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08435

Distr.
LIMITED

UNIDO/IOD.212
7 September 1978
ENGLISH

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

FOOD PROCESSING FOR EXPORT: PAPAIN, PAPAYA AND PUREE*

An agro-industrial pre-feasibility study

Prepared by a consultant for the Office of the
Board of Investment, Government of Thailand

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id.78-5525

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ABBREVIATIONS USED IN THIS REPORT

ASRCT -- Applied Scientific Research Corporation of Thailand located next door to Kasetsart University, about 15 km north of Bangkok.

Baht(฿) -- Unit of Thai currency valued at about U.S.$0.05

CIF -- Cost insurance and freight

cm -- centimeter, 0.39 inch

ENE -- East northeast

FOB -- Free on board

GATT -- General Agreement on Tariffs and Trade, an international agreement to bring down customs duties

GSP -- Generalized System of Preferences; this is a United States trade program whereby 2,700 different types of products are allowed to enter the U.S.duty free from developing countries

ha -- Hectare, 2.471 acres and 10,000 square meters

kg -- Kilogram, 2.2046 lb

kl -- Kiloliter, in the case of essential oils, 1 kl equals about 0.9 metric ton; 1 kl is 6.29 bbls

km -- Kilometer, 0.621 miles and 1,000 meters

MGH -- Mushroom growing house, i.e. building for cultivation mushrooms in specially prepared compost or earth beds

MT -- Metric ton, 2,204.6 lbs and 1,000 kg

NNW -- North northwest

Rai -- Thai unit of area measurement, 6.25 rai = 1 hectare and 0.4 acre and 17,222 square feet

RTG -- Royal Thai Government

SSW -- South southwest

TPI -- Tropical Research Institute, a British Government agency in London.

I. INTRODUCTION

In a determined effort to promote and diversify investment in the agro-industrial sector, the Government of Thailand has undertaken a series of studies relating to prime agricultural commodities being currently produced in the country, from which a number of selected products have been examined in some detail and presented as investment opportunities to encourage the interest of potential foreign and domestic investors.

This report provides a source of information concerning the availability, suitability and cost of raw materials to produce a specific product, the cost of operating in Thailand and a market analysis for the product either for local consumption, import substitution and/or export. Investigations were carried out to assess the economic viability of the project, it's impact on the economy of the country and the possibilities it offers for the creation of employment opportunities.

Consideration has been given to the requirements of this particular project for investment incentives in order to show a sizeable net return on invested capital.

Information has been provided about Thailand and it's economy with a summary of the current Five Year Plan, the investment climate and related laws, and other basic information to assist a potential investor.

As an annex to this pre-feasibility study, there is a Product Area Report that identifies a wide range of possible processed and semi-processed products, and in general, evaluates the domestic and foreign markets for them.

In selecting the product to be given priority for study as an investment opportunity, the socio-economic effects, technical feasibility, availability of labor supply, availability of,

or plans to provide, the required infrastructure, together with restraints on pollution of the environment, were taken into consideration.

This pre-feasibility and product area study is only intended to bring this potential opportunity to the attention of an investor, who it is anticipated would use it as a base to launch a more detailed feasibility study that would be required before making a decision to establish or expand this product industry in Thailand.

These studies have been funded in part by a loan from the United States Agency for International Development, (USAID), and the Board of Investment under whose direction they are being carried out. The BOI is being assisted by Chemonics International Consulting Division of Early California Industries Incorporated in association with Checchi and Company, both of Washington D.C. The Board of Investment would like to take this opportunity to thank the team of Consultants and USAID for their assistance in carrying out these studies.

This pre-feasibility study and annexed product area study, was prepared by Harvey A. Scheel, (Food Processing Specialist), Frank L. Turner (Feasibility Analyst), Alfred A. Strauss (Financial Analyst) and Peter M. Amcotts (Project Manager).

Grateful acknowledgement is made of the assistance given by many Thai Government officials, United Nations and U.S. offices and libraries, and by industrialists and others in the private sector.

SUMMARY

FOOD PROCESSING FOR EXPORT-FRUIT & VEGETABLES
PRE-FEASIBILITY STUDY AND AREA STUDY

The fruit and vegetable section of the area study on Thailand's processed food for export accompanying this pre-feasibility study, reports on the results of a survey of the existing growing and processing industry in this sector of Thailand's agro-industry. The survey revealed that domestic processing of foods presently includes pineapple canning, marine products freezing and canning, some vegetable and fruit canning, sugar refining and milk processing. There are traditional small-scale activities in canning and bottling of numerous other products.

A conclusion was reached that, although growing rapidly, processing of food for export was far below the Kingdom's capabilities and opportunities.

A total of 70 different varieties of fruits and vegetables (including mushrooms) were identified after visiting the Bangkok, Chiang Mai and other wholesale markets as follows:

Fruits:-			29
Vegetables:-	Mushrooms	7	
	Other	34	41
			70

After identifying the products, the survey addressed itself to the question: which of the 70 varieties would be the best raw material for industrial processing? To answer this question, each of the 70 products was evaluated using

the following ten criteria:

1. Is the product potentially available in large and constant volumes for industrial processing 365 days a year? (If the product is continuously available in major volumes, maximum utilization of the investors' capital investment can be assured.)

2. Is it possible to use the product as raw material for an industry which can be established on a small capacity basis in the first year and later expanded so as to minimize the investors' risk? (For example, the investment in processing facilities should be minimal in the first year, followed by a gradual expansion, based on experience, over the following four years.)

3. Is there a proven overseas market for the product in processed form?

4. Is the product a raw material for an industry which is labor intensive and can generate substantial employment, especially outside the Bangkok area?

5. Is the processing of the product likely to yield a high return for the investors?

6. Can the product be grown efficiently in Thailand's environment? (For example, the yields of tomato in Thailand are very low, about one fiftieth of the yields in the United States or Spain).

7. Can the product be used for raw material in an industry that requires a reasonable capital investment (for example, a plant to manufacture furfural from rice husks would cost $50 million or more and may therefore be too large for most foreign or Thai investors to consider.)

8. Is it possible to duplicate the processing facilities in several areas of Thailand? (For example, there could be numerous plants for processing such fruits or vegetables

that can be grown throughout the Kingdom.)

9. Is the technology for growing and processing the product well known and relatively simple?

10. Is the product relatively free of diseases and infestation from harmful pests.

On the basis of the above criteria, it was concluded that mushrooms and papaya were the products best suited to the establishment of new or increased industrial processing. These two products grow 365 days a year, the cultivation technologies are well known, the raw material is relatively disease free, and the processed products are in demand world-wide.

This Pre-feasibility study proposes a project for the cultivation and processing of papaya for export consisting of four operating divisions: (A) 2,500 rai (400 hectare) plantation, (B) fresh fruit packing plant, (C) a papain processing plant, (D) a puree factory. These four divisions comprise an operation refered to as "The Papaya Complex."

The capital investment in all four divisions would amount to $1,491,000 in Year 1 and would rise each year as more hectarage is planted and the processing facilities expanded. The total capital investment by the end of Year 5 would be $2,753,000.

Sales revenue of all four divisions would start in Year 2 after the papaya trees begin to bear fruit in substantial volume. Revenue in Year 2 would be $1,832,000 and would rise to $5,762,000 in Year 5.

The profits earned by the four divisions would be 21% on sales in Year 1, rising to 45% in Year 5. Profits on capital invested in fixed assets would be 24% in Year 2 and 95% in Year 5. These and other figures are shown in

:his summary as a consolidated statement -- Capital Investment and Projected Performance of the Papaya Complex.

Employment in the Papaya Complex by Year 5 would be as follows:

	Management	Factory Labor	Planters/ Tappers/ Pickers	Total
Plantation	25	--	35	60
Fresh Fruit Packing Plant	10	51	45	106
Papain Factory	6	11	531	548
Puree Factory	11	20	47	78
Total	52	82	658	792

The fresh fruit would be sold mainly to Japan and would be priced 30% below the C.I.F price of fresh papaya now being imported. This is necessary because Thai papaya would be a new product, markedly different from the Solo variety now imported by Japan from Hawaii. The comparatively low price is also an incentive to the Japanese importers and a pre-emptive measure vis a vis other potential producers of papaya products in Southeast Asia.

CONSOLIDATED STATEMENT, CAPITAL INVESTMENT AND PROJECTED PERFORMANCE OF THE PAPAYA COMPLEX

(US$ 000 rounded)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Capital Investment						
Papaya Plantation	620	173	185	173	181	1,332
Fresh Fruit Packing Plant	184	Nil	Nil	Nil	Nil	184
Papain	162	Nil	25	Nil	Nil	187
Papaya Puree	525	Nil	Nil	Nil	525	1,050
Total	1,491	173	210	173	706	2,753
Revenue						
Papaya Plantation	Nil	Nil	Nil	Nil	Nil	
Fresh Fruit Packing Plant	Nil	1,089	1,951	2,634	3,187	
Papain	Nil	263	392	522	656	
Papaya Puree	Nil	480	959	1,439	1,919	
Total		1,832	3,302	4,595	5,762	
Operating Cost						
Papaya Plantation	226	293	382	457	538	
Fresh Fruit Packing Plant	36	620	850	1,056	1,352	
Papain	47	147	275	350	430	
Papaya Puree	114	379	473	640	838	
Total	423	1,439	1,980	2,503	3,159	
Profit/or (Loss)	(423)	393	1,323	2,092	2,603	

II. GENERAL PROJECT DESCRIPTION. PAPAIN, PAPAYA & PUREE

A. Papaya Complex

The project proposed in this Pre-feasibility study is called the "Papaya Complex." The objective of the project is to grow and process papaya fruit under a single management. The growing of papaya would start with plantings on 492 rai (79 hectares or 195 acres); this first planting would be followed by a gradual expansion until a total of 2,460 rai[1/] are planted with papaya trees by the fifth year; with infrastructure 2,500 rai will be needed.

Each planted rai would contain 364 trees, and yield 6.6 tons of fruit annually. Output in the first year from 492 rai would be 3,250 tons. When the plantation is fully developed, in the fifth year, output would be 13,000 tons, assuming a 20% grading loss.

B. Processing

The processing operations would be physically located on the plantation premises and would consist of three separate kinds of processing: (1) waxing, treating, packing and chilling of fresh fruit for shipment in 9 kg cartons by refrigerated container to Kobe, Hong Kong and Singapore; (2) tapping papaya fruit on the trees for latex, drying the latex to make papain, vacuum packing the papain for shipment abroad for the beer, meat chewing gum, and other industries. The plantation layout and site for processing are shown in Figure 1. (3) peeling, seeding, crushing, pulping, blast freezing, and packaging in 12 kg cartons of papaya puree for the beverage, fruit juice, yogurt, and ice cream industries chiefly in the United States and Europe.

1/ 1 "rai" = 0.4 acre or 0.16 hectare.

As conceived, the project would attain 100% utilization of the fruit (except for the seeds and skin) in the following manner:

- One half the fruit would be packed for the overseas fresh market, starting with 1,626 tons of fruit in the second year year when trees have matured.
- One half of the fruit, while still tree-born, would be tapped for latex to make papain.
- The same fruit used for latex tapping would be converted to frozen puree. By the second year of the project, 1,626 tons of fruit would be used to produce 813 tons of frozen puree.

C. Project Size

The size of the project and the five-year build-up of production is designed to nearly match the size and growth of the Japanese market, and by the third year, to provide a surplus of fresh fruit for shipment to other Asian countries.

D. Special Characteristics of Project

The proposed project, unlike most agro-industry, would operate continuously without seasonal shut-downs. This is because the papaya tree produces 365 days per year permitting 312 days of factory operations at six days per week.

Flexibility is also a characteristic of the proposed project; if the fresh fruit cannot be marketed abroad, it is priced low enough to sell on the domestic fresh market. If the demand for puree rises unexpectedly, more of the fruit can be used for puree. If the demand for papain declines, more fruit can be sold fresh or converted to puree without first tapping for papain.

Another characteristics of the proposed project is step-by-step expansion rather than the creation of the entire complex at the outset. This means that production can be built up slowly in such way that policies can be changed, plantings retarded or accelerated, and the production schedule and product mix modified to suit changing market demands.

E. Organization and Content of This Report

This report is divided into five parts. The first part immediately following this section describes the papaya as a raw material and comments on growing conditions, availability, and enemies. The remaining four parts of the report deal respectively with each of the four operations or divisions of the Papaya Complex, (A) the plantation, (B) the packing plant, (C) papain production and (D) puree processing.

A financial analysis is provided separately for each of the four operations. Each of the factories is expected to show a profit in the second year of the project after the trees begin to bear fruit in volume.

III. RAW MATERIAL

A. Description and Technical Discussion

1. Species

The papaya (Carica papaya L.) has numerous sub-species, and papaya grown in one country is sometimes conspicuously different from fruit grown elsewhere. Some of the sub-species known are: Solo (Hawaiian Islands), Blue-stem, Panama Red (Taiwan), Graham, Betty, Fairchild, Kissimmee, Hortus Gold, Sunrise (Taiwan) and Mountain.

