



**COMPONENTE AGRICOLA DEL PROYECTO DE APOYO TECNOLOGICO PARA LAS
INDUSTRIAS DE EXPORTACION DE CENTROAMERICA Y PANAMA**

**MARKETING STUDY AND PRODUCTION GUIDE
FOR EXOTIC TROPICAL FRUITS**

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MARKETING STUDY AND PRODUCTION GUIDE FOR EXOTIC TROPICAL FRUITS

PREFACE

As part of the Tropical Fruits Program, initiated by PROEXAG in 1991, the project completed an in-depth study of the current market opportunities for exotic tropical fruits in the United States, Europe and Japan. Because trade statistics are not recorded individually for the seven exotic tropical fruits researched by the project, it was necessary to survey several major fruit importers, by means of a questionnaire, as to the future prospects for exotic tropical fruits. The results of the survey are contained herein. The market study section of this document contains much of the information currently available on the market situation and growth opportunities for exotic tropical fruits. This information is provided to assist producers and investors in their decision-making process.

The strategic tropical fruits program initiated in Central America was designed to assist growers with existing plantations and to bring plant material to the region. As a result of the considerable technical assistance provided by the PROEXAG team to Central American producers, the project has accumulated a great deal of production experience to be shared. A production guide is included as part of this document to provide current and potential producers of exotic tropical fruits with the information necessary to successfully develop these crops in the region.

INTRODUCTION

Tropical fruits are those fruits that are produced in tropical regions; in botanical terms, the definition of "exotic" refers specifically to plants that are not native to a region. By definition, all tropical fruits introduced to markets outside tropical regions are exotics. The best-known tropical fruits are: pineapple, papaya, mango, and avocado. In produce terminology, exotic tropical fruits (ETF) are tropical fruits that have not yet gained awareness in the international market and have an exotic nature such as an intense flavor or scent, or an unusual shape, color, or texture. Litchi, rambutan, logan, mangosteen, carambola, atemoya, and durian are considered to be exotic tropical fruits and they are the focus of this document. For the purposes of this document, "exotic" will be used to describe these lesser known fruits. The purpose of the marketing section of this document is to provide information on world markets for ETF in general.

The exotic tropical fruit industry is still in the early stages of development and international trade in these fruits has been limited. Most countries do not compile specific market data on these low-volume fruits and very little published information on ETF exists. While production, volume, and trade statistics are scarce, there is a growing source of industry studies and opinion. Researchers and businessmen in the industry have published their views on the commercial viability of ETF. They indicate that world-wide demand for tropical fruits, juices, concentrates, and pulp has increased rapidly and should continue its upward trend over the next several years. The reasons for increased demand for tropical fruits apply to some exotic fruits as well. Development of profitable marketing opportunities for ETF will depend on producers' ability to consistently supply high-quality products.

The sources reviewed for this study commonly cited three key characteristics of the ETF market. First, the market as a whole has experienced an increase in demand due to: a familiarity with and demand for unique fruits due to increased travel; rapid growth of tropical fruit production in such areas as Hawaii, Florida, and Australia; increased availability of tropical fruits through a wider variety of retail outlets; increased demand by the growing restaurant and hotel industry; and increased ethnic markets created by new and growing immigrant populations.

Second, the most common problem to overcome in developing the exotic tropical fruit industry is the lack of regular supplies of quality products. Markets lack adequate sources of supply to meet the demand for ETF. At present, producers are unable to respond to volume or to quality demands. In order to develop a profitable relationship with an importer, producers must be able to sustain consistent quality and quantity over an agreed-upon time period. Importers must contribute to the success of the venture by acquiring adequate storing facilities to maintain the shelf-life and quality of the fruit.

Third, because individual trade statistics are not published for these fruits, it is difficult to create support for investment in particular types of fresh tropical fruits based solely on import/sales figures. However, market analysts researching data on world-wide fruit juice and concentrates indicate a definite increase in demand for these products. The worldwide value of exports of fruit juices increased from \$1 to \$2.8 billion between 1977 and 1981.

L. MARKETS FOR FRESH FRUIT

A. The U.S. Market

Although many of the ETF currently being promoted are experiencing increased awareness and demand in many areas, they are currently inadmissible to the United States as fresh produce primarily due to their status as fruit fly hosts. It is important to consider that fruits already admissible and those which may become admissible are part of a world fruit market which, according to Frieda Caplan of Frieda's Finest in California, has started to explode. She is confident that the growth of demand for tropical fruit will bring unlimited opportunities for profitable commercial ventures.

Some U.S. distributors of tropical fruit agree with Frieda Caplan's statement that "to be totally successful, access to the California market is of the utmost importance." The California market has the essential characteristics for profitable fruit sales: high incomes, large ethnic communities, willingness to try new tastes, and high health consciousness. Producers moving their product through Los Angeles can gain access to every major and minor retail outlet in the United States. Retailers and wholesalers in the U.S. and Canada send trucks to California as part of an international distribution system. For all of these reasons, buyers in California are very enthusiastic about the marketing opportunities there.

Other industry experts feel that California in itself is a significant, young market with great potential but that, given the growth of demand in tropical fruit in general, it is not imperative for success. Bill Schaefer of J.R. Brooks in Homestead, Florida believes that demand for ETF in the U.S. is almost limitless. He has stated that, with few exceptions, J.R. Brooks will be handling an unlimited supply of these fruits. In the U.S., these fruits can be marketed profitably even though they lack consumer familiarity. However, demand for a particular fruit may be limited by a specific detrimental quality, such as the odor of durian, for example.

Producers wishing to tap into this promising market should take into account the unique aspects of the general fruit industry as well as the characteristics of the exotic fruit itself. Producers should recognize that in retail outlets, these fruits must be given increased display area in order to increase consumer familiarity. In addition, producers need to become familiar with the two separate pricing tiers: wholesale and retail. Wholesalers may take up to 25% commission of tropical fruit sales. For high quality ETF, they may be willing to work at below-cost when first beginning to work with a new fruit, especially if growers provide samples as an incentive to promote the fruit.

Producers must investigate their options carefully and select one or a few high quality ETF to market. Growers interested in marketing these fruits in the U.S. market should consult the marketing or production sections included in this study for each individual fruit to become familiar with possible quarantine treatments.

Any ETF originating from an area known to have indigenous fruit fly species is considered to be inadmissible in fresh form by the Animal and Plant Health Inspection Service (APHIS) of the USDA. A producer, exporter, export organization or government representative may make an official request for review by APHIS to have a product added to the list of admissible products. APHIS protocol then requires that the Service perform a risk assessment to determine whether the product is a possible host to fruit flies or other quarantine pests. If

importation of the product represents a possible risk of introducing dangerous pests into the U.S., then it will not be admissible without the application of a previously approved quarantine treatment.

Most of the ETF described in this study are considered to be inadmissible to the U.S. in fresh form due to their status as fruit fly hosts, even though the appropriate risk analysis has not yet been conducted for some of the fruits. Testing is currently in progress for many of these fruits to confirm that they may be removed from current APHIS listings of possible fruit fly hosts. The progress being made toward admissibility for these fruits may help growers to determine which fruits can be most appropriately produced for export to the U.S. market.

When researching the U.S. market, it is essential to investigate and monitor the ETF production of southern Florida. With 23,000 acres planted in ETF, decisions made by the major growers of ETF in Florida are indicators of future trends and volumes available to the market. For example, after Hurricane Andrew destroyed many acres of crops in Florida in 1991, mango producers did not replant mango. Instead they planted other ETF crops, which will come into harvest in the next three to five years, increasing the supply of ETF to the U.S. market. Also, while Florida production of ETF decreased in 1994 due to the destruction caused by the hurricane, production for some ETF fruits is expected to surpass pre-hurricane figures as early as 1995, e.g., litchi will double to 1/2 million lbs. and carambola will reach 6 million lbs.

Obviously, the increase in production and the introduction of new ETF to the market from Florida is an important consideration when examining potential competition among tropical fruit suppliers. Producers in Central America should be aware that most of the fruits described herein are not yet admissible to the United States. Increased production of ETF in Florida will result in greater competition for Central American producers shipping to the U.S. market when these fruits become admissible.

Although Florida production may result in increased competition for Canadian, European or other markets to which Central American producers are already beginning to ship, some industry specialists predict that Florida will not be interested in foreign markets because it is unlikely that they will be able to meet the growing domestic demand. In addition, when asked whether these ETF are Florida's farming future, Mr. Schaefer responded that labor costs, environmental controls, and high land costs can make these fruits more expensive to produce in Florida than in Central America or other foreign fields.

Although an increase in Florida production will bring increased competition for U.S. markets, it will also provide some benefits for Central American growers. While the newly developed industry in ETF continues to grow in the U.S., Florida growers will be performing urgently needed marketing and promotion functions to increase awareness of these fruits. While it is not guaranteed that quarantine treatments for admissibility will be approved for these fruits, it is possible that rambutan, mangosteen, and atemoya will become admissible in the next few years. By this time, Florida will have done most of the preliminary marketing to increase demand for products which can be produced in Central America, an environment which is much less susceptible to climatic difficulties than the growing areas in Florida.

In the near future, another source of competition for Central American producers of ETF may be Mexico. Production of ETF in Mexico is likely to increase as the Mexican producers respond to the advantages presented to them through the relations established and encouraged by NAFTA. Mexico is aware of the growing demand for ETF and is already beginning to act.

B. The European Market

Development experts, such as F.J. Proctor of the Overseas Development Natural Resources Institute, indicate that the European market for tropical fruit in general has grown rapidly over the past five years. The countries differ in market share and level of consumption as well as in their specific demands for types and quality of fruits. As previously mentioned, ethnic groups contribute greatly to the increased demand for tropical fruits. The primary markets for tropical fruits in the European Union (EU) are the United Kingdom (UK) and France, both of which have large immigrant populations originating primarily from former colonies in the tropics.

According to produce industry experts, the greatest growth potential exists for pineapple, avocado, mango, and papaya. Due to growing consumer interest, demand is also increasing for ETF such as litchi, rambutan, carambola, and mangosteen. To a lesser degree, there is an interest for cherimoya, durian, and logan. There are over twenty tropical fruits for which official trade figures are not available but which are offered in the market sporadically throughout the year. Despite a paucity of information, estimated import volumes were published in 1987 for certain tropical fruits. In 1987, imports to the EU of litchi were estimated at 3,295 tons, carambola at 1,200 tons, cherimoya and annona at 1,000 tons each and rambutan at 500 tons.

Producers intending to export ETF to meet the demand of these markets should concentrate their efforts on a single fruit or on a limited number of fruits. When evaluating potential investment in ETF for the European and other markets, producers should consider the characteristics required by the target market. In general, fruits should be small to medium in size and weight, easy to eat and prepare, interesting in color or shape, have a long storage life, and demonstrate an ease of post-harvest ripening and handling.

In the UK, rates of growth of consumption of some ETF are unprecedented (2 - 3 fold in 5 years), but consumption of rarer exotics is still low. The indigenous market seems largely confined to groups with higher income levels. Reductions in price lead to more than proportionate increases in demand. Importers participating with marketing boards sell tropical fruits to wholesalers, caterers, and supermarkets. Supermarkets sell tropical and exotic fruits off-season but usually only those fruits that move quickly. Importers sell on consignment and normally charge an 8% commission, plus handling charges and receiving costs. In most cases the UK grants free entry to products imported from Africa, the Caribbean and the Pacific. There are few quarantine or phytosanitary restrictions for most fruits, although they need to meet the market quality standards of the import country to be successfully marketed.

The UK, Germany, and France are the largest buyers of ETF. Demand in these countries continues to rise and importers are interested in additional supplies as the market is far from saturated. Potential importers include: bottlers, food manufacturers, and packers of dried fruits. The large population, high incomes, and strong currency of Germany make it the most promising market for tropical fruit exporters. Improvements in packaging and pricing in Germany have made such fruits more desirable and accessible to consumers. In Germany, some fruits that were once considered exotics, such as bananas, have become staple foods.

In France, demand for ETF has grown over the years and is high even during the French production season, when a variety of traditional fruits are available. Travel, high incomes, and

health consciousness have created consumer groups that are eager to try new products. Although avocados took longer to catch on in France than in other European countries, France now imports three times as many avocados as the UK. Currently 10-20 different tropical products are displayed in French supermarkets.

Holland is a major "re-exporter" of tropical fruits and other products. In other words, Holland imports large quantities of produce and then re-distributes these among other European countries and the Middle East. Holland is successful in this role because the country has an excellent communications and transportation system and the most important modern maritime ports for agriculture imports to Europe. There is special equipment in the Port of Rotterdam for handling fresh produce, such as modern loading and unloading equipment and temperature regulated storage facilities. Holland offers a variety of opportunities for exporters. The development of infrastructure in Holland has led to decreased transportation prices and increased consumption.

The tropical fruits described in this document originate from the developing world. Thailand and Malaysia export primarily to the U.S. and Europe. The majority of Malaysian fruit is produced by small farmers. In 1990, durian, melons, carambola, papayas and bananas accounted for 90% of Malaysian exports and the Malaysians are planning for a 45% growth in the tropical and exotic tropical fruit trade. Malaysia, Thailand and the Philippines are currently developing a less odoriferous durian and are basing a large expansion in durian production on their confidence in its potential in the European market. Of all fresh fruit exported from Thailand in 1991, durian and logan ranked first and second on the list with 3.6 million lbs. and 3.3 million lbs., respectively. Exports of rambutan, litchi, and mangosteen were recorded at 395, 256, and 160 thousand lbs., respectively.

Several European companies have set up export companies in Thailand in order to have tighter control over the produce they receive from that country. These European companies hope to teach producers in developing countries to better understand customer requirements and to ensure production, post-harvest and other general quality specifications. Through their Bangkok-based exporter, Exotic Farm Produce Thailand, Exotic Farm Produce of the UK also provides supplies and assistance to farmers. With new quality control measures, Exotic Farm hopes to double their exports from Thailand. Other systems used by European importers include farm contracts and joint ventures. During a recent seminar, Mr. Michael Paske from Exotic Farm told an audience in Guatemala that some European importers may be interested in similar joint ventures with producers in Central America.

Western Europe is a large and lucrative market and should be seriously considered. Selling to EU markets requires a lot of effort, clever strategy, knowledge of niche markets, and attention to both the demands and potential pricing of the market. Central America already has a comparative advantage in the production of tropical fruits in terms of climate and labor costs. Businessmen in the region are concentrating on adding to this advantage by increasing cooperation with European importers, increasing the exchange of shipping information, and by establishing harmonized export quality standards.

C. The Japanese Market

In Japan, as in other countries, several trends are influencing the growth in consumer demand for ETF: wider knowledge of foreign fruits and vegetables as a result of increased travel, strong currency, change in diet, and improved packaging, shipping, and communication. Japan is also experiencing changes in its socioeconomic structure resulting in the creation of new markets. In general, Japanese households spend a higher proportion of income on food in comparison with other advanced nations.

Since the 1980s, Japan's economy has experienced a growth rate of 4 to 5% annually. Greater purchasing power has increased the Japanese consumer's access to ETF. The Japanese greatly enjoy fruit. High quality fruits are considered a luxury. Fruit and fruit juices are very popular and are often given as gifts. Rare and exotic fruits can be sold at very high prices. Quality fruit can be sold at specialty fruit stores, where a single high quality apple or grapefruit can sell for up to \$8.00 and a melon for up to \$160.00. Cherimoya and mangosteen are the ETF with the largest demand. Some ETF imports have annual growth rates of 20% or more. For example, litchi imports into Japan increased by 54% between 1987 and 1989.

However, the Japanese have a reputation for enforcing very strict controls to avoid infestations and contaminations. Some argue that these restrictions are so strict that they act as trade barriers. Japan is an island nation and for many years followed a seclusionist policy which protected it from invasions from overseas. Japan is deeply concerned about the damage that the entry of certain pests could cause at this point. The Japanese Ministry of Agriculture prohibits entry of fruits (in the botanical definition) from countries that have indigenous fruit fly species, unless treated. The Ministry of Agriculture insists that all treatments be completed prior to shipping, and not in-transit. They have publicized a zero tolerance for live pests on any import and will fumigate shipments found to have any live insects.

Not only are the quality and phytosanitary requirements for imports perceived to be more strict in Japan, but the structure of and access to the market is different from that of the U.S. and Europe. The Japanese market system has more separate levels than any of the other systems. Approximately 80% of imported goods are received by wholesale trading firms. The Japanese have confidence in the system. They believe that the trading firms are well aware of the Japanese quality requirements and preferences, and they trust them to select the most appropriate products.

International trade in horticultural commodities is expanding at a higher rate than for other agricultural commodities. Japan is now the fifth largest importer of fruits and vegetables in the world. It is a promising potential market for Central American produce not only because the volume of imports is expanding, but also because the range of imported horticultural commodities is expanding.

The import structure of the country is changing. Japan is lowering tariff rates and the trade surplus is declining. In 1986, the surplus was approximately \$8 billion, decreasing in 1990 to \$5 billion. The total value of imports surpassed \$40 billion in 1989, 63% higher than imports in 1985. In the past five years, fruit and vegetable imports into Japan have increased by 5.2% to \$2.86 billion.

As imports of both industrial and consumer goods expand, they become increasingly important to all major Japanese market sectors. This is generating more opportunities for foreign companies. In a study conducted by the Japan External Trade Organization (JETRO), 90% of already established foreign companies indicated that more foreign firms will be able to enter the

Japanese market and succeed."

