counts than **tuba** (Table 5).

The microorganisms involved in the fermentation were yeasts and bacteria. Sap from three localities differed in yeast ecology. The yeast flora in freshly gathered sap were:

	Range %	Total
Saccaharomyces cerevisiae	20.0–34.2	29.5
S. chevalieri	21.8–46.5	37.9
S. rosei	0 – 8.1	2.0
S. capensis	0 –13.6	6.4
Candida diddensi	0 –12.7	4.9
C. langeronii	1.6–12.7	5.6
C. mogi	0 – 8.2	2.6
C. rhagii	2.2–16.4	6.3
Torulopsis colliculosa	1.1– 6.4	3.3
Unknown	1.0– 1.8	1.5

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Table 4. The pH and alcohol content by volume of freshly gathered tuba and lambanog sap.

On Tuba

Thesis Advises	Year Completed	Number of samples	pH range	pH ave.	Alcohol content % by volume range	Alcohol content % by volume ave.
4	1974	4	4.6-4.8	4.7	6.6-8.0	7.3
2	1975	10	4.0-5.0	4.6	5.5-10.1	7.6
2	1976	10	4.4-5.0	4.6	5.8-9.3	7.8
1	1982	1		3.5		7.1
					Ave of 25 samples	7.6

%Efficiency of alcohol conversion: range, 48.2-88.6; ave. 66-7

On Lambanog Sap

4	1974	4	3.6-3.8	3.8	7.3-8.8	7.9
2	1975	10	3.0-5.0	4.1	5.4-6.7	6.0
2	1976	10	3.6-4.0	3.8	4.3-6.6	5.7
1	1978	33	3.5-3.7	3.6	4.4-6.1	5.2
1	1982		1		3.5	6.8
					Ave of 58 samples	5.6

%Efficiency of alcohol conversion: range, 37.7-77.2; ave. 49.1

The bacteria were the same as in **tuba**. They do not produce alcohol higher than 2.5% by volume.

In addition to the alcohol, the freshly gathered **lambanog** sap showed 4.5 times titratable acidity, 3.1 times volatile acidity, 13 times lactic acid and 2.8 times tartatic acid than that of **tuba**.

The sources of microorganisms in **lambanog** sap are the same as in **tuba** except for **tungog**, which is not added to the former. The residual inocula of microorganisms in the former are much higher than the latter (Table 6).

The **tuba sahod** is cleaned with a bamboo brush after pouring out the **tuba**. In **lambanog** sap collection, the sap in the **sahod** is then returned to the spadix. This allows more microorganisms to remain in the latter **sahod**. The sediment in the former **sahod** ranged from 0.01 to 0.055 g/ml of rinse water and in the latter **sahod**, 0.22 to 0.25 g/ml.

The pH of the rinse water from **tuba sahod** ranged from 4.5 to 4.8 and in sap **sahod**, 3.5 to 4.1. The lower pH in the latter does not favor desirable yeast growth.

In a one week storage study on **Lambanog** sap, the average alcohol content at 17°C, 27°C, 37°C and ambient room temperature (ART) increased on the first day of storage and decreased rapidly at 27°C and ART but gradually at 17°C and 37°C. In one sample stored at 27°C, no alcohol was recovered on the seventh day storage.

Table 5. Average microbial plate counts of freshly gathered tuba and lambanog sap grown on TGYA (tryptone glucose yeast extract agar), TGYRBSA (tryptone glucose yeast extract rose bengal streptomycin agar), and TGYBGAA (tryptone glucose yeast extract bromcresol green actidione agar).

On Tuba (X 10^3 per ml)

Culture Media

Trial	TGYA	TGYRBSA	TGYBGAA
4	48,290	–	–
10	29,320	15,000	146.76
10	7,094	1,090	162.00

On Lambanog Sap (X 10^3 per ml)

4	2,706	–	–
10	15,951	12,606	75.55
10	2,229	2,631	292.00

Selection of High Alcohol Producing Yeasts

Yeasts were isolated from **tuba** and **lambanog** sap and tested for alcohol production in comparison with known yeast cultures. The inoculum rate was

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one percent and the fermentation time was 50 hr at ambient room temperature (ART). The result showed the following:

In another study using sterilized sap and inoculated with 1% yeasts and fermented for 48 hr at ART, the result was:

Yeasts	% alcohol by volume
Saccharomyces cerevisiae NRRL Y-134	9.77
S. bayanus	9.02
Tuba isolate	8.94
S. cerevisiae (Baker's 2)	8.78
S. sake Kykai N. 7	8.70
S. cerevisiae E	8.60
S. cerevisiae F	8.14
S. cerevisiae (Baker's 1)	7.43
S. cerevisiae C	7.19
S. carlsbergensis	6.33
S. cerevisiae TUA No. 6215	5.66
Schizosaccharomyces pombe	5.10
Saccharomyces fornosensis	1.41

One thing though that has to be mentioned here is that the taste and aroma have not been considered in these studies.

In the testing of bacterial isolates from **tuba** and **lambanog** sap for alcohol production, **Zymomonas mobilis** was included. This bacterium was not found in **tuba** or **lambanog** sap but it produced 6.55% by weight or 8.23% alcohol by volume in sterilized coconut sap in 72 hr fermentation.

A study was conducted wherein new **sahods** inoculated with 50, 100, and 200 ml of yeasts, used **tuba sahods**, and used **lambanog** sap sahods were used in collecting the sap. Ranked from the highest to the lowest alcohol content was the 200 ml inoculum, followed by 100 ml inoculum, 50 ml inoculum, **tuba sahod**, and **lambanog** sap **sahod**.

A set-up was made to imitate the flow of sap from the spadix.

Yeasts	Sterilized sap	Sterilized sap with tungog
Tuba and sap isolates	4.46–7.97	4.71–8.04
S. cerevisiae (Baker's)	7.67	7.12
S. cerevisiae distillery	7.20	7.30
S. cerevisiae Champagne	5.59	4.11
S. carlsbergensis	2.43	6.20
C. utilis BMA	1.89	2.63
C. utilis var thermophila	1.66	0.86
C. utilis	1.50	1.83

Table 6. Average microbial plate count of sahod wherein 100 ml rinse water was used per sahod. No fungi were observed.

Trials	TGYA	TGYRBSA	TGYBGAA	pH
In Tuba sahod (X 10^3 per ml)				
10	6,301	4,329	190	4.75
10	97,320	14,203	340	4.50
In Lambanog sap sahod (X 10^3 per ml)				
10	119,875	86,450	841	4.10
10	65,533	67,400	62,198	3.50

Table 7. Average microbial plate count on tungog. Generally 16 g are added to one liter of tuba.

Trials	TGYA	TGYRBSA	TGYBGAA
On tungog (X 10^3 per gram)			
9	20	10	8
10	1513	828	137
10	589	102	46

The Business of the Lambanog Industry

Labor constituted the bigge tem of expense, 69.77% of the total operating expenses. Tapping accounted for 81.16% of the labor expenses or 56.62% of the total operating expenses. Distillation was tagged at 11.29% of the labor expenses or 7.88% of the total operating expenses.

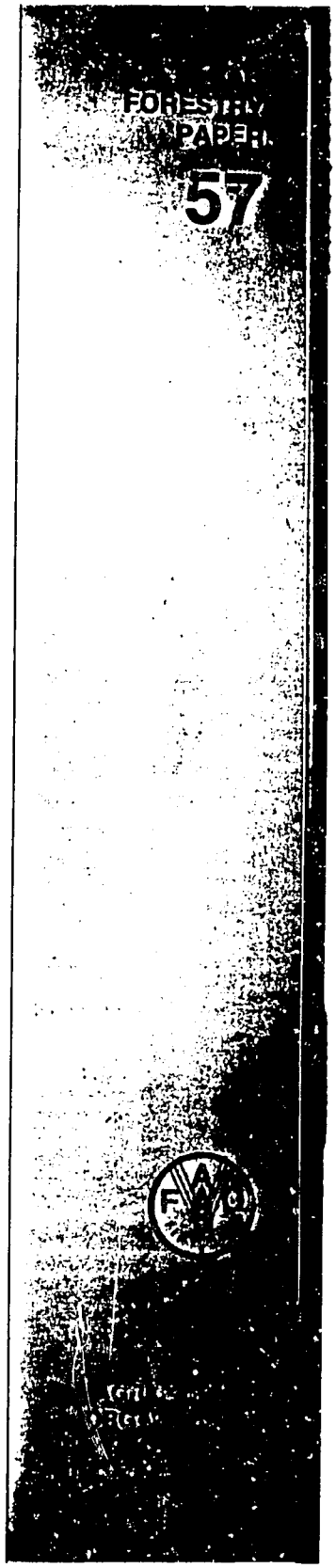
Supplies and materials cost 13.94% of the total expenses. Bamboo constituted 99.86%. Rental on coconut palm was 5.47% of total expenses (1979).

A study was made on the "Bottling and Marketing of **Lambanog** (Coconut Brandy)" in 1979.

Wennin Jorman

Coconut wood

Processing and use



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COCONUT WOOD

Processing and Use

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Processing and Use

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COCONUT WOOD

Processing and Use

INTRODUCTION

Coconut Wood - Processing and Use is an introduction to methods currently in use for the utilization of coconut stems for wood products and fuel.

The stems of the coconut trees become available for use when the tree ceases to yield coconuts as a result of old age, disease or hurricane damage.

Coconut Wood - Processing and Use has been produced for the information of those interested in the development of processing industries.

The information contained in this book represents the most recent findings of institutions and individuals researching the fuller use of superfluous coconut stems.

The economics and management of coconut wood industries, and the organized marketing of their products, will need increasing attention as the industries expand.

Sources of Information for Coconut Wood - Processing and Use were:

Mr. V. K. Sulc, Mr. Rodrigo Juson and colleagues, Zamboanga Research Centre, Philippines; Mr. R. N. Palomar and Mr. A. Mosteiro, Forpride, Philippines; Dr. A. McQuire and J. Kinninmonth, Forest Research Institute, New Zealand; Messrs. R. Ford, J. Turner, and J. Vaney, New Zealand Forest Service, Rotorua; Mr. N. Evans, Fe'ofa'aki Enterprises, Tonga; Mr. R. Evans and Mr. A. Afeaki, Cocostem Development Co. Ltd., New Zealand and Tonga; and Mr. K. Bergseng, Timber Training Centre, Rotorua.

Other individuals were consulted and assessments were made of a number of coconut stem processing operations in selecting material to be included.

Documents from which material has been drawn are cited in the bibliography.

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The editors

Anthony Haas
Len Wilson

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Chapter 1

The Coconut Tree

The coconut palm, *Cocos nucifera L.*, is one of the most important crops of the tropics.

It occurs in all tropical and most subtropical regions, most abundantly in Asia and the Pacific, thriving best on low-lying sites close to the sea with ground water and ample rainfall.

Nuts are produced from when trees are aged five, with highest production achieved between 15 and 50 years. Productivity declines steadily thereafter until at 60 to 70 years the tree is considered to be senile.

It is then, or when hurricanes or disease strike, that the mature coconut trees are suited for conversion to coconut wood.

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Properties, Availability and Utilization

The coconut palm, *Cocos nucifera L.*, is one of the most important crops of the tropics. It occurs in all tropical and most subtropical regions, most abundantly in Asia and the Pacific, thriving best on low-lying sites close to the sea with ground water and ample rainfall. Nuts are produced from when trees are aged five, with highest production achieved between 15 and 50 years. Productivity declines steadily thereafter until at 60 to 70 years the tree is considered to be senile.

Few plants are as versatile as the coconut. The most important product is the flesh of the nut (the solid endosperm) which, dried as copra, is the source of coconut oil used in the manufacture of soaps and detergents, edible oils and fats, oilcake, plasticisers and other industrial products. Worldwide copra production amounted to over 4.9 million metric tons in 1982, and in the same year trade in coconut oil was 1.27 million metric tons with a value of about $US657 million.

Local uses of coconut palm products are many: coir, from the husk of the nut, is a fibre used in the manufacture of mats, ropes, brushes and baskets; the hard endocarp provides charcoal; coconut milk (the liquid endosperm) is used in cooking and as a beverage; sap, obtained by tapping the inflorescence of the palm, is a source of sugar, alcohol and vinegar; the leaves provide thatch and material for basket weaving; the stem is used for house construction and increasingly for other purposes to be described in the succeeding chapters.

1A The Tree of Life

The Copra Industry

The origins of the industry may be traced back to 1841 when a patent was issued for the manufacture of soap from coconut oil. During the subsequent decades copra was harvested, mainly from trees growing wild, by traders supplying the large soap-making firms. Later, in the early 1900s, demand for coconut oil for butter substitutes stimulated the establishment of plantations.

In view of the favourable investment climate at the time, much of the planting was on large estates, especially in the Philippines, but in addition many small farmers planted the coconut as a cash crop which remains to this day an important part of the economies of some island countries.

After 1918 other crops, particularly rubber, appeared to offer better opportunities for investment and large-scale coconut planting diminished, then virtually ceased with the economic depression of the 1930s.

The vast stock of trees created during the planting boom continued to produce in abundance, but wild fluctuations in the price of copra, as well as the growing acceptability of alternative vegetable oils, led to a decline in the industry with a consequent strain on those economies dependent upon it.[1]

The main stock of productive trees was therefore ageing until, at 60 to 70 years old, productivity began to fall steeply. In countries where trade and subsistence farming remained dependent on the coconut the need for replanting became evident and programmes were drawn up accordingly. It thus happened that, for the first time in the history of the copra industry, plantation owners were faced with the problem of cutting, extracting and disposing of overmature trees.

Not only did this involve a reversal of the traditional conservationist attitude to coconuts, but it also required the development of economic means of disposal or utilization. Stems could not be left to rot as the decaying wood provides a breeding ground for

1B Coconuts

the rhinoceros beetle *(Orystes rhinoceros)*, a pest which attacks the core of the stem, the crown and young nuts; while burning or tipping into the sea would have proved expensive and wasteful.[7] For countries with a sustained internal market for timber - especially those relying on imports - the conversion and use of coconut stems offered an attractive economic prospect and industries were developed accordingly.

The development of viable coconut wood industries required in the first place two lines of investigation: the structure and composition of the raw material, with techniques of conversion appropriate to these; and the location and availability of overmature, diseased and dead stems.

1C The Young Tongan

Effect of Stem Anatomy and Structure on Utilization

The properties and peculiarities of the coconut stem were summarised at the Zamboanga (Philippines) Coconut Wood Seminar in 1979. The following notes are derived from the proceedings of that Seminar[8]:

> Because coconut palms have no vascular cambium (lateral growing tissue) they do not increase in diameter with age. It is uncommon to find a stem over about 30 cm in diameter. Minor variations in diameter from one stem to another, or between different locations, are a reflection of the growing conditions for the individual stem during the early stages of its life. Taper is very slight (about 5 mm) and mature stem heights of tall varieties are of the order of 20m thus giving maximum wood volume per stem of about 1 m^3.
>
> To obtain optimum growth and nut production the crowns and roots must have ample space. This limits the stem density in a plantation to about 100 per hectare. Thus the wood volume in a mature or overmature plantation is about 100 m^3/ha. Stems are often curved. This limits the length of sawlog that can be prepared. Although in some favourable locations (e.g. Zamboanga) longer logs are possible, in general a log of length of about four metres is the maximum practicable. The largest sawlog will therefore not exceed about 300 kg in weight which is low compared with sawlogs from mature trees of most forest species.
>
> Most hardwoods and softwoods exhibit density gradients from the centre of the stem towards the outside and from the bottom of the trunk towards the top. This is because the later-formed wood in any cross-section is usually slower growing and is composed of cells with thicker walls. With coconut stems the gradients are much more pronounced, but for different reasons. Palm stem wood consists of a number of scattered vascular bundles (each having vessels for water conduction, phloem for elaborated food conduction, and fibres for mechanical support) set in a matrix of more or less spherical parenchyma cells. The vascular bundles are much more abundant towards the outside of the stem. A typical stem at one

1D The Young Tongan Drinks from the Coconut

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1E Copra Cutting, a Traditional Source of Income

metre height would have about ten bundles/cm² in the central portion and about 50 bundles/cm² near the outside.[11]

In a young stem the cell walls are relatively thin and the basic density of wood in these two zones could be about 90 and 300 kg/m³ respectively. These wood cells are not dead as in normal forest trees, however, and the walls continue to increase in thickness so that by the time the palm is mature the density in these same two regions can be as high as 250 and 900 kg/m³.[29]

All tissues in the basal regions of old palms (including the ground parenchyma cells) have thicker walls. Higher up the trunk the bundles are more abundant and up to 175 bundles/cm² have been found near the outside of an overmature stem at a height of 19.5 metres. The cells in these zones never develop thick walls, however, and the basic density in this zone was only 250kg/m³.[11] In the central region of this stem (at 19.5 metres) the bundle frequency was 68/cm². The basic density varies from stem to stem but in general the distribution of density is of the order shown in Figure 1.1.