The papaya is called by a wide variety names. In English, the world papaw is commonly used in Africa. In Spanish, papaya is called fruta bomba in Cuba; in Puerto Rico, Lechosa; in Mexico, melon zapote; in Dutch, meloenboom or papaja; in French, figuier des isles, papaye or papayer; in German, baummelone or mamaobaum or melonenbaum or papaja; in Portugese, mamao or mamoeiro.

2. Flavor

An attempt to compare the flavor of the different species would be somewhat inconclusive because flavor assessment is subjective and because the flavor can vary as between fruit grown in the same area and even on the same tree. However, the two varieties grown in Thailand if ripe are sweet, melon-like in texture and are an excellent breakfast fruit or an ingredient for fruit salad.

Thai papayas tend to grow to a size and weight that greatly exceed the Hawaiian Solo variety. Thai papayas sold in local fresh produce markets typically weigh from 1 to 2 kg as contrasted with the Solo which tends to weigh from 400 to 650 grams. Thai papayas are generally of an elongated oval shape, with a rounded end at the stem and

a long, tapered end opposite the stem. The Solo tends to be less oval in shape and more bulbous. Thai varieties have an average length of 32 cm while the Solo tends to be less than 20 cm long. The Solo and the Thai varieties also differ as to the seed content; the Solo is heavy with seeds whereas the Thai varieties have only 10 to 30.

There are two distinct sub-species of Thai papayas, the Khag Dam and the Khag Nuan. The only distinguishing characteristic is the color prior to ripening:

Khag Dam -- dark green

Khag Nuan -- light green

After ripening, both of the sub-species turn yellow and gold color, and the flavor, water content, and the number of seeds are indistinguishable.

No one is sure when the papaya was introduced to Thailand, but horticulturalists say that the papaya is probably native to Thailand and was reported in the literature of the Ayutthaya dynasty from 1350 to 1767. Others believe the tree originated in Central America. New and different varieties were brought into Thailand over the years, but none of the foreign species have survived the diseases and insects peculiar to Thailand.

3. Growing Regions

Papaya can be grown throughout the Kingdom, but some of the areas where production is known to be sizable are as follows:

Province	District
Nakhon Ratchasima	Pak Chong
Saraburi	grown throughout province
Nakhon Pathom	grown throughout province
Ratchaburi	Damnoen Saduag
Chumphon	

Figure 2 shows the geographic location of the above provinces.

4. Uses of Papaya in Thailand

Papayas are consumed in two forms, (1) as a fruit when ripe and sweet and (2) as a vegetable when it is still green.

In Northeast Thailand, consumption as a vegetable is especially common. There are three principal uses of papayas as a vegetable: (1) boiled and mixed with garlic, chili sauce, shrimp paste and fresh lime; (2) diced, cooked with chilis, garlic, cherry tomatoes, limes, fish sauce (called som tam, and is most popular in the Northeast); (3) sliced thin, boiled cooked with tamarind juice, chilis, onion, and a special curry, called kang som.

5. Volume of Production and Consumption

Most papayas grown by individual families on their own premises which assures the family of a continuous, year-round supply of either fruit or vegetable. Typically some farmers devote 10 to 20 rai (1.6 ha to 3.2 ha) to a papaya plantation. There is one farm family in Ratchaburi with a 56 rai (9 ha) papaya farm, the largest seen during the survey made for this report. However, such growers frequently change to other crops, depending on price trends in the fresh produce market. Regardless of a rise in papaya prices, the growers uproot and burn the trees when they grow too tall to harvest without mechanical pickers; this uneconomical tree height is usually attained in 19 months.

There are no official statistics on the production volume of papaya. However, on the basis of consumption per household, some estimates have been prepared

by an agricultural economist indicating that about 0.8 million tons are produced of which 10% is lost, suggesting that consumption would be on the order of 0.72 million tons. More detail is provided in Section III regarding papaya markets.

6. Growing Conditions

The papaya tree will grow satisfactorily on most soils except heavy clays. Good drainage is, however, essential. The papaya tree root system is easily damaged if the soil becomes saturated with water. The papaya tree is fast growing and therefore must have a continuous supply of plant food and moisture to insure satisfactory growth.

The papaya is susceptible to frost and sensitive to climate change. Extremes of temperatures will cause changes in the ex of the plant; therefore uniform warm temperatures are needed; high sunlight radiation is required to produce the best quality fruit and maximum yields.

For quality fruit production, it is reported that, given adequate irrigation, drier climates are better because metabolism is quicker under these conditions causing the fruit to be sweeter. Conversely a humid climate, when tapping for the latex to make papain, is preferred since under dry, hot conditions the latex flows less freely or hardens on the fruit.

7. Diseases, Enemies and Shelf Life

Papaya farmers interviewed for this report were unanimous in saying that they had very few insect or disease problems and no nematodes or fruit flies. The only difficulty they reported was from the red spider mite (rai dang)

which damages the leaves and indirectly reduces yields. The farmers said the mites could be controlled by an insecticide called V-80 mixed with lanate. However, there are other diseases which affect the fruit after harvesting but were of no concern to the farmers.

The two diseases that affect the shelf life of the fruit after harvesting are (1) black Spot and (2) Anthracnose; the latter is more prevalent and serious. Both diseases are caused by a fungus that attaches itself to the skin of the fruit while it is still growing. After harvesting, the spores penetrate the skin and the fruit begins to break down from decay.

In 1977, Kasetsart University organized a team of scientists in cooperation with the Japanese Ministry of Agriculture to study papaya (and other fruit) storage. They recommended the following procedure to control the fungus diseases: (a) spraying the fruit before harvest four times with Benlate, (b) immersing the harvested fruit for 21 minutes in a warm (48.9°C) solution of 250 PPM of Benlate, (c) coating with wax and (d) storing at 10° to 15°C. (It is probable that a storage temperature of 4° or 5°C would be preferable.)

According to the Kasetsart University findings, the above method of disease control makes it possible for the papaya to have a shelf life of 15 to 23 days. According to the FAO and the International Institute of Refrigeration (Paris, France), the maximum storage life at 4°C and 85% to 90% humidity is 35 days.

The steaming time (at 18 knots) on a container ship from Bangkok to Kobe is 8 days.

During the survey made for this report, there was no evidence of fruit-fly infestation in Thailand's papaya. This should give Thailand a future advantage in

marketing because the papaya grown in such countries as Hawaii, Taiwan and Venezuela face quarantine delays due to presence of fruit flies (Oriental, Melon, and the Mediterranean fruit flies).

B. Availability under Present Conditions

1. Volume

Unlike maize, cassava, paddy or even pineapple, papaya is not the kind of farm product that can be obtained from smallholders in large and steady volumes. Many agro-industries are established in Thailand on the assumption that their raw material can be obtained from smallholders, for example: rice mills, maize and cassava processing, the manufacture of edible oils, and some fruit and vegetable canneries.

Other agro-industries, not wishing to become overly reliant on smallholders, will produce part of their raw material on company-owned or leased land. For example, Dole Thailand, the Chiang Mai Food Complex (Eisenberg Group), and the Bangkok Feed Mill are in this category of agro-industry.

In the case of an industrial venture expecting to use papaya as a raw material, it would not be prudent to plan on purchasing raw material from small holders. This is because: (a) papaya farms tend to be small and scattered; (b) such farms could not be monitored to make sure proper latex tapping procedures were being followed; (c) fruit varies widely in size, shape, and condition, and some fruit would be suitable for fresh market sales and other fruit would be suitable only for tapping and puree; training numerous smallholders in fruit selection would be almost impossible; (d) fruit would be bruised by careless

handling en route to the plant and would then lose valuable shelf life; (e) small holders nearby would have insufficient growing capacity because they devote some of their plots to other crops; (f) farmers tend to switch from one crop to another depending on market prices.

For these reasons, the projects recommended in this report, Parts A, B, C, D, propose the use of company-controlled farm land, arranged so that the furthest trucking distance would be only 1.3 km (see Figure A-1) Further distances would increase the danger of bruising the fruit.

Sufficient land under the control of the project manager would make it possible to ship out refrigerated containers on a regular schedule. In this way, fruit dealers in Japan would be able to arrange quarantine and customs clearances by knowing the arrival schedule. This is especially important in the case of fresh fruit where the shelf life, even at 5°C, is less than 35 days.

Similarly a regular latex tapping schedule and standardized collection procedures can be assured. No metal must be brought into contact with the latex and only specially made glass or ceramic knives and cups can be used. To monitor widely scattered small holders would involve expensive training programs and complex administration.

Given the plantation size recommended in Part A, there should be no raw material shortage to meet the production schedule because latex and papaya can be harvested throughout the year.

2. Cost of Raw Material

Local costs of ripe papaya in Thailand are as follows:

Local retail markets:	$0.15 to $0.25 per kg
Bangkok wholesale markets:	$0.10 to $0.15 per kg
Buying agent near farms:	$0.05 to $0.10 per kg

Papayas bought green usually sell for 1/3 the price of ripe fruit.

The cost of fruit grown in the plantation described in Part A would decline each year over the five-year schedule of plantings, and costs per kg of fruit would change as follows: Year 1, no fruit available; Year 2, $0.09; Year 3, $0.06; Year 4, $0.05; and Year 5, $0.04.

C. Potential Changes in Production

Without the stimulus of an industrial requirement, there is little prospect of changes in the volume of papaya cultivated. The present level of output, about 3.3 million tons is likely to grow no faster than population, that is about 2.6% annually.

D. Conclusions on Raw Material

As mentioned, the only way to assure a stabilized supply of undamaged fruit will be to organize a plantation where economies of scale can reduce the cost of fruit growing and where full control by the project management can best assure quality.

PART A

I. PROJECT DESCRIPTION. PAPAYA PLANTATION

A. Land Rental Arrangements

The Ministry of Interior, Department of Public Welfare, Settlement Programming and Planning Division manages the use of certain Government-owned lands. The principle use for these lands is farming by individual families who can pay rent on the land and who meet the Ministry's criteria for health, experience, age, and credit-worthiness.

However another use of the land is for plantation farming to meet the raw material needs of agro-industry. Some precedents for this are described below.

Under the Royal Decree for Land Allocation of 2511 (1968), the Department of Welfare in the Ministry of Interior has allocated 3,200 hectares (20,000 rai) to the Thai Oil Palm Industry and Plantation Co., Ltd. This company was then promoted by the Board of Investment, and is now operating an oil palm plantation where 2,550 hectares are under cultivation in the Ao Luk District of Krabi Province in the Southern Region. Leasing of land for the oil palm project costs the company ฿10 per rai per year ($0.50 per rai or $3.12 per hectare).

The Dole Thailand Co., Ltd. in the Hua Hin District of Prachuap Khiri Khan (241 km SSW of Bangkok) is leasing some of its pineapple land, 640 ha or 4,000 rai, from the Resettlement Program of the Department of Welfare, Ministry of Interior also for ฿10 per rai per year.

The plantation proposed in this report would need a total of 2,500 rai (400 hectares) of which 2,460 rai (394 hectares) would be planted with papaya seedlings over a five-year schedule; 492 rai would be planted each year through year 5.

If the 2,500 rai of land for the Papaya Complex are leased from the Government, principal land costs to the investor will be for land clearing and for resettlement of squatters living on the land at the time of leasing.

B. Papaya Plantation Development and Layout

The ideal size of the papaya plantation should be a square area of 2,500 rai with the processing and packing buildings, the nursery, dormitories, etc. in the center (see Figure A-1). It would be desirable to divide the area into one-rai growing units for the assignment of work. Each rai could be designated by numbers or letters.

There would access roads for vehicles to pick up harvested fruit and for agricultural equipment, such as sprayers to maneuver.

C. Tree Spacing

Papaya trees planted 364 per rai would be on a staggered pattern (see Figure A-3). There would be 14 trees at 3 meter intervals in one direction and 28 trees at 1.4 meter intervals in the other direction. The staggered pattern will allow the maximum sunlight to reach the fruit. (If later on, guava trees are planted, 35 trees per rai, they can be interplanted with the papaya as a nurse crop until the guava mature in five years, and would then stand

by themselves after the papaya trees are cut down.)

D. Papaya Culture

The plantation should start with local varieties of papaya and at the same time test the "Solo" variety from Hawaii which is said to yield approximately 36 kg of fruit per tree per year, 59% more than the 22.7 kg of the local varieties. (There may be other high yielding varieties available from Taiwan or the Philippines which also should be nursery tested.

In evaluating the Solo, or any other variety, care should be taken to thoroughly test the resistance to disease because early research in Thailand is reported to have found the Solo vulnerable to local pests and diseases.

II. AGRICULTURE

A. Papaya Seed

Papaya plants are propagated from seed. The seeds would be taken directly from a local variety papaya selected for its shape, papain yield and fruit quality. Seeds removed from a fresh papaya would be planted directly without removing the gelatin-like coating surrounding each seed. Fresh seeds germinate within 10 to 14 days.

If seeds are to be stored, the gelatin-like coating must be removed. The seeds would be washed in clean water to separate the pulp and then kept in a cool, dry room in air-tight containers.

B. Planting Methods

The papaya may be planted directly in the field, or seedling plants may be grown in seed flats (i.e. wood or plastic tray) tin cans, or paper bags. It is recommended

that the seeds be germinated in flats to be transplanted into fields.

If the soil has lain fallow for a number of years, the land would be cleared of scrub growth, trees, bushes, and grass and then plowed and disced and lime and fertilizer applied.