Direct investment overseas is expanding. Japan may offer financial assistance to overseas corporations and tax credits for importers. Investors and importers in Japan have not sought out Central American growers because these producers have not yet demonstrated their ability to export a consistent quality and supply of produce. Some U.S. companies have expressed a willingness to enter into an arrangement with Central American growers to train them to produce according to Japanese standards. In the short term, U.S. companies could use Central American products to extend the U.S. period of supply to Japan. In the long run, transshipping through California could be an economically beneficial arrangement for both Central America and the U.S..

Although Japan is a promising market for foreign companies, the complexity of its market structure and its demand for extremely high quality have resulted in a relative decrease in imports from the Developing World. The variety and quantity of all types of fruit is expanding, but the major suppliers are limited to a handful of countries. The Japanese consider themselves to have very specific, discerning tastes. Quality, not competitive prices brought about through the advantages of low labor costs, will be the most important factor in achieving successful access to the Japanese market. Some of the supplying countries are developing nations in the tropical zones. Although there has been a relative decrease in imports from developing nations, Central American countries could increase exports to Japan if they improve the quality and the phytosanitary condition of their products.

Some large supermarket chains and independent buyers have begun to circumvent the trading firms and at one time expressed an interest in sourcing from Central America. Central American producers are advised to work through trading firms or supermarkets, although home delivery of fruits shipped from their origin is a new feature of the distribution system. A Japanese partner or qualified industry consultant would best be able to assist the producer in understanding the culture and high standards of the Japanese market.

In terms of fresh tropical fruits available from Central America, litchi, cherimoya and mangosteen are in demand. Carambola is imported from New Zealand but is not yet popular.

II. EXOTIC TROPICAL FRUITS IN CENTRAL AMERICA

Besides the specific international markets discussed in this document, opportunities also exist for the creation of new markets and the development of existing markets within Central America. Not only are there several advantages to focusing on these local markets, but by concentrating on the region, producers may be able to avoid some of the greatest disadvantages associated with exporting to foreign markets.

We have already mentioned Central America's geographic advantage: its location, and extensive tropical region as well as its availability of labor. Although ETF are practically unknown in some areas of the region, these fruits are indeed produced here. The trees were originally distributed either by international agriculture or shipping companies or by experimental gardens. Today, these plantations are largely unattended.

There has been limited systematic selection and multiplication of desired clones of export quality. There are already standards of quality cultivars of ETF in the world market. Introductions and trial plantings of the quality cultivars of these crops as well as the local

selections have to be established. These would serve as the nuclei for commercial planting in the region. Products harvested from these higher quality cultivars could then compete in the world markets.

Commercial quality cultivars of the ETF described in this study have been identified for the region by Dr. José Mondoñedo, production specialist, and by Michael Strong of Kahili Farms in Hawaii. Plant material from Hawaii or Australia has been purchased by at least a few producers in each Central American country. Recent introductions of some of these plants in Belize (by BABCO) could also be potential sources of plant material. Experience with existing fruit trees and these recent introductions has provided information and results confirming that they can indeed be grown successfully in the region.

Experience also indicates that advantageous marketing opportunities exist to successfully sell ETF in the region's markets. First, ETF already sell in the areas where they are available, even with limited recognition and when they are of poor quality. Secondly, it may be even easier for producers to gain access to consumers in local markets, given their geographic closeness to production areas. Producers in Central America can better control marketing practices and efforts to increase consumer knowledge in closer, regional markets than in more distant markets. Feedback to promotional campaigns would be rapid and adjustments therefore more timely.

Panelists at the 1993 AGRITRADE, Central America's international agricultural trade fair, stated that a lack of communication between exporters and receivers is a major obstacle to Central American producers' success as exporters. Obviously, this obstacle would be diminished if producers were dealing with buyers in the region with whom producers share fewer cultural, language and distance barriers to communication. Importers from Europe have stated that exporters must know the market side as well as the production aspects of ETF. Producers selling within the region would also have a greater knowledge and understanding of local markets than of distant foreign markets.

Many of the factors that have increased demand for ETF in other markets also exist in Central America. Travel and broadening of cultural experiences have made consumers more likely to sample and purchase different types of fruit. In addition, Central American countries also have growing Asian populations.

There are no fruit fly restrictions for transportation of these fruits within the countries of the region, although other phytosanitary restrictions may apply.

A. Marketing of Exotic Tropical Fruits in Central America

Exotic tropical fruits are already being sold in supermarkets, specialty stores, and street-side stands throughout the region. The greatest volume of sales are within the local markets of the production areas. For example, in Costa Rica, rambutan can be purchased for less than a dollar a pound on almost any street corner. Costa Rica also imports rambutan from Panama to meet local demand.

Panama has discovered that success is not dependent on exports. The local market supports sufficiently high prices for rambutan and other produce. One Guatemalan producer has been successfully exporting fruits and vegetables to Panama, citing high prices and dollar currency as the incentives. Panama will most likely continue to be a profitable market for other

Central American countries because they do not have enough agricultural lands to produce sufficient supplies to meet demand. Panama also has different production seasons than some Central American countries creating marketing windows during certain times of the year.

Because the higher elevation agricultural areas of El Salvador have little water and little agricultural production, they are fairly dependent on food supplies from other countries. Trucks from El Salvador line up along the Honduran border to purchase litchi. There is a limited supply of fruits and vegetables in El Salvador. Many of the available products are trucked in from other Central American countries. It is likely that El Salvador would readily accept ETF made available as part of the distribution process.

Marketing tests have been conducted in Guatemala with rambutan and mangosteen from Panama and Costa Rica. These fruits were placed in specialty fruit and vegetable stores and sold out quickly. Store buyers from these stores have stated their eagerness to carry more of these fruits were they available. In fact, in Guatemala, several tropical fruits which are not widely known and are sold in poor condition still manage to sell out. Examples of these are cherimoya, other annonas, and mangosteen from the Atlantic Coast of Guatemala.

Nicaraguans eat and greatly appreciate the "Spanish lime" which is a small round fruit with a smooth brown shell. The interior fruit is much like a logan. Alternative fruits that are similar to the Spanish lime but of better quality, such as logan, litchi, and rambutan may be easily introduced to consumers who enjoy limes and would experiment with similar ETF from the region. In addition, prices in Nicaragua are much higher than in other areas and producers may find this market profitable.

B. Export Experience

Several Central American producers of tropical fruits have had hands-on experience in exporting these fruits out of the region. In Honduras, producers in collaboration with the export federation (FHIA) and two U.S. brokers have had success exporting rambutan to Canada. In 1992, a major producer of rambutan in Panama developed his own label and with the help of a local export organization, was able to conduct the first trial shipments to the United Kingdom. In 1993, trial shipments of rambutan to Europe were conducted by a producer in Costa Rica who reports that the results were so positive that the company plans to arrange larger shipments for this season's harvest.

Certainly, given that imports of tropical fruits by developed nations is on the rise, concentrated efforts to increase production and to acquire admissibility for the fruits of Central America to the United States and even to Japanese markets can only be beneficial. As many of these fruits cannot be commercially grown outside of the tropical region, it is logical for producers in the Central American region to investigate opportunities to meet the increasing demand in foreign markets.

However, the local Central American markets should not be overlooked in searching for viable markets for these fruits. In fact, efforts should be made to increase consumer knowledge and develop these markets. In addition, technology designed to expand the industry, such as methods and machinery to increase exports of these fruits in processed form, should be investigated and established throughout the region.

III. MARKET OPPORTUNITIES FOR FRUIT JUICES, CONCENTRATES, AND PULPS.

Although few detailed trade statistics are available, estimates, industry experience, and professional opinion indicate that conditions are optimal for development of, and investment in, high quality ETF. Available figures for the market for tropical fruit juices, concentrates and pulps indicate a statistically significant upward trend for imports and consumption worldwide. Developing country suppliers accounted for half the world supply of fruit juice in 1988 and should be able to expand their share given increased consumer interest. The available figures for, and the characteristics of, the fruit juice market suggest that ETF juices will experience a similar growth pattern.

A. Fruit Juice Markets

The tropical fruit juice market is becoming more attractive to producers. First, processed fruits involve less risk for producers because they are less delicate than fresh fruit which requires greater post-harvest care and must be transported quickly. Secondly, consumers tend to be more willing to try juices from exotic fruits than the fresh fruit itself. The number of worldwide markets for fruit juice is increasing. For example, some reports indicate that newly developing markets in Eastern Europe and the Middle East are expected to offer sales opportunities for certain fresh fruits and juices.

Tropical fruit juices are exported from a number of countries in Latin America, Africa, and Asia. Three of the more popular fruits for juices are mango, banana, and passion fruit. Central America exports small quantities of all three. The five leading markets for juices are the United States, Germany, the United Kingdom, Netherlands, and Canada. The fastest growing markets in 1984-88 were Italy, France, and Spain.

Japan currently imports 31 varieties of tropical fruit juices without volume quotas. All fruit juices are subject to import tariffs which are usually determined according to sugar content. In 1987, imported juices to Japan increased 11%, valuing \$77 million. In the first nine months of 1988 demand for natural juices increased by 37 percent and in 1990, Japan's foreign purchases rose by 216%.

Market Makers Inc. of Tokyo stated in a 1989 AgExporter article that because of anticipated sales increases, a growing number of Japanese buyers are looking abroad for reliable sources of juice. Many manufacturers seek closer ties with foreign suppliers through exclusive sales contracts, licensing agreements and the construction of Japanese processing facilities abroad.

B. Fruit Juice Consumers and Outlook

Over the last two decades consumer attitude towards fruit juices has changed considerably. While fruit juices have traditionally been consumed as a breakfast drink, they are now replacing beverages consumed throughout the day. In the Middle East there is a limited availability of fresh fruits and as in Japan, fruits are often considered a luxury. Fruit juice is a refreshing alternative to coffee or teas and a healthy substitute for carbonated sodas.

Fruit juice raw material is increasingly used in other foods such as dairy products

(yogurt), bakery products and baby food. Demand for these raw materials is increasing as a result of promotional activities. There is also a growing demand for pieces/slices of some tropical fruits. Sources recommend that exporters ship fruit slices, pulp or puree, rather than consumer packs with added water which increases their weight and subsequent shipping costs.

Although the current expansion of markets indicates increases in world trade in tropical fruit juices, rapid long-term development of the industry will depend on consumer familiarization as well as consistent supplies of high quality product.

IV. PRODUCTION

A large part of any successful business venture is based on consistency, research, and dedication, as well as the ability to invest one's efforts in visionary, profitable activities.

Based on these parameters and a solid market analysis of the U.S. and European market, in 1992 specialists at PROEXAG initiated the introduction of selected varieties of ETF to the Central American region such as: atemoya (a hybrid of two annona), carambola (sweet), durian, logan, mangosteen, litchi and rambutan (selected varieties) following the pioneer spirit of explorers such as Wilson Popenoe and others that have left an invaluable legacy to the countries of Central America.

The efforts that are described here encompass considerable economic, human, and technical resources which are singularly unique in the region.

A. Background

The varieties selected for the fresh market are those mentioned above. Although at this time there are a few plantations of ETF scattered throughout the region, most of them have resulted from seed that were obtained 50 years ago by multinational companies such as Standard and United Fruit Co, and there has been no selection or systematic multiplication of clones with characteristics desirable for export.

Given that the world market for these crops is already demanding extremely high quality, trial plots should be established with introductions and selected material here in the region. These will also serve as nuclei for multiplication and expansion of the most desirable cultivars to establish commercial plantations in the region which will provide product that can compete in the world market.

B. Introduction of Commercial Cultivars

The sources of commercial cultivars include commercial nurseries in Florida, Hawaii, and Australia. The recent introductions of materials from BABCO in Belize could be an additional source of certain cultivars of atemoya, carambola, and litchi.

For mangosteen crop development it is not necessary to introduce selected material given that its reproduction is asexual-apomictic by seed. Air layers or grafts from selected cultivars of rambutan, litchi, logan, atemoya, carambola, and durian will be used from those that were received from Hawaii and Australia in March and July of 1993. These initial orders consisted

of 10 to 20 air layers/grafts from each cultivar (there are almost 20 different cultivars of the 6 species of plants involved) for each participating country which totals more than \$65,000 in plant material. Future introductions will be carried out to complete those materials that are lost in the process and to introduce other promising cultivars, within the limits of the PROEXAG budget. Enormous enthusiasm has been generated in the region and in Costa Rica, El Salvador, Honduras, and Guatemala, producers are prepared to invest hundreds of dollars to import material selected from various exotic tropical species.

V. SPECIFIC EXOTIC TROPICAL FRUITS

A limited budget, an estimated gross revenue analysis, and an availability chart is provided in this study for the fruits described. In addition, market prices are included in Annex C. There is a wide range of prices for tropical fruits depending on quality and timing. Producers who market fruit at the beginning and end of a season, when supplies are lower, usually receive better prices. The production of these fruits in large volumes is necessary not only to reduce transportation costs to the producers but also to reduce the price for the ultimate consumer, encouraging them to increase purchases.

A. Litchi

Litchi is a very popular and versatile fruit. 90% of the ETF receivers interviewed in a recent survey placed litchi at the top of the list of fruits with the greatest potential.

Litchis can be purchased fresh, dried, frozen, or canned with syrup. In Australia, small quantities of litchi are used to manufacture wine, ice cream, and yogurt. In Taiwan, litchi is used to make fruit juice for export.

Data on worldwide litchi production are scarce because most producing countries do not compile statistics specifically for litchi. However, it is known that litchi production has increased steadily since the 1970's. Litchi continues to be planted for commercial production in Southeast Asia. Volumes are expected to continue to increase significantly as these new plantations begin bearing fruit. In the U.S., Florida expects production in 1995 to reach 1/2 million lbs., up from 200,000 lbs. in 1994. Florida has approximately 200 acres of litchi which was worth \$2 million in 1993.

In 1987, the U.S. imported 5.1 million lbs. of canned litchi and logan. Canned litchis are popular in Chinese restaurants and are increasingly available in supermarkets, but recently, consumers have begun to demand more fresh litchi. During 1987, the U.S. also imported about 55,730 lbs. of fresh litchi from Mexico. The U.S. imported a combined 54,960 lbs. of litchi from other countries. The major ports of entry for litchi to the U.S. were San Diego, New York and Los Angeles. The major exporters of litchi are China, India, Thailand, Israel, South Africa and Australia.

Litchi has a limited production period of six weeks in most areas. For example, litchis grown in Florida are usually available in the U.S. market from mid-June to mid-July. Limited availability of fresh litchi fruit presents a marketing challenge because customers are not exposed to the product long enough to become accustomed to it.

Markets for litchi in France (the major West European importer), the United Kingdom, Germany, and the Netherlands share similar traits. Consumers in these countries prefer fresh litchi, which is available from November through March from South Africa and from April to September from Thailand and Israel. Firm, deep-red litchi which are large and uniform in size and maturity are preferred.

Industry experts suggest that prospects for increasing sales in Western Europe and North America seem likely given that the popularity of litchi has increased so quickly in some markets that production has not been able to keep up with demand.

Litchi is also very popular in Southeast Asian countries where domestic consumption provides an important market for producers. As mentioned in the Central America section of this study, local sales would likely be an important part of a profitable venture for Central American producers as well.

1. Litchi from Central America

The results of market studies conducted by the College of Tropical Agriculture in Hawaii forecast good growth potential in the European fresh litchi market. Importers are interested in marketing litchi year-round in Europe. Litchi from South Africa, Europe's largest supplier is readily available only from November through February (see Table 1). Importers are seeking

new suppliers from February to June when the European soft fruit season starts. Litchi from Central America could be marketed in Europe during the regular Central American production season which falls in between February and June, when European prices are much higher than in the winter months.

Canada is also a potential market for litchi from Central America. China, the world's largest producer, exports to Canada and several Asian countries between May and August. Litchi from Central America could be marketed in Canada between February and May, before litchi from China enters the Canadian market.

Although litchi from Central America is duty free under the Caribbean Basin Initiative, it is not admissible fresh to the United States because of fruit fly quarantine. Litchi from the region faces competition from Mexican litchi which is grown in a production area that is not considered to have indigenous fruit fly species. Studies are currently being done on the viability of hot water and cold treatments to disinfect litchi of the fruit fly. Frozen litchi may be an alternative for export to U.S. markets.

Other obstacles to the successful exporting and marketing of litchi include the short selling season, and freight costs. An estimated gross revenue analysis using the following figures is possible. At an average price of \$1.32 per lb and with an initial harvest in the fifth year of 60 lbs produced per tree, producers can calculate a rough value of \$80.00 per tree, and 70 trees per hectare, or approximately \$5,600 gross value per harvest. The cost for establishing such a plantation will be burdensome until the 8th year, because producers will be investing nearly \$29,000.00 on maintenance along until the 5th year when commercial harvest begins.

Lychee	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hawaii												
Florida												
California												
Thailand												
South Africa												
Mexico												
Madagascar												
Israel												
India												
China												
Australia												

Table 1. Availability of litchi in different markets.

2. Market Opportunities

Worldwide production has increased since 1970, following the market "discovery" of litchi in 1964. Major producing countries are: India, China, Australia, Madagascar, South Africa, Taiwan and Thailand; other sources of litchi are Israel, Kenya and Brazil.