Strength and density are very closely related[11] so the density distribution governs the sawing pattern that must be chosen if high-strength timber is to be produced. Because logs are small in diameter, and the high-density zone is fairly narrow, it follows that only a few relatively small-dimension pieces of top strength can be produced from a stem.

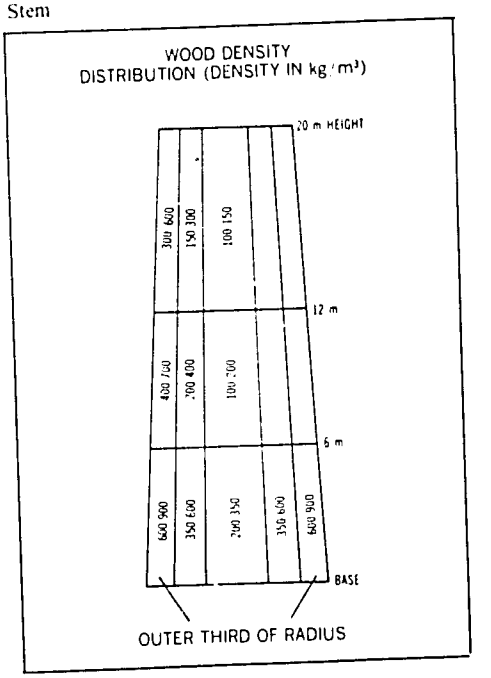
In Zamboanga the diameter average at breast height is approximately 32.5 cm - the maximum recorded is 43.6 cm.

Up to the six metre mark the high-density zone (outer one-third radius) accounts for about 20 per cent of the total stem volume but by the time allowances are made for saw kerf and other wastage, the net recoverable very high density wood falls to below ten per cent of the total. The maximum size of member that can be cut from this high density zone is 100 × 50mm. Although the quantity of this material per stem is low, the quality is uniformly high. As the palm has no branches there are no branch remains (knots) in the wood. Consequently no piece is weakened by the presence of natural defects.

Sawing

The actual operation of sawing coconut is difficult and standard steel saws will become blunted and unusable after relatively few cuts. Two factors probably contribute to this: firstly, the thick-walled fibres are extremely hard; and, secondly, the parenchyma tissues disintegrate into a fine abrasive powder which is not easily removed from the cut and which causes frictional heat increase. As the wood dries and the cell wall material becomes harder, these problems are intensified. The silical content of coconut wood is low so this is not a contributing factor as in some difficult-to-saw-hardwoods. The use of tungsten carbide tips (or Stellite-tipped or inlaid-teeth) has overcome basic sawing problems but has increased problems of saw maintenance. More costly equipment and greater operator skill are required.

Figure 1.1 Diagrammatic Section through a Coconut Stem



Seasoning

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Seasoning

Conventional timbers have a distinct grain pattern caused by periodic radial growth. Even in species which do not show distinct growth rings the wood has different properties in the radial and the tangential directions. One of the most important of these properties is shrinkage when the wood dries from fibre saturation (about 30 per cent moisture content) to equilibrium moisture content. Shrinkage in the tangential direction is approximately double that in the radial direction so unless the wood is truly flat or quarter-sawn some distortion of shape is inevitable on drying.

With coconut wood there is no such grain differentiation so material will dry uniformly and without cross-sectional distortion. Lateral shrinkage in any direction is less than three per cent when drying from green to 12 per cent moisture content.

With low density coconut wood, shrinkage is accentuated by collapse, which is not recoverable by subsequent reconditioning with high temperature steam. There is a sharp increase in this tendency to collapse as the basic density of material decreases below about 350 kg m^{-3}. Collapse is severe. Uses for this type of material are very limited. The volume of such unusable wood is approximately 15 per cent of the stem total.

1F Coconut Logs, Dense on the Outside, Soft Inside

Natural durability and wood preservation

The coconut palm does not form heartwood as most forest trees do. This affects its utilization in several ways. The wood is uniformly wet and approaches saturation throughout the whole trunk; variations in moisture content are dependent on variations in density and therefore the space available for water. The main consequence of having no heartwood is that the wood of the coconut stem has no natural resistance to attack by wood-boring insects and decay fungi. Freshly cut wood is very susceptible to infection by mould and stain fungi and also to attack by ambrosia beetles. Hence it is essential to dip timber in a prophylactic chemical solution immediately after sawing if a clean product is required. No part of the trunk is resistant to fungal decay but higher density material will take longer to rot completely, simply because the thick-walled cells retain some strength for a longer period. Low density wood will decay in the ground within weeks whereas very high density wood may last for two to three years.

Pressure treatment trials indicate that the wood can be treated with preservatives such as copper-chrome-arsenate. But the distribution of preservative is not as uniform as in pine sapwood where the rays are an important pathway of penetration, or in permeable hardwoods where vessels are more continuous and free of obstruction.

Transmission poles

The stems have strength properties which make them ideal for use as transmission poles. But it is difficult to dry them in a manner that will result in the preservative being concentrated in the high-strength outer zones, and without degrading.

Coconut wood is known to be more susceptible to soft-rot decay than is pine timber. So coconut wood will certainly require higher preservative loadings, but just how much more will be required to guarantee an economic service life is yet to be determined.

In the preparation of poles or posts it is first necessary to remove the bark so that the underlying wood will dry out. With most pole species this debarking operation is relatively simple, and effective machines have been developed for the purpose. With coconut stems, however, there is a gradual transition from wood to bark. The debarking region is indefinite and very fibrous. Debarking by machine is not yet possible. At present debarking must be done by hand using simple tools such as draw-knives or bush-knives. Treatment of poles by sap displacement is an alternative to normal pressure treatment but the deeply fissured nature of the bark makes it difficult to obtain an effective pressure seal on the log. Furthermore the sap-conducting elements (vessels within the vascular bundles) occupy only about four to five per cent of the total tissue volume compared with 30 to 40 per cent for the vessels in most hardwoods and 90 per cent plus for the tracheids in softwoods.

Pulp and paper

Trials in the Philippines and in New Zealand have shown that coconut stem wood can be used for making pulp and paper with qualities similar to those made from most hardwoods, although the high proportion of fines (from parenchyma tissue) greatly reduces overall yields. These small parenchyma cells also cause problems in the manufacture of particle board.

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Wood fuel

The calorific value of coconut wood (heat energy released on burning, per unit weight of dry wood) is similar to other woods. But some predrying is necessary before coconut wood will burn easily. To achieve the necessary drying, the stem must be cross-cut into short lengths and then split, using suitable equipment and techniques to overcome the lack of planes of weakness in the radial direction.

1G Firewood from Coconut Logs

Summary

The coconut palm stem has a number of features that make it unique as a wood source material.

Early attempts at utilization were somewhat disheartening because results did not compare well with conventional wood from either hardwoods or soft woods. Many of the problems, however, were the result of trying to apply technology developed for one material to another that was quite different.

The development of equipment and technology specific to coconut wood has overcome many of these problems.

There is no doubt that the future will see the coconut stem being used as a conventional wood alternative in a number of applications, and in many instances doing the job equally well or even better.

Availability of the Resource

A prerequisite for the establishment of a coconut wood industry is an adequate supply of overmature or otherwise disposable stems of known volume. Estimates of the availability of raw material must be made with precision if industrial investment is contemplated.

A preliminary assessment may be made by a visual inspection of a plantation. The age of a palm can be calculated by counting the scars on the surface of the stem, while the volume of the stem is derived in the usual manner from height and diameter. A mature palm grown in the tropics will yield about one cubic metre of wood from which some 40 per cent recovery of dense and medium grades of sawnwood may be expected. In Zamboanga an average stem volume of 1.158 m^3 with stocking of not more than 115 stems per hectare is recorded.

Given these assumptions of maturity and yield, the potential volume of industrial wood follows from a tree count - typically 100 stems per hectare.

Resource assessment by estimation - South Pacific

Prior to the Coconut Stem Utilisation Seminar held in Tonga in 1976, all South Pacific countries attending were requested to complete a questionnaire on the extent and productivity of their coconut resources.[1] In spite of some differences in the methods of assessment and reliability of the data on which they were based, the results indicated a trend which may be significant for management policy in the future. The responses to the questionnaire showed the status of the coconut resource in the South Pacific to be as follows:

Total land area	547,989 km^2
Area under coconuts	460,000 ha
Percentage of resource considered overmature	31
Percentage of resource considered immature	23
Percentage of resource considered productive	46

Less than half the resource was considered productive in 1976, and it is possible that the rate at which this part becomes overmature will exceed the rate of replacement by immature stock. If that were the case, as much as two-thirds of the area would be available for logging and replanting. A subsequent study[1] assumed that the area of the resource available for logging in the South Pacific over the next 50 years would be of the order of 350,000 ha, and that at a felling rate of 7,000 ha per annum an annual yield of roundwood of approximately 1 million m^3 would be available (based on a high estimate of 125 trees per ha and 1.25 m^3 per tree).

On the same assumptions, it was calculated that in the Philippines 4.06 million m^3 per annum would be available from 1.6 million ha of plantations over the next fifty years.[1]

Resource assessment by survey - Tonga

In 1981, the Kingdom of Tonga completed surveys on coconut palm population, age ranges and productivity, as a result of which quantitative information was obtained on the size and distribution of the resource of overmature stems. On this basis the Government announced in 1982 a policy for controlled utilization of the resource, together with the rules

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to regulate the embryonic sawmilling industry to ensure its viability along with that of the copra industry.'[4]

The effect was to permit the annual felling of 1.6 per cent of the total coconut palm population, with the completion of a stem utilization and replanting cycle every sixty-two years.

Resource assessment by inventory - Fiji

The usual preliminary to investment in a wood-based industry is an inventory of the source of raw material. In 1977, the Japan International Co-operation Agency undertook an inventory of coconut stems on the island of Taveuni.[5]

Aerial photography of the island was completed at a scale of 1:10,000, followed by a stratified random sample to obtain information on the number and volume of stems. Detailed photo interpretation with ground control then provided details of individual plantations including areas, number of stems per hectare, average height and total volume. Stem volume tables were prepared. Individual plantation statistics were recorded on a 1:10,000 map and overall distribution of the resource was shown on a 1:50,000 coconut location map. Reliable and detailed information of this type is needed by Governments in the preparation of plantation management plans, and by sawmillers for industrial feasibility studies.

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Chapter 2

The Uses of Coconut Wood

The denser grades of coconut wood can be used as structural material while the lower grades are suitable for joinery and interior use. It has proved economic to construct dwelling houses entirely of coconut wood.

The denser material makes attractive furniture and is also widely used for utility items and curios.

The roundwood has excellent strength propertie and is suitable for transmission poles and fence posts provided the problems of preservation treatment can be overcome.

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The Uses of Coconut Wood

As noted in the first chapter, the well maturity of coconut plantations and the need for their replacement by higher-yielding varieties has been the foundation of all recent work on developing the use of coconut wood and of appropriate processing industries.

By the 1960s, coconut producers were expressing alarm at the problems caused by over mature palms diminishing productivity and decay and infestation of dead and dying trees. To these has often been added the destruction caused by hurricanes.

Among the institutions pioneering these studies, special mention is justified of those in the Pacific region. These include the Philippines Forest Products Research and Development Institute; the Philippines Coconut Authority's Zamboanga Research Centre, supported by the United Nations Development Programme and the Food and Agriculture Organization of the United Nations; the Fiji Forest Department, the New Zealand Forest Research Institute and the New Zealand Timber Industry Training Centre.

The range of studies covered are anatomy and wood properties, sawmilling, seasoning, preservation, mechanical properties, engineering design, charcoal manufacture, wood based panels, kraft pulping properties, machining, house construction and utilization for a variety of manufactured products. The U.K. Tropical Products Research Institute investigated the use of coconut wood in particle board manufacture and other processes.

Research and development findings were summarized at two important meetings in Tonga in 1976 and in the Philippines in 1979.[27]

In the meantime, small scale sawmilling industries were set up in parts of the Pacific in an attempt to market the products of the coconut wood becoming available.

By 1983 mills were being operated in Tonga by the Government, by the Catholic Church and by a commercial operator. Growers used the mills to have their own overmature stems milled. They used the sawn timber for their own projects. A commercial operator also negotiated with growers to acquire logs, processed them, and offered the sawn timber for local sale. In the Solomon Islands a commercial operator processed logs and offered the dense grade of sawn timber for export to a New Zealand company for further processing into wall panelling and flooring. In Sri Lanka a semi-government agency acquired fallen stems after a hurricane and processed sawn timber for the local market. In Kiribati a mobile sawmill began operations on an outer island to mill timber which was freighted to the Republic's capital and stockpiled pending a decision on its end use. In another Kiribati outer island a project to mill stems with chainsaws to provide timber for 30 houses was planned. Near to Los Banos in the Philippines a sawmilling project was planned to supply timber for low-cost housing. In Zamboanga, commercial and Government interests tested the use of coconut timber as a component in a low cost housing programme.

By 1983, coconut stem sawmills had operated also in Fiji, Western Samoa, French Polynesia, Vanuatu, Tuvalu, Papua New Guinea, India, Indonesia, the People's Republic of China, and Jamaica.

Some sawmilling projects have experienced difficulties arising from management, technical and economic problems which not unexpectedly had to be faced in a relatively new and widely dispersed industry. Typical of these are inadequate or irregular supplies of raw material, excessive transportation costs, insufficient attention to sawing techniques appropriate to recovery of the better grades of timber, imperfect seasoning and preservation practices, lack of quality control, incorrect assessments of markets and inability to compete with other materials.

Problems of this nature can be overcome as the public and private sectors gain experience in processing, marketing and management. Replanting programmes and incentives will ensure an adequate supply of stems; demand for the wood exists or can be developed especially in communities lacking alternative materials; and enough experience exists of production and utilization technology.

The remainder of this chapter is devoted to examples of the end-uses and products already demonstrated and in several cases marketed.

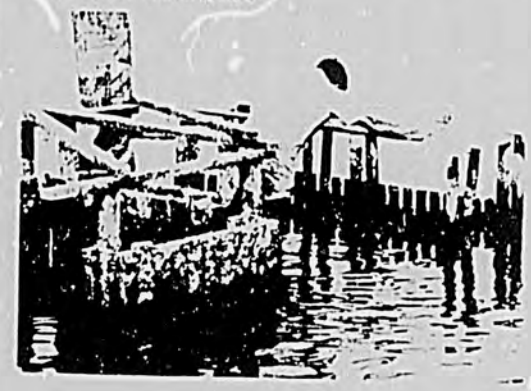
Construction

Experience has shown that almost the entire range of coconut wood can be used in appropriate functions in the construction of buildings, particularly houses.

Structural load bearing components in the house should be made from dense timber grades.

Trusses and internal members are made of medium density material and it has been possible to develop a wide range of advanced designs for the former. In addition to conventional methods of manufacture, nail plates and truss jigs facilitate the accurate prefabrication of trusses. Designs have been prepared covering a range of uses from small thatched roofs, through several house types, to school room buildings. Floors and steps are made of hard material either as machined boards or parquet. The internal linings of the walls of houses may be made of soft wood, which is quite suitable for non-load bearing surfaces, although harder wood is used when a high finish is required.