C. Growing Seedlings for Transplanting

The seedling flat would be filled with clean soil that has been steam sterilized or chemically treated with methyl-bromide to destroy organisms. The seeds would then be spread over the soil and covered with about 0.5 cm or more soil.

A week after the seeds have germinated, the seedlings would be transplanted into individual pots or cups again using sterile soil. For growing seedlings, care should be taken that no soil should be used that had previously been infested with nematodes. Precaution must be taken that young seedlings are not destroyed by powdery mildew or mites (see disease and insect control following.)

D. Transplanting

When transplanting seedlings from plots to individual pots the seedling should be at the two leaf stage or about one week old.

Fifty percent shade (by using loosely-woven reed cover) should be provided to prevent the young seedlings from wilting before becoming established in the pot. Shade should be removed in about two weeks after transplanting into pots. Two or three weeks after the shade is removed, the seedlings should be ready for field planting. They should then be approximately 10 cm tall.

The field soil should be in a moist condition to accept the transplants. Two or three plants are set in a cluster at each location where a tree will ultimately grow as previously described in Figure A-3. The seedlings should be approximately 15 cm apart. The need for two or three seedlings at one place is to ensure that there will be at least one hermaphrodite tree in each location.

The soil at the bottom of the hole is mixed with double or triple super-phosphate. The seedlings would then be set in the hole and placed at a level that is slightly deeper than they were in the pots. The seedlings should be set in the soil firmly.

E. Thinning

Thinning in the field occurs as soon as the papaya flowers are visible and are large enough to determine whether a seedling is a hermaphroditic or female tree. Trees at the stage are about five months old. Only one hermaphroditic papaya tree is selected and allowed to grow at a single location. In the event that all of the papaya seedlings in one location develop into female trees, they are removed and a hermaphroditic tree or seedling is planted in the same location.

F. Weed Control

Shallow cultivation with a spring tine cultivator is recommended to destroy weeds growing between trees. Where weeds are numerous, chemical weed control may be advisable, but weed killers containing 2-4-D must not be used around papaya plants. Aromatic oil or an aromatic oil emulsion made with pentachlorophenol is a good economical weed spray. The oil is sprayed in rows directly on the weeds using a knapsack type sprayer or a power sprayer. Low pressures from 0.9 to

1.8 kg per cm^2 are best in applying herbicides. Small papaya seedlings are not sprayed with the aromatic oil.

The interval between applications of aromatic oil is about two months, or as long as three months during a dry period. An alternate material for weed control would be paraquat, in a solution of 91 to 120 liters of water per rai containing 0.51 liters of paraquat chemical.

G. Fertilization

Fertilization should begin with the application of 225 grams of triple super-phosphate and 0.454 grams of super-phosphate in the hole at the time of planting. This is followed by a small handful of 10-20-20 fertilizer spread on the surface in a circular band 10 to 13 cm from the seedling after planting. Early applications are made close to the papaya tree. On larger trees, fertilizer should placed on the soil near the outet tips of the young roots. Papayas are heavy potash feeders.

More fertilizer is applied each month after planting, using a 10-20-20 formulation at the rate of 454 grams per tree for the first six months after the sex of the tree has been determined, then 227 grams per tree per month thereafter: Total application per rai per year would be approximately 730 kg of 10-20-20 fertilizer.

H. Papaya Diseases and Insect Pests

Diseases can reduce the yield and marketability of papaya. A plant pathologist should be constantly alert to observe disease infection. A systematic spraying program is essential for disease prevention and control, including four sprays of Benlate at 7-day intervals before harvesting. This is to prevent anthracnos and black spot.

Some of the more important diseases of papayas are as follows; those marked with an asterisk (*) are known to exist in Thailand.

Virus Diseases

Papaya	Mosaic
Papaya	Ringspot

Fungus Diseases

Anthracnos (*)
Black spot (*)
Damping-off of seedlings
Dry Rot and Stem-end rot
Internal blight
Phytophtora blight

Nematode Diseases

Root-Knot Nematode
Reniform Nematode

The insects that attack papaya is most countries are mites, aphids, thrips, fruit flies, and red spiders. As mentioned, only the red spider seems to present a problem in Thailand.

III. HARVESTING

A. Harvesting Methods

The papaya tree starts producing mature fruit in about 8 to 12 months after planting. Papayas are ready to pick when the first trace of yellow appears on the skin. Such fruit, ripened off the tree, will taste just as good as those that become entirely yellow on the tree. Papayas are harvested at approximately three day intervals. During the four-month period, November through February, the fruit ripens more slowly and the picking interval may be lengthened.

Harvesting is a simple operation when the papaya trees are short and the fruit is within reach of the picker on the ground. All fruits that show a slight tinge of yellow at the blossom end are picked and placed into a hand-carried container. The picker will harvest both the sound fruit and the scarred fruit previously tapped for papain. The picker then carries the fruit to the roadway and places the fruit into a hamper (called a "kheng" in Thailand containing 60 kg). Unscarred fruit is placed in one hamper and scarred fruit in another. In handling the picked sound fruit, every possible precaution should be taken to avoid bruising, which results in rapid spoilage. The hampers should be padded to provide added protection for the fruit.

As the papaya tree grows to the point that the picker cannot reach the fruit from the ground, the technique of harvesting is modified by using special equipment such as a light ladder, a large rubber cup attached to a pole which has two prongs to pull the fruit into the cup. The rubber cup is put on the end of a bamboo pole about

2½ meters in length. The picker then places the rubber cup against the end of rhe papaya to snap it off from its stem causing the fruit to fall. The picker catches the fruit before it falls to the ground. A picker can pick about 455 kg per day by this method.

B. Field Transport

The filled hampers are picked up by carts and taken to an access road where half-ton trucks would haul the hampers to the puree and packing plants.

IV. FINANCIAL PROJECTIONS

A. Plantation Costs

Operating costs of the plantation are listed for five years in Table A-1, following this section. The items in Table A-1 are identified by Roman numerals (i, iv, vii, etc.) and the following comments refer to the same numerals.

i. Plantings

Plantings would be scheduled at the rate of 492 rai (79 hectares) per year over a five-year period so that the total plantings in year 5 would be 2,460. The residual 40 rai in the total area are needed for access roads and five facilities: (1) project management, (2) fresh papaya packing plant, (3) puree factory, (4) papain factory, and (5) tractor, tool storage, garages.

ii. Land Rental

Land would be rented as in the case of Dole Thailand at Hua Hin from the Ministry of Interior at $0.50 per rai per year.

iii.-ix. Soil Preparation and Cultivation

Costs of land clearance, resettlement of squatters, plowing, planting of seedlings, liming, fertilizing and weed control are based, in part, on the experience of Dole Thailand at Hua Hin and on interviews with large-scale farmers.

x. Cost of Seedlings

Papaya seedlings would have to be grown from seed in a nursery during the first year of operations. These costs are shown in a separate supporting table, Table A-2. Costs of cultivating seedlings are shown in Tables A-1 and A-2 as $13,960 in the first year. Costs of seedlings in Year 2 through 5 will decline to $11,680 because two items in the 1st year, land clearance and the resettlement of squatters, are non-recurring.

xi. Management and Administration

The plantation management staff would consist of only six persons in the first year but would expand to 35 in year 5. The professionals would include an entomologist and a pathologist to safeguard the plantation against pests and diseases. The personnel for the management of the plantation are listed in Table A-3.

xii. Depreciation

Roads, buildings and equipment depreciate at different rates. Annual depreciation is calculated on the basis of differing useful lives for the various facilities and pieces of equipment as shown in Supporting Table A-5. Supporting Table A-7 shows total depreciation as being $41,300 in Year 1, rising to $94,750 in Year 5.

xiv. Interest

Interest is calculated at 8% on a capital investment that rises each year to a total of $1,333,100 over five years. The investment schedule taken from Supporting Table A-6 is summarized as follows:

Year	Cumulative Capital Investment	Interest
1	$ 619,950	49,600
2	793,200	63,450
3	978,650	78,300
4	1,151,900	92,150
5	1,333,100	106,650
Total	$ 1,333,100	390,150

The cumulative capital investment on which the interest calculations are based is shown in Supporting Table A-4.

xv., xvi. and xvii. Total Plantations Costs, Weight of Fruit and Cost per Kilogram

The total plantation operating costs would rise from $226,500 in Year 1 to $ 538,480 in Year 5 as shown in line xv of Table A-1. However, the weight of harvestable fruit would rise at a substantially faster rate from 3,252,000 kg in Year 1 to 13,008,000 in Year 5. While the operating costs would go up two-and-a-half times in four years, the weight of harvestable fruit would go up four times. Thus the cost of the fruit per kilogram would decline over the five-year period. Line xvii in Table A-1 shows that the cost per kilogram would decline from $0.09

in Year 1 to $0.041 in Year 5.

A management structure is recommended which would include an overall administrator for the entire complex plus specialists in charge of each of the four divisions (a) plantation, (b) fresh fruit packing, (c) papain and (d) puree.

B. Supporting Tables

Supporting Tables A-1 through A-7 follow. These tables cover the plantation development costs for five years, the cost of seedlings, administration, the cumulative capital investment, and depreciation,

No profit and loss statement is provided because the plantation operates for the benefit of the fresh fruit packing plant, papain factory, and the puree factory; therefore, in all except the year , the plantation shows no profit nor loss.

There is a loss in the first year, but this is recovered by profits from the three processing facilities shortly after Year 2. (See tabulation entitled "Capital Investment and Projected Performance" in the summary at the beginning of this report.)

TABLE A-1

PAPAYA PLANTATION DEVELOPMENT COSTS,

WEIGHT OF HARVESTABLE FRUIT AND GROWING COST

(Units: U.S.Dollars, except for line (i) and (xv) which are rai and kg respectively. One rai - 0.4 acre or 0.16 hectare)

		Year 1	Year 2	Year 3	Year 4	Year 5	Total
i)	Number of rai planted.	492 rai	492 rai	492 rai	492 rai	492 rai	2,460 rai[a/]
ii)	Land rental @ $0.50 per rai x 2,460 rai from Ministry of Interior.	$ 1,250	$ 1,250	$ 1,250	$ 1,250	$ 1,250	$ 6,250
iii)	Land clearance @ $20/rai.	9,840	9,840	9,840	9,840	9,840	49,200
iv)	Resettlement of squatters @ $40/rai.	19,680	19,680	19,680	19,680	19,680	98,400
v)	Planting of seedlings @ $6.10/rai.	3,000	3,000	3,000	3,000	3,000	15,000
vi)	Disc plowing, Soil preparation @ $9.10/rai.	4,480	4,480	4,480	4,480	4,480	22,400
vii)	Lime and fertilizer @ $36.80/rai.	18,110	36,200	54,310	72,420	90,530	271,570
viii)	Weed control @ $12.75/rai.	6,270	12,540	18,810	25,080	31,350	94,050
ix)	Insect and disease control @ $ 28/rai.	13,780	27,560	41,340	55,120	68,900	206,700
x)	Cost of seedlings @ $0.078 x 492 rai x 364 seedlings/rai (Table A-2).	13,970	11,700	11,700	11,700	11,700	60,770

a/ 2,640 rai = 984 acres = 394 hectares.

(Continued on next page)

TABLE A-1

PAGE 2

Number of rai planted	Year 1	Year 2	Year 3	Year 4	Year 5	Total
xi) Management and administration (Table A-3).	33,600	49,850	71,050	81,550	96,350	332,400
xii) Depreciation of plantation facilities and equipment (Tables A-4 and A-7).	41,300	53,700	68,450	80,850	94,750	339,050
xiii) Depreciation on trees planted in 1st year; i.e. cost of seedlings to start replacing old trees in 5th year.	11,700	-	-	-	-	11,700
xiv) Interest on capital @ 8% (Table A-4).	49,600	63,450	78,300	92,150	106,650	390,150
xv) Total plantation costs (Items ii through xiii).	226,580	293,250	382,210	457,120	538,480	1,897,640
xvi) Weight of harvestable fruit, kg.		3,252[a/b/]	6,504[b/]	9,756[b/]	13,008[b/]	32,520[b/]
xvii) Growing cost per kg of fruit.		$ 0.090	$ 0.059	$ 0.047	$ 0.041	$ 0.058 (average for 5 years)
Profit (loss)	(226,500)	c/	c/	c/	c/	

a/ 364 trees/rai x 22.7 kg/tree, less 20% rejects = 6,610 kg/rai x 492 rai = 3,252,000 kg in first year.

b/ Thousands of kg, i.e. metric tons.

c/ Plantation sells fruit to packing, puree, and papain plant at cost, therefore no profit or loss is shown. First year loss is covered by combined profit of 3 plants.

TABLE A-2

SEEDLING COSTS, DEPRECIATION, INTEREST

(Unit: US$)

Capital Costs and Depreciation

	Capital Costs	Usful Life	Depreciation Rate	Annual Depreciation
Office, 49M^2	$12,250	20	5%	$ 610
Nursery shed	5,000	20	5%	250
Concrete work area 200 M^2	4,400	20	5%	220
½ Ton truck	4,250	5	20%	850
Total	$25,900			$1,930
Annual interest at 8%				

Variable Costs

a. Land clearance, 38 rai (1st year only)	$ 760
b. Resettlement of squatters	1,520
c. Supervisor	1,200
d. Unskilled workmen, 3	1,500
e. Nursery supplies	5,000
Total	$9,980

(costs in 2nd through 5th year decline by $45.6 because a and b are non-recurring.)