For 1989, annual world production was estimated to be 200,000 tons; area under cultivation has continued to expand since then. Nevertheless, supply is limited during the months of November to February. Recently, buyers in Europe have been willing to handle litchi (which is preferred to rambutan in that market) year around, which has aroused the attention of the Central American producers who are serious about litchi as a major crop.

There is more supply and lower market prices in January to March (see Figure 1). The rest of the year, prices are good enough to justify exploiting the European market with litchi from Central America.

Worldwide, the main importers of litchi are: Hong Kong, Singapore, Malaysia and Japan. There is limited information on the market for processed litchi but it is widely sold canned in syrup or in dehydrated form.

In Europe, France is the major importer of litchi and is also an intermediate port for the litchi from Madagascar and the Reunion Islands. The U.K. receives most of its litchi (98.3%) from South Africa. South Africa also provides 89.3% of Holland's litchi and 98.6% of Germany's. As ex-colonies of France, Madagascar and the Reunion Islands receive preferential treatment within the European Union, however, South Africa has to pay an 11% *ad valorem* tax.

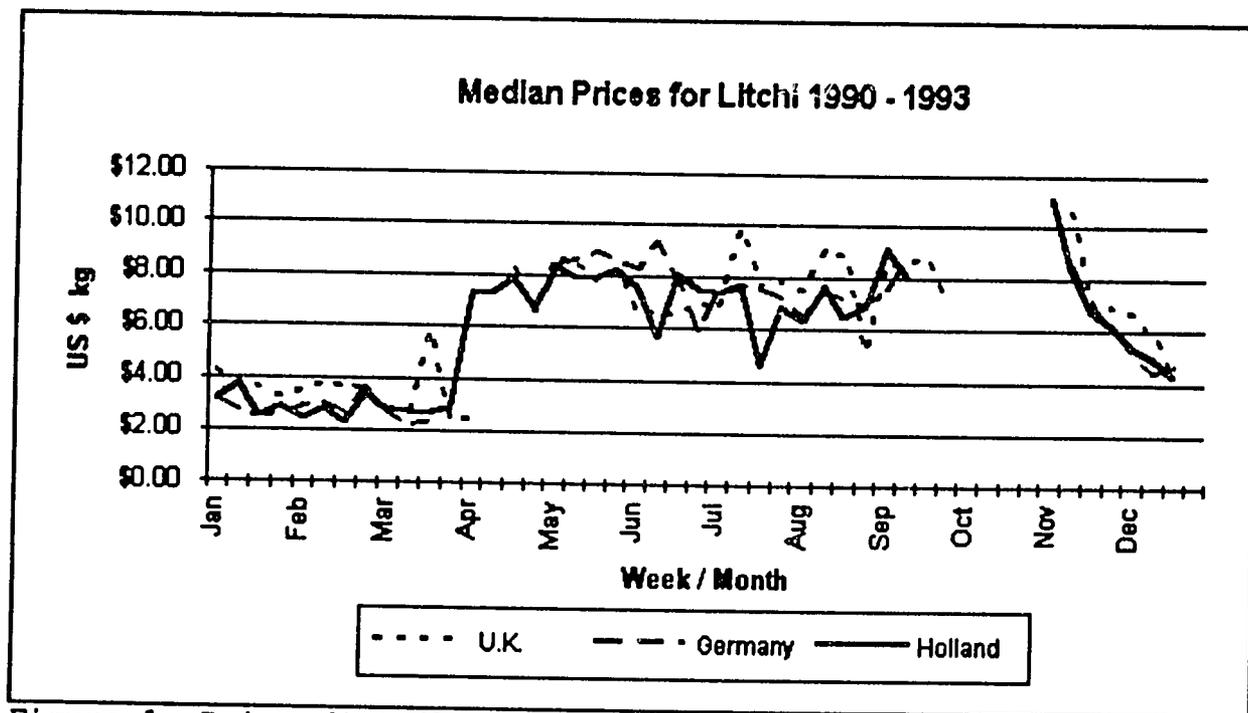


Figure 1. Price distribution in different markets.

3. Production of Litchi

Commonly known as: Litchi or Lychee

Botanical Name: *Litchi chinensis* Sonn **Family:** Sapindaceae.

Origin: Lower areas of the southern provinces in China, along the rivers and on the island of Hainan. Arrived in Florida in 1883.

Varieties: There are two general types of varieties and a large number of selections given that it is a crop that has widely expanded. The "dry and clean," or the type which when opened does not release juice, is achieved with such varieties as the 'No Mai Tze' and 'Kwaluk', and the wet type with 'Hak ip'. For the Central American region, Michael Strong, a producer from Hawaii, has recommended 'Kai Mana' and the tropical type of 'Groff' for minimum night temperatures of 15°C and day time lows of 25°C; 'Pink Kwai Mi', 'Salathiel' and 'Mauritius' subtropical types for minimum night temperature of 10°C and day time lows of 20°C and 'Kwai Mei Red' and 'Hak Yip' cold types for minimum night temperatures of 5°C and day time lows of 15°C. Australian producers recommend 'Tai So' for the tropical regions. Plants grown from seed reach 18 meters and produce within 6 - 10 years, while grafted trees grow to 12 meters and produce within 4 or 5 years.

Pollination: The flower does not have petals. Litchi demonstrates various types of flowering in uneven or simultaneous sequence depending on the cultivar, climatic or internal conditions surrounding or affecting the trees and panicles. But as a general rule between 10 and 60% of the feminine flowers remain functional.

In general, the litchi is a plant with a neutral photoperiod and the flowering is favored by low nocturnal temperatures and is enhanced at the same time by dry periods which are associated directly with the accumulation of starch content in the leaves.

Three stages are observed in the development of the fruit. Using the 'Mauritius' variety as an example:

- I) Formation of the shell, embryo and membrane that covers the seed
- II) Development of the cotyledon and beginning of the aryl development
- III) Rapid development of the aryl. In this final stage, the development of the pericarp and aryl are independent from the embryo, which explains the occurrence of parthenocarpic and small seed size with abortive embryo, known as "chicken tongue" which produces fruit that are greatly appreciated since the cavity that is normally occupied by the seed is filled with aryl.

Fruit matures between 90 and 115 days depending on the variety.

Controlling flowering: With a great deal of care, a ring can be used which circles the trunk once

followed by an alternate girdling each year with a simple tool that does not perforate further than the cambium and that is similar to the point of a juice opener tied to a stick. It is reported that a good harvest yields 10,000 lbs/ha/yr.

Climate: Groff has been used as the example to describe the requirements of litchi. The winter should be cold and dry to provide for a resting period and to induce flowering. It can not stand temperatures of less than -4°C. Requires an approximate precipitation of 1,600 mm and relative air humidity of 70 to 80%.

Soil: pH from 5 to 6.5. Requires well-drained soil but is adaptable to different types of soils, especially sandy and volcanic soils.

Propagation: The seed rapidly loses its viability. The most recommended method is air layer, above all with branches that are on the periphery of the canopy exposed to the sun. Branches should be chosen that are between 5/8" to 3/4" in diameter with a 40 - 50% survival rate. A simpler method has been found which consists of planting air layers from selected plants and allowing them to grow for 2 1/2 years. Later these are cut to within 25 cm of the ground and left to grow as many sprouts as possible over a four month period. Later these are all girdled except for one and a lanoline paste is applied which contains 2,500 ppm of Indolebutyric Acid. They are placed in small hills of earth 10 days later or are covered with soil in order to protect the formation of roots which in two months will be ready to be separated and replanted. These will likely offer a 81 to 82% survival rate. This will leave, in the field, a stalk which will grow for another 2 1/2 years to repeat the process. The application of mulch of leaf cover and decomposed manure is recommended for a maximum of 100 mm around the stalk.

Planting Distance: 8 to 12 meters. Wind curtains are extremely important.

Fertilization: According to the soil analysis. It has been determined that a harvest of 1,000 lbs. extracts from the soil, approximately: 3 lbs. of potassium, 1 lb. of phosphorus, and 1 lb. of nitrogen, 340 grams of calcium, and 228 grams of magnesium. An application of zinc chelate is also recommended to correct deficiencies that are manifested by falling leaves.

For growth, Australians recommend: 450 grams in a ratio of 10 N, 2 P and 17 K per tree per year during the first three years (in 3 split applications). In addition, a positive response has been observed during the first year with 20 to 30 grams of urea per month during the hot season.

For fruiting: immediately after harvest apply to each tree 320 g of a 10 N, 2 P, 17 K mix per year for up to 12 years. A positive response has been observed with the application of 0.2 kg of dolomite per year when the tree is ten years old.

Insects and Diseases: Litchi is seriously affected by a series of insects such as: Mealy bugs, *Aceria* sp., Coleoptera such as *Tessarotoma* sp., *Banasa* sp. ; and all types of perforator spiders, aphids, thrips, scales. In the fruit themselves, fruit flies perforate the fruit and cause internal rotting. To avoid this, many growers cover the branches, after the terminal has been defoliated, with water-resistant bags 6 to 8 weeks before harvest. A few diseases of importance have been

reported to attack litchi including *Phomopsis* sp. *Botryodiplodia* sp. *Colletotrichum* sp.; and at the post-harvest periods they are attacked by certain types of yeasts.

Harvest: Litchis poses a strong alternate production pattern and it has been classified as biannual. A fruit is mature when the protuberances that grow forth from the skin have separated and are lightly flattened. Also, maturity is indicated by their red color. Great care should be taken when cutting because the litchi skin can be easily broken when attempting to separate it from the peduncle. The boughs are easily broken; therefore, harvest should be carried out with special tools that cut and support the branch so that it does not get thrown to the ground. The ends of the terminals should also be pruned, whether they are bearing fruit or not, in order to maintain the size of the tree and encourage the greatest number of sprouts possible in the subsequent flowering.

Post-Harvest: (according to the USDA)

1. Classification: Oval, 150 to 230 mm long, brown-colored shells, pink meat, somewhat soft when pink.
2. Treatment: Research is needed to determine an acceptable quarantine treatment for import into the U.S.
3. Pre-cooling: Cold storage
4. Temperature and Relative Humidity: 13 to 18°C and 85 to 90% It has recently been demonstrated that 5°C is the optimum temperature.
5. Sensitivity: Cooling damage, bruising, loss of moisture. Ethylene producer.
6. Storage/Transit Life: 2 to 6 weeks.
7. Packaging: Fiberboard (Styrofoam) bases wrapped in foam or shredded paper.

Litchi can be sold in frozen form, which is admissible into the U.S. As much as 55,000 lb of frozen litchi was imported into the U.S. in 1987. Also, in 1989, the U.S. imported around 5.1 million lb of canned litchi and longan.

On August 10, 1993 in the USDA Federal Register, litchi from Israel was granted admissibility to the U.S. Litchi fruit from Israel must be treated with one of the following cold quarantine treatments for the control of Mediterranean fruit fly:

10 days at 0°C or lower
11 days at 0.55°C or lower
12 days at 1.11°C or lower
14 days at 1.65°C or lower
16 days at 2.22° or lower

These temperatures refer to the temperature reached by the flesh of the fruit at the beginning of treatment.

Nutritional Value: Each 100 grams of fresh fruit contains the following: 63 calories, 0.8 g of protein, 15 g of carbohydrate, 0.3 g of fiber, 0.4 g of fat, 9 mg of

calcium, 0.4 grams of iron, 3 mg of sodium, 170 mg of potassium, 28 mcg of thiamine, 0.05 mcg riboflavin, and 42 g of ascorbic acid.

B. Longan

U.S. imports of fresh and frozen litchi and longan are reported by APHIS. APHIS figures are available from 1983 to 1987, during which time, there were no reports of fresh longan imports. In 1989, over 1.1 million lbs. of canned litchi and longan were imported into the U.S. This represents a 70% increase over 1980 figures. Frozen longan imports also increased rapidly, reaching 29,400 lbs. in 1987.

In Florida, fresh longan production reached 1/2 million lbs. before Hurricane Andrew. In 1994, production will be substantially less (approx. 100,000 lbs.), but by 1995, production will surpass previous amounts, reaching an estimated 1.5 million lbs.

Consumer preference has led importers to purchase primarily large fruit with a high percentage of pulp. ETF receivers surveyed indicate that there is a demand for longan in the off-season. The world market for longan is far from saturated.

1. Longan from Central America

Longan from Central America is currently not admissible fresh into the United States because it is considered to be a fruit fly host. In Central America, harvest begins in Costa Rica in August, and ends in Honduras in October.

Longan was introduced to Central America as seedlings with no specific selection. The region has fertile ground for selections better-adapted to different altitudes and climatic conditions.

This fruit is highly esteemed in Central America. Longan trees are often stripped of fruit in the attempt to meet the local market demand.

Longan	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
USA												

Table 2. Availability of Longan.

Longan is originally from South China and was first brought to Florida in 1906. J.R. Brooks, tropical fruit sellers, offers longan for sale June to August, probably from South Florida production because fresh longan is not admissible into the U.S. from most other producing countries.

This fruit is sub-tropical and behaves like a cool-climate litchi, withstanding temperatures as low as -20C. For flower induction, a dry, cool period (without freezing) is required. The production cycles are strongly alternate in bearing years. The cultivar 'Kohala', selected in Hawaii, can bear good quality fruit 4-6 years from planted seed. The final selection for mature, bearing trees should be done at that time.

Production depends in large part on plantation management and can vary from 300 to 700 lb per tree annually. At those yields, or more, with good fruit and good marketing you can be assured of making a profit on your production.

This fruit is considered a delicacy by South East Asians and their ethnic populations in the U.S. and Europe will spend well in order to obtain fresh longan. Reports from South East

Asia indicate that one hectare of longan is enough to support a family of four on an annual basis. An estimated gross-revenue analysis is not possible because prices are presently not quoted for longan in Europe, but all indications are that it would sell profitably there.

2. Longan Production

Commonly known as: Longan or Longana.

Botanical Name: *Dimocarpus longan* Lour.
Euphoria longana

Family: Sapindaceae.

Origin: Originally from southern China, provinces of Guangdong and Fujian. Arrived in Florida in 1906.

Varieties: The recommended varieties for the region, provided by Michael Strong are: 'Chompoo 1', 'Kohala', 'Biew Kiew' y 'Haew'. 'Sri Chompoo' will be introduced from Australia.

Climate: From 150 to 450 meters above sea level. It is a subtropical fruit. Mature trees will support temperatures no lower than -2°C. A three month cold period without frost will favor flowering and fruiting, while very hot summers will suppress them. In a study, Drs. Campbell and Malo indicate that it is necessary to evaluate the different longan materials under tropical conditions in order to be able to recommend the cultivation of this crop.

Soils: Longan does well in very sandy soils to sandy soils that are somewhat acidic. Uletic limestones soils are even better. Humid organic soils will cause deficient growth.

Propagation: The majority are propagated by seed, which is germinated in 7 to 10 days and they should not be planted deeper than 2 cm. Trees should be planted in the shade for 2 years and should be transplanted in the dormancy of winter. Propagation by air layer is recommended. Changing the crown is easy to do using a graft patch on the new sprouts that will appear after a severe pruning.

Planting Distance: 10 to 12 meters

Fertilization: There is no specific information regarding fertilization for this crop, but light fertilization is recommended during fruiting.

Insects and Diseases: Few have been found in literature searches.

Harvest: Longan production season alternates from year to year. Trees should be pruned to maintain the size of the tree within 5 meters. In China, harvests of up to 500 lbs. per tree have

been reported. The production in Costa Rica, (in the experimental station "El Naranjal" on the Pacific Coast) begins in August and ends one month later. In Honduras, the harvest also lasts one month, in September on the Caribbean coast, close to Tela.

Post-Harvest: (according to USDA)

1. **Classification:** Light brown color, 25 to 40 mm in diameter. Fairly rough peel. The aryl is gelatinous, white, translucent and has a strong sweet flavor. The seed is round, shiny and black with a white spot on the bottom.
2. **Pre-Cooling:** Forced Air
3. **Temperature and Relative Humidity:** 1.5°C and 90 to 95%.
4. **Sensitivity:** Damage by freezing, high rate of moisture loss.
5. **Storage/Transit Life:** 3 to 5 weeks.
6. **Packaging:** Fiberboard box. 10 lbs.

Nutritional Value: Each 100 grams of fresh fruit contains 61 calories, 1 g of protein, 0.1 g of fat, 16 g of carbohydrates, 10 mg of calcium, 42 mg of phosphorus, 1.2 mg of iron, 6 mg of ascorbic acid, and 0.4 g of fiber.

C. Rambutan

Rambutan is very popular in Southeast Asia where it is a backyard as well as a commercial crop. It has an appealing flavor and an exotic appearance. Demand in areas outside of Asia is centered primarily in ethnic Asian communities, but is growing in non-ethnic sectors of the market in the U.S., Canada and Europe as well. Demand for rambutan worldwide increases when supplies of litchi are short.

Like litchi, rambutan is so popular that Frieda's Finest, the largest specialty produce broker in the U.S., often receives requests for fresh rambutan that the company is unable to fill because it is inadmissible to the United States from the major production areas of the world. Should rambutan become admissible, its market prospects as an export are positive. Industry experts feel that as rambutan moves into the general market and becomes more widely available in the U.S., demand will increase.

Preferences are for uniform size, pink or red shells, fruit with good flavor, and seed that readily detaches from the pulp.