2A Coconut Wood House



2B Frame of Building

2C Cocowood in Water Contact

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2F Wall

External cladding, also of the softer material, requires preservative treatment to prevent damage by weather, as do the hard wood window frames and any material which is in ground contact.[1]

Because of size limitations, the use of coconut wood in larger building necessitates the adoption of laminated members. This technique has proved to be successful. Some very advanced beams have been made by combining laminated coconut wood sections with plywood webbing.[1]

The hard outer layer, or high and medium density grades of coconut timber have sufficient strength for structural use in buildings.

Solid rounds used as posts placed on top of concrete foundations may be used in house construction and other parts requiring strength and durability.[2] Flooring joists, flooring, ceiling joists, trusses and framing timber can be made from dense coconut timber. The bottom and top studs, horizontal studs, top members and bracing can be made from medium density coconut timber.[2]

Coconut timber framing and flooring should be dried to the local equilibrium moisture content level before fixing.

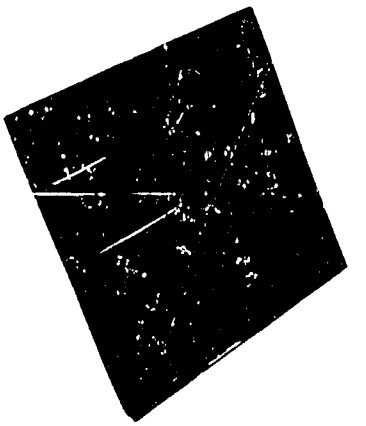
Coconut wood can be used for roofing either as sawn timber or shingles. When rainwater is to be collected for drinking purposes, the roofing material may be treated with a water proof sealant rather than one of the toxic water-borne preservatives.

2D Shingles

2E Feature Wall of Cocowood

2F Wall Cladding

2G Block Flooring



2H Strip Flooring

2I Cocowood Folding Table

Furniture

The harder density coconut wood, which is extremely attractive, can be used in the production of furniture, although its weight imposes some limitations on the size of pieces made entirely of this material. Naturally this problem is easily overcome by utilizing coconut wood in framing and using lighter woods or laminating plywood to complete the items. Carving and fairly intricate turning is possible so attractive designs can be developed.

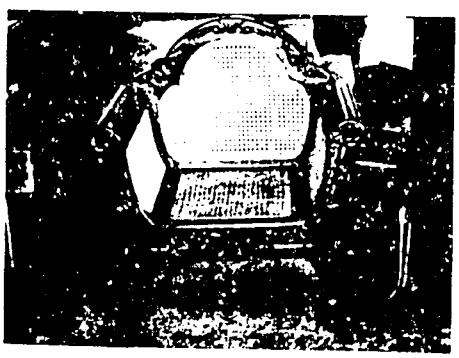
Hard density (No.1 grade) coconut timber is normally preferred for decorative furniture and is adequately strong in bending and stiffness and hard enough to resist indentation. Its colour, texture and figure enhance its suitability for this purpose.

Grade No.1 coconut timber has such a striking figure, in fact, that it can in some cases be considered overpowering if used to excess and this point should be kept in mind when designing furniture.

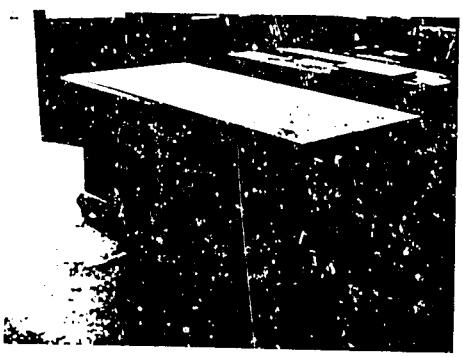
Selected medium density coconut timber is suitable for non-decorative and utility furniture manufacture. It is easy to screw, drill, glue and profile. Medium grade can also be used in conjunction with hard grade in decorative timber if the colour difference is allowed for or utilized in the design.

Preservative treatment for coconut wood furniture timber is usually not necessary.

For commercial furniture production it is necessary to use tungsten carbide tipped cutters on planers, spindle moulders, etc., in order to achieve a reasonable production rate.



2J Cocowood Chair



2K Cocowood Desk

Utility Items and Curios

The structure of coconut wood makes the harder material extremely suitable for a wide range of utility items with demanding specifications. The interlocking nature of the grain, which is a partial cause of the difficulties encountered in sawing, makes the wood ideal for the manufacture of tool handles with complex shapes such as axes and paint brushes where splitting along the grain is a problem. Furthermore, the resilience of coconut wood helps to absorb impact shocks in hammers and axes. By using lamination, extremely durable saw handles can be made.

The combination of durability and attractiveness

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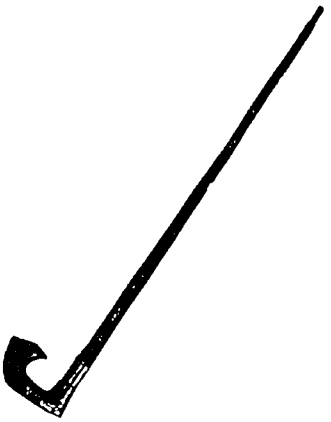
should also allow coconut wood to obtain a place in the big market of wooden bowls and boards for carving and servings. The high modulus of elasticity suggests that the material can be used in a range of rod forms, from broomsticks to surveying staffs.'

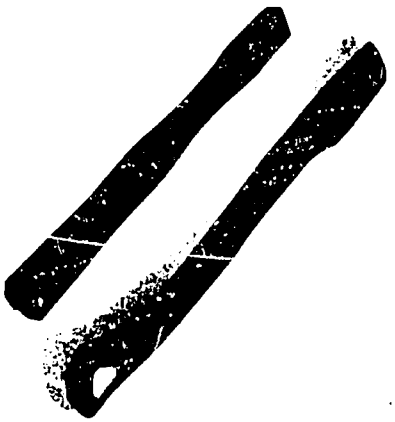
A wood with such attractive properties may well be utilized increasingly for the manufacture of curio items. Although this market cannot dispose of large volumes, it could be an important cottage industry giving gainful employment to many people. Items manufactured include bookends, candlestick holders, trays, bowls, mugs, chessboards, salt and pepper shakers.



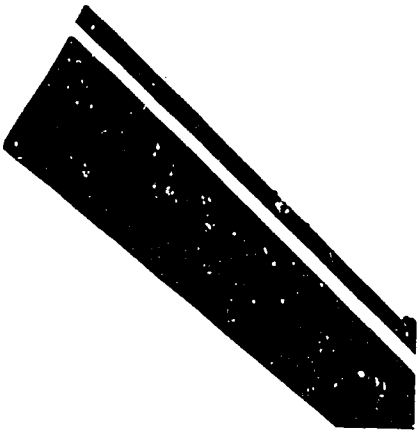
2L Walking Stick

2M Bow and Arrow

2N Hammer Handles



2O Eggcup



2P Sliced Veneer

2Q Laminated Cocowood

Board Products

Trials in the United Kingdom and in the Philippines [illegible] have been carried out on the production of particle board from coconuts.

2R Particle Board

The stem proved to be a difficult raw material for the purpose, though it was technically feasible to make boards conforming to accepted standards. An economic appraisal indicated however that board manufacture was unlikely to be viable in local conditions where competing materials exist or the market is too small.

Roundwood Products

The structure of the palm stem is ideally suited to its use as a utility pole since it has great strength and flexibility and is able to withstand high wind loads.[illegible] It is usually possible to select straight and defect-free stems suitable for power transmission lines.

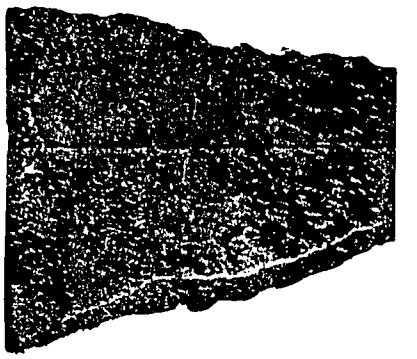
2S Power and Utility Poles

The main problem has been to dry poles sufficiently to permit pressure impregnation with a water-borne preservative. Debarking is an essential preliminary and no suitable fully-mechanized method has yet been developed. The process can be carried out manually with a spokeshave-type debarking knife.[illegible] The use of coconut rounds as house poles presents a similar problem.

Coconut fence posts should be prepared in semi or quarter rounds with the less dense material removed before drying and pressure treatment. This produces a post of adequate strength which can be efficiently preserved.

Fuel and Energy

The uses of coconut wood for charcoal and for the production of gas and by-products are described in Chapter 8.



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Chapter 3

Logging

Coconut stems can be felled and extracted in the same manner as other plantation trees.

In practical terms the felling and removal of coconut stems from plantations to a sawmill has to take into account the situation within the plantation - whether the area beneath the palms has been inter-cropped or grazed with stock, is flat or steep or rocky, whether the trees are concentrated or scattered.

The size and sophistication of the equipment is dependent, as in other forest operations, on the scale of felling and the location and capacity of the sawmill being supplied.

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Logging

Coconut plantations are usually in easy and accessible terrain. The branchless and nearly straight stems, and their almost uniform and modest dimensions allow the use of comparatively simple equipment for felling, extraction and transport.

Selection and Felling

In Chapter 5 the principles of grading coconut timber are described. Quality control begins with the standing tree which may be assessed for age and potential log quality before felling.

Felling, while apparently a simple operation, is often complicated by the need to prepare the land for planting. This implies that, where the topography and absence of boulders permit mechanical cultivation, it is desirable to remove the stumps or at least reduce them to ground level.[2,3]

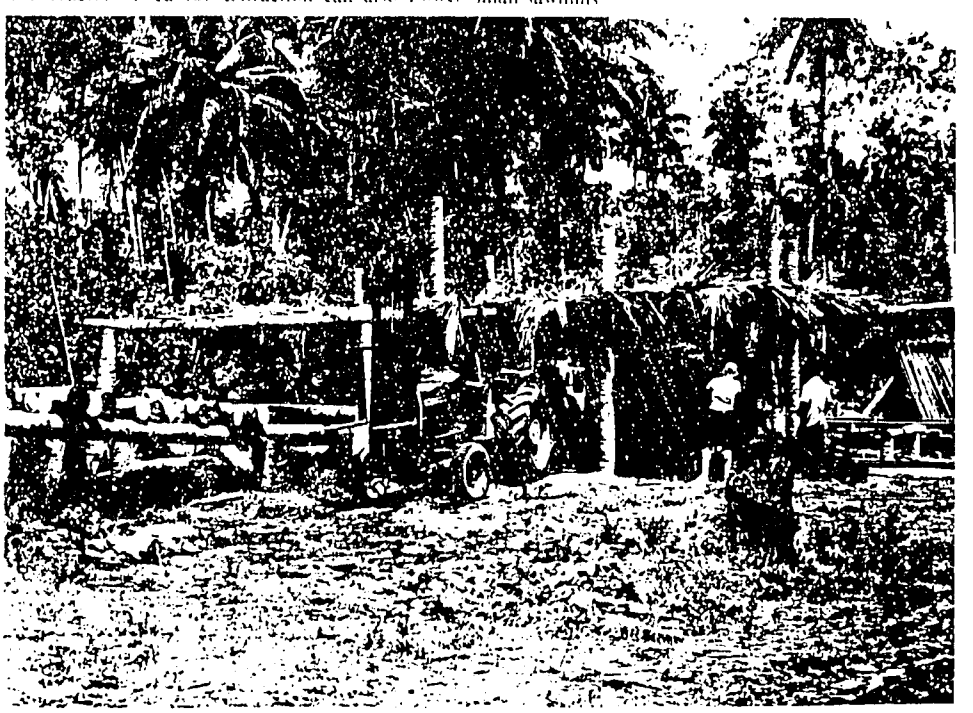
The extraction of the stump, together with the roots, is always a costly undertaking, requiring either heavy equipment or a costly input of labour, often both. If it has to be done, the roots and stump must be undercut so that the palm can be pulled or pushed to the ground by winching or bulldozing. The latter is unsatisfactory as it creates a massive problem of disposing of the stump and root system to which a massive ball of earth generally adheres. It commonly requires one man/day per stem to remove the earth and to expose the stump for burning (Figures 3.1, 3.2).

Uprooting of the stump is not, however, a standard practice, because of the cost. Stump disposal after normal felling remains a problem. One solution, already tested in the Philippines, may be the pulverising of the stump with a mechanical flail.[1]

Felling may be by axe or two-man handsaw where the number of trees to be felled is few, as in selective logging to eliminate dead, diseased or unproductive trees within a healthy plantation.

Clear felling for replanting is an operation of scale justifying the use of chainsaws. Experience in the Philippines indicates that this is the most efficient method provided that care is taken to fell the stems in a uniform direction to facilitate cross-cutting and extraction. Careful training and supervision of operators are essential, together with suitable arrangements for maintenance.

3A Tractors Used for Extraction can also Power Small sawmills



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3B Log extracted by Draught Animals

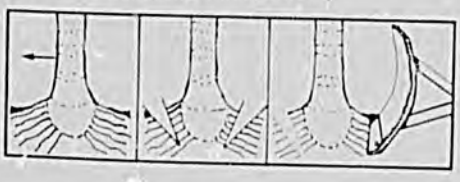
Extraction

Sawmill logs are neither large nor unduly heavy and present no problems in extraction. Depending on the scale of the operation and the nature of the terrain, extraction may be by draught animals, adapted agricultural tractors or specialised skidders.

The water buffalo, or Carabao, can play an important role in moving logs in isolated areas.

One of the most efficient and least expensive systems of log extraction is the use of an agricultural tractor with a towing bar fitted to the hydraulic lift arms.' This enables the butt of the log to be lifted clear of the ground for skidding. The same type of machine has proved suitable for the extraction of stems up to seventy feet long.

[Figure 3.2 Bulldozing through roots]



[Figure 3.1 Cutting through stem roots]

Transport

Loading and hauling do not require heavy or highly specialised equipment for the usual scale of plantation operation. Loading may be done manually when the logs are small; in other cases, by cross-hauling with a skidding tractor or with a hydraulic front-end loader.

Log transport, as in any forestry operation, has to be by the most economic means. In small scale plantation clearances unspecialised flat bed trucks, or four-wheel bunk trailers towed by agricultural tractors, have proved suitable.'

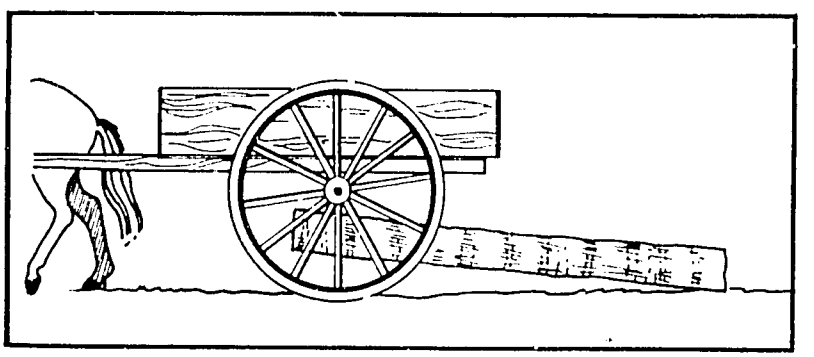
Cross-Cutting

Before the palm trunk is cut into logs, the location of each cut must be marked, the length of the log depending on the curvature of the stem and the intended end-use. High quality stems for special uses such as transmission poles, for example, must be identified and cut accordingly. Sawmill logs are usually cut into four to six metre lengths, each stem yielding one or two logs depending on the height and soundness of the tree.

Disposal of Debris

In order to minimize infestation by the rhinoceros beetle and by the palm weevil, it is of great importance to dispose of the palm fronds and the discarded top portion of the stem after logging. Utilization is in some cases possible through transport of woody material as fuel to nearby users, or by charcoaling on the spot. Otherwise all debris should be piled for drying and then burnt.

Figure 3.3 Skidding Log Behind Horse



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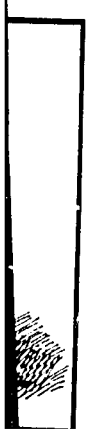

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Chapter 4

Primary Conversion

The sawing of coconut logs calls for care in selecting cutting patterns which ensure the maximum yield of the higher density outer material.

The hard and abrasive nature of the wood makes it necessary to use hardened saw teeth.