Cost Summary	1st Year	2nd-5th year
Variable costs	$ 9,980	$ 7,700
Interest	2,050	2,050
Depreciation	1,930	1,930
Total	$13,960	$11,680

Cost per Payaya Seedling

First year cost of seedling:	$13,960	=	$ 0.078 (per seedling)
Number of seedlings (364 seedlings per rai x 492 rai)	179,000		

TABLE A-3

COST OF ADMINISTRATION FOR PLANTATION

(Unit: US$)

	Year 1	Year 2	Year 3	Year 4	Year 5	No. of People, Year 5
Manager	$12,000	$12,000	$12,000	$12,000	$12,000	1
Assistant Manager			5,400	5,400	5,400	1
Secretary	3,000	3,000	3,000	3,000	3,000	1
Personnel Manager	5,400	5,400	5,400	5,400	5,400	1
Assistant Personnel Manager					4,000	1
Personnel clerks		1,800	4,400	7,700	11,300	6
Accountant	3,600	3,600	3,600	3,600	3,600	1
Bookkeepers		1,800	3,600	5,400	7,200	4
Agronomist	6,000	6,000	6,000	6,000	6,000	1
Fieldmen	3,600	7,200	10,800	14,400	18,000	5
Record Keepers		1,800	3,600	5,400	7,200	4
Entymologist		3,600	3,600	3,600	3,600	1
Laboratory Technician			3,000	3,000	3,000	1
Botanist		3,650	3,650	3,650	3,650	1
Laboratory Technician			3,000	3,000	3,000	1
Total	$33,600	$49,850	$71,050	$81,550	$96,350	35

TABLE A-4

CUMULATIVE CAPITAL INVESTMENT AND
DEPRECIATION OF PLANTATION

(Unit: US$)

Years	Capital Investment	Cumulative Investment	Interest at 8% (rounded to nearest $50)	Depreciation	Cumulative Depreciation
1st	$ 619,950	$ 619,950	$ 49,600	$ 41,300	$ 41,300
2nd	$ 173,250	$ 793,200	$ 63,450	$ 53,700	$ 95,000
3rd	$ 185,450	$ 978,650	$ 78,300	$ 68,450	$163,450
4th	$ 173,250	$1,151,900	$ 92,150	$ 80,850	$244,300
5th	$ 181,200	$1,333,100	$ 106,650	$ 94,750	$339,050
Total	$1,333,100	-	$ 390,150	$ 339,050	-

TABLE A-5

CAPITAL INVESTMENT AND DEPRECIATION
OF PLANTATION FACILITIES
AND EQUIPMENT

(Unit: US$)

Fixed Assets	Cost each	Years of Life	Annual Depreciation
4 km laterite road	$ 44,000	20	$ 2,200
Office building	110,000	20	5,500
Agricultural supply bldg.	110,000	20	5,500
Dormitory	137,500	20	6,875
Car	12,750	5	2,550 (two)
Van	7,950	5	1,600
½ ton truck	4,250	5	850 (two)
Waste disposal	125,000	20	6,250
Tractor	15,000	5	3,000
Disc harrow	750	15	50
Plow	750	15	50
Sprayer	15,000	10	1,500
Laboratory equipment	20,000	10	2,000
Total	$602,950		$ 37,965

TABLE A-6

FIVE-YEAR CAPITAL INVESTMENT SCHEDULE FOR PLANTATION

(Unit: US$)

Fixed Assets (number in 5th year)	Year 1	Year 2	Year 3	Year 4	Year 5	Total
4 km laterite road	$ 44,000					$ 44,000
Office building	110,000					$ 110,000
Agricultural supply building	110,000					110,000
Dormitories (5)	137,500	$137,500	$137,500	$137,500	$137,500	687,500
Cars (2)	25,500					25,000
Vans (3)	7,950		7,950		7,950	23,850
½ Ton trucks (7)	8,500	4,250	8,500	4,250	4,250	29,750
Waste disposal	125,000					125,000
Tractors (5)	15,000	15,000	15,000	15,000	15,000	75,000
Disc harrows(5)	750	750	750	750	750	3,750
Plows (5)	750	750	750	750	750	3,750
Sprayers (5)	15,000	15,000	15,000	15,000	15,000	75,000
Laboratory equipment	20,000					20,000
Total	$619,950	$173,250	$185,450	$173,250	$181,200	$1,333,100

TABLE A-7

DEPRECIATION OF PLANTATION FACILITIES AND EQUIPMENT ON YEAR-BY-YEAR BASIS

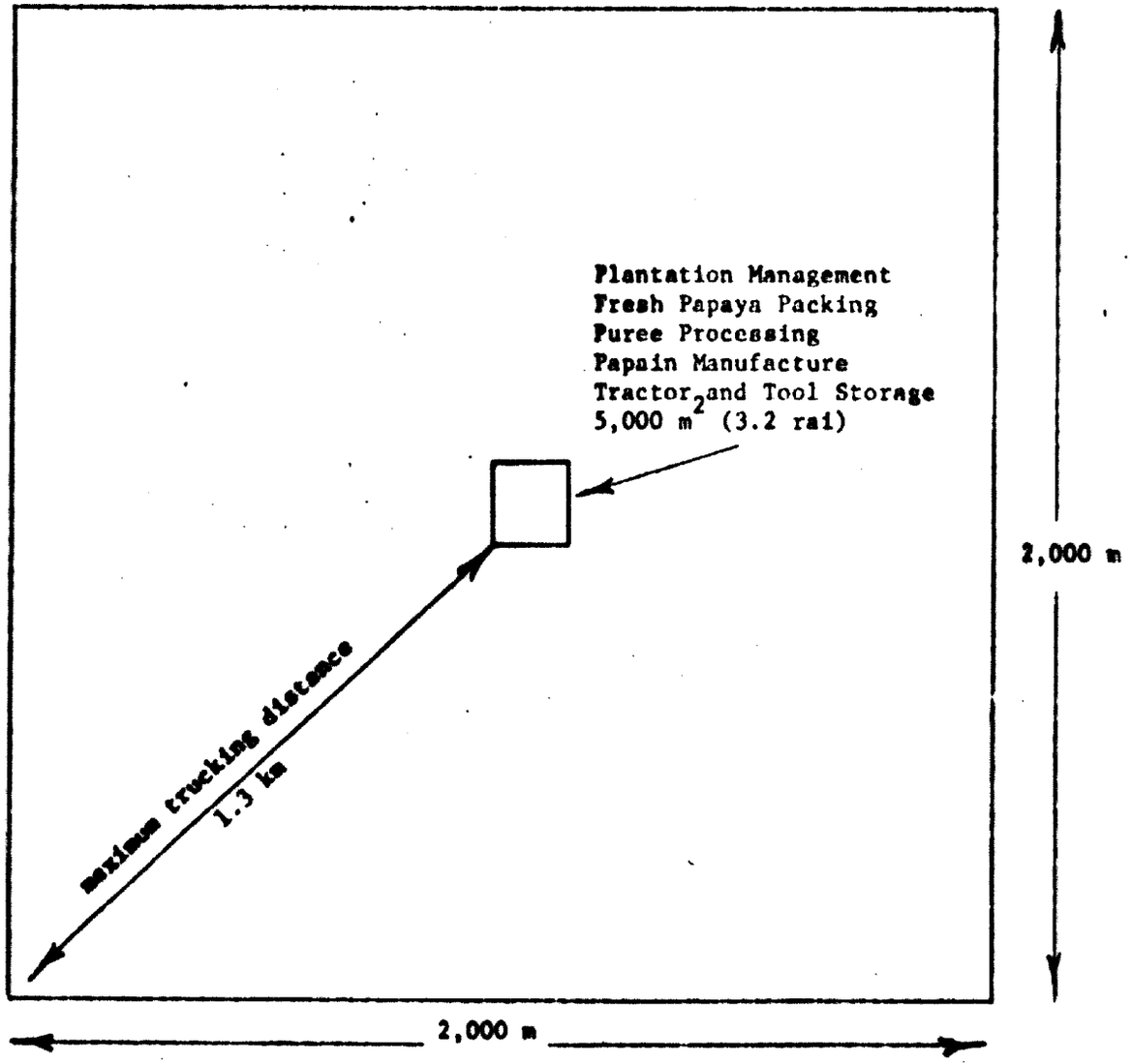
(Unit: US$)

Fixed Asset	Year 1	Year 2	Year 3	Year 4	Year 5	Total
4 km laterite road	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 2,200	$ 11,000
Office building	5,500	5,500	5,500	5,500	5,500	27,500
Agricultural supply building	5,500	5,500	5,500	5,500	5,500	27,500
Dormitories	6,875	13,700 (two)	20,550 (three)	27,400 (four)	34,250 (five)	102,750
Cars (two)	5,100	5,100	5,100	5,100	5,100	25,500
Vans	1,600 (one)	1,600 (one)	3,200 (two)	3,200 (two)	4,800 (three)	14,400
½ Ton trucks	1,700 (two)	2,550 (three)	4,250 (five)	5,100 (six)	5,950 (seven)	19,550
Waste disposal	6,250	6,250	6,250	6,250	6,250	31,250
Tractors	3,000 (one)	6,000 (two)	9,000 (three)	12,000 (four)	15,000 (five)	45,000
Disc harrows	50	150	200	300	350	1,050
Plows	50	150	200	300	350	1,050
Sprayers	1,500	3,000	4,500	6,000	7,500	22,500
Laboratory equipment	2,000	2,000	2,000	2,000	2,000	10,000
Total	$41,300	$ 53,700	$68,450	$80,850	$94,750	$339,050

FIGURE A-1

ILLUSTRATIVE LAYOUT OF PAPAYA COMPLEX, 400 HECTARES

(984 acres or 2,460 rai plus access roads requiring 36.8 rai and factory space of 3.2 rai)



Scale: 1cm = 133.3 meters.