Rambutan is grown in a tropical zone between 12° south and north of the equator in areas with warmer temperatures, more humidity, and higher elevations, where litchi cannot be grown. The major producers are in Asia. Thailand is the largest exporter to Europe. Thai rambutan earns approximately \$2.5 million annually. Other producers include: Malaysia, Australia, India, Madagascar, and recently Panama and Honduras. These countries export to several different countries including: Singapore, which re-exports to the UK, Hong Kong, and Japan; the Netherlands, which re-exports to Europe and the Middle East; and France.

It is estimated that the area planted in producing countries began to increase considerably in the 1980's. While exact figures are not available, annual production figures are estimated at 400,000 tons for Thailand, 180,000 tons in Indonesia, and 100,000 tons for Malaysia. These countries normally transport rambutan to foreign markets by air due to the relatively short shelf-life of the fruit, although Thailand has had successful sea shipment trials to Hong Kong and the UK. Thailand and Indonesia export year-round.

1. Rambutan in Central America

The Central American production period coincides with those of Thailand and Indonesia, and Australia. Central American producers can take advantage of the fact that rambutan can be managed to produce in the region during the winter months when there is less production in the other producing countries.

Rambutan is considered to be a fruit-fly host and is not admissible fresh into the United States from Central America. Unlike with litchi, hot or cold treatments do not work well for rambutan as the treatments damage the appearance of the fruit. Testing to develop an effective disinfestation treatment is currently being conducted in Australia, Hawaii and Honduras in cooperation with APHIS to remove rambutan from the list of fruit fly hosts.

An estimated gross-revenue analysis using the following figures is possible. Assuming an average price of \$1.80 per pound and a yield in the sixth year of 50 pounds per tree, producers can calculate that \$90.00 per tree for 125 trees/hectare will equal an estimated \$11,250 per hectare per harvest.

Rambutan	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
California												
Thailand												
Indonesia												
Hawaii												
Australia												

Table 3. Availability of Rambutan all year-around.

On a worldwide basis, Asia has both the most production and the largest importation of rambutan, in competition with litchi. Malaysia is the major importer and also a major exporter of rambutan after Thailand which is one of the largest exporters of rambutan to Europe. Another strong importer is Singapore which then also re-exports to Europe, principally to the United Kingdom. Indonesia supplies the Dutch market from where the fruit is distributed to other countries, including the Middle East. Other countries contributing supplies are Mauritius, Australia, Puerto Rica and, recently, Honduras and Panama. Central American production, would be in competition with Thai rambutan at the low levels of Thai production and not at its peak.

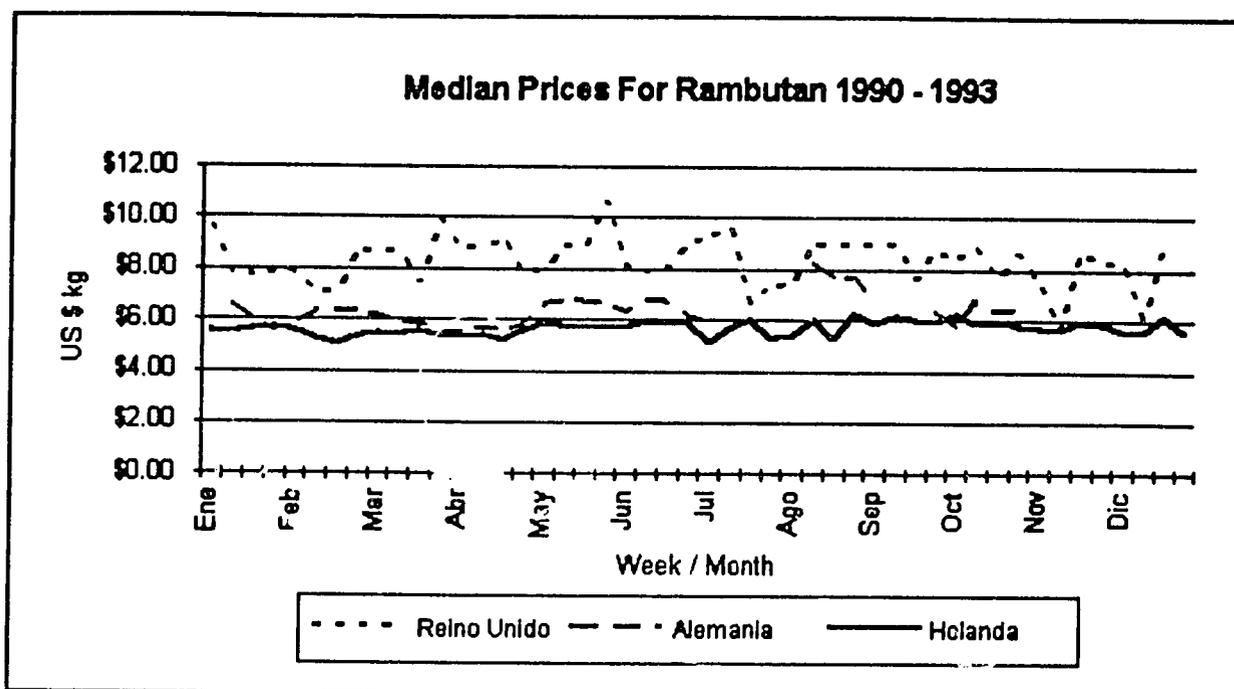


Figure 2. Prices in different markets.

2. Production of Rambutan

Commonly known as: Rambután or Mamón Chino.

Botanical Name: *Nephelium lappaceum* L.
Euphoria nephelium DC.

Family: Sapindaceae

Origin: Malaysia

Varieties: The varieties recommended by Michael Strong for the region are: 162, 167, 134, 156-RED, 170, 'Jit Lee' and 'Binjai'. Recently, 'Seelengkeng' has been mentioned as a delicacy among the Chinese.

Climate: Rambutan develops very well in a humid tropical climate where rains are well-distributed, from sea level to 600 meters above sea level. The ideal conditions are an average temperature of 27°C, 82% relative humidity, 1,800 mm of annual precipitation and a dry season that does not last more than 3 months.

Soils: Very deep soils with a high content of organic material and above all, soils should be well drained.

Propagation: Propagation by seed is recommended only to obtain root stock that are adapted to the soils and the climates of the region and later to introduce these internationally recognized varieties which have already imposed quality standards.

Germination takes 9 to 25 days. The seed should be placed with the flat side down to ensure that the resulting seedling will be strong and of normal growth. Great care should be taken so as not to damage the principal root. From seed, rambutan can produce for harvest within 4 or 5 years. There is a possibility that 50% of the trees will be male and 50% females of which only 3% will be hermaphrodite, bearing types, with superior qualities corresponding to those that the international market recognizes. Vegetative propagation is essential. The best method is the graft patch, taking great care to do it at the right time, choosing dormant, not sprouting buds. Currently, graft by proximity and air layer are being used on a commercial scale in Honduras, Costa Rica and Panama.

Planting Distance: 8 to 10 meters.

Fertilization: Fertilization should be carried out according to the results of a previous soil analysis, but in general, 2 applications of 1 kg of ammonium sulfate is recommended plus 1 kg from a complete source 12-24-12, which contains calcium and magnesium as well. One should be applied at the end of harvest and another at the end of the rainy season. It has been determined that a harvest of 6,724 kg/ha extracts from the soil: 15 kg N, 2 kg of P, 12 kg of K, 6 kg of calcium, and 2.67 kg of magnesium.

Insects and Diseases: The relevant literature reports few diseases. An adequate integrated control program is suggested. Cancer of the stalk from *Ophioceras* spp., y *Fomes lignosus* has been reported and may be fatal.

Harvest: In Malaysia, there are 2 harvests, the largest in June and another in December. On the South Coast of Guatemala, flowering begins in March just as in other areas of the region and harvest is expected from July through October. Production has been reported of up to 5,000 fruits per tree. At the time of harvest, a light pruning is recommended for all terminals, fruit bearing or not.

Post-Harvest: (according to various sources)

1. Ambient Temperature: can withstand 3 to 5 days. They will last longer if treated with 0.5% copper sulfate and placed in perforated plastic bags.
2. Panama has been able to export successfully to Europe without any type of special packaging using 2 kg cardboard boxes kept at 10°C. Semperfresh, edible wax on a commercial presentation, was also applied although it has not been determined to be necessary. Drying and discoloration of the shell will be delayed at higher relative humidity (95% or more).
3. For select markets in Europe and Canada, fruit is packed in punnets (small plastic boxes, like those for berries) in 12 punnet flats.

Nutritional Value: Every 100 grams of fresh fruit contains: 0.46 g of protein, 3 g of sugars, 6 g of sucrose, 16 g of other carbohydrates, 0.24 g of fiber, 10.6 mg of calcium, 13 g of phosphorus, and 30 g of ascorbic acid.

D. Carambola.

Carambola, or star fruit, is considered by some industry experts to be one of the most promising of ETF fruits with rising consumer demand. Carambola is mainly sold as fresh fruit although it is also used in fruit juices. In China, dried and sugared carambola is sold as a special sweet treat. Its attractive star shape makes it an excellent garnish, as well as a decorative addition to fruit salads. Carambola can also be made into various sauces, preserves and jellies.

Most consumers in North American and European markets are still not familiar with carambola. In order to increase demand, promotional campaigns focusing on the major quality attributes of the fruit, such as carambola's high potassium and vitamin C content, are necessary. In Malaysia such campaigns already exist. In North America preference is for sweet varieties with well-colored (orange/yellow) fruit. There is little demand for tart fruit.

Although demand in Europe is steadily increasing, volumes sold will likely remain low there. In Europe, carambola is becoming more widely used as a garnish. Europeans care less about the sweet or tart flavor than the appearance. For the European market, harvest and post-harvest practices should be focused on maintaining an unblemished appearance.

In the United States, carambolas are grown commercially in Hawaii and Florida (300 hectares combined). Carambola (and most other ETF) from Hawaii is not sold on the U.S. mainland because, as a fruit fly host, it is not admissible. Small amounts are exported from Hawaii, primarily to Canada, which does not impose fruit fly restrictions on imports. Fruit is transported by truck within the U.S. mainland from Florida to California.

A cold treatment has recently been approved for cultivar 'Arkin' carambola from Florida for transport to California. The treatment requires the fruit to be cooled at 33° F for a period of 15 days.

Although carambola is a potentially important horticultural commodity in Florida, the industry is new and there is little practical information on orchard practices or fruit handling. J.R. Brooks & Son, Florida's largest tropical fruit shippers, increased their shipments of carambola from half a million lbs. in 1986 to one million in 1987. By 1992, production of carambola in Florida had reached eight million lbs. Although the 1994 harvest will be only half of that, production for 1995 is expected to jump to six million lbs.

Dr. Jonathan Crane of the Tropical Research and Education Center in Homestead, Florida has stated that, "Production is increasing exponentially, not only doubling or tripling but increasing by 20 or 30 times." In the near future, production will likely reach 25 million lbs. For the U.S. market, Florida production will make it very difficult for imported carambolas to compete except in May, although Florida is currently working on production for May as well.

Major producing countries outside the U.S. include: Malaysia, Taiwan, Indonesia, China, Pakistan, Brazil, and Madagascar. Israel has also recently begun production of carambola. Major importers now include: Europe, Canada, Japan, Hong Kong, and Singapore. There are no published international quality standards for carambola. Carambola is usually transported to distant markets by air, however, Malaysia, which exports 80% of its production, also ships by sea.

1. Carambola from Central America

Carambola from Central America is not admissible fresh into the United States due to its status as a fruit fly host. Cold treatments for certain types of carambola exist to enable producers in the region to export fresh fruit in the future, provided that the study conducted in Florida for 'Arkin' is validated for the Central American region.

While the season for carambola from Florida is currently from June through February, Florida producers will soon be able to produce year-round, eliminating the advantages of a particular market window for Central America.

In Europe, Malaysia generally dominates the market with consistent supplies and competitive prices. However, receivers of carambola in Europe surveyed for this study indicate that they receive carambola year-round and that the majority of them would be able to handle greater amounts (increases of 10-100%). Central American producers should calculate their production costs and compare the European prices provided in the annexes of this document to evaluate the potential success of exports to Europe.

The acidic Carambola is well known in Central America where it is used in fruit beverages. It is known as melocotón in Nicaragua and Fruta China in Panama. Carambola is basically a backyard crop, although there are plantations of cv. "Arkin" in Costa Rica. Belize has had particular success with "Kyra" and "Kari" varieties.

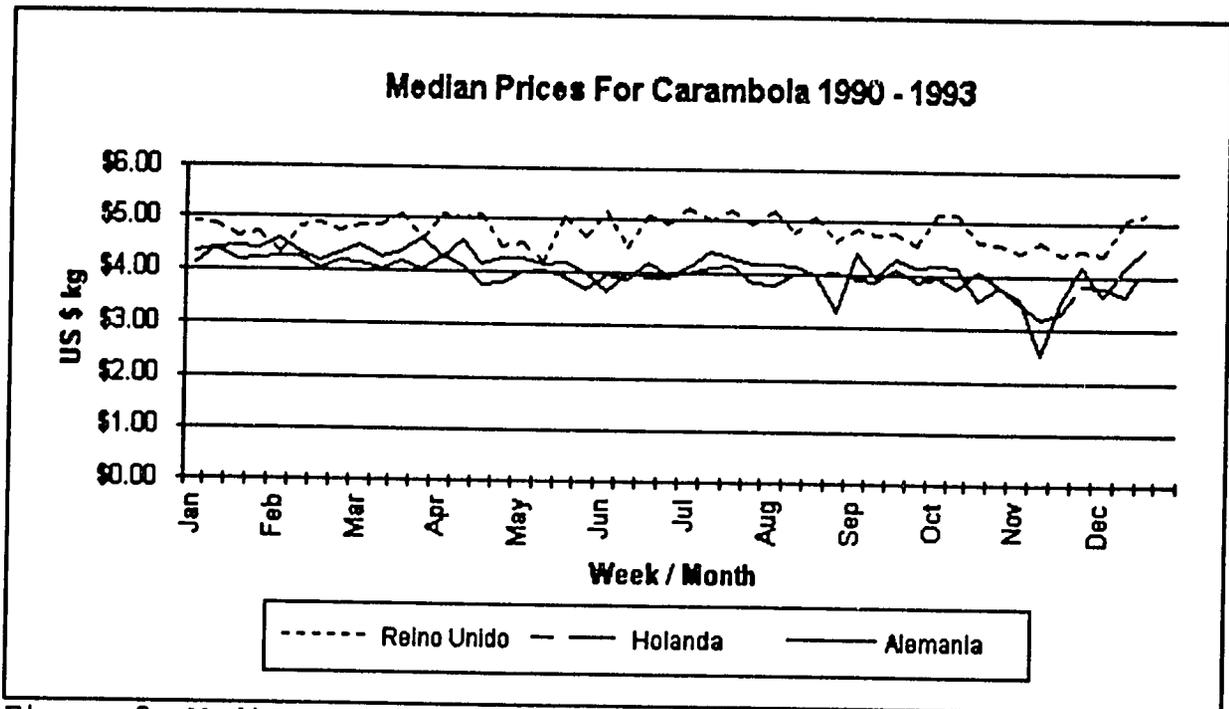


Figure 3. Median prices in different markets.

A well-managed tree will produce 30 kg of exportable fruit in the second year and will increase to 70 and 120 kg in the third and fourth years, respectively. With 400 trees/ha, minus 5 % loss of harvest for defects, annual yields would be 45,000 kg. At a production cost of \$3.25/10-kg box C.I.F. Europe, and a minimum sales price of \$3.58/box, profit per hectare would be \$1,485.00 annually.

There is no identified market window for carambola production is year round because of worldwide production and a grower must rely on his quality and consistency for accessing the competitive European market.

2. Production of Carambola

Commonly known as: Carambola, Star fruit, Melocotón (Nicaragua), or Fruta China (Panama).

Botanical Name: *Averrhoa carambola* L.

Family: Oxalidaceae.

Origin: Malaysia and Indonesia. Arrived in Florida before 1887.

Varieties: There are 2 distinct types of carambola. The smaller type has the greatest oxalic acid content and the larger, or sweet variety, has less. Several lines have been derived from the larger type, such as 'Arkin' and more recently, 'Kari' and 'Kyra' which are recommended for the region by Michael Strong. Also, PROEXAG II is introducing 'Sri Kembangan' and 'Fuang Tung' which come from Australia, among others.

Climate: Carambola is classified as tropical and subtropical. It can tolerate temperatures even lower than 3°C and according to the Australians, it requires 1800 mm or more of well-distributed rain throughout the year. It flourishes in high relative humidity and can be grown up to 500 meters above sea level. It requires full sun.

Soils: Soils need to be well-drained but carambola can stand almost any type of soil. It does very well in deep soils and in very clay-like soils. The application of a light mulch 100 mm thick is recommended, especially during the first three years.

Propagation: Well-developed seeds should be used for root stock, and they should be planted immediately as they quickly lose their viability. In moss and with moisture it will take a week at high temperatures or 14 days at lower temperatures. To graft, the root stock should be a year old and be 1 to 1.5 cm in diameter. A side graft can be used of a cutting of mature woods or a wood patch in green woods, the latter resulting in 90% success. The first harvest is obtained within 10 months of the transplant. Different lines should be interplanted to ensure better pollination. If there are strong rains and winds during the flowering period, the carambola will be seriously adversely affected. Management through pruning is vital as it directly influences flowering.

Planting Distance: 5 to 6 m when planted as a crop between rows, up to 9 meters.