These considerations apart, primary conversion can be satisfactorily carried out with conventional sawmills, although special types, designed for portability, have been developed.

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Primary Conversion

Cutting Patterns

Approximately 70 per cent of the cross-section of a coconut log is hard to medium wood, confined to the periphery, and of this slightly less than half may be recovered as sawn wood. The soft core, often extending to 100 x 100 mm sawn, must be separated and graded as inferior. It is preferable to leave bark on the higher quality outer wood rather than include any of the core. Resawing for export quality can be undertaken as required.

A typical cutting pattern for 200 to 300 mm diameter logs, designed for a centre-held log to ensure separation of hard and soft material, is shown in Figure 4.1. This gives a choice of 100 x 500 mm or 75 x 50 mm pieces plus 50 x 50 mm and 50 x 25 mm offcuts. The same pattern can be used in conventional mills as indicated in Figure 4.2.

Cutting patterns for beams and purlins are shown in Figures 4.3 and 4.4, and for grade selection in Figure 4.5.

Sawmill Systems for Coconut Timber

The most important factors in selecting milling equipment are portability and ability to be relocated if this is required; simplicity of design to avoid breakdowns which are difficult to repair in isolated situations; ease of operation as skills of operators will often be limited; and inexpensiveness as the industry is often sited in poorer, underdeveloped areas.

There are many designs of sawmill in use. In Tonga in 1983 there were in fact six mills operating, all of different design, five being manufactured in New Zealand and marketed as coconut wood sawmills, and one an old locally redesigned stationary mill. The mill layout and operation should relate to the end use at which the product is aimed. The inflow of logs should be simple, with lifting avoided and limited storage space as logs should be milled within hours of delivery if possible. Immediately after sawing, all timber should be dipped in a bath of anti-sapstain chemical and then tillet-stacked in an orderly and systematic manner for drying, carefully retaining grading marks applied in the forest.

Types of Mill Used for Sawing Coconut logs[1]

Full service tests have not been reported on all the mills used in milling coconut wood, but tests reported from the Zamboanga Research Centre in the Philippines and the Timber Industry Training Centre in New Zealand provide a guide to the selection of mills for different conditions. Other trials have been reported from field use in the Philippines, in Tonga and Kiribati.

The specifications, advantages and disadvantages of these mills are as follows:

1. Medium-size portable sawmill

A mill of this type was designed with the assistance of the FITC, specifically for the milling of coconut stems in Tonga. It is a robust machine capable of being towed over rough terrain without distortion to the frame. The main unit has jack screws at either end which can be wound down on to wooden pads to prevent movement. (The weight of the carriage travels from one end of the track to the other.) As it is on a single axle with dual pneumatic wheels it is desirable to jack and put solid packing under the central main frame to prevent movement during operation. It is desirable but not essential to have the machine set up perfectly level. All parts of the unit are tied in rigidly together (track, carriage, headsaw, power unit, rollcase) and need to be in true alignment to each other.

This machine was originally designed with a 9-gauge 1120 mm diameter saw which is adequate for most coconut logs. The companion breast bench unit can be towed by a car on roads or a tractor in rough terrain. It is self contained, of rugged construction, with trolley tracks mounting directly on to the main frame. It thus stays in true alignment with the machine regardless of the circumstances. The power pack on the main unit is mounted on a frame that can be rolled in from its operating position, making the unit more compact for transporting.

The breakdown unit requires a motor of power equivalent to a 75 h.p. electric motor and the breastbench a 30-35 h.p. motor.

Field trial

A production study of this type of mill was undertaken in the Philippines [1,2] at the Coconut Authority Research Station.

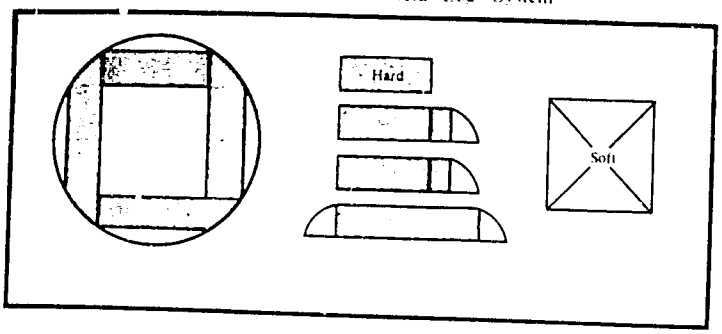
The logs used were from 116 coconut palms felled and left on the ground in the field for about eight months, and from 241 newly felled coconut palms. The trunks, cross-cut to log lengths ranging from 10 to 16 feet from the butt to the upper portion, were piled near a fairly level site where the mill could be set up.

The portable sawmill consisted of a 1120 mm diameter breakdown saw and a 195 mm diameter saw in the breastbench. Both circular saws, equipped with 17 and 13 stellite teeth respectively, were driven by a single engine. The mill was towed to the site with an ordinary farm tractor and was set up in one day.

The mill was set to an engine speed of 2100 r/min giving an equivalent breakdown saw speed of 770

625

Figure 4.1 Cutting Pattern for Centre-held Log System



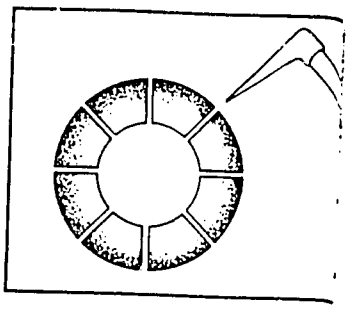


Figure 4.4 Additional Pattern for Cutting Purloins

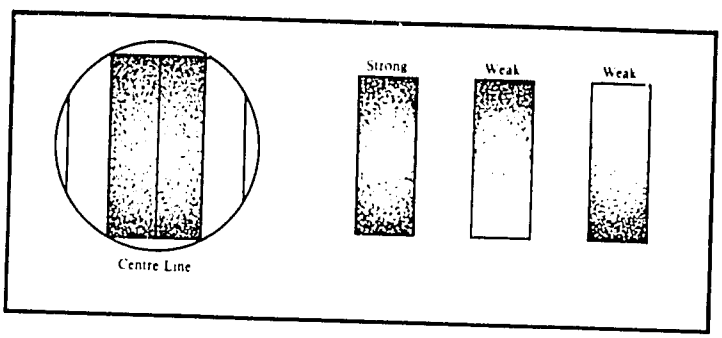


Figure 4.3 Cutting Pattern for Beams

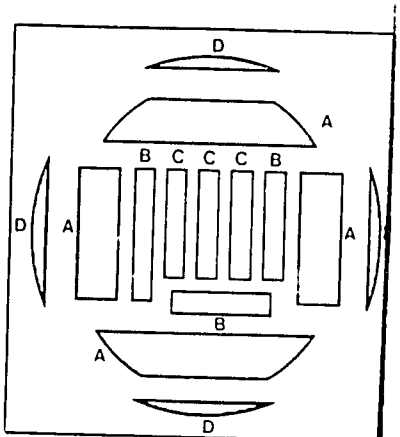
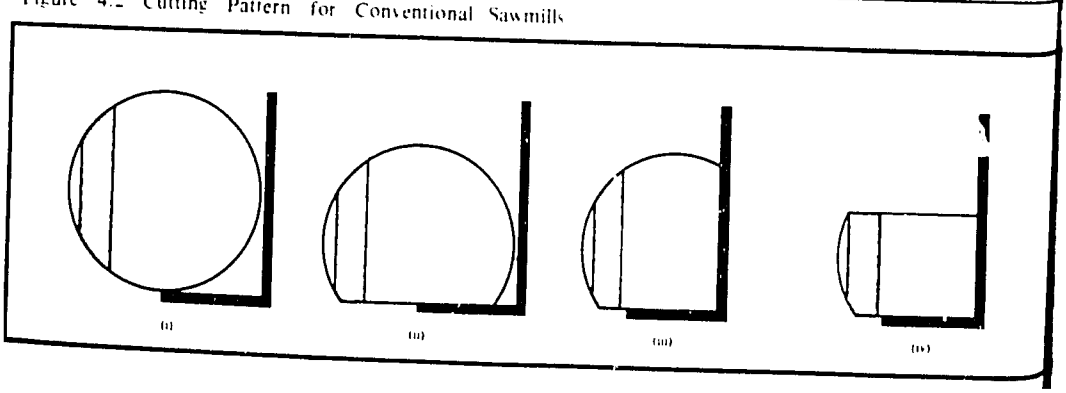


Figure 4.5 Cutting Pattern Relative to Selection and Grading

Figure 4.2 Cutting Pattern for Conventional Sawmills



r/min which in turn generated a saw speed of 1250 r/min in the breastbench. A 30-degree hook angle was maintained throughout the sawing process. A crew of seven men operated the mill in sawing the specimen with one man assisting in the gathering of data.

About 16 per cent of the logs from coconut trunks stored for eight months could not be sawn because of decay, stain or holes in the core. The average sawing time was three hours a day. About five hours were spent in conducting and fetching the crew to and from the mill, grading and stacking the sawn timber, sharpening the saw, removal of sawdust, and rolling of the logs to the deck of the mill.

The sawn timber was graded and stock-piled outdoors according to density classification. Coconut stumps 45 mm long were used as posts in stacking the sawn timber above the ground. Square 25 mm fillets placed across each layer of timber allowed the air to pass through the pile. Inspection was done once a week for the first month, and twice a month thereafter. Recovery from the old trees was 34 per cent and from the freshly felled trees 41 per cent. Approximately 14 per cent of the sawn timber was of dense grade.

The implications of harvesting steps cut in the side of coconut stems were evident in the Philippines. The steps reduced the recovery of sawn timber, particularly denser grades.

Results of the sawing tests showed that the portable sawmill can operate efficiently under field conditions. The average feeding sawing rates varied according to the type of log sawn as follows: butt logs, 23.4 m min; second logs, 30.6 m min; third logs, 36.3 m min. Loss of power was observed in the engine when sawing butt logs at an increased feeding rate. An average of 30 logs were sawn per sharpening. The stellite saw teeth with 30-degree hook angle had to be replaced after seven to eight sharpenings.

The results also revealed that ten fresh logs can be sawn at an equivalent output of 0.7 cubic metres sawn timber per hour.

Recommendations resulting from the trial:

(a) Coconut trunks should be sawn in 'green' condition to obtain better quality timber. Building up of heat in the saw blade during the sawing process is minimised as the trunks are very wet.

(b) There should be a saw doctor in the crew, an anvil for tensioning the saw blade, and a 1.5 h.p. generator for the jockey grinder used to sharpen the teeth.

(c) For commercial operations the mill should operate at least six hours daily with a crew of 12 men. Six men including the saw doctor will operate the mill and the remaining six will roll the logs to the deck of the mill, grade and stockpile the sawn timber, remove the sawdust and slabs, and supply water to the mill.

2. Larger Transportable Sawmill

A larger sawmill was designed to meet the demands of milling coconut stems in the Philippines.

In design it is almost identical to the previously mentioned mill. It is larger and has a three headblock carriage. It is transportable rather than portable, being dismantled in sections and put on a carrier rather than having its own axle and draw bar.

The unit can also be equipped with a bandsaw in place of the 1372 mm circular.

The breastbench equipment and saw are identical to those described earlier.

3. Light, General Purpose Portable Sawmills

Sawmills not designed for the cutting of coconut but rather as simple low cost mill units suitable for farms or contractors with small blocks of timber are quite widely used but have their limitations.

One variety is lightly constructed of RHS and angle iron with a steel plate sliding on the top runners as a table top carriage. It also has a lightly constructed breastbench as part of the complete mill set up. Although the main unit is on its own axle for portability, setting up is not as quick and simple as the first mill described.

4. Mini Mill

There are several mini designs now built in America, New Zealand and Australia. The smallest of the range is probably the most suitable for cutting coconut logs.

Differing from other designs where the log is fed to a stationary saw, this particular design has an air-cooled petrol motor mounted on a frame driving two circular saws which are mounted at right angles to each other. The saw unit travels along a track on the main framework. The saws are raised and lowered in relation to the log, and can also be moved laterally. With each pass both a horizontal and a vertical cut are made with the two cuts meeting accurately. These mills were originally designed for cutting large logs which were supported on skids on the ground, and are far less efficient in cutting small diameter logs. The unit is capable of milling coconut stems, but is not well suited to the purpose because the logs are small and must be rotated to recover the maximum high density timber.

5. Breastbench With Light Weight Carriage

Breastbench mill with an added light-weight, carriage which is merely a heavy timber plank with metal bracing. It has a steel section on its underside running in a groove in the trolleys and the feed rolls on the bench and has light dogs attached that may be hammered into the log. The feed rolls are hydraulically powered with easy control of speed and reversing. This bench is ideally suited for small logs. The log is first broken down on the carriage to manageable sections, then the carriage is removed and the unit used as a normal breastbench. Production is low but only three operators are needed.

6. Sawing with a Chainsaw and Guide Attachments

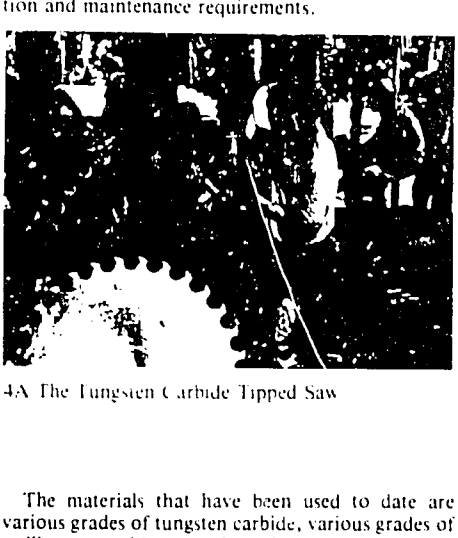
Where high production is not needed, chainsaws are useful in log conversion and have the advantages of portability and low initial cost.

Chainsaws should be of at least ten horsepower and chipper chains are recommended because of the ease of sharpening. Tension must be maintained and the bar and chain kept well oiled. A sprocket-nosed bar assists in maintaining high chain speed.[4] [4] The saw is fixed and the log fed slowly through.

Sawblades for Coconut Stem Conversion [4]

In the milling of coconut stems as with any other species it is the saw blade that is the work tool used for reducing the log to sawn timber. If there are any peculiarities in a particular species (hardness, irregular grain, abrasiveness etc), the saw blade will be changed or the cutting speed altered. Peculiarities of coconut wood are its abrasive nature and the extreme hardness of the bundles of fibres in mature stems.

Consequently it is not practical or economic to use standard plate saws, as a very limited number of cuts would be made before the saw became too dull to cut. Hard facing of the saw teeth is necessary if cocostems are to be sawn economically. There are various materials that are suitable for the hardfacing of saw teeth, each having its own method of application and maintenance requirements.



4A The Tungsten Carbide Tipped Saw

The materials that have been used to date are various grades of tungsten carbide, various grades of stellite, tunsweld, tungtech, carbitroning, high speed steel and high frequency hardened steel.

Tungsten Carbide

Tungsten carbide tipping of saw teeth is the most successful way of overcoming excessive saw teeth wear or dulling. The tungsten carbide tips are formed during manufacture to shape and dimensions suitable for fixing straight into recesses on the face of the saw teeth. Grinding to final shape and dimensions for the required use is carried out on the complete saw blade.

Although tungsten carbide has been used successfully on bandsaws and there would be no problem on frame saws (provided there was adequate clearance of the tips on the back stroke) it is mainly used on circular saws. Tungsten carbide is not an economic tipping method for bandsaws because of the number of tips required, the type of equipment to service them, and the time and skill required to maintain them.

A high degree of skill is required to maintain tungsten carbide tipped circular saws. Relatively expensive precision grinding equipment utilizing diamond grinding wheels is essential. A suitable sawshop is required which rules out servicing the saws in the field. The best known practical option in the field is a single grinder for face grinding of the carbide. The grinder would need to be a precision machine utilizing diamond wheels. The face grinding could be carried out only two to three times before the saw was sent to the sawshop for a full service.