FIGURE A-2

PRINCIPAL PAPAYA GROWING REGIONS

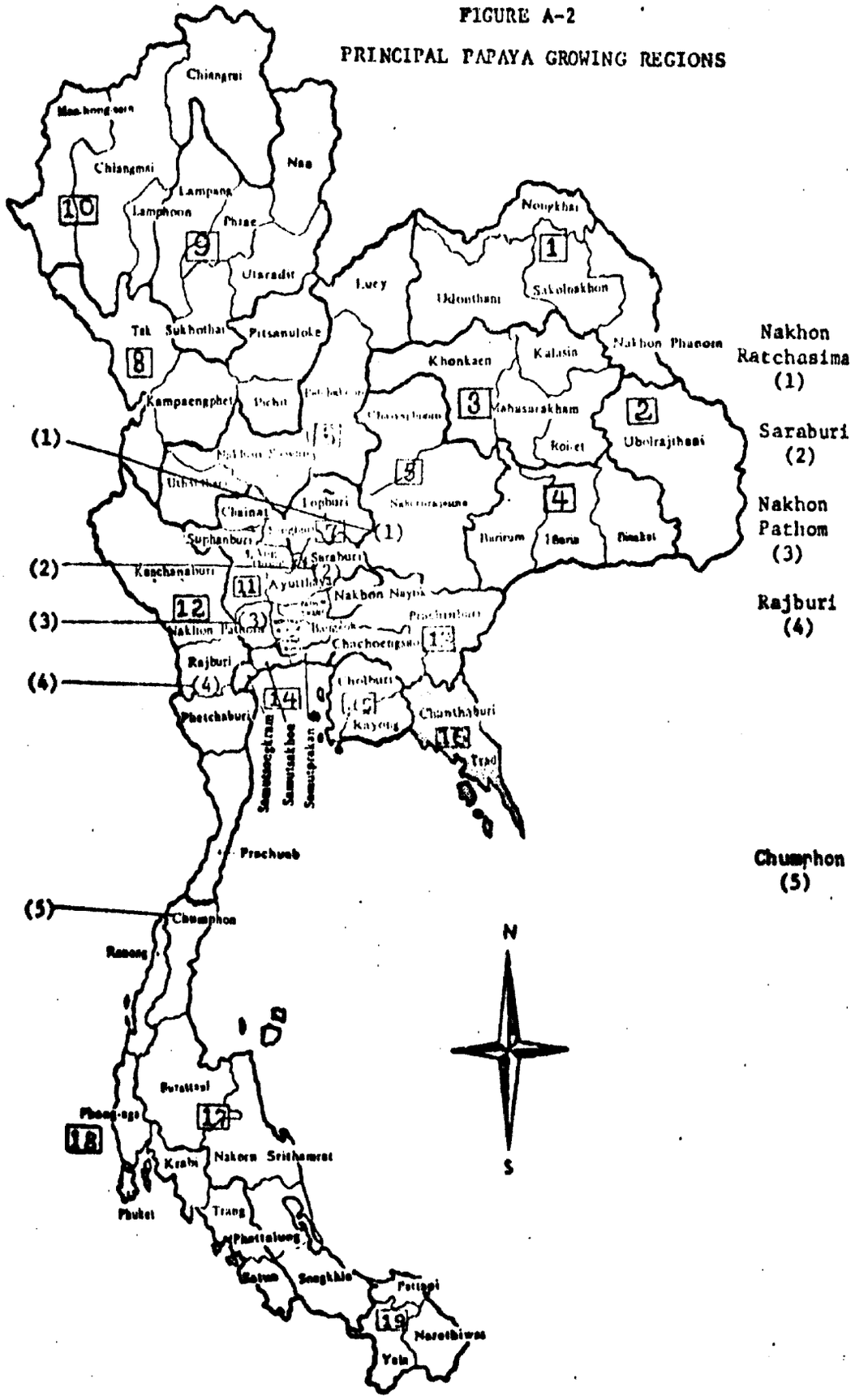
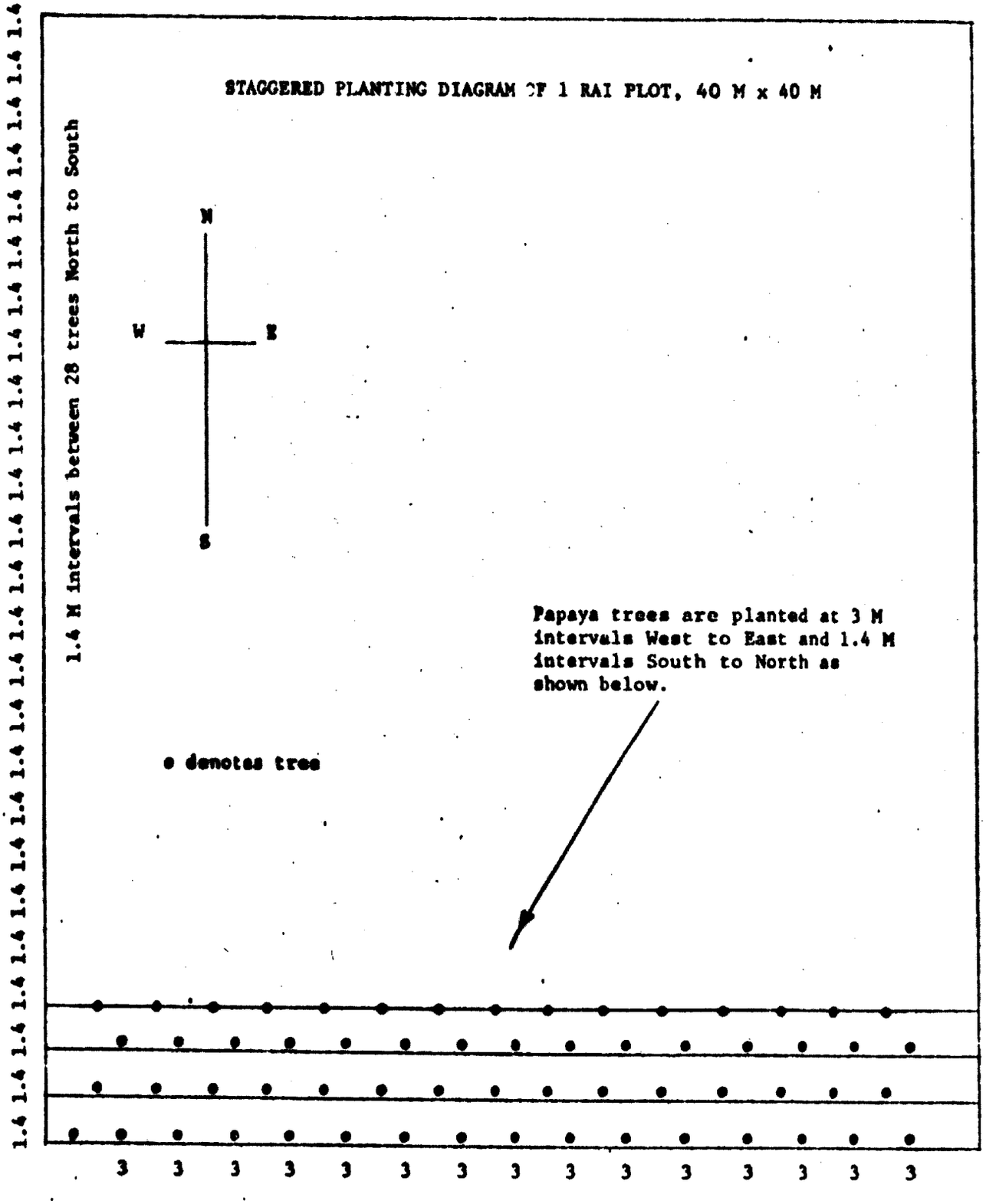


FIGURE A-3


STAGGERED PLANTING DIAGRAM OF 1 RAI PLOT, 40 M x 40 M
1.4 M intervals between 28 trees North to South
1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4
N
W
E
S
Papaya trees are planted at 3 M intervals West to East and 1.4 M intervals South to North as shown below.
• denotes tree
3 3 3 3 3 3 3 3 3 3 3 3 3 3
13 trees planted at 3 meter intervals, West to East.

PART B

I. PROJECT DESCRIPTION. FRESH PAPAYA PACKING PLANT

The fresh papaya packing plant is one of the four projects in the Papaya Complex. The packing plant would consume one half of the fresh papaya grown on the plantation.

The fresh papaya, after selection and treatment, is wrapped in "Kimpac" and flexible polystyrene and each piece is protected by separators. Six pieces of fruit weighing about 9 kg are packed in each carton. Hawaiian papaya is packed in a 5 kg carton containing 6 to 8 pieces of fruit. The larger 9 kg carton recommended here is to facilitate handling by reducing the number of cartons per shipment.

Overseas shipment would be made in refrigerated containers holding 850 cartons.

II. RAW MATERIAL

The plantation as described in Section II A would provide raw material for the fresh papaya packing plant in ever-increasing amounts each year based on the following formula:

492 rai planted each year x 364 trees/rai x 22.7 kg of papaya/tree/year less 20% rejected fruit = 3,252,000 kg of fruit less 50% for papain tapping and puree manufacture = 1,626,000 kg of fresh fruit in the first year.

The increases in raw material would be as follows over the five-year planting schedule:

	1st year	2nd year	3rd year	4th year	5th year
Total fruit available (kg,000's)	nil	3,252	6,504	9,756	13,008
Allocation of 50% for the packing plant (kg,000's)	nil	1,626	3,252	4,878	6,504
Number of cartons @ 9 kg each	nil	180,667	361,333	542,000	722,667

III. MARKETING AND PRICING CONSIDERATIONS

The production of fresh fruit and the projected size of the Japanese market would compare as follows:

	Production of Thailand's Papaya Complex @ 60% annual growth-(MT)	Projected Japanese Demand @ 20% annual growth (MT)
1979 (1st year of project)	nil	2,943
1980 (2nd year)	1,626	3,532
1981 (3rd year)	2,601	4,238
1982 (4th year)	4,163	5,086
1983 (5th year)	6,660	6,103

The increase in annual production of the Papaya Complex would be at an average annual rate of 60% if the 492 additional rai were planted as proposed. At the same time, capital investment would rise each year, but at a slower pace than the production of fruit. This means that the cost of the fruit per kg would decline. Summarizing from Table A-1 below, the cost of fruit would decline as follows:-

Year	Cost of Fruit, $/kg
1st	(no fruit in Year 1)
2nd	0.090
3rd	0.059
4th	0.047
5th	0.041

The rising scale of the harvest makes it possible for the fresh fruit packing plant to start in the 2nd year with fruit priced at 30% below the present landed price of papaya in Japan, and makes it possible to progressively reduce the FOB price and still maintain a high profit on sales, ($0.29/$0.67 = 43% profit on sales in Year 2). See Exhibit on next page showing FOB and CIF costs and profit.

To assure a high rate of return to give ample incentive to the importers, and to allow for a price decline each year as a pre-emptive measure vis a vis other producers, the economies of scale must be substantial. Table B-1, Packing Plant Pro Forma Statement of Profit and Loss, shows the pre-emptive price decline each year.

EXHIBIT

FOB COSTS OF FRESH FRUIT PER CARTON AND KILOGRAM IN SECOND YEAR, AND COSTS OF SHIPPING TO JAPAN

(Unit: US$)

Cost items	Cost Per carton	Cost per kg	Supporting Table
FOB cost of fruit	0.810	0.090	A-1
Transportation to port	0.087	0.010	B-5
Factory labor	0.053	0.006	B-3
Harvesting	0.033	0.004	-
Cartons, kimpac, and polystyrene separators	0.335	0.037	-
Depreciation and interest	0.144	0.016	B-2
Administration	0.083	0.009	B-3
Start-up	0.027	0.003	
Fuel, power, miscellaneous	0.061	0.007	-
Marketing and promotion	1.190	0.132	-
Spoilage @ 10% of FOB price	0.600	0.067	
TOTAL	3.423	0.381	
FOB price to customer:	6.030	0.670	

LANDED COST-YOKOHAMA

	Per Carton-$	Per Kg-$
Cost	6.03	0.67
Insurance & freight	1.32	0.15
CIF	7.35	0.82
Duty, customs clearance etc.	1.44	0.16
Landed cost	8.79	0.98

IV. MARKETS FOR FRESH PAPAYA

A. Domestic Market

1. Volume and Value of Production

The following estimates of papaya consumption and production in Thailand are based on average consumption per household in various regions; consumption per household is 7 to 10 times higher in the 16 Northeastern provinces than elsewhere. Papaya accounts for about 1% of the Kingdom's total agricultural product.

ESTIMATE OF THAILAND'S CONSUMPTION AND PRODUCTION OF PAPAYA

Annual consumption-tons	720,000
Farm gate value per kilogram-$	0.05 (฿ 1)
Value of total papaya production (adjusted for 10% losses) $ million	$36
Total value of agricultural and fisheries product, estimated for 1977 (the comparable 1976 figure was $ 4,856 million)-$ million	5,170
Papaya production as a percentage of total agricultural product in 1977	0.07%

There is no evidence to suggest that domestic consumption will rise any faster than population growth, or about 2.6% annually. There are indications that papaya production can increase very substantially in the event

demand were to rise from industry. The papaya tree grows in all parts of the Kingdom and can be grown in almost all Thai soils except where flooding occurs to rot the root system.

The papaya is a well established component in the Thai diet and declines in output or consumption are not foreseen.

2. Distribution Methods in Thailand

There are established wholesale buying centers for papaya in the provinces where the largest volumes are grown (see Figure A-2 earlier in this report). Farmers will truck their harvest to the buying centers. Well-to-do farmers use 5 ton trucks and poorer farmers typically use half-ton trucks (Datsun, Toyota or Mazda). Papayas are packed in wicker baskets (60 cm in diameter, known as kheng) containing 70 kg each. In the case of shipments from the farm in larger trucks, the baskets are stacked one on top of each other which is damaging to the fruit and shortens shelf life, but this does not seem to concern the wholesaler who usually delivers to retail markets early in the morning of the following day.

The five wholesale markets in Bangkok begin to receive fruit about 3 to 4 AM, and trucks from local retail markets start to take delivery shortly thereafter.

The mark-ups tend to follow the pattern shown below:

Farmer receives $0.05/kg from the buying agent

The buying agent receives $0.06 from the Bankok wholesaler (+ 20%)

The Bangkok wholesaler receives $0.08 from the retailer (+ 33%)

The retailer receives $0.15 from the individual customer (+ 66%)

B. Foreign Markets for Fresh Papaya

1. Japanese Market

The project outlined in Section B.V of this report is projected to serve the Japanese market. In the second year of the project, output of fresh fruit available for shipment by refrigerated container to Japan would be 1,626 MT.

Trade statistics on Japanese papaya purchases show that imports rose from 234 tons in 1972 to 1,633 tons in 1976 and to a probable 2,044 tons in 1977 (the figure of 2,044 tons is the annualized import figure based on the January through September 1977 record). This is more than an eightfold increase in five years, or an annual average growth of 55% as follows:

	Tons of fresh papaya imported by Japan	Growth over prior year-%
1972	234	--
1973	767	227
1974	1,105	44
1975	1,297	17
1976	1,633	26
1977 (est.)	2,044	25

Annual growth rate 1974-77: 23%

The proposed project, in its fifth year of operations, would produce 6,504 tons of fresh papaya for export. If Japanese consumption continues to rise at about 20%, then imports should be 6,103 by 1983. (This assumes that the proposed project would start in 1979

and the fifth year of the project operations would be 1983; see Section B-III.)

If these projections materialize, the proposed "Papaya Complex" in Thailand would produce somewhat more than the Japanese requirement as follows:

a.	Proposed project output of fresh papaya in 1983:	6,504 MT
b.	Japanese imports in 1983 assuming 20% annual average growth:	6,103 MT
	a less b:	401 MT

2. Hong Kong and Singapore Markets

Probably by 1983, markets for Thai papaya could be found in Hong Kong and Singapore. These two destinations in 1976 accounted for 64% of the value of fresh fruit of all varieties shipped by Thailand overseas ($5.7 million out of a total of $8.9 million). In terms of tonnages, the two destinations accounted for 80% of the total fresh fruit shipped from Thailand (47,385 tons out of a total of 59,000 tons).

Of the two markets, Hong Kong is far more promising than Singapore. In 1976, the value of exports of fresh fruit to Hong Kong was $5.7 million (tonnage shipped was 33,833); the value of exports of fresh fruit to Singapore was only $1.4 million.