Fertilization: Fertilization should be based on the results of a soil analysis. Three or four applications per year are recommended of 1 lb of N-P-K-Mg in a 6-6-6-3 ratio. Australian producers recommend 200 g of P in and around the hole before transplant. In addition, divide into three application per year an applications of 10 g N, 2 g P and 19 g K as well as an application of Dolomite or Limestone.

Insects and Diseases: These are mostly fruit flies, especially *Daucus dorsalis*. Some beetles have been observed in over-ripe fruit and nematodes exist that can cause a decline in the tree. Diseases from anthracnose: *Colletotrichum gloesporioides* and in fruit, *Cercospora* spp.

Harvest: production per tree is between 50 lbs in the first year and 150 lbs. in the third year. In Malaysia, there is fruit year-round. In Florida, there is fruit from the end of summer to the beginning of winter. The fruit is in good condition for post-harvest storage and it has been transported without refrigeration, for which it must be harvested green with a light yellow tint and placed in boxes stem downwards at a 90° angle, making sure that the "wings" of one fruit coincide with the cleft of another. It is beneficial to apply a layer of wax; at 60°F they can be stored for 3 weeks.

Post-Harvest: (According to USDA)

1. **Classification:** Firm, with a shiny skin, mature fruit is yellow-orange with brown borders, up to 100 mm long, cross section in form of a star.
2. **Pre-cooling:** Forced air and cold room.
3. **Temp. and R.H.:** 9 to 10°C, 85 to 95%
4. **Sensitivity:** Damage due to cooling, loss of humidity.
5. **Transit/Storage life:** 3 to 4 weeks.
6. **Packaging:** 2-piece, waxed, fiberboard box with lid, plastic pillow in the bottom to reduce bruising; 8 to 10 lbs/box.

Nutritional Value: Each 100 grams of fruit has: 36 calories, 0.38 g of protein, 0.08 g of fat, 9 g of carbohydrates, 0.86 g fiber, 5 mg calcium, 18 g phosphorus, 2 mg iron, 0.3 mg carotene, 0.03 mg thiamin, 0.34 mg niacin, 40 mg ascorbic acid, and more than 17 amino acids.

Other Uses: Some people react poorly to even small amounts of oxalic acid and according to tests from Puerto Rico, mature fruit can contain up to 0.5 g per 100 ml of juice. Carambola is also claimed to have medicinal properties and is used as a cure for hemorrhoids, relief from an excessive indulgence in alcohol, as a diuretic, as an antidote against poison, and for asthma. Carambola can be toxic to a degree and the acidic varieties have been used to polish metal, dissolve tarnish, rust and to bleach cloth.

E. Atemoya

The atemoya is a hybrid of the sugar apple and the cherimoya. The atemoya tree closely resembles that of the cherimoya. It is slightly hardier than the sugar apple and does well in tropical or near tropical areas.

Before Hurricane Andrew, J.R. Brooks & Son had doubled the amount of atemoya marketed in the U.S. in previous years. Although atemoya production in Florida for 1994 will be approximately 50,000 lbs, in the near future production will increase to pre-hurricane production of 200,000 lbs.

The atemoya, more commercially feasible and attractive than the sugar apple, is sold to Miami's Cuban and Southeast Asian populations, and is sold in non-ethnic supermarkets as well. Atemoya is currently being shipped by air from Florida to Washington State. Importers of cherimoya who may be interested in atemoya include: Austria, Bahrain, Italy, Sweden, Switzerland, and the United Kingdom.

Atemoya is delicate and it must be carefully packed. Special packaging (a fixed cost) represents a large percentage of the end price. The fixed cost of packaging makes price negotiation with distant buyers difficult.

1. Atemoya in Central America

Atemoya is not currently admissible into the United States from Central America due to its status of fruit fly host. Recently, a treatment for mealy bugs was approved for Chilean cherimoya entering fresh into the U.S.. This treatment can be emulated by Central American countries, opening a new avenue for production from Central America. Under the new procedure, cherimoya will be washed in a soapy bath and then coated with an edible wax. A future treatment may be applicable to atemoya permitting its admissibility from Central America into the U.S. Clearance by the USDA for Chilean cherimoyas was first requested almost eight years ago. Central America will likely be able to avoid the waiting period by taking advantage of the Chilean experience and accessing the right channels to conduct treatment testing under USDA regulations.

Production of atemoya in California requires a great deal of hand labor because it has to be hand-pollinated. The high cost of production will keep overall prices high and will limit the expansion of new acreage. The comparative advantage of lower labor cost of atemoya production in Central America may make prospects for the region seem more positive.

Because atemoya is extremely delicate and serious injury of the fruit easily occurs, careful postharvest handling and shipping is required. Some industry experts suggest that the atemoya's relatively short shelf life (about 1 week) inhibits its commercial production far from market.

Atemoya is available in Australia from April through August, and in Florida from July through November. Using techniques such as hand pollination and early fruit protection (bagging) developed for cherimoya and sour sop, it is possible for Central America to produce year-round.

Atemoya is commonly packed in 10 lb boxes for shipment in which fruits are individually wrapped in paper or in styrofoam net cups.

Even though atemoya is not admissible into the U.S. from most producing countries, it is still seen as a crop with promise. Especially since the recent approval by USDA-APHIS of a quarantine treatment for cherimoya from Chile, which can now be sent fresh to the U.S. from that country. Atemoya is typically susceptible to infestation by most of the fruit flies, as well as other quarantine pests. J.R. Brooks Co. offers atemoya for sale only in July to October (see Table 4), although it is possible, using defoliation and hand-pollination methods developed for the sour sop and for cherimoya to be in production year-round.

Atemoya	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Holland												
U.K.												
Germany												
USA												

Table 4. Annual availability of Atemoya.

Prices quoted from world markets are for cherimoya rather than for atemoya. Using an average price for cherimoya of \$ 1.00/lb and an estimated 25 lb of export fruits per tree and 250 trees per ha will amount to \$ 6,250.00/ha. Considering that atemoya can be used as an alternative crop for another like Litchi will result in a better use of the land through an income the second year.

2. Production Potential

In Central America, the atemoyas are the annonas in the tropical zones and the cherimoyas in the more temperate zones, therefore, the introduction of a fruit that is a hybrid of the annona and the cherimoya, with much of the same characters, ensures that the internal market will respond favorably to this crop. For example, after only 2 years in production, the cultivars 'Geffner' and 'African Pride' have gained wide acceptance in the market. An example of excellent production is in Panama where the sour sop is produced with hand-pollination and by using insecticide-impregnated plastic bags to protect the fruit on the tree. Central America is equally capable of producing atemoya in the same, efficient way as Panama, Belize, Australia and Hawaii.

In the coastal areas, using *A. squamosa* as root stock, the tree requires temperatures of 25-28°C during flowering and prefers a high relative humidity (80-90%) during the entire vegetative growth period, except during flowering.

At higher altitudes, using *A. cherimola* as root stock, atemoya can withstand temperatures to -3°C, nevertheless, at +4°C there is occasional damage to the fruit with ruptured skin and discoloration.

Atemoya requires deep, loose, well-drained soils with high organic matter and pH of 5.7 to 6.3.

The USDA publication, Transportation of Perishable Products, recommends pre-cooling with forced air, maintenance at 13°C with RH in transport of 85 to 90%. This will give the fruit

4 to 6 weeks of postharvest life. The recommended packing is in boxes of 10 lb with a single layer of fruit covered with paper, sponge or sawdust, to avoid damage.

3. Production of Atemoya

Commonly known as: Atemoya or Custard Apple.

Botanical Name: *Annona squamosa* x *A. cherimola*

Family: Annonaceae.

Origin: Hybrid obtained in 1908 by P.J. Wester from USDA Miami.

Varieties: 'African Pride' is a clone obtained in South Africa, 'Geffner' is an Israeli selection, propagated in AREC Homestead and 'Priestly' from Zill Nursery in Boynton Beach. 'Cherimata' and 'Finny', are Egyptian clones, the former is considered to be the best for coastal areas. 'Pinks Mammoth' and 'Hillary White' are varieties from Australia and Hawaii which have been introduced by PROEXAG II to the Central American region.

Climate: According to the root stock being used. For example, in the tropical zones and coastal areas, atemoya requires temperatures of 25 to 28°C during the flowering period. It prefers high relative humidity from 80 to 90% during the entire vegetative period except during fruiting. When planting at higher altitudes using cherimoya as the root stock, trees will tolerate light frost to 3°C. However, 4° C can cause a rupture of the skin and discoloration of the fruit.

Soils: Deep, open texture, high in organic material and very well-drained soils, pH of 5.7 to 6.3 is recommended.

Propagation: Root stock from seed are recommended for future grafting with varieties of the selected varieties. Germination occurs at four weeks. The modified horqu type graft or the side graft should be taken from the tropical plant when the cambium is in active growth, or rather when the bark is easily removed. The recommended root stocks for the region by Michael Strong are cherimoya (*A. cherimola*) for shade in the higher zones, "anona de Castilla" (native name) (*A. squamosa*) which is recommended as excellent root stock for areas with moist soils, and (*A. glabra*) for semi-boggy to marshy soils in the tropics.

Pollination: The Annonaceae has protogynous hermaphrodite flowers and asexual pollination is not common. For example, the flower expresses itself as female from 2 to 4 pm and from 3 to 5 in the afternoon on the next day as male. In Israel, beetle pollinators have been identified from the Nitidulidae family such as: *Carpophilus*, *Haptoncus*, y *Uroporus*. However, pollination by hand will allow for better quality fruits and will allow us to program the harvest. The seed plays an important role in the internal quality of the fruit.

Planting Distance: Depending on the root stock to be used, the planting system and the pruning

system to be used as well as the fertilization of the soils, the distance will vary between 9 and 12 meters. The trees need wind curtains. Upon transplanting to the chosen fields a rigorous method of pruning should be followed. Trees should be pruned to 76 cm in the first growth stage. Only two leader branches should be allowed to grow and these should be pruned to 23 to 25 cm at the onset of winter, after which a ladder method should be followed leaving 2 or 3 alternate branch for each leader branch. The objective is to have a shorter tree with a structure that allows it to support the weight of the harvest and will manageable for future spraying, pollination and harvest.

Fertilization: Although the application of organic fertilizers and a mix of these along with chemical fertilizers such as urea, superphosphate potassium and muriate is recommended, a soil analysis will allow one to adjust the fertilization for each different area.

Table 5. Foliar Analysis Nutrient Levels for Annona Leaves.

Nutrient	Suggested Range
Nitrogen-(% N)	2.5 - 3.00
Phosphorus-(% P)	0.16 - 0.20
Potassium-(% K)	1.0 - 1.50
Calcium-(% Ca)	0.60 - 1.00
Magnesium-(% Mg)	0.35 - 0.50
Iron (ppm Fe)	40 - 70
Manganese (ppm Mn)	30 - 90
Zinc (ppm Zn)	15 - 30
Copper (ppm Cu)	10 - 20
Sodium -(% Na)	0.02
Chlorides -(% Cl)	0.30
Boron (ppm B)	15 - 40

Source: Queensland Agricultural Journal. Sept-Oct 1987.

The following guidelines should also be noted:

- * The application of covers of dry vegetable origin at the base of the plants (mulching), favors the formation of vigorous, feeding roots on the surface and will improve fertilizer absorption.
- * The pH of the soil should preferably be maintained at 6.0 since the varieties are more sensitive to low pH figures, but that could be corrected using dolomite.
- * The doses of nitrogen to be applied vary in increments with the age of the tree, fruit load, and number of branches. Weak growth and excessively vigorous growth are both undesirable.
- * The fruit demands large quantities of potassium. Mature trees of the 'African Pride' variety can require up to 2 to 4 kg of potassium per year per tree. The foliar level of

- potassium should be no less than the 1% recommended.
- Fertiligation is ideal given that it achieves a quicker and more controlled response of the nutrition and the application of fertilizers, the lesser elements above all.
- When the number of fruit on the tree is at a maximum, the absorption by the roots is at a minimum. So, the application of foliar fertilizers can be beneficial, monitoring closely the dosage and frequency of the spraying.
- Annonas in general, are sensitive to the Boron and Zinc deficiencies. To correct Boron deficiencies Boron applications of Boron 2.0 g per square meter to the soil are recommended below the drip line area of the tree. Zinc deficiencies can be corrected through monthly spraying of Zinc Heptahidrate (at 0.1%). Likewise, foliar sprays of Boron and Calcium during flowering and at the beginning of fruit formation is beneficial and contributes to reduce the incidence of internal staining of the fruit.

Insects and Diseases: *Planococcus citri* common to citrus, that attacks the base of the fruits, scales, Chalcididae flies that place eggs and their larvae live in the seeds until the fruit is formed and later dig to the surface, damaging the fruit on their way out. In sour sop serious attacks by *Bephrata* spp. have been reported. The bee perforates the fruit and later digs out a tunnel which lets in secondary pathogens causing most fruit to fall and those that survive are deformed. Bacterial Wilt provoked by *Pseudomonas solanacearum* is the primary problem caused by poor drainage, with wilting, rotting, falling leaves, yellowing of roots and in extreme cases death of the tree. Chemical control does not exist, there just seem to be some root stocks that are more resistant than others. Root rot is due to *Armillaria leuteobubalina*, the symptoms of which are black lines from the fungus that look like shoe laces around the roots.

Certain diverse pathogens exist that cause either black canker *Phomopsis annonacearum* with symptoms that include dotting or marked areas that confine the outer layer. Rot due to *Botryodiplodia theobromae* similar to the previously described disease but which is characterized by internal discoloration, among others.

Among the physiological disorders that exist, the most common are those that split the fruit which could be due to the sudden changes in the moisture content or temperature of the fruit. Some varieties appear to be more resistant than others. Hardening of the fibers that cover the seed and the small interior brown balls, is attributed to the Boron deficiency or sudden changes in the water content of the fruit.

Harvest: The harvest in Florida is from September through December. Fruits take five months between flowering and harvest. A five year-old tree produces 50 fruits per year. Irrigation during flowering and fructification improves the quality of the fruit, reducing the cracking of the rind and consequently increases the harvest. Fruits should be cut when a few cream colored lines appear around the areolas indicating that the space between them is expanding. Fruit should be cut with a segment of the pedicel, making sure that the pedicel is no higher than the "shoulders" of the fruit.

Post-Harvest: (According to USDA)

1. Classification: Light green, heart-shaped fruit, with scales, 90 to 140 mm in diameter,

from 280 to 450 grams.

2. **Pre-cooling:** Forced air, cold room.
3. **Temp. and RH:** 13°C and 85 to 90% RH.
4. **Sensitivity:** Cold damage and bruising.
5. **Transit/ Storage Life:** 4 to 6 weeks.
6. **Packaging:** Single layers in 10-lb, fiberboard boxes, wrapped in paper, sponge, or shredded paper to reduce bruising.

Nutritional Value: Each 100 grams of fresh fruit contains 94 calories, 1.2 g protein, 0.5 g fat, 24 g carbohydrate, 1.3 g fiber, 17 mg calcium, 0.3 mg iron, 0.2 mg zinc, 0.05 mg thiamin, 0.8 mg niacin, 50 mg ascorbic acid, 4.5 mg sodium, 250 mg potassium, 32 mg magnesium, 0.07 mg riboflavin, 10 mcg carotene, and 10 mcg beta carotene.

F. Durian.

The two most outstanding characteristics of the durian are simultaneously its best seller and its worst obstacle. It has a rich, delicious taste but it also has a strong, offensive odor. Durian is welcomed by most people who have been adventurous enough to taste it and it is quite popular in many tropical countries. It is exceptionally nutritious, with a high protein, carbohydrate, and vitamin E content.

The fruit is eaten fresh. The pulp is used in preserves, cakes and ice cream. The seeds, either roasted or boiled, can also be eaten. Durian is considered by Southeast Asians to be a delicacy. In the U.S., members of immigrant Asian communities with limited income are willing to pay \$8-10 per pound for durian, although only a small percentage of the fruit is edible. Varieties with a less pungent odor, such as Montong or Chawnee, are preferred.

Malaysia, Thailand and the Philippines are concentrating production efforts on developing a non-pungent variety. They are so confident of the future of these durian varieties, that they hope to flood the European market within a few years.

1. Durian from Central America

The Netherlands and the UK import durian from Southeast Asia almost year-round. There appears to be a window in January and February when prices are somewhat higher. Central American durian could be price competitive in Europe during these months. However, producers should examine transportation options carefully as many airlines refuse to carry durian due to its penetrating odor.

In Central America, Honduras has benefitted from the introductions made by USDA explorer Wilson Popenoe in the Lancetilla Botanical Gardens. The gardens have 50 year-old trees which still produce fruit every year. These introductions serve as valuable examples and source material.

Durian is admissible fresh into the United States. As mentioned, there are Asian communities in the U.S. who are willing to pay high prices for durian. Central America enjoys an advantage over Florida and other states in durian production because the climate in the continental U.S. is too cold for commercial production of durian.

Durian	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Holland												
U.K.												

Table 6. Availability of Durian in different markets.