Tungsten carbide is available in various grades. These range from softer less wear resistant but tough material, to harder more wear resistant but brittle material. Most tungsten carbides have a cobalt base. But some are also available with a nickel base. Nickel is recognised as being more corrosion resistant, tougher and easier to braze to the sawblade. The normal grade of carbide used on saw teeth is I.S.O. K20 or equivalent. But for cutting coconut the next tougher grade I.S.O. K30 may be desirable.

Preparing saws for tungsten tipping, and fixing the tips securely into the accurately ground or milled recesses in the saw tooth faces, requires skill and scrupulous attention to detail. Similarly, final grinding to produce an optimum cutting edge demands knowledge and skill, and good quality equipment. Silicon carbide grinding wheels may be used for rough grinding but diamond wheels are essential for finishing.

The essentials of carbide saw use and maintenance can be summarised as follows:

(a) Cleanliness is extremely important
(b) Carbide is brittle and must be handled with care
(c) Too large a tooth bite should not be made as the shock of overbiting can cause carbide breakages. Recommended maximum bite is approximately 1.3 mm per tooth
(d) The sharpness angle should be kept to at least 45° to ensure a strong tooth point
(e) The correct diamond grinding wheel for the job should be selected. Extreme care should be exercised while grinding
(f) Diamond wheels are expensive items and ought only be used on precision grinding machines
(g) Carbide requires great accuracy in the grinding finish. Angles on its face, back and sides and should be ground on precision grinding machines
(h) Trained personnel ought to carry out the work.

Stellite (Tungsten Cobalt Alloy)

As with tungsten carbide, stellite is available in various grades from softer, tougher grades to harder more brittle grades. The tungsten carbide manufacturing process requires that all components, including saw teeth, are formed close to their final

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shape early in the process and then fixed to their working place by another medium such as silver solder. In contrast, stellite is available in rod form It can be fused directly, with heat, on to the base metal.

Consequently, stellite can be used equally as well on any type of saw, including bandsaws. It is used extensively where hardwoods with an abrasive nature are to be cut. Grade 6 stellite, which is identifiable by a red tip, is the most commonly used on saw teeth.

Cobalide 3 which is a similar material under a different trade name is also quite satisfactory. A newer material put out by Eutectic, called Eutecbor 9000, has become very popular for this use and has proven very satisfactory. The main reason for its popularity is its ease of use in applying it to the base metal, it also has very good wear and shock resistance.

Stellite is also available for saws as a preformed tip. This can be fixed to the saw using silver solder. However, these tips are more expensive than carbide.

Me .iod of Tipping

There are three main methods of applying stellite to saw teeth.

(a) A drop of molten stellite can be applied to the swage cup

(b) A large deposit of stellite can be melted on to the end of a saw tooth which has been ground back slightly. The stellite is then formed with dies so that it looks similar to a swaged and shaped point

(c) Molten stellite can be poured into a ceramic mould around the tooth point. This gives a finished point similar to Step b

The usual procedure in grinding stellite tipped saws is to grind the faces and backs first, then to grind the sides of the swage with an "equalising" machine. The main reason for following this procedure is that the size of the finished point can be more easily controlled if the side grinding is performed last. When grinding the faces and backs of the teeth, care must be taken to ensure that the feed finger does not push on the stellite deposit.

It is common to find sawmills using stellite tipped saws running the saws to the extent that the points become rounded and dull. In most cases it would be better to change the saw before it got to this point. This would result in less time being taken to sharpen a saw. More sharpenings would be gained from the stellite. Sharper tips also mean production of less badly cut and thus wasted timber. It would also increase the overall life of the saw.

With bandsaws, this tendency to continue sawing too long before re-sharpening (particularly with softer wood) frequently leads to gullet cracks as the saw becomes fatigued.

Details of methods of forming and grinding stellite tips have been omitted from this account. But it must be recognised that considerable skill, and the use of precision equipment are necessary for satisfactory saw performance. For these reasons most smaller mills used for cutting coconut wood have favoured the use of circular saws with inserted teeth which are rugged, easy to maintain by face grinding, and can be easily and quickly replaced when too worn for further grinding. The most satisfactory inserted tooth for cutting coconut to date has been a stellite inlaid tooth. This is a standard carbon steel tooth with a coating of stellite over the top and side surfaces, approximately one to two mm thick. Wear resistance is good. Only face grinding is necessary. Filing is not possible. Grinding is best done on a hand gulleting machine with the saw removed from the rig. A good finish must be maintained with angles accurate and face square. Portable jockey-type grinders which clamp on to the saw blade have been used in small coconut mills, but none seem to have been really satisfactory for maintaining a good cutting edge.

Tungtech

Tungtech is a powder application that can be used to harden the surface of any base metal. The alloy powder containing particles of tungsten is applied through a special oxy-acetylene torch to the surface of pre-heated base metal. The flame sweats the alloy powder into the surface of the material. This has only been used in trials so far. It has proven successful on heavier gauge circular saws. Some skill and care is required in this application as misuse of the heat will result in melting and rounding the cutting edges.

As the coating of powder is quite thin even a light grind would remove it. Therefore it must be applied to the tooth after sharpening.

A thin layer is then applied to the face of the tooth. The tooth is again ground lightly on the back to regain a sharp cutting edge without removing the hard facing from the face of the tooth.

Carbitroning

Carbitroning is the deposition of materials such as tungsten carbides and titanium carbide from an electrode of these materials by spark action on to the surface of the saw teeth. The electrode which is held in the electrical machine designed for this method of coating is vibrated against the tooth surface. The vibration makes and breaks contact causing sparks which transfer the molten carbide to the tooth. The thickness of the deposit layer will only be up to about 0.07 mm (.003 inch). For this reason the method is not entirely efficient as in some species, acids in the timber apparently will eat under the layer lifting it off. However cutting time is claimed to be increased up to five times and longer.

High speed steel

High speed steel is used in the form of inserted saw teeth. As with the stellite inlaid teeth the high speed steel teeth were designed for use in cutting species that ordinary carbon steel would not cut effectively. These bits can be used in inserted tooth saws for cutting coconut, but are not as wear resistant as the stellite inlaid teeth, nor as economical.

Waste Disposal

Waste products — or by-products — from the felling and milling of coconut trees are either a costly embarrassment to dispose of or a potential additional resource. The most important consideration with regard to removal of the trunks and other debris from coconut plantations is the phytosanitary aspect - the potential threat of pests on the newly established plantations. Rotting logs and other decaying debris provide ideal breeding places for two major coconut pests, the coconut beetle *Oryctes rhinoceros* and palm weevil *Rhynchophorus schach (Oliv).*

Disposal of the woody waste left over from milling is a problem. Burning is the cheapest and safest means. Discarded round logs, generally from the upper softer trunk, are best cut to approximately half-metre lengths, split and stacked to partially dry. They can then be burned, or used for some form of fuel (charcoal, gas, firewood). Palm fronds and the "palmit" or delicate fleshy bud in the crown of the tree become available as useful by-products if organised collection and disposal is carried out.

Chapter 5

Grading Coconut timber

Grading coconut timber according to low, medium and heavy densities is important, since the different grades have different end uses. Timber of mixed densities is more likely to twist and degrade.

Grading should begin at the commencement of logging, and be followed through the sawnwood conversion process.

The development of a uniform grading standard would help to promote local and export marketing.

Timber can be graded visually or by more elaborate techniques. A simple colour coding system is appropriate for use in recording grades.

Grading Coconut Timber

Quality Control, Particularly Relating to Export

In the course of coconut market research and product development it has been established that no importer in any of the countries surveyed is prepared to make a commitment to purchase large volumes of coconut wood unless both quality of material and reliability of supply are guaranteed. It is also desirable that uniform grading should be established within the various producing countries.

When any country considers the establishment of a coconut milling and processing industry, there should be emphasis on an overall control which is sufficient to co-ordinate quality standards. This control should not restrict efficient management but should aim to protect and foster the interests of the country, the coconut industry and its customers. An enforceable quality standard provides such a control.

System of Identification

The maintenance of quality control of coconut wood is not merely a matter of inspection and grading at the point of sale or export. Because of the widely varying densities of material within each log, and the difficulty of differentiating these by superficial inspection after sawing has taken place, it is essential that grading and identification of the wood from different parts of a log and from different logs along the length of a tree be carried out in the plantations at time of felling. Such a grading system, consisting of colour-coding the butts of logs immediately after the trees are felled and cut to length, whereby the colour markings remain on each timber piece after the logs are sawn, has been developed and tested.

The general principles of this grading system are as follows:

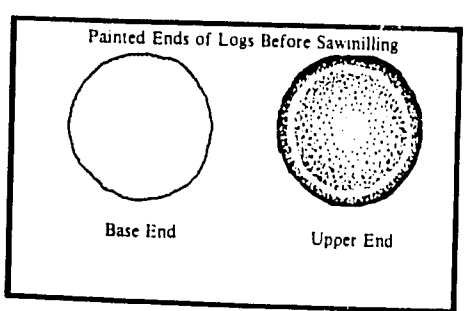
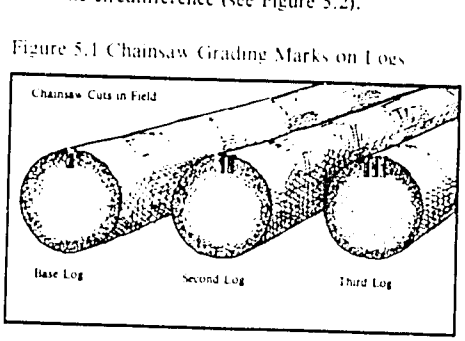


Figure 5.2 Colour Grading on Log Butt

It is first necessary to inspect standing trees so that a judgement can be made as to a tree's age, by means of length of leaf, nut production and the characteristic thinning of the stem below the crown. Suitable trees are then marked, felled and cut to length.

Before extraction, every log must be marked to establish from what part of the tree it comes. It is convenient when sawing to length to make a single chainsaw niche on the lower end of base logs, two niches for second logs and three niches for upper logs (see Figure 5.1). Then, after the logs are stockpiled butts are painted different colours on the lower end (base logs RED, second logs GREEN and third logs YELLOW). On the reverse ends they should be painted with a WHITE band extending 70mm in from the circumference (see Figure 5.2).

Figure 5.1 Chainsaw Grading Marks on Logs



Grading

After such an identification system as described above is in place, quality specifications are then necessary in relation to each end use.

In the local house-building market little further grading would be required, though general information on the characteristics and appropriate use of each grade should be available.

For other building construction, which may be subject to local government regulations or building codes, more detailed specifications are required.

Timber should be graded hard, intermediate or soft, corresponding to high, medium and low densities. The technical limits between the grades are:

High Density above 500 kg/m³

Medium Density between 500 and 350 kg/m³.

Low Density less than 350 kg/m³.

As a rule only high density coconut timber is acceptable for structural purposes.

Sample Specifications

Specifications for coconut timber drawn up by a timber exporting company[4] are as follows:

-Milling tolerance minus nil plus 2.5 mm

-Minimum basic density 400 kg/m³- for medium density and 600 kg/m³- for high density

-Maximum moisture content E.M.C. of supplying country

-Timber must be clean and free from defects such as bark, rot, collapse, sapstain, brown spot, twist, cup, spring, checking, warp, wane or other visible imperfections

-Timber should be milled within eight hours of felling trees

-Dip all timber in approved anti-sapstain solution immediately after milling

-Protect timber from rain after dipping

-Transport timber to drying yard immediately

-Re-dip in anti-sapstain solution prior to stacking. It is preferable that this is carried out under cover to avoid any chance of chemicals being diluted by rainfall

-Fillet stack timber in proper drying racks protected from rain and direct sunlight within 24 hours of milling.

The anti-sapstain solution utilized was a proprietary mixture of captapol and chlorothalomil, maintaining a minimum concentration of 0.4 percent captapol.

Packing specifications for rough sawn timber established for export control were that all timber for shipment should be steel banded, using 75 x 25 mm fillets under all-steel banding. Packets should be banded on 100 x 50 mm gluts to facilitate forking. Packets should contain timber of like specification and be in packets of no greater than one cubic metre. After drying to E.M.C. packets must not be exposed to wet conditions.

Grading Techniques

Techniques which have been examined include visual grading, basic density determination, and grading by weight. Checks on density can be made by means of the Janka hardness test.

Visual grades may be as follows:

C-1 (clear one-face)

-Clear of step or wane on one face

-Step or wane can appear on up to half of the thickness away from the clear side of the board

-Solid spot can appear on the clear face, but in area less than two percent of the face, and individual areas of less than 0.5 cm²

-No string spot allowable

-Lengths to a minimum of one metre accepted

C-2 (clear both faces)

-Clear of step or wane on both faces

-All sides square

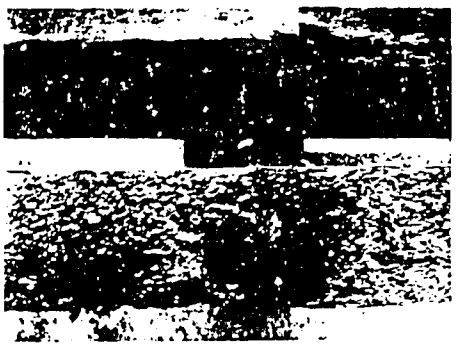
-Spot as described in C-1, for both faces

-Lengths as described in C-1

Utility

-Wane allowable up to half an edge and half one face

-Step allowable on one edge all across; but not more than one-quarter width of the face; OR one face all across but not more than one-third of the edge



5A The Low-density Grade Collapses

-Hard spot allowable in any quantity in medium and hard density, and 20 per cent area of any face in soft density

-String spot allowable up to five percent of the surface area of any face

Grading by Basic Density

The basic density of a piece of coconut timber is information of considerable value in grading and utilization of the timber. It is calculated as the oven dry weight of a sample divided by its green volume. The procedure is relatively simple and can be used within the trade to check the quality of a consignment.

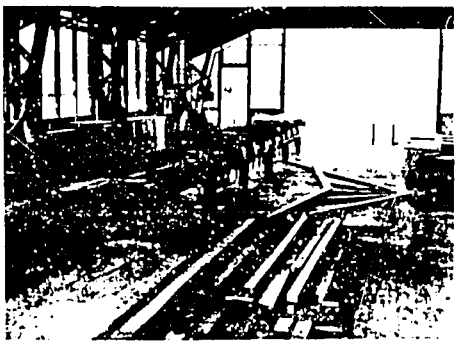
Density is closely correlated with hardness which may be measured by the Janka test. This measures the pressure required to compress a metal ball of standard diameter for a measured distance into a timber sample. Tests carried out on the wood from the peripheral zone of butt logs from coconut trees from Tonga showed an average resistance of 10,950 newtons radially and 10,800 newtons tangentially at 12 percent moisture content. Comparative figures for other timbers are :[7]

European Oak	5050N - 5550N
North American Oak	5600N - 6250N
Teak	5050N - 5550N
Tawa	6300N - 7100N
Rimu	2850N - 3550N
Sapele	5600N - 6250N
Radiata Pine	2250N - 2800N
Kwila	8050N - 8900N

The figures illustrate the significantly higher hardness rating of selected coconut wood.

Appearance

The appearance of coconut wood is distinctive. The grain is strong and irregular so that the texture is variable. There is also a noticeable colour variation, sometimes related to density, the denser wood being darker. It has also been noted that there are two varieties of tree, one which produces very dark wood and the other a lighter wood. There is thus opportunity for the production of a range of colour grades in joinery or decorative features. It follows that colour classification of the wood during processing is sometimes advantageous.



5B The Densest Grades are Strong Enough for Structural Uses

Chapter 6

Seasoning Coconut Timber

Coconut sawn timber dries readily as 25 mm boards but thicker sizes dry very slowly. Degrade is not severe apart from collapse in material below 350 kg/m³ basic density 16. Sawn timber should be sorted according to density before seasoning.

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Seasoning Coconut Timber

Coconut sawn timber dries readily as 25 mm boards but thicker sizes dry very slowly. Degrade is not severe apart from collapse in material below 350 kg/m³ basic density.[1,4] Sawn timber should accordingly be sorted according to density before seasoning.

Air Drying

The moisture content of coconut sawn timber ranges from 90 per cent to 180 per cent. The risk of stain and mould in air drying is such that appropriate chemical dip or spray treatments should be applied before stacking. For the same reason, protection from rain is desirable and air drying should be carried out in an open-sided roofed shed.