The recent year trends in Thailand's exports of fresh fruit to the two places also make Hong Kong look the more promising for the future. During the three-year period, 1974 through 1976, exports of fresh fruit to Hong Kong rose from 28,419 tons in 1974 to 33,833 tons in 1976,

an annual average growth of 9%. By contrast, Singapore's purchases of Thai fresh fruit declined from 8,316 tons in 1974 to only 3,552 tons in 1976. The decline in purchases from Thailand is thought to have been caused by the better organization of the fruit market in near-by Malaysia and Indonesia.

In considering these two and other foreign markets for fresh papaya from Thailand, careful analysis of the CIF or landed price is needed. In the case of shipments to Japan, the proposed project in Section B-V of this report shows that Thai papaya can be delivered to Japanese fruit wholesalers for $0.98 per kg including customs duty and handling charges at the port. This landed cost is 30% below the cost of fresh papaya coming from Hawaii. This competitive pricing is necessary to give the Japanese importers a strong incentive to introduce Thailand's papaya which is markedly different from the Solo variety now being imported by the Japanese from Hawaii. Such pricing will also have a pre-emptive effect on the Philippines, Taiwan, Vietnam, Malaysia and other papaya producers.

Similarly in the Hong Kong market, fresh papaya exported from Thailand must be priced below the landed price in Hong Kong at least during the early years when the Thai product is being introduced. The FOB price per kg of fresh papaya described in Section B-V is $0.67 including a $0.29 profit for the Thai investors; the freight rate to Hong Kong from Klong Toey by refrigerated container is $0.091 per kg. Assuming an additional 8% for customs clearance and handling, the Thai papaya would be priced at $0.82 per kg to the wholesalers receiving the fruit in Hong Kong.

Specific price data on Thai exports of papaya are not reported, but the landed costs per kilogram of other Thai fresh fruits in Hong Kong were about as follows in 1976:

Type of fresh fruit	(a) FOB Thailand price per kg 1976	(b) Ocean freight to Hong Kong kg	(c) Estimated customs and handling per kg	(d) Total landed cost in Hong Kong per kg (a+b+c)
Bananas	$ 0.058	$ 0.091	$ 0.012	$ 0.161
Mangoes	0.239	0.091	0.026	0.356
Oranges, tangerines	0.235	0.091	0.026	0.352
Pomelos	0.224	0.091	0.025	0.340
Grapes	0.391	0.091	0.039	0.521
Longans	0.600	0.091	0.055	0.746
Other fresh fruit	0.170	0.091	0.021	0.282
Papaya as proposed in Section B-V	0.67	0.091	0.061	0.82

According to the above tabulation, Thai papaya landed in Hong Kong for $ 0.82 would not be competitive with other Thai fresh fruit.

However, very little papaya reaches Hong Kong at present and most of it originates from Taiwan where the fruit fly is a definite handicap. Under these circumstances, further investigation might disclose that Thai papaya could be competitive in Hong Kong just as it

can be in Japan. Also the $0.29 profit per kg (43% profit, 0.29/0.67) might well be reduced to penetrate the Hong Kong market.

3. Pricing in the Japanese Market

The only papaya known to be reaching Japan at present, comes from Hawaii. Taiwanese exporters were given permission to ship to Japan in 1976, but they succeeded only in making a trial shipment which did not satisfy the Japanese quarentine authorities. As of June, 1977 there were no further imports into Japan from Taiwan. Therefore, the only competition known to exist for Thai papaya at the present time is Hawaii.

The Hawaiian papaya is first shipped by surface from Hilo, Island of Hawaii to Honolulu where it is loaded on Japan Air Line flights for Haneda International Airport in the outskirts of Tokyo. The cost of the air freight is $0.758 per kilogram as compared to $0.15 by refrigerated container from Klong Toey (Bangkok) to Yokohama. The landed cost in Japan for papaya originating in Hawaii is $1.40 per kg whereas the same for papaya from Thailand would be $0.98, according to the analysis in Section B-V of this report. This $0.98 cost is 30% below or $0.42/kg less than the landed cost of papaya from Hawaii

After the fruit has moved through the complex distribution network in Japan (See below), the ultimate price to the consumer has risen 2.7 times.

JAPANESE INTERNAL DISTRIBUTION SYSTEM FOR FRESH HAWAIIAN PAPAYA AND COST AND MARK-UP AT EACH LEVEL OF DISTRIBUTION -- June 1977

(Source: State of Hawaii, Dept. of Planning and Economic Development)

Level a,	Importer's cost	$1.40	--
Level b,	1st Wholesaler's cost	$1.55	11% mark-up
Level c,	2nd Wholesaler's cost	$1.69	9% "
Level d,	Retailer's cost	$2.00	19% "
Level e,	Customer's	$3.79	89.5% "
e/a:	2.7 times		
e-a:	$2.39		

The price differential between Thai and Hawaiian imports would increase even more as the fruit moves through the distribution channels, although the percentage difference of 30% would remain the same. At the retail level, the Hawaiian papaya would cost $3.79 (per kilogram whereas the Thai papaya would cost $2.69 per kilogram or $1.10 less per kilogram.

The comparison of the CIF and retail prices of Hawaiian and Thai papaya is tabulated below:

COMPARISON OF LANDED COSTS AND RETAIL PRICES OF HAWAIIAN VS. THAI PAPAYA

(Based on project proposed in Section B-V)

	(a) Cost of papaya shipped from Hilo via Honolulu to Tokyo-$/kg	(b) Cost of papaya shipped from Klong Toey to Yokohama-$/kg	Difference, b in relation to a %
FOB cost	0.444	0.671	+ 51
Freight to Japan	0.758 (by air)	0.150	- 80
Insurance	0.036	(negligible on sea freight)	same
Duty (10%)	0.124	0.124	"
Customs Handing	0.034	0.034	"
Miscellaneous	0.004	0.004	"
Landed cost	1.400	0.983	- 30
Retail Price (after same mark-ups)	3.79	2.65	- 30

4. Distribution system in Japan for Fresh Papaya

Assuming that Japan is the target market for the project, the best approach would be for the investors in the project to work out marketing arrangements with one of the four leading Japanese importers who have the largest market shares as follows:

FREQUENCY AND QUANTITY OF PAPAYA SHIPMENTS AND MARKET SHARE BY IMPORTER, AS OF NOVEMBER, 1976

(Note: 1 carton from Hawaii Weighs 5 kg.)

Importer	Frequency (cartons/shipment)	Imports per year (Metric Tons)	Market share %
Tokyo Seika Co.Ltd. 4-14 Soto Kanda, Chiyoda ku, Tokyo	Twice/week (1,500-2,000)	771	48
Starlanes Corporation	Twice/week (6,000-15,000)	499	30
Mitsubishi Corp.Ltd. 2-3 Marunouchi Chiyoda ku, Tokyo	Once/week (1,000-2,000)	227	13
Fujii Hajime Co.,Ltd.	Once/week	91	6
Others		45	3
Total		1,633	100

Source: State of Hawaii, Dept. of Planning and Economic Development.

5. Conclusions and Recommendations on Markets for Fresh Papaya

In view of the rapid growth, about 20% annually, of the Japanese market, it is logical to concentrate sales efforts in Japan. It is also logical to seek Japanese investment in the proposed papaya complex. The presence of Japanese investors is important for reasons discussed below.

The Japanese agriculture and health authorities have a complex system of controlling the imports of agricultural products. Thailand has successfully penetrated the Japanese market for cut flowers and orchids and in 1975 was the largest supplier after Taiwan (Thailand's exports to Japan were 22% of the total Japanese purchases.) Therefore it seems probable that Thailand could also gain permission to send papaya to Japan.

The Exhibit on the following page explains the Japanese requirements for fresh papaya from Hawaii; papaya from Thailand would doubtless be subjected to similar procedures.

Before shipments of papaya could be made from Hawaii to Tokyo, it was necessary for the Hawaiian authorities to agree to the presence of a Japanese inspector in Honolulu. This inspector, a representative of the Ministry of Agriculture and Forestry, sometimes causes problems in the export of papaya because he may be absent or ill when a shipment is scheduled for loading. Recommendations have been made to the Government of the State of Hawaii that the inspector be replaced by local State officials working under the terms of an agreement with the Japanese authorities.

Imports into Japan are governed by a law entitled, "Plant Protection Law and Enforcement Regulations" dated June 30, 1950. Article 9 of Appendix 1 of this law provides that an agreement must be reached between Japan and the exporting country on the sanitation measures needed to make sure that fresh fruit imports do not result in any infestation injurious to Japanese agriculture or to human health. The first of such agreements on papaya was entered into in 1972 with the United States with respect to papaya exported from Hawaii.

Another agreement was entered into with the Philippines with respect to fresh mango in 1975 and a further agreement was made with Taiwan in 1976 covering imports of fresh papaya. However, the latter has not been implemented as of June 1977.

In general, the Japanese are favorably disposed toward entering into more of these agreements because of the trade imbalances with Southeast Asian countries, especially with Taiwan and Thailand, and because of the high cost of fruits. However, the political and economic factors cannot out-weigh the strict enforcement of the plant quarantine regulations, and therefore the sale of papaya from Thailand will have to depend on the successful conclusion of an agreement with Japan. The procedures leading up to such an agreement can best be handled by a Japanese investor in the proposed papaya complex.

EXHIBIT

JAPANESE GOVERNMENT STANDARDS
FOR THE IMPORTATION OF FRESH PAPAYA FROM HAWAII

Fresh Papaya.

The standard of quarantine inspection for fresh papaya as listed in the Ministry of Agriculture's Decree No. 798, dated May 27, 1972, is described in the following statements.

1. Plant type: Fresh fruit of the solo papaya variety.

2. Area: Products of the Islands of Hawaii.

3. Transportation: Air cargo, ocean cargo, or hand-carried by air.

4. Inspection in the producing country and certificate:

   a) Fruits have to be inspected by a competent U.S. Government organization and the plant inspection certificate must be issued to the effect that nothing harmful is attached to the fruits.

   b) The certificate should specify that the fruits are free from damage by the Mediterranean fruit fly, mango fly and melon fly, and that are fully disinfected.

   c) The plant inspector's statement to confirm that the prescribed disinfection procedures have been effected.

5. Disinfection in the producing country:

   a) Saturated steam fumigation is made to the extent that the temperature at the center of the fresh fruit reaches 47.2°C, or

EXHIBIT

Page 2

b) The fruits are fumigated for two hours at a temperature exceeding 22°C by the employment of ethylene dibromide ($CH_2BR\ CH_2BR$) at the rate of 8 grams per grams per cubic meter of contents.

6. Packing:

a) Disinfected fresh fruits have to be packed with materials which prevent infiltration of flies, such as the Mediterranean fruit fly, etc.

b) Packing has to be made at a place free from the infiltration of flies, such as the Mediterranean fruit fly, etc.

c) The packed cargo has to be sealed by the U.S. Plant Quarantine Office.

7. Storage for air hand-carried fruits:

Fruits hand-carried by air must be kept at a place designated by the U.S. Government organization.

8. Markings:

Fresh papaya which has been inspected and disinfected must have stated on three sides of its box the fact that the contents have been inspected and that it is bound for Japan.

V. FRESH PAPAYA PACKING PLANT. THE PROJECT

A. Description

The fresh papaya packing plant would require a total capital investment of $184,500 (Table B-2). Operating costs in Year 1 would be $620,000, rising to $1,353,000 in Year 5.

A marketing and promotional program in Japan is recommended along with pricing at 30% below the landed cost of papaya now being imported. Despite the expense to the investors of these two items, high profits would be expected beginning in Year 2 of the project. Profits would be expected to rise from $469,000 in Year 2 to $1,834,000 in Year 5.

As planned in this report, the fresh fruit packing plant would yield the highest returns on investment of any of the three processing facilities in the Papaya Complex. Return on investment in Year 2 would be 254% and would be higher thereafter. Profit on sales would be 43% in Year 1 and 58% in Year 5.

B. Raw Material Acquisition

Figure A-1 in Part A shows the ideal plantation layout whereby the raw material can be readily brought to the packing factories in protective cartons, transported by half-ton trucks.

C. Processing

The flow diagram, Figure B-4 graphically describes the steps required:

1. The fruit is harvested with care to avoid bruising; the stem should be cleanly cut.

2. Hampers of fruit are delivered to the packing plant.

3. The fruit are inspected and sorted by color to classify the fruit by different degrees of ripeness so that the quality at the destination can be controlled.

4. The fruit is immersed in a 49°C (120°F) solution of Benlate (250 PPM). for 21 minutes. This will control decay from fungi that cause Anthracnose and Black Spot.

5. The fruit is cooled to ambient temperature.

6. Fumigation with ethylene dibromate is then required for export to Japan.

7. Aeration is required after fumigation to free the fruit of residual chemicals and to protect handlers and packers.

8. Final sorting and grading.

9. Six pieces of fruit weighing 9 kg are packaged in polystyrene and Kimpac and placed in partitioned cartons.

10. The cartons are stored at 5°C (55°F); and necessary to control ripeness further, temperature may be lowered to 3°C (45°F).