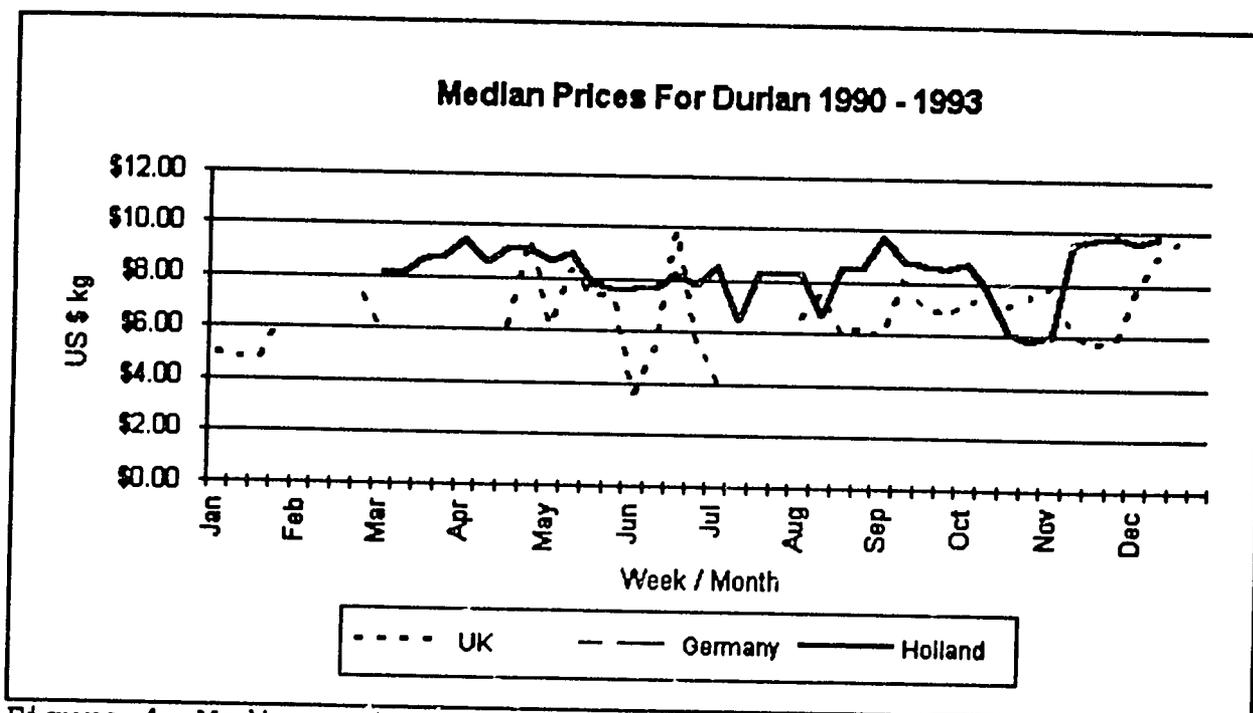


Figure 4. Median prices in different markets.

Reports from Texas indicate that durian has sold for up to US \$5.00 per kg with the shell on. Prices in Europe vary. A cost-benefit analysis is possible using the following estimated figures. Beginning harvest in the fourth year a tree will yield 10 fruits per tree and up to 30 fruits in the eighth year. Each fruit weighs approximately 6 kg. This would lead to an estimated value of US \$900 per tree. At 25 trees per hectare, producers can calculate the total value at US \$22,500 per hectare per harvest.

2. Production of Durian

Commonly known as: Durian or Durio.

Botanical Name: *Durio zibethinus* L.

Family: Bombacaceae.

Origin: Borneo y Sumatra

Varieties: There are more than 300 varieties in Thailand, 100 types in Malaysia and approximately 44 clones in the Malaysian peninsula. For the Central American region, Michael Strong suggests 'Montong', 'D2', 'Chancee' y 'Guan Yaow'. 'Montong' and 'Gompong' will be introduced to the region from Australia. 'Montong' and 'Guang Yaow' are brought to the region from Hawaii.

Climate: The durian is tropical and grows well at no more than 800 meters above sea level, from 1,500 to 3,000 mm of well-distributed rainfall per year. The minimum temperature for durian is 14°C. Durian requires abundant water during flowering, except for the 'Chancee' variety from Thailand.

Soll: Deep, sandy and clay-like soils derived from basaltic or granite material with a pH of 4.5 to 5.5. It demands excellent drainage.

Propagation: The seed quickly loses viability, more so if it is exposed to sunlight. The seed should be well-washed, separating it from the aryl. It should be dried and placed with the flat side of the seed downward. From seedling to harvest may take between 5 and 21 years. It has been reported that the D96 variety flowers at five years. Grafting should be done when the root stock is about the width of a pencil and a foot from the ground and the bark is easily separated. A patch graft will reduce the flowering period to 4 years as well as the size of the tree as do the side grafts, cradle or shield types and the micrograft in greenhouses. It is essential to avoid having the graft area come in contact with water since the pressure may cause the loss of the graft. Several root stocks such as *Durio mansoni*, *D. malaccensis* and *D. lowianus* have been used as they are resistant to *Phytophthora palmivora*. In India, tests have been conducted, using *Cullenia excelsa* as a root stock which apparently encourages a certain level of precociousness. For a long time and with great success approach grafts have been used. Experience in the region and the literature obtained recently in the Philippines recommend the importation of Durian plants that have been grafted at least a year previous to shipment, or those that are at least 1.25 to 1.75 m at the time of planting.

Pollination: The female flowers open from 3 p.m. to 7 a.m. and the male flowers from 7 in the afternoon to midnight with variations according to the areas and conditions as well as selections. Pollination is performed mostly by small bats and a few insects, although it is possible to pollinate by hand, which leads to more uniform and better quality fruit. Afterwards, the stamen, sepals, epicalix, and petals are removed, and only the pustule remains. From fruit set until harvest, maturity takes between 90 to 150 days, depending on the variety.

Planting Distance: 9 to 15 meters. Ensure that at the moment of transplant, the seedling is hardened off. In some cases a pruning of roots is beneficial to ensure a good radicular system. Planting should be carried out in the rainiest months. Rows of banana and plantain are recommended to provide shade until the durian begins its production in the fifth year.

Fertilization: A ratio of 6-6-6 to 5 grams of calcium and magnesium source is recommended per tree per month. For growth, the Australians recommend 15 g of P per plant upon planting. For the growth stage from 0 to 6 years, a mixture of 150 g N, 15 g P and 100 g K divided into three applications per year is recommended. For fruiting, an application of 130 g N, 15 g P, and 160 g K per tree per year is recommended beginning from the first flowering. At 15 years, one third of the application should be applied when the first flower buds appear and the remaining third when the harvest is complete. In addition, no more than 100 mm of mulch should be applied and the end of the harvest 5 kg per tree per year should be added of very dry chicken

manure. These steps should all be carefully evaluated based on the results of a soil analysis.

Insects and Diseases: Few insects and diseases are reported in relevant literature, although some *Pseudococcus lilacinus* is reported when the trees are young. Diseases such as *Phytophthora* sp. are seen in the form of a maroon gummy secretion close to the neck of the plant. This continues to grow until eventually it surrounds the plant causing defoliation and die back. The conditions that favor the pathogen are moisture, shade, and excessive mulch. It can also be quickly disseminated in a nursery by contaminated tools and wounds in the bark of the lower branches.

Harvest: During the harvest period, pruning and a light thinning will facilitate the upcoming tasks and improve the exposure of future flowers to the sun. Almost all Asian varieties fruit during the same period: July and August. In general, they wait until the fruit has fallen to collect it, although in Thailand they have developed a harvest method, based on experience and different cutting times, that has allowed them to harvest early and export to Europe and the Middle East.

Post-Harvest: (According to USDA)

1. **Classification:** Fruit with a spiny, olive-green colored rind, 150 to 380 mm long, 150 to 250 mm in diameter, 18 kg. Should be cut green to minimize its strong odor.
2. **Pre-cooling:** Forced air and cold room.
3. **Temperature and R.H.:** 4 to 6°C and 85 to 90%.
4. **Sensitivity:** Releases an offensive odor when ripe. Keep separated from other products.
5. **Transit and Storage Life:** 6 to 8 weeks.
6. **Packaging:** Single-layer in fiberboard, film-covered box, wrapping each box separately.
7. **Shipping:** Do not ship in mixed loads.

This fruit is permitted fresh into the United States from all of Central America, Panama and Belize, except Nicaragua.

Nutritional Value: Each 100 g of fresh fruit contains 144 calories, 2.6 g protein, 3.5 g fat, 12 g sugar, 13 g starch, 30 g other carbohydrates, 1.7 g fiber, 8 mg calcium, 42 g phosphorus, 1 mg iron, vitamin A, 0.32 mg thiamin, 0.20 mg riboflavin, 0.7 mg niacin, 24 mg ascorbic acid, and the fruit is very high in vitamin E.

G. Mangosteen

This delicious fruit is regarded by many as one of the best-flavored in the world. It's an ETF whose taste is much like more familiar fruits and is therefore easily accepted by consumers in Western markets. Mangosteen is an important seasonal fruit consumed primarily by Southeast Asians and Chinese. Mangosteen is available when litchi and rambutan are not. Preference is reflected by the higher prices of mangosteen compared to litchi and rambutan.

Not only is mangosteen highly esteemed in Asia, but also by Asian communities in Europe. In 1987, the largest importer of mangosteen in Europe was the Netherlands which imported 15-20 tons compared to a total of 1-5 tons by other countries. In the Netherlands and other European countries, importers cater mostly to markets selling to ethnic communities, but they also sell small quantities to exclusive hotels, restaurants, and specialized fruit outlets. Mangosteen is also imported to markets in North, Central, and South America, and in Australia, Africa, and the Middle East.

Mangosteen originated in Malaysia. It was introduced to Panama and Puerto Rico in 1903. The Canal Zone Experimental Gardens have distributed approximately 15,000 seeds to many areas of Latin America. Mangosteen flourishes in the Magdalena Valley of Colombia where the fruit is sold on the local market. Trees distributed by the United Fruit Company have done well on the Atlantic Coast of Guatemala and in Honduras. However, the major producers continue to be Malaysia, Thailand and the Philippines with small volumes from Indonesia and Sri Lanka.

Mangosteen can not tolerate temperatures below 40°F. Mangosteen can be adapted to produce under different climatic conditions and in different seasons of the year. However, cold weather will cause the interior, white fruit of the mangosteen to harden although the damage is not visible. Some importers will only import mangosteen during the summer period to ensure that it has not been hardened by exposure to cold temperatures. Some importers perceive the disadvantage caused by the comparatively small edible portion to be an obstacle to the successful marketing of mangosteen.

1. Mangosteen from Central America

Commercial production of mangosteen must overcome several difficulties to be successful: low seed viability, slow plant growth and delayed maturity. Central America does have an advantage over other tropical fruit production areas because of its warmer climate and the existence of established plantations. Mangosteen has been unsuccessful in both California and Florida because of production problems. Some producers feel that it is not worth the trouble to produce despite indications that demand is likely to increase.

Fresh mangosteen is not admissible into the U.S. by the USDA. While it has not been proven to be a *Mediterranean* fruit fly host, official testing has not yet been conducted to eliminate the possibility. Testing has been done on mangosteen in Thailand for possible cold treatments for exports. Although the climate in the continental U.S. is too cold for commercial production of mangosteen, some members of the Rare Fruit Council, a group of hobbyists in Florida have grown mangosteen. Contact information for the Council and for growers in Hawaii is provided as an annex. They may provide additional production advice.

High season for mangosteen in Thailand is from May to September. In Puerto Rico, trees in full sun will produce in July and August; shaded trees, in November and December. In Central America the harvest season stretches through the region, starting in Panama around May and ending in December in Guatemala.

Mangosteen is considered to be a difficult crop to produce. Mangosteen production should be carefully researched and planned before an investment is made.

Mangosteen	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Thailand												
Guatemala												
Philippines												
Indonesia												
Australia												

Table 7. Availability of mangosteen in various European markets.

In European markets, mangosteen is in supply almost year around (see Table 7). In Central America, harvest starts in Bocas del Toro, Panama (on the Caribbean Coast) and then moves to the Pacific Ocean side at Puerto Armuelles and Potrerillos, up to Golfito in Costa Rica and then to Kukra Hill in Nicaragua, jumps to Guatemala and terminates in Honduras where there are still trees in harvest in November. The prices as distributed throughout the European markets give us a good indication of market acceptance. A mature tree of 25 years can easily yield 3,000 fruits. Mangosteen can be frozen and is sold in this form in Japan.

There are no known varieties of mangosteen because of its peculiar, apomictic form of reproduction, i.e., without fertilization by pollen, the 'seed' will produce a plant with very similar character to its parent. Care should be taken in selecting 'seed' for planting, choosing only the largest per fruit, not allowing the 'seed' to dry out and planting immediately.

At one year, a selection of seedlings should be made, eliminating the smallest and weakest plants. Transplanting to bags from nursery can be done in the second year and, after a year under shade, the sapling's can be transplanted to the field. Some growers wait until the fourth or fifth year to transplant. Mangosteen is considered to be ultra-tropical (the same as durian) and prefers loose, sandy soils rich in organic material with pH of 5 to 6. Studies done in Australia show that grafting onto mature root stock gives little benefit except to accelerate production somewhat. Normally, first yields are at 6 to 8 years of age but may not be until 10 to 15 years of age.

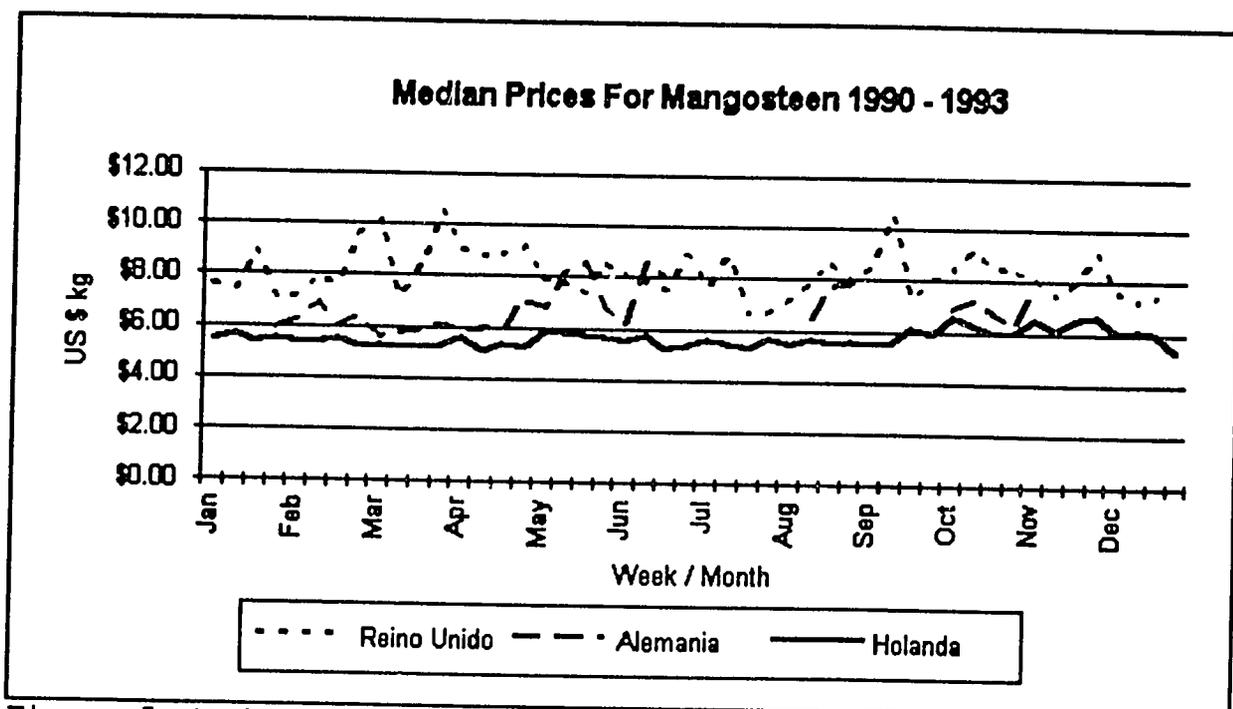


Figure 5. Median prices in different markets.

A gross-revenue analysis is possible using the following estimated figures. Trees from 10 to 20 years old produce 200 to 300 fruits. Estimating 5 fruits per lb and using an average price of \$3.50 per lb producers can calculate a value of \$210.00 per tree. At 25 trees per hectare this leads to a total estimated value of \$5,000. However, a 30 year-old tree can easily produce 2,000 fruits.

2. Production of Mangosteen

Commonly known as: Mangosteen or Mangostán.

Botanical Name: *Garcinia mangostana* L.

Family: Guttiferae.

Origin: Not established although some trees are found in the wilderness on the Sunda and Molucca Islands and in the forests of Kemaman in Malaysia.

Varieties: There are currently no official reports that indicate the existence of different varieties. Mangosteen cultivars are probably ecotypes. Therefore, its not necessary to import materials since there are mature mangosteen trees that are producing and from which seeds can be use in Central America.

Climate: Mangosteen is tropical and can not tolerate temperatures lower than 5°C. It grows

well up to 800 meters above sea level. However, in India mangosteen is reportedly grown in Madras up to 1,500 meters above sea level. Mangosteen has not been successfully produced above 20 degrees latitude north or south. It requires high relative humidity and 1,300 to 3,000 meters of well-distributed annual precipitation.

Soils: Deep, rich in organic material preferable clay loam with a pH of 5 to 6.

Propagation: Technically the so-called seed is actually an adventitious embryo. Mangosteen employs a vegetative propagation known as apomixis. Trees should be chosen that are large and bulky since the size and vigor of the seedling corresponds directly to the size of the seed. It is also greatly benefited by the application of very decomposed mulches.