6A Correctly Stacked for Air Drying

Similar drying times have been reported from several Pacific Island countries.[2,3] 25 mm boards dry from green to equilibrium moisture content (17 to 20 per cent) in 9 to 10 weeks, while 50 mm material may require 6 months or more.

Kiln Drying

The New Zealand Forest Service, Forest Research Institute, has recommended kiln schedules as a result of studies on material from Tonga.[1]

25 mm Material

Moisture Content[1]	Dry Bulb Temp °C	Wet Bulb Temp °C
Green	60 (140°F)	54 (150°F)
100	60 (140°F)	51 (125°F)
60	71 (160°F)	60 (140°F)
Final conditioning	77 (170°F)	76 (168°F)4hr

[1] *Average moisture content of the two sample boards of the highest moisture content.*

Drying time is six to seven days in a commercial stack.

50 mm Material

Preliminary air drying to 25-30 per cent moisture content is recomended since 50 mm pieces cannot be satisfactorily kiln-dried from green.[1] Drying may take five to six days on the following schedule.

Moisture Content	Dry Bulb Temp °C	Wet Bulb Temp °C
30	60(140°F)	54(130°F)
25	66(150°F)	57(135°F)
20	66(150°F)	70(158°F)
Final conditioning	71(160°F)	70(158°F)8hr

The denser grades of coconut do not have a high differential shrinkage so the tendency to distort is not severe. Twist is commoner than bow or spring.[2] Collapse is the most obvious seasoning degrade, increasing progressively below about 350 kg/m³ basic density at which level it may not be recoverable. In denser material, reconditioning after drying gives good recovery from collapse.[1]

Seasoning of poles

Because coconut wood has a high moisture content and is very prone to fungal infection it requires special care in drying in the round before preservative treatment.[1,4] Debarking is essential and the material should be stacked in sheds or under a rain-shedding cover in locations with good air movement.

Chapter 7

Preserving Coconut Timber

Coconut wood in contact with ground or water requires preservation if it is to last more than a few years.

Coconut wood for interior uses, such as furniture, flooring or walling, does not generally need to be treated with preservatives, although in some environments the timber (particularly low density wood) should be treated against termites and other wood borers.

Preserving Coconut Timber

Provided the timber is adequately seasoned, coconut wood can be treated by the vacuum/pressure method using copper-chrome-arsenate preservatives. It can be used in the sawn form for weatherboards and verandah decking, in either sawn or round form for house piling, in the round or quarter round form as posts, and in round-form as poles.

Material which has been treated and exposed in service trials indicates that if used clear of the ground, a life of 20 years could be anticipated, and rounds or quarter rounds used in contact with the ground should have a service life at least in the order of 15 years.[19]

Coconut wood in contact with ground or water requires preservation if it is to last more than a few years. Coconut wood for interior uses, such as furniture, flooring or walling, does not generally need to be treated with preservatives, although in some environments the timber (particularly low density wood) should be treated against termites and other wood borers.

In some environments all densities of sawn timbers will need protection against termites and other wood borers.

Some uses exposed to the weather may not justify full strength treatment. The preservation required may be necessitated by standards and local building codes, or by the length of life required. Housing from coconut timber which has been brush treated with preservative will give the house a longer life than a thatched roof house of lesser quality. Local economics can determine the preservative and length of building life desired.

It is preferable and more feasible to avoid ground contact by placing a house on foundations with a waterproof barrier between the foundation and the wood.

Health standards and public attitudes to the use of preservatives with toxic ingredients provide further cause for concern at the suitability of different types of preservation.

Load bearing poles, from fence posts to electric transmission poles, require higher standards of treatment. Coconut wood can be used inside buildings without treatment. Insects are not a major threat to dry wood.

When exposed to the weather but not in contact with the ground some protection is required. Pressure treatment with copper-chrome-arsenate to intermediate retentions (five to ten kg commercial salts/m^3) gives excellent results. Brush-coating dry wood with creosote or copper naphthenate will give good protection but retreatment will be necessary every three to four years. Surface pre-treatment with inorganic salts (e.g. 12 per cent acid copper chromate) followed by one or two coats of latex emulsion stain will give a good and durable surface.

Preservative requirements for ground-contact timber, e.g. posts and poles, are still unresolved, and more well-controlled tests are needed before a confident assessment can be made of the suitability of treated coconut wood in this situation. The most crucial factor seems to be making absolutely sure that the wood does not become infected by any fungi between felling and final treatment.[20]

Coconut stem wood is not very susceptible to attack by wood boring insects and will give good service without treatment if it is protected from the weather. If protection from insects must be ensured the wood can be readily treated with boron by diffusion.

Exposed to the weather or in ground contact coconut wood is perishable and preservative treatment is essential. Debarking round poles and posts is an extremely difficult task but is necessary if they are to be treated by conventional pressure methods or hot and cold bath. The wood must be at least partially air-dried before treatment and this must be done under cover. Provided the outer zones are well dried, good retention and distribution can be achieved with creosote by hot and cold bath, and copper-chrome-arsenate by vacuum pressure.

Pressure sap displacement of unbarked logs has proved impracticable.[20]

Oil- and Water-based Preservative Techniques

There are two general types of wood preservatives. These are the oil-type such as creosote and pentachlorophenol, and the water-borne salt-type such as copper-chrome-arsenate.

A black or brownish oil made by distilling coal tar or coal-tar creosote, is effective for preserving wood, but its colour, and the fact that creosote-treated wood cannot be painted satisfactorily, make this preservative unsuitable for finished timber where appearance is important. In addition, the odour of the creosoted-wood is unpleasant. Nevertheless, coal-tar creosote can be satisfactorily used in treatment of fence posts and posts of low-cost houses where the materials are used externally and in ground contact.

Pentachlorophenol solution preservative generally contains five per cent solution of chlorinated phenols in a solvent of liquid petroleum gas. The heavy oil remains in the wood for a long time and does not usually provide clean or paintable surfaces. Pentachlorophenol solutions are usually applied to wood for exterior use.

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Copper-chrome-arsenate preservative is highly soluble in water. This is sold in the market under trade names such as Tanalith C, Boliden K33, Celcure AP. Copper-chrome-arsenate is now preferred and more widely accepted than coal-tar creosote/pentachlorophenol because it leaves the wood clean, paintable and free from objectionable odour after treatment. Furthermore, coal-tar and pentachlorophenol have become more costly than the water-borne preservatives. However CCA is not acceptable for the treatment of roof shingles where the roof is to be used as a catchment for drinking water.

Preparing Timber Prior to Treatment

All coconut timber to be treated must be free from defects to attain satisfactory treatment and good performance thereafter. Treatment of timber by diffusion using water-borne preservatives may be done on freshly-cut sawn timber to permit movement of solution into the wood. For other methods drying before treatment is essential. Drying the material before treatment permits adequate penetration and uniform distribution and reduces risks of checking and the consequent exposure of untreated timber.

It is also of great importance that all machining should be done prior to treatment. This includes incising of wood to improve the penetration of preservative and machining operations such as planing, cutting, and boring.

For round coconut timber, debarking should be done to accelerate drying. The bark greatly retards moisture removal from the inner zone of the log thereby prolonging drying and risking decay and insect infestations to the log. Under Zamboanga conditions, it takes three to four months air drying of debarked round coconut timber to ensure good preservative treatment.

Treatment Methods

Preservative treatment of timber is undertaken by pressure or non-pressure processes. The pressure method of treatment is unlikely to be feasible in rural areas, where the relatively simple non-pressure processes can be readily adapted to local facilities.

Brush Treatment

Brush treatment is the simplest method of applying wood preservative. A minimum of five per cent pentachlorophonol or five per cent copper-chrome-arsenate can be used in treatment of dried coconut wood. One to three coatings may be applied depending on the dryness of the material. In most cases, however, wood treated by this method is recommended for internal use only.

Soaking

Cold soaking of well-seasoned coconut timber generally achieves better preservative penetration and retention than does brushing. The timber is soaked in a three to five per cent copper-chrome-arsenate solution for one to eight hours depending on the intended use. Material treated by this method can be used for construction of buildings.

7A Debarking Poles

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Hot and cold bath

The hot and cold bath process involves the heating of coal-tar creosote, or pentachlorophenol in heavy petroleum oil, with the material totally immersed during the duration of treatment. The wood is heated in the preservative in an open tank for several hours, then immediately submerged in cold preservative for at least an equal number of hours. For well-seasoned coconut timber a hot bath of two or three hours followed by a cold bath of like duration or more is apparently sufficient. Longer periods are preferable, especially during heating, to ensure that the wood is properly penetrated by the preservative. During the hot bath (at about 100°C), air in the wood expands and is forced out. In the cold bath, the residual air in the wood contracts, thereby creating a partial vacuum, and the preservative solution enters the wood.

A double diffusion process, using a water-borne preservative, involves the immersion of wood in a copper sulphate solution which is then heated to about 80° C for three to six hours and cooled overnight. The material is then immersed in an equal mixture of cold sodium dichromate and arsenic pentoxide solution for one or two days. The preservative penetration and retention are satisfactory for the treatment of power electric poles and fence posts. The copper sulphate solution is highly corrosive to metal, so the treating tank should be constructed of stainless steel.

Other treatments using ammonia solutions of preservatives, and ammonia to precipitate the chemicals in the wood, have been developed at the Forest Research Institute, New Zealand, and are currently being tested at Zamboanga. The objective in these developments is to produce a safe, economical treatment for moderate decay hazards.

The plant may be a standard vacuum pressure unit installed at a permanent location. Schedules used for this technique will give a high standard of protection.[3]

Logs should be cut to pole or post length and peeled or sawn into timber as soon as possible after the palms have been felled. Once processed into the form in which it will be dried the wood should be given a prophylactic treatment with a good fungicide. Dipping is preferable to spraying, but if spraying is the only alternative, a complete coverage should be ensured. Indications are that the best chemical mixture is Captafol (0.4 per cent a.i.) plus Chlorothalonil (0.5 per cent a.i.).

Drying stacks should be erected with care. The site should be elevated, free draining, clear of vegetation and open to sun and wind. Bearers should be of concrete or adequately treated wood, and should be at least 500 mm high. The stack should be protected with covers which should extend beyond the stack in all directions, to a distance equal to at least one quarter of the stack height. The timber should be open stacked using treated fillets or, in the case of posts, in the form of an open crib so that air can move freely. Stacks should be marked to show the date of erection, and the material should remain in stack for a period of five to 24 weeks, dependent on whether it is sawn, quarter round or full round.

Drying and preservation schedule

Use	Material	Size	Drying Period	Solution conc. (comCCA)	Initial vacuum (-85 kPA 25 in)	Pressure (1400 kPA) (200 psi)	Final vacuum (-85 kPA 25 in)	Minimum absorption (Litres/m³)
Exposed[1]	Sawn Timber	25mm thick	5 weeks	2%	20 min	45 min	10 min	250-350[2]
Exposed[1]	Sawn Timber	50 mm thick	10 weeks	2%	20 min	60 min	10 min	250-350[2]
Ground contact	Posts	Quarter Round	12 weeks	6%	30 min	120 min	10 min	200
Ground contact	Poles	Round	26-24 weeks	6%	30 min	120 min	10 min	200

Notes:

1 Exposed to the weather but not in ground contact

2 Depending on density, e.g. minimum of 250 litres/m³ for hard high-density wood

3 For structural or high value components, solution concentrations of 3 to 4 per cent are recommended

Chapter 8

Energy from Coconut Wood Residues

Coconut wood, especially of high density, will make good charcoal. Any charcoal kiln or process is suitable. But a system using old oil drums is cheap, simple and effective. Briquetting charcoal is possible with any starchy binder such as sorghum.

Coconut wood can be used in direct fired boilers although it must be well dried before it will burn.

Coconut wood if adequately dried, can be used for gasifiers.

Energy from Coconut Wood Residues

Coconut Stems as Fuel

Coconut wood is similar to other woods in its characteristics as a fuel, though the range of densities within the stem leads to variation in the energy potential.

Less than 20 per cent by volume of an average coconut stem is suitable for conversion to timber, and the remainder, together with sawmill residues, is readily usable for charcoal making and for the production of energy.

Charcoal Making

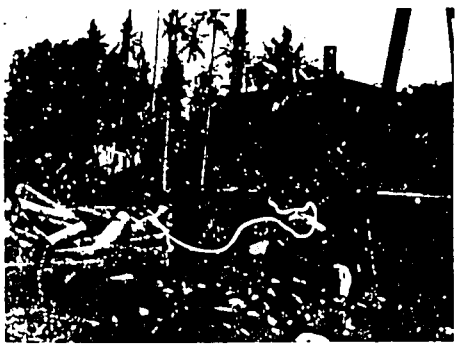
Many rural areas in the Asia-Pacific region make use of the traditional earth pit for conversion of coconut stems and shells to charcoal. The method requires only a small investment in tools and equipment but, because of the lack of control of the carbonization process, yields are low and the quality of charcoal inferior.

More modern methods, at various levels of sophistication, are now being applied. A portable metal kiln was constructed for the Philippine Coconut Authority in Zamboanga to a design similar to the kiln developed by the United Kingdom Tropical Products Institute. Yields from this kiln averaged 20 per cent recovery.

The approximate chemical analysis of the charcoal is: fixed carbon 70 per cent; volatile combustible matter 16 per cent; moisture content 12 per cent; ash 2 per cent.

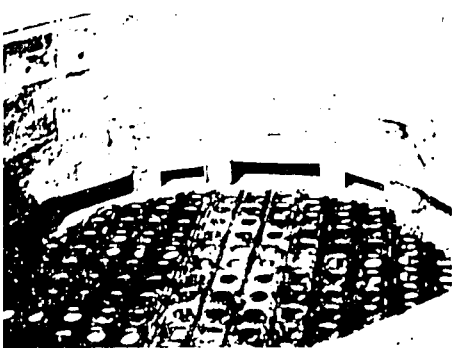
Tests were undertaken on another kiln based on the TPI Mk IV design with a volume of eight m^3. The main difference in design was that instead of being of all-metal construction, the bottom cylinder was made of two layers of brick. The inside layer was firebrick lined with clay, while the outside layer was the standard building brick. This kiln had eight openings, four covered with chimneys which could be rotated from opening to opening to provide varying air flows to facilitate even burning and carbonization. The material used for charcoal was waste material from logging, and some waste slabs from sawmilling.

In Tonga, a simple kiln is constructed from a 44 gallon drum. A slot 14 cm wide and 73 cm long is cut along one side. The billets of cocowood are loaded through this slot a little at a time. The kiln is started by lighting a fire on the bottom, with the slot facing horizontal to the ground. As the billets start burning the kiln is tilted so the slot is gradually moved to a vertical position, billets being added until the kiln is full. When the billets are burning well, the cover is put on, and the kiln turned until the slot is once again facing the ground. The kiln is left sealed until cool.



8A Zamboanga Research Centre Charcoal Kiln Exterior

Several other drum designs have been used or described, differing mainly in the number and placements of air vents and therefore of operating techniques. Measurement of the efficiency of these kilns are however often imprecise since production operations do not have consistent descriptions of the nature, weight and moisture content of the initial charges. Suffice to say that the simplicity of the drum system (steel or brick) makes it appropriate where more elaborate systems cannot be justified.



8B Zamboanga Research Centre Charcoal Kiln Interior

Charcoal Retorts

Charcoal retorts differ from kilns in that the charge is sealed in a closed chamber and the heat is supplied externally, without an initial combustion stage. The efficiency of the retort lies in its recycling of effluent waste gases from the central chamber

holding the wood block charge to the fire box. After an initial firing to begin the reaction, the gases become the fuel source to carry the reaction to completion. The charcoal conversion process is achieved with a low energy input, and pollution is eliminated. The design of the retort and combustion process ensure a consistent quality and higher yields. Industrial charcoal is produced, with an average fixed carbon content of 80 per cent, for a capital outlay little in excess of the traditional brick kiln method.

Charcoal retorts are capable of converting 11 metric tons of wood to four metric tons of charcoal in a 48-hour cycle including loading, firing, conversion, cooling, unloading and bagging. With the waste wood used in the initial firing of the retort, the wood to charcoal conversion ratio is between 3½ to 4:1 for air-dried wood at 20 to 25 per cent moisture content.