11. Cartons are stored at controlled temperature until a sufficient volume accumulates to fill a refrigerated container, namely 850 cartons weighing 7,650 kg. (The maximum weight allowable by most container services is 11,000 or 12,000 kg. Loading 7,650 kg of fruit is recommended because the container tare weight, 2,563 kg, when added to the fruit weight comes to a total of 10,213 which is within the upper limit.)

Extensive research in Hawaii, Taiwan and Venezuela has been conducted on treating fresh papayas with gamma radiation rather than a fumigant. Cobalt 60 is the source of the gamma rays. At 100 "K-rad" (i.e. moderate) radiation exposure, the fruit was not harmed nor flavor affected. The shelf life of the papaya was extended by 3 to 3½ days. The process as yet has not been approved for papaya by the U.S. Food and Drug Administration nor by the Japanese Ministry of Health.

If at a later stage, fruit flies were to appear in Thailand's papaya, the gamma radiation technique would have to be considered as a means of eliminating the pupae and larvae contained in the fruit. In short, radiation has a far more thorough purgative effect than the fumigants. However, the use of radiation must be cleared with the health authorities in the country of destination. So far, the Japanese Government has approved the use of gamma rays only for various domestic food products but not specifically for papaya.

The method of packing the papaya is shown in Table B-4. Each carton would contain six pieces of fruit, packed in a manner that utilizes the space taking into account the peculiar shape of Thai papaya. This means that the round and the tapered ends must be alternated. The Thai papaya varies substantially in weight and often exceeds 2 kg. However, by selection, pickers would bring in fruit about 1.5 kg in weight leaving the others for papain and puree.

A diagram of the packing arrangement is shown in Table B-4.

D. Equipment and Facilities for Packing of Fresh Papaya

A concrete and steel frame building is suggested, with 600 M^2 of floor space (20 x 30 M) and a receiving platform where the half-ton trucks can be unloaded.

Equipment would include a washer-sterilizer equipped with underwater jets to gently tumble the fruit. Water jets on the opposite side of the washer prevent the fruit from colliding with the steel sides. Other equipment needed would be (a) fumigator, (b) aerator (c) carton sticher, and (d) dollies.

Refrigeration space for at least two container loads of papaya cartons will be needed, that is a minimum of 50 M^3 (7,650 kg x 2 = 15.3 tons 850 cartons x 2 = 1,700 cartons requiring 50 M^3). Cooling capacity down to 3^o - 5^oC is required. No separate facility for refrigeration is needed because part of the 500 ton capacity cold room in the adjacent puree plant, equipped with separate control instrumentation, could be used. The equipment list and capital requirements for the fixed assets in the packing plant are shown in Table B-2.

E. Marketing Arrangements for Fresh Papaya

The four leading papaya importers in Japan are listed earlier in Section IV-B-4. The largest consignment accepted by any of the four was 75 tons (Starlanes Corporation) which is the equivalent of nearly 10 containers (7.6 tons of fruit each) loaded with Thai papaya. Most of the consignments, usually twice weekly, amounted to 1.5 to 2.0 tons which would be the equivalent of one fifth to one half of a container of Thai papaya.

The annual shipments in the second year from the proposed packing plant would be 1,626,000 kg packed in 180,667 cartons. One container holds 850 cartons weighing 7,650 kg. This means that 212 containers would be loaded and shipped in the second year of the project. The shipping schedule would have to be arranged so as to avoid over-loading the facilities of the customers in Japan. A Monday, Wednesday, Friday, Saturday shipping schedule would mean four shipments weekly of 7.6 tons each or about 31 tons per week. This tonnage divided among the four leading Japanese importers, would be well within the handling capacity which at the peak (New Year holiday season), was 65 tons during 1976 for all four importers as shown below:

PEAK PAPAYA IMPORT VOLUME IN DECEMBER/JANUARY

Toyo Seika,	5kg x 1,500	cartons, twice weekly	= 15 tons/week
Starlanes Corp.,	5kg x 4,000	cartons, twice weekly	= 40 tons/week
Mitsubishi Corp.,	5kg x 1,500	cartons, once weekly	= 7.5 tons/week
Fuji Hajime,	5kg x 500	cartons, once weekly	= 2.5 tons/week
TOTAL			65 tons/week

F. Costs and Revenues of Packing Plant

1. Capital Requirements

The total capital requirement of the packing plant comes to $184,500 as shown in Table B-2. This however excludes two items which are charged elsewhere; the cost of the land is covered by rentals for the plantation and the cost of the refrigeration space is charged to the puree factory.

The largest item of investment is the building, 600 M^2 which at \$250/M^2 comes to a total of \$150,000. The machinery and equipment would cost \$34,500.

These and other items are listed in Table B-2.

2. Revenue

A pro forma profit and loss statement is shown in Table B-1. Details, as discussed in the following are numbered to correspond to the items in the statement.

Number of cartons packed (i) and the operating level in terms of the weight packed (ii) have been discussed previously. (iii) annual sales are estimated as follows:

Year	Revenue (\$ 000's)
1	nil
2	\$1,089
3	\$1,951
4	\$2,634
5	\$3,187

The retail price of papaya in Japan in now prohibitive, \$1.72 to \$2.41 per single papaya (400-800 grams). This is four times the price of the best quality fresh tangerine. To help bring down the retail price, to gain market penetration, and to satisfy the Japanese importers, this report suggests two kinds of price concessions. First, a basic price structure that will enable Thai fruit to land in Japan for \$0.98 per kilogram, which is 30% below the \$1.40 per kilogram price of Hawaiian Solo papayas. Second, that a moderate price reduction be scheduled each year from Year 3 through 5, as follows:

Year	FOB Klong Toey cost per kg	Landed cost Yokohama per kg	Change
1	nil	nil	nil
2	$0.67	0.98	nil
3	$0.60	0.91	- 7%
4	$0.54	0.85	- 7%
5	$0.49	0.80	- 6%

These prices were used in calculating annual revenue

3. Operating Costs

(iv) Cost of fresh papaya to the packing facility has been discussed in Part A and in detailed in Table A-1.

(v) Harvesting labor costs are calculated as follows:

Weight of fruit harvested per day by 1 picker: 450 kg

Wages per 8-hour day of 1 picker for 312 days/year: $1.60 ($32)

Operating year	Weight of fruit harvested for shipment as fresh papaya (kg)	Daily harvest, 312 days per year (kg)	Required number of pickers @ 450 kg per man-day	Annual cost of harvesting labor @ $1.60/day, 312 days
1st	none	none	none	none
2nd	1,626,000	5,212	12	6,000
3rd	3,262,000	10,423	23	11,500
4th	4,878,000	15,635	35	17,300
5th	6,504,000	20,846	47	23,500

(vi) Factory labor costs shown in Table B-3 are estimated at $.053 per carton ($.006/kg) based on the following:

Weight of harvested fruit:	3,262,000 kg (Table 5-A)
Fruit to be packed fresh:	1,626,000 kg (½ of total)
Number of days worked in the packing house per year:	312 days
Kg packed per shift:	5,212 kg (1,626,000 kg/312 days)
Cartons packed per shift:	579 cartons (5,212 kg/9 kg)
Cartons packed per hour:	72 cartons (579 cartons/8 hours)

(vii) Packaging material cost is based on information obtained from local dealers.

(viii) Administration costs are detailed in Table B-3.

(ix) Fuel and electric power costs are estimated as follows:

Year after planting	1	2	3	4	5
Fuel for boiler- $	nil	6,000	7,500	9,000	10,500
Electricity - $	nil	5,000	6,500	8,000	9,500
TOTAL	nil	11,000	14,000	17,000	20,000

(x) Transportation from factory to port costs are based on information obtained from local shipping firms and agents and are detailed in Table B-5.

(ix) The two largest items in the operating costs are fruit, marketing and promotion. Some comment is needed regarding the latter.

Thai papaya is a new product in the Japanese market and is different in size, shape flavor and color from the Solo (some say it tastes more like a fruit than a melon). To gain customer acceptance, advertising will be needed chiefly on color TV (as the Hawaiians have done), in the hotel industry and restaurant trade press, and in women's magazines where color pictures are used.

Japanese importers probably would resent the profit margins (43% on sales) enjoyed by the Thai project unless the investors in Thailand were willing to make a major contribution to the promotional effort in Japan.

Thus far in Japan, 68% of the papaya are consumed in the Tokyo-Yokohama area, 26% in the Osaka-Nagoya-Kyoto area and only 6% in all the rest of Japan. This means that an intensive job of consumer education is needed outside of the Tokyo-Yokohama area, focussing on the health properties of papaya, the pleasant taste, and the brilliant red-orange color of the Thai product.

In view of the sizeable promotion program needed, $215,000 is suggested as a budget beginning in Year 2 when the Papaya Complex is ready to deliver its fruit. Such a budget should be spent with one or more public relations companies or advertising firms (e.g. McCann Ericson, J. Walter Thompson, Hakuhodo or Dentsu).

(xii) Start-up expense is a non-recurring cost charged in Year 2 for personnel training spoilage in packing and miscellaneous minor expenses.

(xiii) Depreciation based on the useful lives of assets is shown in Table B-2.

(xiv) Interest at 8% on investment represents the opportunity cost of capital.

(xv) Spoilage in transit is allowed for in proposition to the weight of fruit shipped.

4. Revenues, costs and profits are summarized:

Operating Year	1	2	3	4	5
Operating Level (No. of cartons 9 kg each)	Nil	180,667	361,333	542,000	722,667
			($ 000)		
Revenue	Nil	1,089	1,951	2,634	3,187
Operating Cost	36	620	850	1,056	1,353
Profit or (loss)	(36)	469	1,101	1,578	1,834

G. Financial Projections

1. Pro forma Profit and Loss Statement

A pro forma profit and loss statement is shown in Table B-1 based on the following assumptions and computation. It is assumed that the project will have BOI promotional privileges and will be exempt from machinery and equipment import duties and taxes. No costs for these items are included in the statement. Also, no costs are included for property damage, casualty or workmen's compensation insurance. Explanations to the statement are numbered to correspond to the items in Table B-1.

2. Sensitivity

The interaction of the factors of revenue and cost are examined at the production level attained by full operation of Year 2 of the project. This is the so-called "break-even" point (BEP) analysis which determines the minimum level of profitable operation. For this analysis, amounts that are not influenced materially by production level are termed fixed costs, and those that are a function of activity are termed variable costs.

The break-even point (BEP), may be estimated in terms of sales revenue, fixed and variable costs for a given period. In this computation, sales revenue is that accruing from the output of Year 5. Fixed charges are based on investment cost and variable cost on the operating expenses shown in the financial projections.

The BEP area may be determined by the formula:

$$BEP = \frac{\text{Fixed cost}}{1 - \frac{\text{Variable cost}}{\text{Sales revenue}}}$$

$$BEP = \frac{272}{1 - \frac{1,081}{6,504}} = \$327,000$$

Where:

	($ 000)
Fixed cost	
Administration	31
Depreciation	11
Interest	15
Marketing and Promotion	215
	272
Variable cost	
Fresh Papaya	377
Harvest labor	23
Factory labor	37
Cartons	242
Fuel and power	20
Transportation	63
Spoilage	319
	1,081
Revenue	6,504

The very low BEP is typical of those operations having low fixed costs such as a fruit packing plant.

H. Conclusions Regarding Feasibility

1. Ratios

The ratios of profits to sales are:

Year 1	Year 2	Year 3	Year 4	Year 5
Nil	$\frac{469}{1,089}$ = 43%	$\frac{1,101}{1,959}$ = 56%	$\frac{1,578}{2,634}$ = 60%	$\frac{1,834}{3,187}$ = 58%

The ratios of profits to investment are:

Year 1	Year 2	Year 3	Year 4	Year 5
Nil	$\frac{469}{184.5}$ = 254%	$\frac{1,101}{184.5}$ = 596%	$\frac{1,578}{184.5}$ = 855%	$\frac{1,834}{184.5}$ = 994%

The payback period is in the second year on the basis of pro forma earnings.

2. Feasibility

The relevant technological and financial factors relating to the project examined in the study indicates its feasibility as an investment opportunity in conjunction with the other sections of the "complex".