Recently, a mangosteen graft system has been developed in T.R.E.C. and USDA in Puerto Rico using a cleft graft in greenhouses with mist irrigation which reports more than 90% successful attachments. Also, in Malaysia (Chong & Chai, 1991) 85% attachment has been reported. Reportedly, a healthy, vigorous 5 month root stock is cut to 4 cm and two opposite cuts are made at 45° so that a pointed end is made. Afterwards the leaves are cut (to avoid excessive transpiration) from a 5 cm stick from a mature tree in which two opposite cuts are also made so that the cambium is closely linked. The pieces are tightly wrapped with adhesive film. Results can be checked in one month. To date, no harvest has been obtained from this system and it has not been determined whether or not it has been effective.

Australian producers report an abnormal development of the graft after a few years in which it presents a disorderly tree shape and poor yield.

Planting Distance: 10 to 15 meters. Mangosteen requires shade (30 to 65%) during the first few years which should be removed bit by bit. This can be accomplished by covering the plants in the field with palm leaves which will dry slowly and allow exposure to light bit by bit. Wind curtains should also be established to protect the fruit.

Fertilization: Organic fertilizers are recommended with a general source of 10-10-9 that should be split in 2 applications per year. After the 1st or 2nd year in the field 0.25 kg should be applied per tree, from 2 on to 4 years 0.5 kg of 10-10-9/tree, 4 to 6 years increase the amount of the general formula to 1 kg/tree, 6 to 8 years double to 2 kg/tree as the tree prepares itself for flowering and fruiting, and from 8 to 10 years 4 kg of 10-10-9 per tree as the tree requires more energy to be spent in full production and needs to recover. This should be tested by the grower and adjusted according to a soil and foliar analysis.

Insects and Diseases: Few insects are reported in the relevant literature. There are some diseases such as *Pellicularia koleroga* found in very moist areas. More commonly, physiological disorders are found such as those reported in Honduras which cause little crystal "rocks" to form in the center of the fruit, ruining it completely. Another disease in "Gamboge" in which sap is found on the outer skin and branches during periods of excessive rain but does not affect the quality of the fruit. Cracks are found on the fruit in areas of excessive humidity. Fruits exposed to direct sunlight can exude latex.

In Guatemala a wasp is reported that scratches the external layer of the fruit causing damage due to the subsequent discoloration and darkening of the scratches.

Harvest: The maturity of the fruit from the anthesis until harvest takes 110 to 145 days. The harvest is irregular and demonstrates alternate production from year to year. In the 7th or 9th year (although production may not begin until 10 or even 20 years) the mangosteen will produce approximately 200 to 300 fruits per tree. Production will increase, producing up to 2,000 or more for a mature 30 year old tree. Some trees have been observed to produce for up to 100 years. Fruits should be cut (and not allowed to fall to the ground) when its full purple color has been developed and fruits are somewhat soft. Puerto Rico and other places report that trees in full sun will produce from July to August and trees in shaded areas will produce from November to December.

Post-Harvest: (According to USDA)

1. Classification: Purple fruit, 40 to 80 mm in diameter, harvested when ripe.
2. Pre-cooling: Forced air.
3. Temperature and Relative Humidity: 13°C and 85 to 90% R.H.
4. Transit/Storage Life: 2 to 4 weeks.
5. Packaging: Cellular packing in fiberboard boxes or wood crates, in 29-49 count, approximately 10 lbs.
6. Asia exports whole, frozen fruit to Japan and Europe which is first opened to ensure that it is free from damage and then closed and frozen.

Nutritional Value: Each 100 g of fresh fruit contains 62 calories, 0.5 g protein, 0.4 g fat, 16 g sugars, 15 g carbohydrates, 5 g fiber, 4 mg calcium, 6 g phosphorus, 0.5 g iron, 0.03 mg thiamine and 1.5 g ascorbic acid.

VI. CONCLUSIONS

A. Tropical Fruit Survey

European and Canadian importers were surveyed regarding the market for ETF by means of a questionnaire. The principal conclusions include:

- * All of the receivers were familiar with at least some of the fruits; a few have handled all the ETF mentioned. EXOTIC PRODUCE in the UK is selling ETF to retail supermarket chains, not just specialty stores or the London China Town.
- * All of the receivers surveyed are interested in working with these fruits. Each can handle between 1,200 a 5,000 lbs of produce per harvesting season. The producer should be willing to provide free samples in order to create more demand.
- * Litchi is considered to be the major ETF after the more common tropical fruits such as pineapple and mango.
- * Receivers indicated that they expected an increase in the market volume for ETF of 20 - 100% if consistent supplies of high quality fruit can be produced.
- * Many of these products at this point have a limited customer base and an increase in demand for these products is dependent on growing ethnic communities or familiarization in broader markets. Several respondents stressed the need for promotion for these ETF. One respondent suggested using recipes.
- * A receiver from the UK indicated that the sales of all of these fruits can be increased a great deal by pre-packing into retail packs, giving added value to the producer and reducing the importer's cost.

The following Table presents the averages of all responses from the questionnaires received.

Table 8. Averaged summary of results of a survey on market familiarity of tropical exotic fruits.

Question	Fruit						
	Litchi	Rambutan	Logan	Mangosteen	Carambola	Atemoya	Durian
Have you handled these fruits?	100 %	100%	80%	80%	80%	60%	60%
What quantities have you handled?	5,000 Lb/wk	1,000 kg/wk	30 kg/wk	14-500 boxes/wk	1,500 fruit/wk	115 fruit/wk	120 Lb/wk
What quantities could you handle in the future?	all	20% more	25-50 Kg/wk	0-100% more	10-100% more	50% more	0-3 more
Demand in the off-season (yes/no)?	100%	50%	40%	40%	40%	No	20%
Range of prices (\$)	2-6.5/kg	3-5/kg	6-9/kg	3-6/kg	6-10/kg	4-10/kg	4.5/kg
Rate these fruits future promise	90% #1	80% #2	80% #3/4	80% #3/4	60% #3	60% #5	60% #7
Interested in new suppliers (yes)	100%	96%	60%	20* -40%	60%	60%	40%

* 20% said they would be interested in new suppliers depending on the quality of the product. This was true in varying percentages for other products as well.

B. General Conclusions

1. There is general support and a positive outlook for these ETF. However, a major concern for a would-be investor in these exotic, medium to long-term fruit crops is the lack of tools for making this a well-founded venture such as a feasibility study including specific figures or cash flows. There is also an unfortunate lack of previous experience with these fruits in the region.

At the moment, based on indicators of the future in consumer trends, the paucity of volume producers of ETF in the region, and the information that we have received from major importers and distributors in the U.S., Canada, and Europe, we can determine that there is certainly a large market for these fruits.

At least 80% of the importers and receivers responding to our questionnaire indicate that they have handled all of the ETF described in this study except for atemoya and durian which have been handled by only 60%. The respondents indicated that they could handle 20-100% more of these fruits. Their interest in new suppliers of ETF depends on the quality of the product being offered. Overall, respondents indicate that the increase in market volume for ETF will depend on the producers' ability to provide consistent high quality fruit. They perceive that producers are offering ETF of insufficient quality and irregular supply. As one of these brokers clearly put it, "Anything else than top quality has no market."

Quality and supply can both be better controlled through careful selection of cultivars that are appropriate to the elevations, soil types, and climatic conditions of the intended production area. Choosing a cultivar which has worked well in other areas will not ensure success in Central America. Producers outside of Central America are demonstrating their dedication and competitive spirit through their investment in research and production monitoring. Examining conditions in areas in which these fruits are indigenous may help to give indicators of temperature and growing conditions.

In conjunction with consistency, producers must focus on improving packaging, maturity, and overall condition as well as communication for feedback on conditions, trends, and prices at the receiver's end.

2. Producers intending to participate in successful tropical fruit enterprises must be prepared to respond to the primary opportunities and obstacles of the industry. Most importantly, growers must match their product to their market.

Although figures for most of these still minor tropical fruits are scarce, analysts and experts within the industry report increasing demands and growing markets. Demand has grown due to increased travel by consumers, increasing immigrant communities, increased availability in retail stores and hotels and restaurants. These factors served as the impetus for the increasing demand for ETF. Increasing supplies to meet the demand of consumers in ethnic communities, hotels, restaurants, and retail outlets will help to increase the overall awareness of ETF and will continue to boost the demand for these fruits.

Producers should investigate the market conditions in each area. A specific niche can be more easily identified or created in some markets than in others. While

consumers of ETF in Vancouver come primarily from ethnic communities, in California ETF can be sold in upscale restaurants and specialty fruit stores for higher prices. Some products, such as durian, will command high prices within certain ethnic communities anywhere. FTK Holland, a produce distributor in Holland, does not distribute durian to their regular buyers; they have special trade deals upon specific request. A broker in the U.S. says the end consumers of litchi in California are supermarket buyers but he has also developed institutional distribution.

Other products may lack consumer familiarity, but may be profitable if marketed correctly. Some importers are willing to work at, or even below, cost to introduce a new fruit that may be a high profit item in the future. The importer may make a greater effort to market a product if the supplier is willing to provide quality samples. One Mexican litchi exporter was able to turn Frieda Caplan's skepticism into support by supplying samples of high quality litchi which Caplan was not originally interested in, but was later able to market successfully.

Producers may find that they can reduce the risks related to fresh tropical fruits by diversifying into tropical fruit juices, purees, and concentrates. Demand for fruit juices and fruit juice raw material is also increasing world-wide. Tropical fruit juices require less careful shipping and handling and do not have the problem of a limited shelf life. Japan is seeking closer ties with suppliers in developing nations. In many European countries, bottlers, baby food and other food manufacturers, hotels, caterers, and bakeries use tropical fruit raw materials and may be interested in adding ETF products to their marketing mix to take advantage of the growing demand for ETF.

Industry experts have also suggested that in order to have an extremely successful operation, one must have a way to utilize the cull fruit. Installing a processing plant alongside a fresh operation allows the business to use the fruit that is not of export-quality for frozen or processed products. The ability to take advantage of these additional opportunities makes the business as a whole more economically sound.

3. The major obstacle to the rapid growth of the tropical fruit industry is the lack of consistent, regular supplies of quality product. And this, in turn, may be the major opportunity for Central American producers. A grower who is able to connect with an experienced importer and who can offer better quality fruits over an agreed-upon time frame will have taken his first step on the road to success. Some importers who are currently working with the major supplying/exporting countries (which dominate the market at times due to their producing seasons), find them to be difficult and demanding to work with and their products of inconsistent quality. Sam Hugh of Ham Produce in Honolulu, Hawaii has stated that importers are eagerly searching for alternative suppliers who are more flexible, and that importers will offer producers the opportunity to demonstrate the quality of their product in hopes of a more beneficial venture.

The ETF described in this study are feasible alternatives to traditional products. While the demand for these fruits is increasing, would-be investors and producers must also consider the competition before making a final decision as to these crops. Actions taken by the major growers of ETF in Florida are indicators of the future availability of these fruits. Producers in Florida have access to production and market information and

experience not available to Central American producers. Their decisions as to the types and areas of fruits to be produced represent their expert opinion of the prospects of future markets.

Producers in Central America should keep in mind that most of the fruits described here are not yet admissible to the United States. Increased Florida production may result in increased competition for some fruits in U.S., Canadian, European or other markets. Increased participation by Florida may increase Central American marketing opportunities because Florida will also be increasing overall awareness of these fruits by performing urgently needed marketing and promotion functions.

4. While most of these ETF are inadmissible to the U.S. in fresh form, possible treatments to eliminate the fruit fly risk are currently being researched for some of these fruits. In addition, Dr. Carl Campbell of the Tropical Research and Education Center in Florida suggests that irradiation would work well for these fruits if approved for use. Bill Schaefer has stated his belief that there is already a potential market for these inadmissible items and that there is a great opportunity for those fruits that can not be produced in the U.S.

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Tel: 010-2431122
Tlx: 24080
Fax: 010-4530709

JAN V.D. BRINK BV
Marconistraat 19
Postbus 6179
3002 AD Rotterdam
Tel: 010-4766122
Tlx: 21477
Fax: 010-4255415

CASA BENESCIA
Centrale Markt Pier D 6
1051 KL Amsterdam
Tel: 020-822631
Tlx: 18410

CINTRONAS BV
Keileweg 80
Postbus 6094
3002 AB Rotterdam
Tel: 010-4766544
Tlx: 22007
Fax: 010-4779712

CONTINENTAL FRUIT IMP. BV
Postbus 120
2990 AC Barendrecht
Tel: 01806-14611
Tlx: 20192
Fax: 01806-16311

DENIMPEX BV
St. Anthoniebreestraat 10
1011 HB Amsterdam
Tel: 020-246390
Tlx: 14252

EDEKA FRUCHTKONTOR GMBH
Postbus 850
2678 ZZ De Lier
Tel: 01745-30430
Tlx: 21528/259
Fax: 01745-15747 tlx. 20270

EXOTIMEX BV
Postbus 226
2230 AE Rijnsburg
Tel: 01718-31555
Tlx: 39386
Fax: 01718-31391

FRESHWAY INT. BV
Handelscentrum ZHZ loods 4
Postbus 266
2990 AG Barendrecht
Tel: 01806-11222
Tlx: 28114
Fax: 01806-12429

FRUITAGENTUUR HOLLAND BV
Zuideinde 61
2991 LJ Barendrecht
Tel: 01806-44444
Tlx: 28782
Fax: 01806-11932

F.T.K. HOLLAND BV
Klappolder 191-193
2665 MP Bleiswijk
Tel: 01892-41700
Tlx: 22593
Fax: 01892-19616

GEBR. DE GROOT BV
Brielseweg 23, Postbus 51
5330 AB Kerkdriel
Tel: 04199-3985
Tlx: 50237
Fax: 04199-1172

ESPORO FRUIT BV
Chopinstraat 7
Postbus 885
Tel: 01890-18583
Fax: 01890-18006

FORTUNA FRUITS CONT. BV
Nieuw Mathenestestraat 38-44
3113 AH Schiedam
Tel: 010-4738811
Tlx: 23322
Fax: 010-4737625

FRUGALIS BV
Zuideinde 57B
Postbus 259
2990 AG Barendrecht
Tel: 01806-19688
Tlx: 20556
Fax: 01806-11376

FRUIT SELLERS INT. BV
Postbus 129
2990 AC Barendrecht
Tel: 01806-19711
Tlx: 28786
Fax: 01806-11376

CARL GOTTMAN'S HANDELSMIJ BV
Baarlandhof 116
3086 EC Rotterdam
Tel: 010-4800177
Tlx: 62407

GREENFOOD IMPORT SERVICE BV
Postbus 566, 6040 AN Roermond
Tel: 04750-10729

HOLANDA

FTK HOLLAND B.V.
Klappolder 191-193
2665 MP Bleiswik
Netherlands
Tel: 31-1892-41700
Fax: 31-1892-191616

BUD HOLLAND B.V.
Hoornseweg 15
Postbus 8
2600 AA Delft
Netherlands
Tel: 31-15-690-690
Fax: 31-15-622-790

EXOTIMEX B.V.
Postbus 226
2230 AE Rijnsburg
Netherlands
Tel: 31-1718-31555
Fax: 31-1718-31391

CAMPBELL NEDERLAND BV GROKO
Wernhoutse weg 26
PO Box 7
4880 AA Zundert
Netherlands
Tel: 1696-73151
Fax: 1696-76619

CATZ INTERNATIONAL BV
Blaak 22
PO Box 180
3000 AD Rotterdam
Netherlands
Tel: 10-4113440
Fax: 10-4045406

GLOE & CO.
Van Riensdijkweg 68
PO Box 53027
3008 HA Rotterdam
Netherlands
Tel: 10-4295033
Fax: 10-4292194

HEL SU HELMINK HOLLAND BV
Industrieweg 11
7070 AC Uft
Netherlands
Tel: 8356-32525
Fax: 8356-31333

HERO NEDERLAND BV
Teteringse dijk 227
PO Box 3243
4800 BE Breda
Netherlands
Tel: 76-798000
Fax: 76-875746

MONDI FOODS
Zuideinde 65
PO Box 363
2900 AJ Barendrecht
Netherlands
Tel: 1806-14433
Fax: 180611747

**SPYER, VAN DER VIJVER EN
ZWANENBERG (SVZ) BV**
Oude Kerkstraat 8
PO Box 27
4870 AA Etten Leur
Netherlands
Tel: 1608-27321
Fax: 1608-13321

**Receivers of Tropical Fruits: CANADA
HAM PRODUCE, INC.**
1714-A Homerule Street
Honolulu, Hawaii 96819
Tel: 808-842-7171
Fax: 808-845-9999

CENTRAL CANADA GROCERS
6363 Millcreek Drive
Mississauga, Ontario L5N 1L8
Tel: 416-826-4650
Fax: 416-826-6817

ONTARIO PRODUCE COMPANY
The Ontario Food Terminal
165 Queens Way, Suite 240
Toronto, Ontario M8Y 1H8
Tel: 416-259-6391
Fax: 416-259-7584

TRANSCONTINENTAL TRADING
165 Queens Way, Suite 236
Toronto, Ontario M8Y 1H8
Tel: 416-251-3100
Fax: 416-251-5687