Charcoal Briquetting

Coconut stem charcoal has a lower fired-carbon and higher ash content than wood (and coconut shell) charcoal. Briquetting, although not necessarily increasing the fired-carbon content increases the density necessary for industrial applications, to approximate that of coke.[7]

Briquetting is the process of compressing the charcoal to form a compact, uniform mass of higher density and strength than the original material. Studies on the briquetting of charcoal from coconut stems, carried out in the Philippines using sorghum flour as a binder[8], showed that a suitable charcoal-to-binder ratio is of the order of 16:1.

Activated Carbon

Activated carbon can be made from coconut wood charcoal by the removal of hydrocarbon tars adhering to the carbon, to create a vast network of molecular capillaries to increase and improve the absorptive power of charcoal. Activated coconut-shell charcoal can be best applied ingas and vapourabsorption because of its high density. The activated low-density wood charcoal and coconut-trunk charcoal are best suited to liquid purification.

Since coconut-shell charcoal is comparable to the so-called charcoal produced from dense trees in structural strength and low-ash content, it can be a reliable source of carbon for the manufacture of various chemicals such as carbon disulfide, calcium carbide, silicon carbide, sodium cyanide, carbon monoxide; paint pigments; pharmaceuticals; moulding resins; black powder, electrodes; catalyst reactor; brake linings; and gas cylinder absorbent.

Producer Gas - Gasifier

Gasifiers work by drying wood with heat radiating from the hearth zone at the bottom of a producer. As the wood works its way towards the hearth it turns into charcoal. The charcoal reacts with the air which is fed in through nozzles. When that takes place basic gas production starts.

The gas produced is led through a bed of charcoal which causes reduction to the main fuel gas, carbon monoxide (CO). The by-products of distillation such as tar are cracked to form hydrogen and the final moisture of producer gases is:

Combustible gas	
Carbon Monoxide	20 per cent
Hydrogen	19 per cent
Methane	1 per cent
Non Combustible gas	
Carbon dioxide	9 per cent
Nitrogen	51 per cent

Heat energy to mechanical energy:

5 kg of wood/hour yields approximately 6 hp/hour (Engine)

5 kg of wood/hour yields approximately 4 kW/hour (General)

The hearth module is the actual gas-making component of the system and is supplied as the standard stock item. All other components of a particular gasifier system are custom made or assembled from stock parts to suit the purchaser's special needs, whether they are for heat generation or for engine fuelling. Where producer gas is intended for use in process heating operations such as timber drying and gas cooling, filtration need not be employed. Where producer gas is intended for use in engine fuelling operations, cooling and greater purity of the fuel gas is essential and therefore appropriate equipment is added to the plant to obtain this result.

Ethanol from Coconut Waste Products

The production of ethanol from grains and sugar-rich crops has been practised for thousands of years. Toddy and arrack from the sap of the coconut palm are a well-known example.

The alcohol has been used mainly for drinking, for medical purposes and sometimes for chemical production. Cost of production has not been an issue. Modern techniques have however lowered costs of production and in some countries ethanol is already produced for energy use from prime agricultural products.

Considerable advances have been made in the use of cellulosic materials for ethanol production. Recent testing of coconut utilization of the softer inner core of the stem has shown promising results.[11]

Power Generation Systems

Mechanical and electrical power generation fuel led by wood, straw and similar materials has been practised commercially for over one hundred years. The earliest systems used steam and hot air external

combustion engines. More recently internal combustion engines have been used in conjunction with various methods of converting the fuel to combustible gas.

Other systems incorporating closed cycle gas turbines and engines are being developed and could come into regular use in the future.

The main factors limiting the use of wood or woody material as fuel for power generation have been economic rather than technical and thus any evaluation of the potential must be concerned primarily with the economics of the systems, including saving of foreign exchange. The economics are determined by factors such as fuel costs, capital cost, plant efficiencies, labour costs etc.

The low cost of oil fuels and their simplicity of use were the major reasons why there was a move away from solid fuels at the beginning of this century.

At present there are two basic systems which can practically and economically be applied to generating power from coconut wood and other wood wastes. One system is burning with or without gasification and generation of steam to operate engines or turbines. The other system is direct gasification from wood or charcoal to produce a fuel suitable for use in internal combustion engines.

The degree of complexity, the safety hazards and capital cost are similar for both burning and gasification plants. The most significant differences are in the fuel consumption rates. Gasification direct from wood uses about half as much wood as either a direct burning system or charcoal-making followed by gasification system, to produce the same energy output. The steam engine has however advantages in simplicity of operation and reliability.

Establishment and Operation of Power System

There are many possible reasons for considering power generation based on wood. Before commencing such a project it is necessary to consider many factors in order to be sure that the project will be profitable and desirable.

The higher capital cost of wood-fuelled systems as compared with diesel systems result in higher fixed costs. This makes it very important to achieve high utilization. Greatest effectiveness can be achieved from a wood-fuelled system where there is a steady load without large peak demands and the plant is used to supply the base load demand of an existing system. This latter condition can be planned so that the load is shared between the wood and the diesel plants in such a way that the wood system generates at or near full output most of the time. The use of diesel is restricted to those times where the demand is high thus making maximum use of its facility for quick start-up and shut-down whilst dramatically reducing total diesel fuel consumption.

Electric power must be reliable. Many consumers need continuous supply or a very low incidence of failures if losses or hazards are to be avoided. For example, fish freezers at a base port, hospitals and large industries may be seriously jeopardised by power shut downs.

A wood-fuelled plant which is not connected to another system will usually require some duplication of equipment and some diesel engine stand by capacity, although the smallest systems such as for villages, may not need these features.

Because of the bulky nature of wood fuel, it is important, in locating a plant, to minimise roading and transportation costs. Thus power plants will generally be near the fuel source rather than close to the consumers to be supplied.

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Footnotes

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DEVELOPMENT OF BEVERAGE TYPE SIMULATED DAIRY MILK BASED ON COCONUT SKIM MILK

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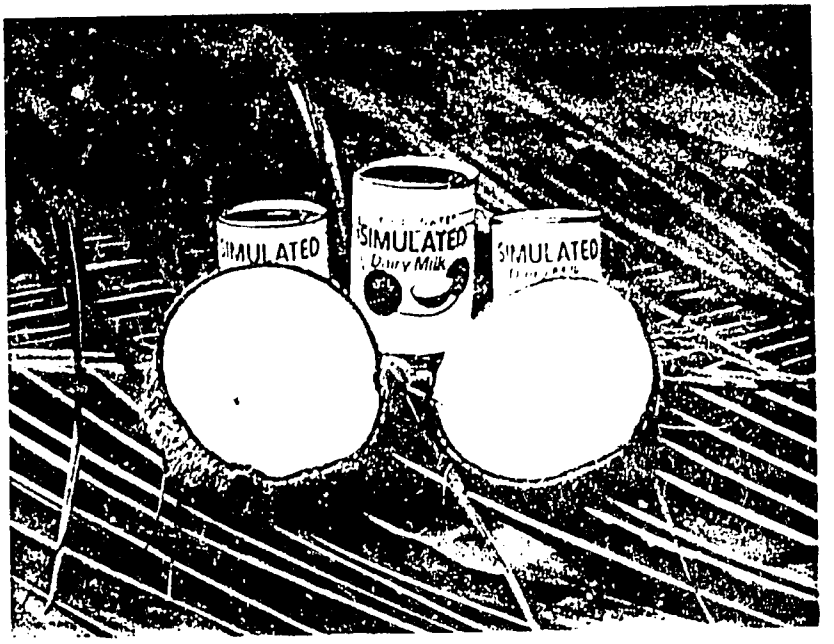

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ABSTRACT

A formulation/process has been developed and standardized for a beverage type simulated dairy milk based on coconut skim milk. The developed vegetable-based milk formulations, the unflavored "Coco Gatas" and the chocolate flavored "Choconut" were stable milky dispersions which received satisfactory scores (Hedonic Rating) as beverages or when incorporated in some food preparations from a panel of evaluators randomly picked from the Food Research Program Staff.

Protein, the most valuable component in the starting material was concentrated by heating to 98°C, decanting portions of whey and blending to redisperse coagulated protein. Sucrose, fat, cocoa, stabilizers were added then blended, pH adjusted to 6.4-6.6, pasteurized at 70°C for 10-15 minutes, homogenized, cooled and packed in sterile milk bottles or .004 mm polyethylene bags.

Determination of proximate compositions, pH, percent titratable acidity, specific gravity and total solids showed the end-products to be comparable to their dairy milk counterparts. Beverages were free from coliforms and total plate count of about 200-360 col. per ml indicating samples to be safe for human consumption.

Samples stored at refrigerated temperatures (3-3°C) kept well for seven to ten days. Samples boiled or autoclaved at 10 psi (115°C) for 20 minutes exhibited no appreciable coagulation nor separation nor significant browning.

INTRODUCTION:

The coconut (Cocos nucifera, Linn), available in abundant quantities all year round is produced locally at approximately 13 billion nuts per year. It is considered as the cheapest source of energy and nourishment for the Filipinos. It is a potential source of plant protein because it is widely grown. It was reported that mass consumption of coconut protein could be a means of ameliorating protein malnutrition in the country (Lava, 1941). Consequently coconut utilization has been the subject of interest of various food researchers for so many decades now.

An important component of the coconut which has undergone extensive research is the coconut skim milk (CSM). This is a liquid by-product obtained from fresh coconuts by aqueous extraction followed by centrifugal separation of the cream. It is used to a limited extent as raw material for the manufacture of dehydrated coconut protein isolate. The CSM was reported to contain most of the proteins of the original milk and is considered a high protein food for child feeding program. It has actually been used by Walker (1926) and Maniquis (1969) for feeding babies.

CSM was found to be of good nutritional value and contains all the principal proteins present in human milk (Brosel, 1963; Banzon, 1982). CSM likewise has the following excellent attributes: it contains proteins of good biological value; produces soft curds enhancing its digestibility, can support growth and maintenance and has no anti-nutritional substances.

The Philippines has been importing a great deal of non-fat dried cow's milk (NFDM) and/or dried whole cow's milk but due to its prohibitive cost, there has been a continuous attempt to produce milk simulating that of cow's. Locally, we have filled milk or product resembling milk made by combining reconstituted NFDM with fat other than butter-fat (coconut fat is normally used together with corn oil to increase linoleic acid content); toned milk or reconstituted NFDM combined with local milk from local breed or with non-dairy milk of plant origin; coffee whitener, soymilk, peanut milk and other products resembling milk but of non-dairy origin. Consequently, the development of a simulated dairy milk from an indigenously available protein source, particularly the widely grown coconut, may replace or provide a cheaper alternative to the imported dairy milk primarily in regions deficient in protein.

The development of a milk-like product based on coconut skim milk as an alternative to the imported dairy milk will help improve the nation's economy and provide maximum utilization of coconut protein in the country. Nutritious milk-like product will be provided for those who can not obtain conventional dairy milk because of insufficient supply or prohibitive cost. Furthermore, the development of this product will provide a technology for the utilization of CSM, a by-product of the wet processing of coconuts. Developed product may be used in bakery products, confectioneries, desserts/ice creams, beverages, dishes or may be taken as a nutritious drink.

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EXPERIMENTAL PROCEDURE:

Based on previous studies and actual experiments, the following procedure was followed in the preparation of CSM:

Coconut meat from mature nuts was comminuted using a mechanical coconut grater. An equal amount of hot (65-70°C) tap or fresh coconut water or a combination of both was used as extracting liquid. Coconut milk was expressed with extracting liquid for about 5-10 minutes. The resulting milk was then centrifuged to separate CSM from the cream. CSM was collected in a clean receptacle and heated immediately to 90-98°C using live steam to coagulate the proteins. Coagulated protein was then allowed to settle and portion of the whey was decanted to concentrate protein to about 3%. Coagulated protein was redispersed by blending in an osterizer or colloid mill.

Series of formulation studies for milk and chocolate beverage were conducted using starting formulations recommended for milk substitutes. Recommended process for milk substitutes was adopted and/or simplified. Sugar, fat, cocoa, stabilizers, neutralizing salts were added to the concentrate at the most economical but effective levels required to perform the desired functions. Formulations were tested for stablility, physicochemical properties (TSS, pH, specific gravity), proximate composition (protein, fat, ash, carbohydrate) and organoleptic qualities. Results of the sensory evaluation tests were analyzed statistically.

Holding pasteurization for 10-30 minutes at 70°C was applied to improve keeping quality. Milk was homogenized at 2500 or 5000 psi following heat treatment, cooled rapidly to 8-10°C in an ice bath, filled aseptically in sterile milk bottles or in opaque white polyethylene bags with 0.004 mm thickness. Stability, sensory evaluation tests and microbiological examination (viable and coliform counts) were conducted to assess the efficiency of the heating or homogenization treatment given the product and its effect on the organoleptic quality.

TABLE 1. Average Acceptability Scores* for a trial formulation of Milk Beverage as affected by kind of extracting liquid

Extracting Liquid	Acceptability Scores
tap water	6.7
coconut water	6.0
combination (30% coconut water 70% tap water)	6.5

* based on 10 panel members

Developed products were subjected to storage studies at refrigerated conditions (3-8°C) for purposes of checking behavior of product on storage for a period of one to two weeks. Products were tested for physico-chemical (pH, percent titratable acidity, stability tests) and organoleptic properties. Microbiological tests for viable and coliform counts initially and at twenty-four hour intervals for a period of one to two weeks were conducted.

Studies were done to determine effects of heat on the organoleptic quality of developed products packed in no. 300 x 400 tin cans, exhausted, sealed then autoclaved at 10 psi (115°C) for 20 minutes. Developed products were also incorporated in some food preparations such as bakery products confectioneries, desserts, beverages and evaluated for acceptability.

RESULTS AND DISCUSSION:

Use of coconut water as extracting liquid to avoid wastage of essential nutrients gave an end product with a marked coconut flavor typical of young coconut (buko) with milk and sugar. It increased susceptibility to souring as revealed by a marked decrease in pH and changes in odor and viscosity after 12 to 16 hours standing at refrigerated temperature. Statistical analysis revealed that samples using tap water and samples using 30% coconut water and 70% tap water* were not significantly different in terms of acceptability. Results are shown in Table 1.

Preliminary studies conducted on the use of parings or brown meat indicate no deleterious effect on the organoleptic quality of experimental samples. Parings (13% of total meat) were utilized to increase yield of milk and avoid wastage of essential fatty acids.

Pre-heating CSM to 98°C to coagulate proteins then mechanically breaking the curds gave an assurance against coagulation problems in the sterilized end-products. Coagulum obtained was larger and the whey clearer than that obtained at 90°C. Ninety five percent of the total proteins was reported to be retrieved at 98°C (Birosel, 1968). Thirty percent whey was decanted to concentrate protein to about 3%. The concentrate had the following average proximate composition: 6.5% TSS, 2.6% protein, 0.2% fat, 0.7% ash and 3.0% carbohydrate.

Previous trials of concentrating raw CSM by vacuum evaporation at 55°C to proper solids content was rather costly and uneconomical because the initial concentration of protein in the starting material is only 2% and much energy had to be expended. Souring was observed even after 30 minutes pasteurization of raw CSM at 60°C. Furthermore, there was no assurance against coagulation in the sterilized end product.

Different levels of both sugar and cocoa were added to the concentrate basically following levels used in commercial practice. 0.8, 1.0 and 1.2% cocoa were tested and evaluated. Statistical analysis indicate a significant difference among samples in terms of color, taste and acceptability. However, 1% level was adopted for economic reasons as it was effective in giving proper shade of brown. Sugar levels of 3, 3.25, 3.5, 7, 7.5, 7.8 and 8.0 percent were evaluated and scores were analyzed statistically. 8% and 3.5% levels were adopted for chocolate and milk beve-

* Approximately 17% of the whole coconut is water which is about 30% of the meat.