TABLE B-1

PACKING PLANT — PRO FORMA PROFIT AND LOSS STATEMENT

Operating year	1	2	3	4	5	
(i) Number of cartons	Nil	180,667	361,333	542,000	722,667	-
(ii) Operating level (kg packed/year; see Table A-1)	Nil	1,626,000	3,252,000	4,878,000	6,504,000	A-1
		Units below: US$ '000's, rounded to nearest 000				
Revenue						
(iii) Annual sales (f.o.b.)	Nil	1,089 (@ $0.67/kg)	1,951 (@ $0.60/kg)	2,634 (@ $0.54/kg)	3,187 (@ $0.49/kg)	-
Operating costs						
(iv) Fresh papaya (Table A-1)	Nil	146	192	229	377	A-1
(v) Harvesting labor	Nil	6	11	17	23	-
(vi) Factory labor	Nil	10	19	29	37	B-3
(vii) Cartons, "kimpac" and polystyrene	Nil	61	121	182	242	-
(viii) Administration	10	15	26	31	31	B-3
(ix) Fuel and power	Nil	11	14	17	20	-
(x) Transportation to port	Nil	16	31	47	63	B-5
(xi) Marketing and promotion	Nil	215	215	215	215	-
(xii) Start-up expense	Nil	5	Nil	Nil	Nil	-
(xiii) Depreciation	11	11	11	11	11	B-2
(xiv) Interest (8%)	15	15	15	15	15	B-2
(xv) Spoilage in transit	Nil	109	195	263	319	-
Total	36	620	850	1,056	1,353	-
Profit (loss)	(36)	469	1,101	1,578	1,834	-
Cash flow						
Net profit (loss)	(36)	469	1,101	1,578	1,834	-
Depreciation	11	11	11	11	11	-
	(25)	480	1,112	1,589	1,845	-

TABLE B-2

PAPAYA PACKING PLANT CAPITAL INVESTMENT AND DEPRECIATION

(Unit: US$ 000's)

Land (already covered in rentals on plantation (Table A-5, item 11)	none
Building, concrete and steel frame, 600 m^2 @ $250 per m^2, 30 x 20 includes office wiring, piping, receiving platform, employee facilities	150.0
Subtotal	150.0
Washer-sterilizer	5.0
Cooling tank	2.7
Fumigator	4.4
Aerator	2.2
Box sticker	1.7
Dollies (4)	0.5
2, 1 ton trucks (5.2 tons per day must be hauled)	18.0
Subtotal	34.5
Total capital cost	184.5
Depreciation on building @ 5%	7.5
Depreciation on machinery @ 10%	3.5
Total annual depreciation	11.0

TABLE H-3

STAFFING PLANS

Year after planting	1	2	3	4	5
Operating year		1	2	3	4
Management and admin. cost					
Production manager	6,000	6,000	6,000	6,000	6,000
Assistant manager			5,400	5,400	5,400
Supervisor		3,600	3,600	3,600	3,600
Supervisor			3,600	3,600	3,600
Supervisor				3,600	3,600
Clerk	1,800	1,800	1,800	1,800	1,800
Accountant	1,800	1,800	1,800	1,800	1,800
Accountant		1,800	1,800	1,800	1,800
Account			1,800	1,800	1,800
Accountant				1,800	1,800
TOTAL	9,600	15,000	25,800	31,200	31,200

Factory Labor

(Note: 312 days per year
Labor cost is $1.60 per day; truck drivers, $5.77)

Year after planting	1	2	3 (2 shifts)	4 (3 shifts)	5 (3 shifts)
Sorting	-	2-$1,000	4-$2,000	6-$3,000	6-$3,000
Washing	-	1- 500	2- 1,000	3- 1,500	3- 1,500
Fumigation	-	1- 500	2- 1,000	3- 1,500	3- 1,500
Waxing	-	2- 1,000	4- 2,000	6- 3,000	6- 3,000
Packing	-	2- 1,000	4- 2,000	6- 3,000	9- 4,500
Storage	-	2- 1,000	4- 2,000	6- 3,000	9- 4,500
Truck drivers	-	2- 3,600	4- 7,200	6-10,800	9-16,200
Auxiliary	-	2- 1,000	4- 2,000	6- 3,000	6- 3,000
TOTAL		14-9,600	28-19,200	42-28,800	51-37,200

TABLE B-4

ASSUMPTIONS REGARDING PAPAYA SIZES TO BE SHIPPED FRESH IN OCEAN-GOING REFRIGERATED CONTAINERS AND RECOMMENDED CARTON DIMENSIONS

(Note: Papaya are tapered and six fruits can be packed so that no two round ends are next to each other, see packing diagram below.)

Weight of papaya: 1 to 2 kg

Average weight: 1.5 kg

Length: 29 cm to 35 cm

Average length: 32 cm

Maximum diameter: 11 cm to 14 cm

Average maximum diameter: 12.5 cm

Length of fruit to be shipped:

not more than 30 cm (largest size fruit will not be shipped)

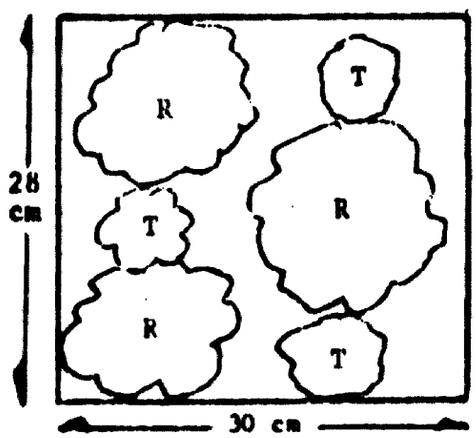
Maximum diameter of fruit to be shipped:

not more than 12 cm

Recommended carton dimensions: 30 cm x 28 cm x 35 cm

Cubic space for each carton: 29,400 cm^3

Packing diagram, 6 fruits/carton



R = round end

T = tapered end

TABLE B-5

COST OF TRANSPORTATION PER CARTON AND PER KG

From Factory to Port (Klong Toey)

Cubic capacity of 1 refrigerated container: 25 m^3 = 5 million cm^3
(Exterior dimensions 6m x 2.4 x 2.4)

Size of 1 carton containing 6 papayas: 28 cm x 30 cm x 35 cm
= 29,400 cm^3

Number of cartons to be shipped in 1 container:
25,000,000 cm^3/29,400 cm^3 = 850

Weight of container:

tare:	2,563 kg
fruit (850 cartons x 9 kg):	7,650 kg
	10,213 kg

Cost of truck per ton/kilometer: $0.06 (฿1.2)

Cost of transportation, assuming 120 km distance from plant in Saraburi to Klong Toey (120 km x $0.06 x 10.213 MT: $73.53

Cost of transportation to port per carton ($73.53/850): $0.087

Cost of transportation to port per kg ($0.087/9 kg): $0.01

To Japan

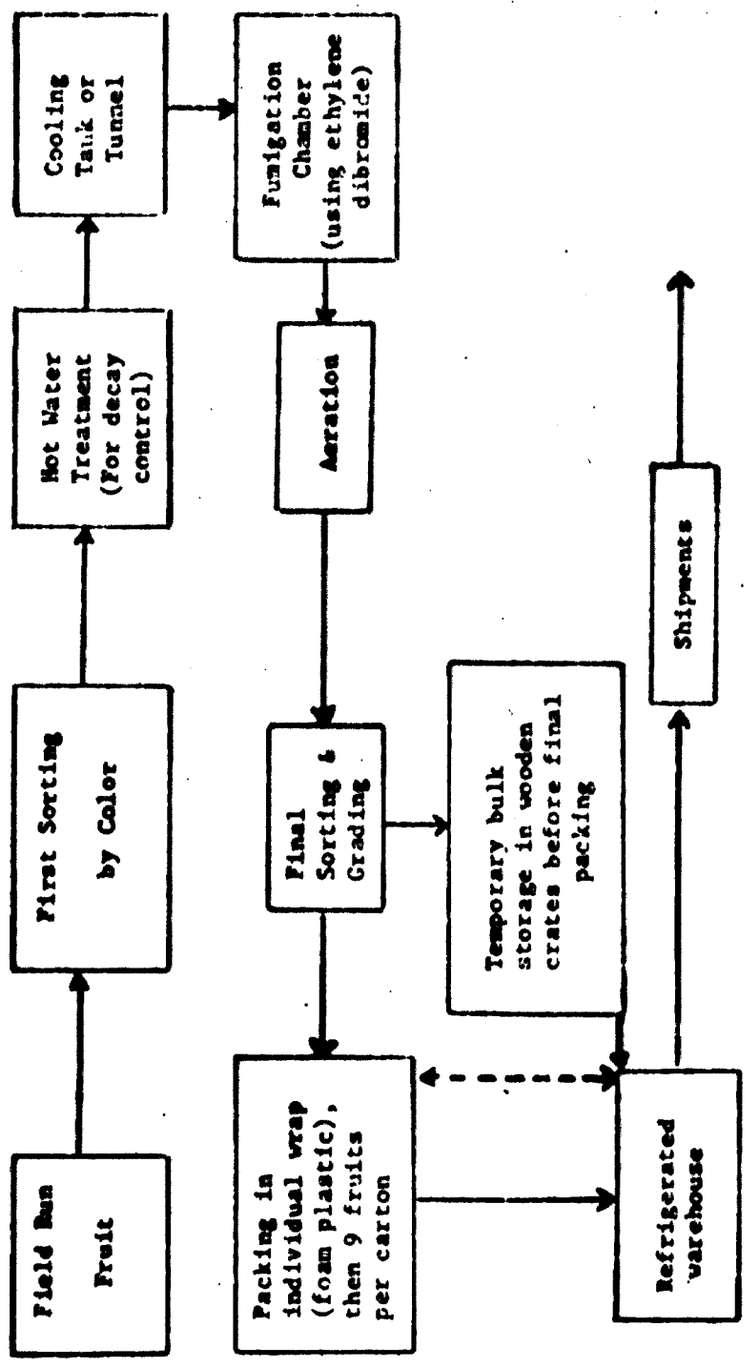
Cost of container shipment per MT: $109.50
Shipping cost of container loaded (10.213 x $109.50): $1,118.32
Shipping cost per carton ($1,118.32/850): $1.32
Shipping cost per kg ($1.32/9): $0.147

To Hong Kong

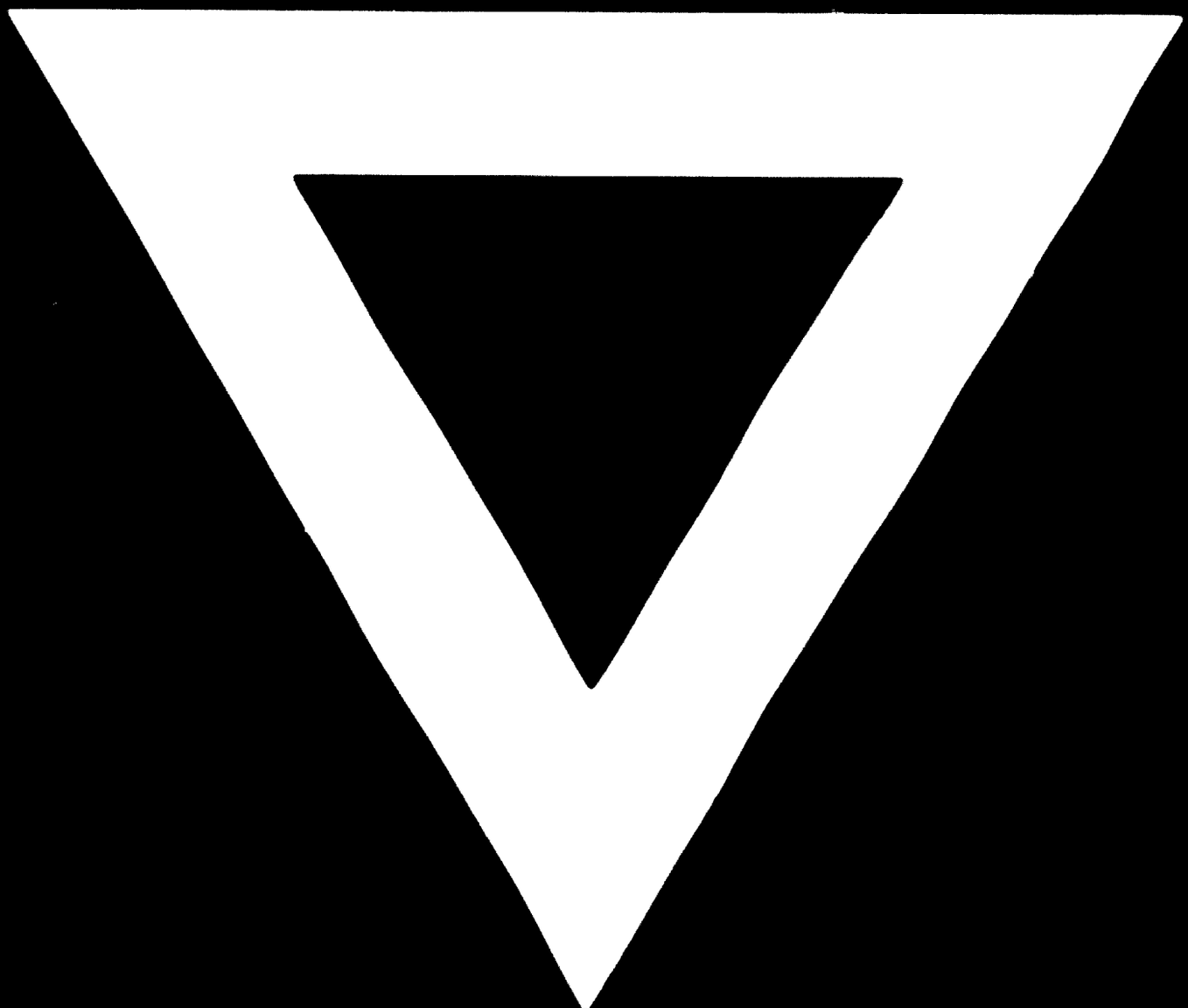
Cost of container shipment per MT: $68.39
Shipping cost of container loaded (10.213 tons x $68.39): $698.47
Shipping cost per carton ($698.47/850): $0.82
Cost of shipping per kg ($0.82/9): $0.091

FIGURE 3-4

Flow Diagram for the Processing of Fresh Papaya



C-8



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