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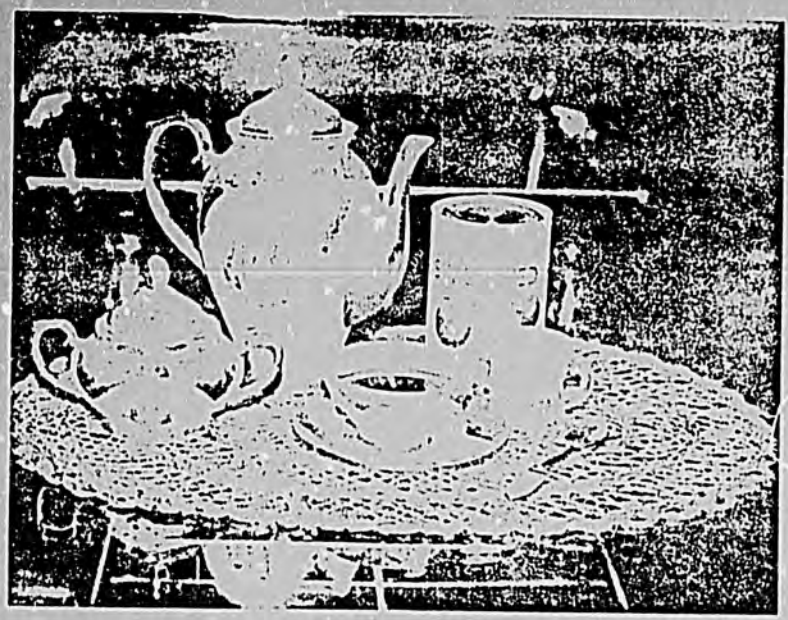

rage, respectively. Lactose, dextrose and dextrin were tested but were not considered in later trials due to cost and/or the lactose intolerance problem. Hydrogenated coconut oil added to give a total fat of 2% was used due to certain objections to coconut cream which was used in preliminary trials. The inherent coconut odour and flavour were pronounced in the finished products thus, acceptability, odour and taste scores were significantly lower.

Sodium caseinate, recommended in imitation milks to assist in structural development by imbibing large amount of water and suspending disperse particles (Arenson, 1969) was tested at 0.2 to 0.5% levels. Efficiency in stabilizing the structure was assessed by visually observing changes on storage at refrigerated condition and by determining freeze thaw properties for a period of 4 to 5 days. Destabilization of structure was reflected by settling of particles i.e. precipitated coconut proteins and/or wheying-off. The use of 0.3% sodium caseinate in both beverages provided protection against syneresis or wheying-off and sedimentation of redispersed coagulated coconut protein. Some carrageenan-based stabilizers were tested but were found ineffective in stabilizing the structure.

Sedimentation of cocoa particles in chocolate beverage utilizing natural cocoa powder was controlled with the use of 0.02% RPG, a calcium carrageenan specifically designed as suspending agent for chocolate drinks.

Emulsifiers added to improve dispersibility of fat were evaluated for their efficiency in preventing oiling-off or oil-water separation. Homogeneity test recommended by Jacobs (1958) was followed. Emulsifiers tested were Atmos 150, Tween 60 and Palsgaard 586 at different levels of use recommended by their respective manufacturers. Atmos 150 and Tween 60 at effective levels of 0.05 to 1.0, respectively, imparted a bitter after-taste in experimental samples which were rejected by the panel. Minimum amount of Palsgaard 586 sufficient to prevent oiling-off was determined. Milk and chocolate beverage were effectively stabilized at 0.08 and 0.06%, respectively.

pH was adjusted to 6.4-6.6 to simulate pH of dairy milk. Studies were done to determine effects of three common salts namely: sodium bicarbonate, sodium citrate and calcium phosphate on the organoleptic quality of experimental samples. Comparative results (Table 2) indicate preference for the bicarbonate treated sample. Statistical analyses of numerical scores for acceptability and taste of bicarbonate treated samples showed significant difference from the rest of the samples at 5% level of probability. Sodium bicarbonate increased the pH to the recommended level with the least amount of use.

Holding pasteurization for 10 minutes for milk beverage and 15 minutes for chocolate beverage at 70°C were found adequate. Samples were stored at refrigerated temperatures for one week and changes in appearance, odour, pH and microbial load were observe to determine adequacy of pasteurization. Initial microbial count was 200 to 300 colonies per ml and average viable count was 14,000 bacteria per ml. compared to standard count for pasteurized dairy milk*. There was no souring and no abrupt change in pH for 7-10 days. Test for presence of coliforms was negative. Pasteurization for 10 minutes for milk beverage and 15 minutes for

* Viable count of not over 20,000 bacteria per ml; coliform count of 10 colonies per ml (Frazier, 1972).

TABLE 2. Panel Mean Scores for Milk Beverage treated with common neutralizing salts at optimum levels of use

	Treatment		
	Sodium Bicarbonate	Sodium Citrate	Calcium Phosphate
color	6.7	7.1	6.9
odour	6.5	6.5	6.3
taste	7.1	5.5	5.7
consistency	6.6	6.8	6.5
acceptability	6.4	5.7	5.5

pH 6.4

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TABLE 3. Standardized Formulations of Beverages

Ingredient	Milk Beverage	Chocolate Beverage
	percentage	
CSM concentrate	100.00	100.00
hydrogenated coconut oil	2.1	2.1
sucrose	3.5	8.0
sodium caseinate	0.3	0.3
paalsgaard 586	0.08	0.06
cocoa powder		1.0
RPG		0.02

Percentage based on the weight of CSM concentrate

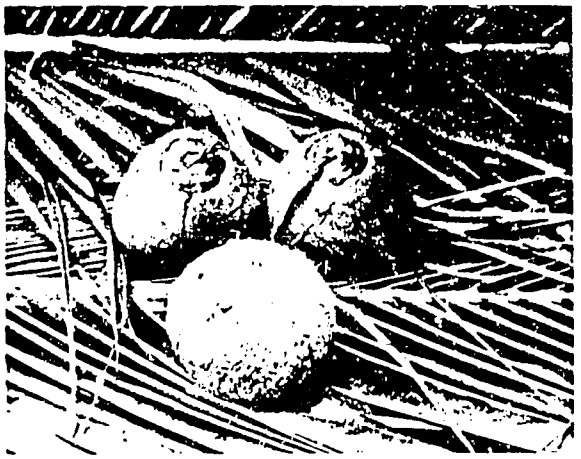

TABLE 4. Panel Mean Scores* for Milk Beverage and Chocolate Beverage

	Milk Beverage	Chocolate Beverage
color	6.5	7.2
odour	7.0	7.0
taste	6.6	6.7
consistency	6.6	6.8
general acceptability	6.6	7.1

* based on 12 panel members

TABLE 5. Proximate Composition of Milk Beverage and Cow's Milk

	Milk Beverage	Cow's Milk
	Percentage	
total soluble solids	12.0 - 12.5	12.0 - 13.5
fat	2.0 - 2.4	2.0 - 3.0
protein (N x 6.25)	2.5 - 3.0	2.5 - 3.5
carbohydrates	7.0 - 7.2	6.0 - 8.0
total minerals (ash)	0.6	0.6 - 0.7
calories	56/100g	60/100g

Results are the average of 6 8 trials

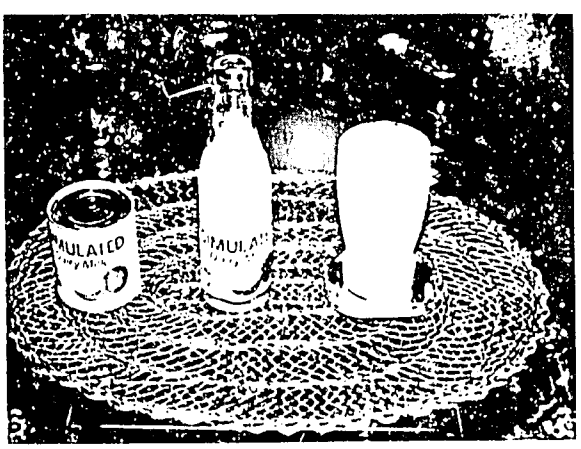

TABLE 6. Proximate Composition of Chocolate Beverage and Commercial Chocolate Drink

	Chocolate Beverage	Commercial Chocolate Drink
	Percentage	
total soluble solids	17.5 - 18.0	18.0 - 19.0
fat	2.0	2.0 - 3.0
protein (N x 6.25)	2.0 - 2.4	2.0 - 3.0
carbohydrates	12.0 - 13.0	12.5 - 13.5
total minerals (ash)	0.7	0.7 - 0.74
calories	80/100g	85/100g

Results are the average of 6 8 trials

TABLE 7. Physico-Chemical Properties of Developed Products and Dairy Milk

	Milk Beverage	Cow's Milk	Chocolate Beverage	Commercial Chocolate Drink
pH	6.6	6.4 - 6.6	6.4	6.4 - 6.6
titratable acidity*	0.11%	0.1 - 0.26%	0.16%	0.14 - 0.20%
specific gravity**	1.04	1.032	1.05	1.04 - 1.05

* As lactic acid

** at 20°C Est 20°C

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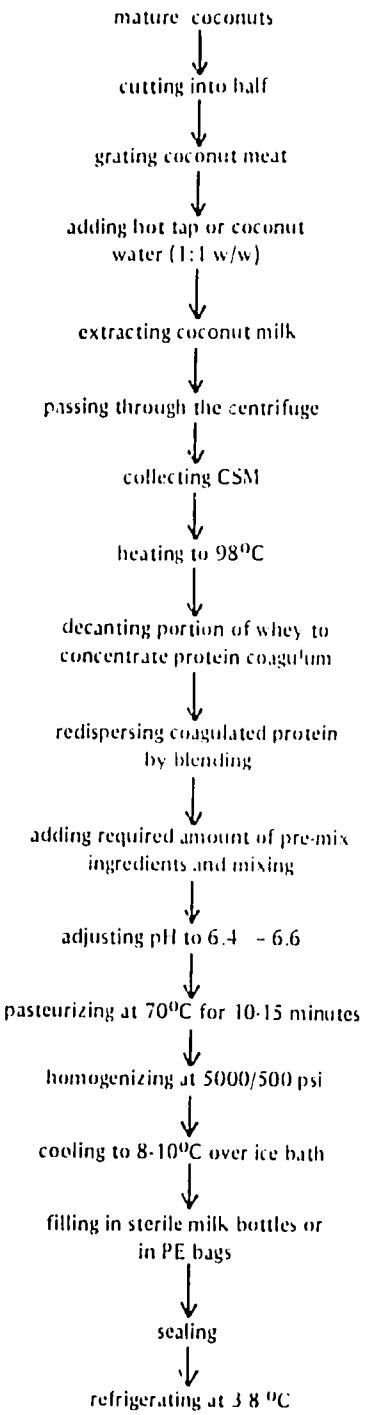
FIGURE 1. Schematic Diagram of Process for Beverage Type Simulated Milk based on Coconut Skim Milk



chocolate beverage reduced the microbial load by 95 to 98%. Rapid cooling over ice bath after homogenization may have contributed to the destruction of microorganisms which survived the heating treatment aside from providing added stability.

Based on homogeneity test, homogenization at 5000/500 psi (1st and 2nd stage, respectively) was found necessary to achieve a more uniform and stable end-product. Statistical analyses showed significantly higher scores for color, consistency and general acceptability than in samples homogenized at a lower pressure of 2500/500 psi. Use of blendor or colloid mill as substitute to the homogenizer was found ineffective.

Developed formulations are shown in Table 3. Schematic diagram of process is presented in Figure 1. Unflavored beverage had milky white color with slightly brownish tinge which was not objectionable to the panel. Soy or peanut milk commercially available are darker in color. Milk beverage had pleasing slight coconut odour. It possessed inherent coconut flavour generally described by the panel as slight to moderate. The chocolate beverage was described as free from any coconut flavour. Beverages were free from off-flavour and odour. Both products imparted a smooth mouthfeel. Table 4 shows the panel mean score for both products. Tables 5, 6 and 7 shows the proximate analyses and physico-chemical properties (pH, percent titratable acidity, specific gravity) of developed products in comparison to dairy milk.

Studies were undertaken to determine effects of heat treatment upon the quality of developed products. When boiled at 100.3-100.5°C, beverages exhibited scum formation which naturally occurs when dairy milk is heated. Continued boiling of milk beverage for about 15 minutes resulted in progressive darkening. Milk and chocolate beverage autoclaved for 20 minutes at 10 psi (115°C) were rated highly acceptable. No sedimentation, oiling-off nor coagulation were observed. Canned samples stored for almost two years were negative for flat-sour organisms and anaerobes.

Studies were conducted to determine effects of added flavoring materials on the organoleptic qualities of milk beve-

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rage. Natural and artificial flavorings tested were *pandan*, vanilla, strawberry, coffee and caramel. Most of the flavoring materials increased the palatability of milk beverage.

Studies were likewise done on vitamin A and D and calcium supplementation. However, these were discontinued not only because of the prohibitive cost of added vitamins and minerals but also because of observed variable losses of vitamins during processing and/or storage and the poor solubility of calcium as reported by researchers working on milk substitutes. Studies have to be done on establishing measures in the preservation of vitamins. One limiting factor in milk substitutes fortified with vitamins and minerals is the fact that the price may be higher than that of dairy milk. Furthermore, the equipment used are sophisticated e.g. HTST pasteurizer or UHT sterilizer to assure preservation of vitamins.

Beverages were incorporated in the following food preparations: pan cake, vanilla ice cream, gelatin, nougat, *pastillas*, white cake and milk topping. Control samples utilizing dairy milk were also evaluated. Samples except for nougat, *pastillas* and topping were comparable to that with dairy milk in terms of over-all quality. Nougat, *pastillas* and topping utilizing milk beverage had pleasant coconut odour and flavour. Candies and topping were coffee brown in color but received high acceptability scores. No coagulation, oiling-off nor sedimentation were observed. Table 8 shows the scores for coffee, ice cream, gelatin, pan cake, white cake and milk topping prepared with milk beverage.

SUMMARY AND RECOMMENDATIONS:

A series of experiments has been conducted in the development and standardization of formulation and process for a beverage type simulated dairy milk based on coconut skim milk. Coconut skim milk was heated to 98°C to coagulate the proteins. Portion of the whey was simply decanted. Coconut skim milk was blended to redisperse coagulated proteins. Required amounts of pre-mix ingredients (sucrose, fat, stabilizer, cocoa) were added to the concentrate at the most economical but effective level. pH was adjusted to 6.4 to 6.6 with sodium bicarbonate. Mixture was then pasteurized, homogenized, cooled and packed aseptically in milk bottles or in polyethylene bags.

The chocolate flavoured (Choconut) and the unflavored (Coco-Gatas) received high acceptability scores from a technical panel when taken as is or when incorporated in the following food preparations as substitute to dairy milk: milk nougat and *pastillas*, vanilla ice cream, gelatin, pan cake, white cake, milk topping and coffee. Developed products approximate commercial dairy milk counterparts in: proximate composition, pH percent titratable acidity, specific gravity, microbial load and shelf life. Both products are stable milky dispersions even when boiled, autoclaved at 10 psi (115°C) for 20 minutes, frozen for 4-5 days or allowed to stand at refrigerated temperatures (3 to 8°C) for seven to ten days. Developed products are at least 35% lower in price than the commercial pasteurized dairy milk.

Heat penetration, thermal death time studies and process calculations to establish required processing schedules for product packed in tin cans are currently going on. HTST or UHT applied in dairy milk manufacture is a more conservative treatment that may apply to developed formulations. Consequently, production may be run in a commercial dairy company using the conventional processing equipment. A private dairy company has expressed willingness to assist in producing UHT treated products in tetra-briks. Vitamin supplementation may therefore be applied to this type of product.

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TABLE 8. Panel Mean Scores* for Food Products with Milk Beverage

	Color	Odour	Taste	Texture/ Consistency	General Acceptability
hot coffee	6.9	6.8	6.8	6.8	6.8
vanilla ice cream	6.5	6.5	6.2	6.7	6.5
gelatin	7.3	7.2	7.3	7.2	7.3
pan cake	7.1	7.0	7.1	6.8	7.0
white cake	7.3	7.5	7.3	7.4	7.5
milk topping	7.1	7.4	7.5	7.2	7.5

* Based on 10 panel members

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