DOMINION CITRUS LIMITED
Ontario Food Terminal
165 Queens Way
Toronto, Ontario M8Y 1H8
Tel: 416-259-5481
Fax: 416-259-4126

BAIZER, S. & SON
775 Rue de Marche Central #60
Montreal, Quebec H4N 1K1
Tel: 514-384-2390
Fax: 514-384-2472

FRUITS BOTNER, LTEE.
775 Rue du Marche Central Suite 33
Montreal, Quebec H4N 1K1
Tel: 514-383-1717
Fax: 514-389-7286

CROWN SALES
Toronto, Ontario
Fax: 416-252-7220

CANADA FRUIT DISTRIBUTORS
4299 Canada Way, Suite 241
Burnaby (branch in Vancouver)
Tel: 604-439-0829
Fax: 604-439-0829

KELLY, DOUGLAS & CO. LTD.
PO Box 2039 (V6B 3S1)
Vancouver, British Colombia
Tel: 604-444-6626
Fax: 604-444-6666

PAHOA PRODUCE CO. LTD.
180-11960 Hammersmith Way
Richmond (Vancouver)
Tel: 604-275-8576
Fax: 604-275-6680

JIRSTREK LTD.
41 Chemin du Tremblay
Loc. 306-307
Boucherville (Montreal)
Tel: 514-449-7844
Fax: 514-449-7845

AUSTIN & MASTERS
165 The Queens Way
328 Ontario Food Terminal
Tel: 416-259-6363
Fax: 416-259-6364

CATANIA, M.L., CO.
165 The Queens Way
214 Ontario Food Terminal
Tel: 416-259-5495
Fax: 416-259-9594

MANSON PRODUCE
250 Nugget Ave.
Scarborough (Toronto)
Tel: 416-412-6188
Fax: 415-412-3787

MECA TRADING
33 Belvia Rd.
Etobicoke (Toronto)
Tel: 416-251-5104
Fax: 416-251-6721

Receivers of Tropical Fruits: UNITED STATES

BLUE ANCHOR, INC.
P.O. Box 15498
Sacramento, CA 95851-0498
Tel: (916) 929-3050

J.R. BROOKS & SON INC.
18400 S.W. 256th Street
P.O. Drawer 9
Homestead, FL 33090
Tel: (305) 247-3544

CALAVO GROWERS OF CALIFORNIA
4833 Everett Avenue
Los Angeles, CA 90058
Tel: (213) 587-4291

FRIEDA'S FINEST/PROD. SPECIALTIES, INC.
P.O. Box 58488
Los Angeles, CA 90058
Tel: (800) 421-9477

Receivers of Tropical Fruits: PROCESSED FRUITS

Annex A

TRITON IMPORTS

320 N. Eucalyptus Avenue, Suite B

Inglewood, CA 90302

Tel: 310-677-0022

Fax: 310-677-0560

BEAR CREEK OPERATIONS

P.O. Box 9000

2518 S. Pacific Highway

Medford, Oregon 97501

Tel: 503-776-2017

Fax: 503-734-2934

THE TUPMAN THURLOW, CO., INC.

Cedar Plaza

20 Cedar Street

New Rochelle, NY 10801-5217

Tel: 914-633-0777

Fax: 914-633-9876

TROPIC EXOTICS

402 NW 87th Avenue

Suite 302

Miami, FL 33172

Tel: 305-554-4900

Fax: 305-225-0059

SOURCES OF TROPICAL AND SUBTROPICAL FRUIT PLANTS
Dade County, Florida - Area Code 305

FRUIT & SPICE PARK

Chris Rollins, Director/Naturalist 24801 S.W. 187th Avenue Homestead, FL 33031	(305) 247-5727	
Arkin, Morris Robbia Avenue Coral Gables, FL 33146	667-3808	Arkin "papershell" macadamia, 1454 Arkin carambola, "Aeae" bananas (striped), and jaboticaba.
Brookstone's Wonderland Citrus Nursery 17401 N.W. 19 Avenue Miami, FL 33056	625-0921	Akee, allspice, annonas, macadamia, citrus, guava, wampi, jakfruit, assorted tropical fruit trees
D'Martinez Nursery, Inc. 12350 Krome Avenue Miami, FL 33196	255-0287	Fruit trees, mamey, mango, annon, avocado, lychee, citrus, and roses and cut flowers.
Elva Nursery 20500 S.W. 177 Avenue Miami, FL 33187	251-4235	Tropical fruit trees.
Flinn Nursery 23201 S.W. 197 Avenue Miami, FL 33031	247-8466	Wholesale & retail lychee, longan, carambola, mamey, mango, guava, jaboticaba and other tropicals.
Hill Brothers 25373 S.W. 202 Avenue Homestead, FL	246-0770	Assorted tropical fruit trees.
Morey's Garden Center 17740 S.W. 292 Street Homestead, FL 33030	247-3535	Assorted tropical fruits.

Annex B

Pine Island Nursery 16300 S.W. 184 Street Miami, FL 33187	233-5501	Wholesale citrus and assorted fruit trees.
Possum Trot Tropical Fruit Nursery 14955 S.W. 214 Street Miami, FL 33187	251-5040	Large assortment of tropical fruits, nuts, and spices.
Steele's Grove and Nursery 22320 S.W. 256 Street Homestead, FL 33031	247-0722	Wholesale lychee and longan.
The Love Bug Nurseries 22305 S.W. 157 Avenue Goulds, FL 33170	245-9224	Citrus, assorted tropical fruits.

Other Nurseries in Florida

Elson's Exotics 3960 Flamingo Road Davie, FL 33330	(305) 963-6075	22 varied carambola, jakfruit, passion fruit, coconut, thornless Key lime, other exotic fruit trees.
Garden of Delights 14560 S.W. 14 Street Davie, FL 33325	(305) 370-9004	Wide variety of exotic tropical fruit trees.
Just Fruit Rt. 2 Box 4818 Crawfordville, FL 32327	(904) 926-5644	Assorted tropical fruit. (We also ship)
Lychee Tree Nursery 3151 S. Kanner Hwy. (St. Rd. 76) Stuart, FL 34994	(407) 283-4054	Tropical fruit trees.
Marks Landscape 829 Benoist Farms Road West Palm Beach, FL 33411	(305) 793-1855	Avocado, lychee.
Our Kids Orchids & Nursery 17229 Phil C. Peters Road Winter Garden, FL 32787	(305) 877-6883	Vandacious orchids and tropical fruit trees.

Annex B

Rood Landscape Co., Inc. P.O. Drawer 1568 4546 County Line Road Jupiter, FL 33458	(305) 746-5186	Avocado, apple, banana, carambola fig, lychee, mango, sapodilla, and other tropical fruits.
The Treehouse Nursery P.O. Box 124 Bokeelia, Fl 33922	(813) 283-3688	Many fine exotic trees.
Winnie's Studio 5430 Pine Tree Road Pompano Beach, FL 33067	(305) 752-4295	Rare fruit trees.
Zill Nursery 2925 S. Federal Highway Boynton Beach, FL 33438	(305) 732-3555	Wholesale only. Many mango varieties, mamey, sapote, atemoya.

Nurseries Outside Florida in Continental United States

South Seas Nursery P.O. Box 4674 Ventura, CA 93004	(805) 647-6990	Tropical fruits. Avocado, guava, carambola, cherimoya, atemoya, loquat and passion fruit.
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Nurseries Outside The Continental United States

Dow Flora Singapore P T E Ltd. 51 Duncan Road Singapore, 1130	256-4722 253-3198	Seeds for mangosteen, rambutan, langsat, jack and pulisan.
Frankie's Nursery 95-139 Kapawa Place Mililani Town, HI 96789	(808) 623-2412	Exotic fruits: abiu, caimito, jakfruit durian, rambutan, mangosteen, langsat.

MARKET NEWS SERVICE (MNS) - 1994

NOTE: Prices are in US dollars per kilos, for air freight
unless otherwise indicated.

CARAMBOLA (STAR FRUIT)

Receiver	Exporter	Price \$/kg
Austria	Malaysia	6.10
Belgium	Malaysia	4.00
Denmark	Malaysia	3.70
Finland	Malaysia	4.00
France	Malaysia	4.80
Germany	Malaysia	4.20
Holland	Malaysia	3.90
Norway	Malaysia	4.80
Sweden	Malaysia	4.60
Switzerland	Malaysia/Thailand	4.50/3.20
UK	Malaysia	4.70

CHERIMOYAS

Receiver	Exporter	Price \$/kg
Bahrain	Australia	7.50

DURIAN

Receiver	Exporter	Price \$/kg
Holland	Thailand	8.24

GRANADILLA

Receiver	Exporter	Price \$/kg
Austria	Colombia	6.15
Belgium	Colombia	4.50
Germany	Colombia	4.80
Holland	Colombia	6.40
Sweden	Colombia	6.20
Switzerland	Colombia	6.90
Finland	Colombia	10.40

PAPAYA

Receiver	Exporter	Price \$/kg
Norway	Costa Rica	3.10
Spain	Canary Islands	6.20
Sweden	Costa Rica/Malaysia	3.60/2.90
Switzerland	Brasil/Jamaica/USA	3.30
UK	Brasil	3.60

PITAYA

Receiver	Exporter	Price \$/kg
Austria	Colombia	6.12
Belgium	Colombia	7.52
Germany	Colombia	6.26
Holland	Colombia	6.38
Switzerland	Colombia	5.96

RAMBUTAN

Receiver	Exporter	Price \$/kg
Belgium	Indonesia	4.40
Denmark	Indonesia	6.90
Holland	Indonesia	5.45
Norway	Indonesia	6.40
Sweden	Indonesia	6.30
Italy	Indonesia	7.21
Finland	Indonesia	6.98

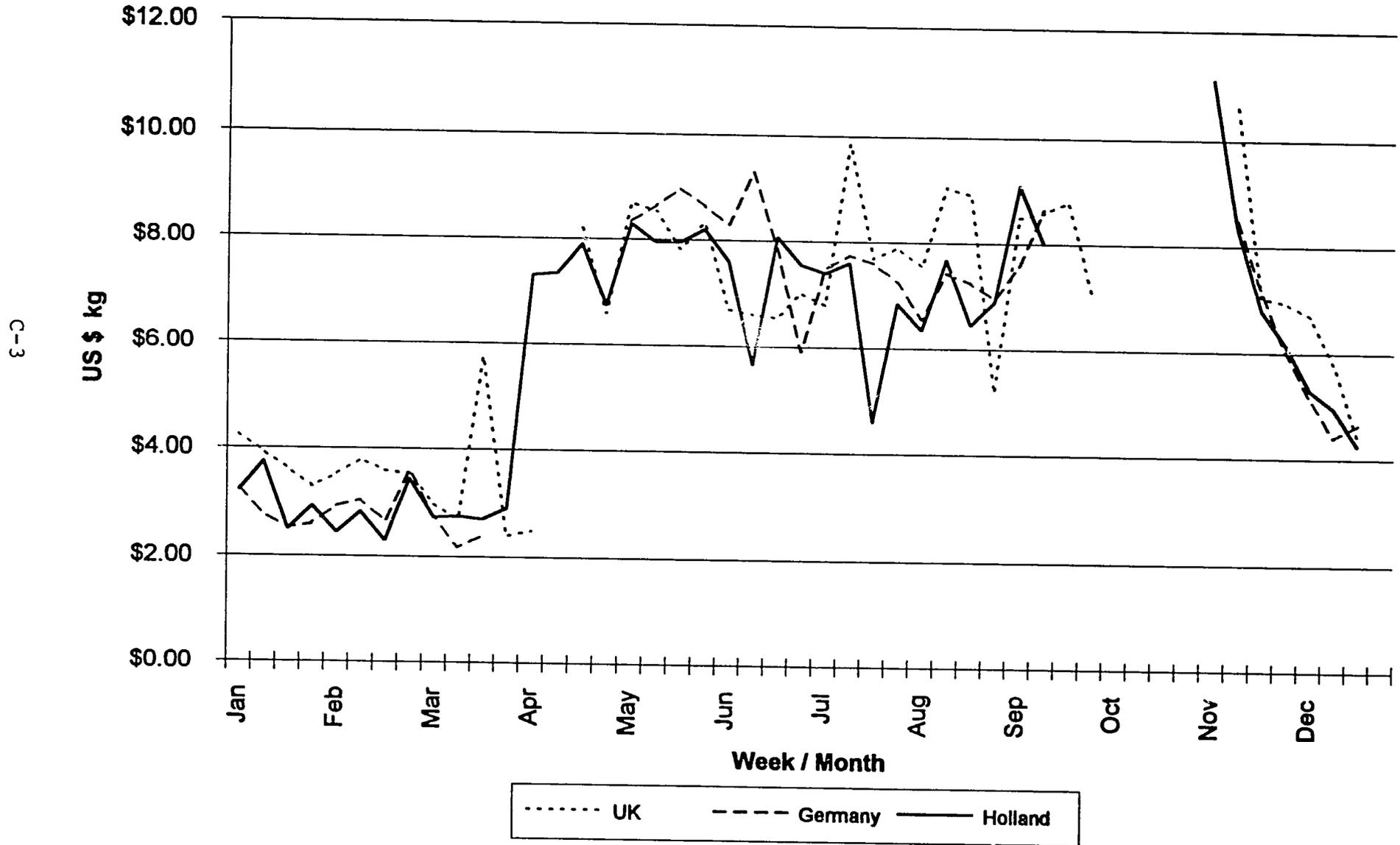
SAPODILLA

Receiver	Exporter	Price \$/kg
Norway	Thailand	6.52
UK	Thailand	8.62

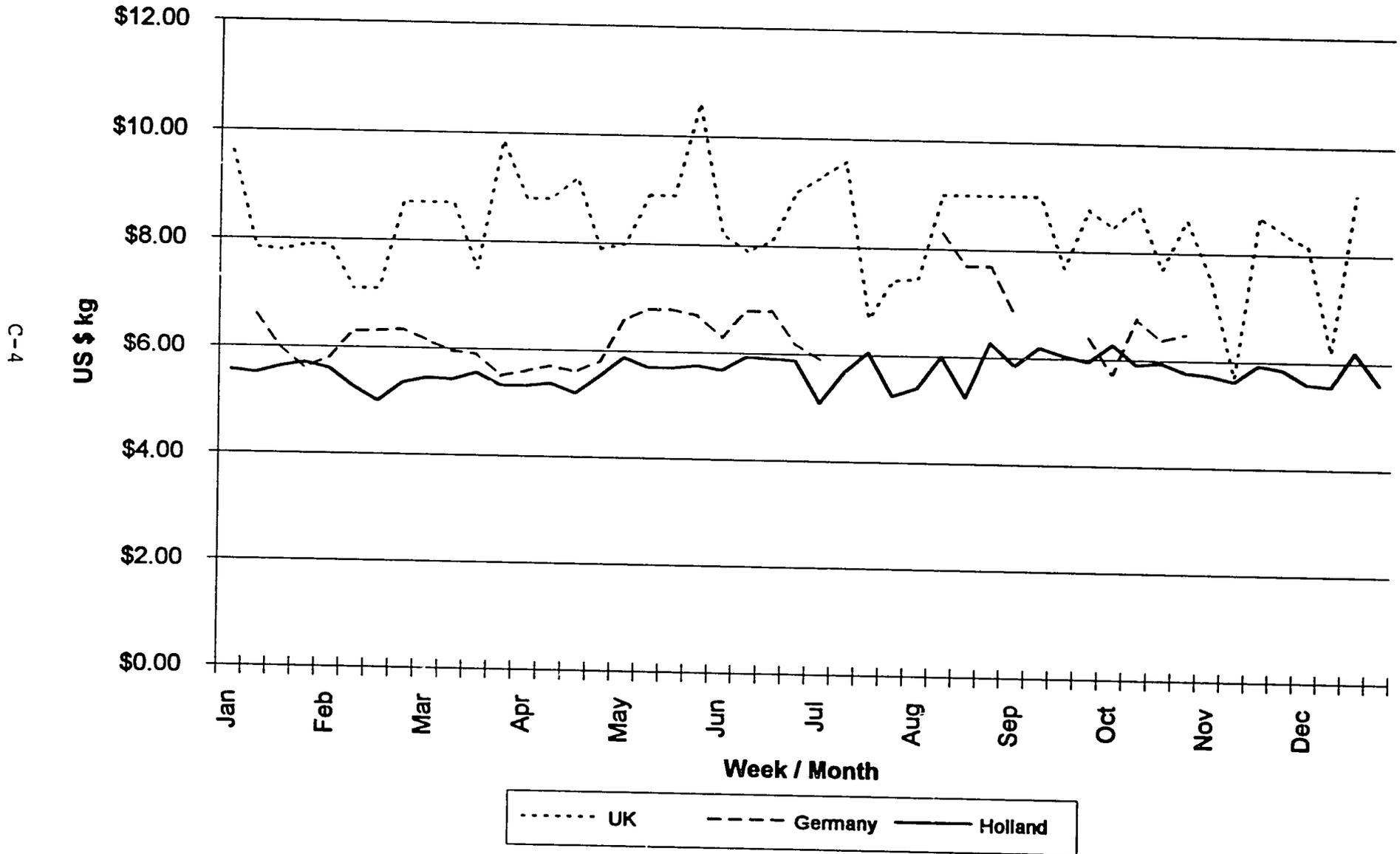
TAMARINDO

Receiver	Exporter	Price \$/kg
Holland	Thailand	7.98

Median Prices for Litchi 1990 - 1993

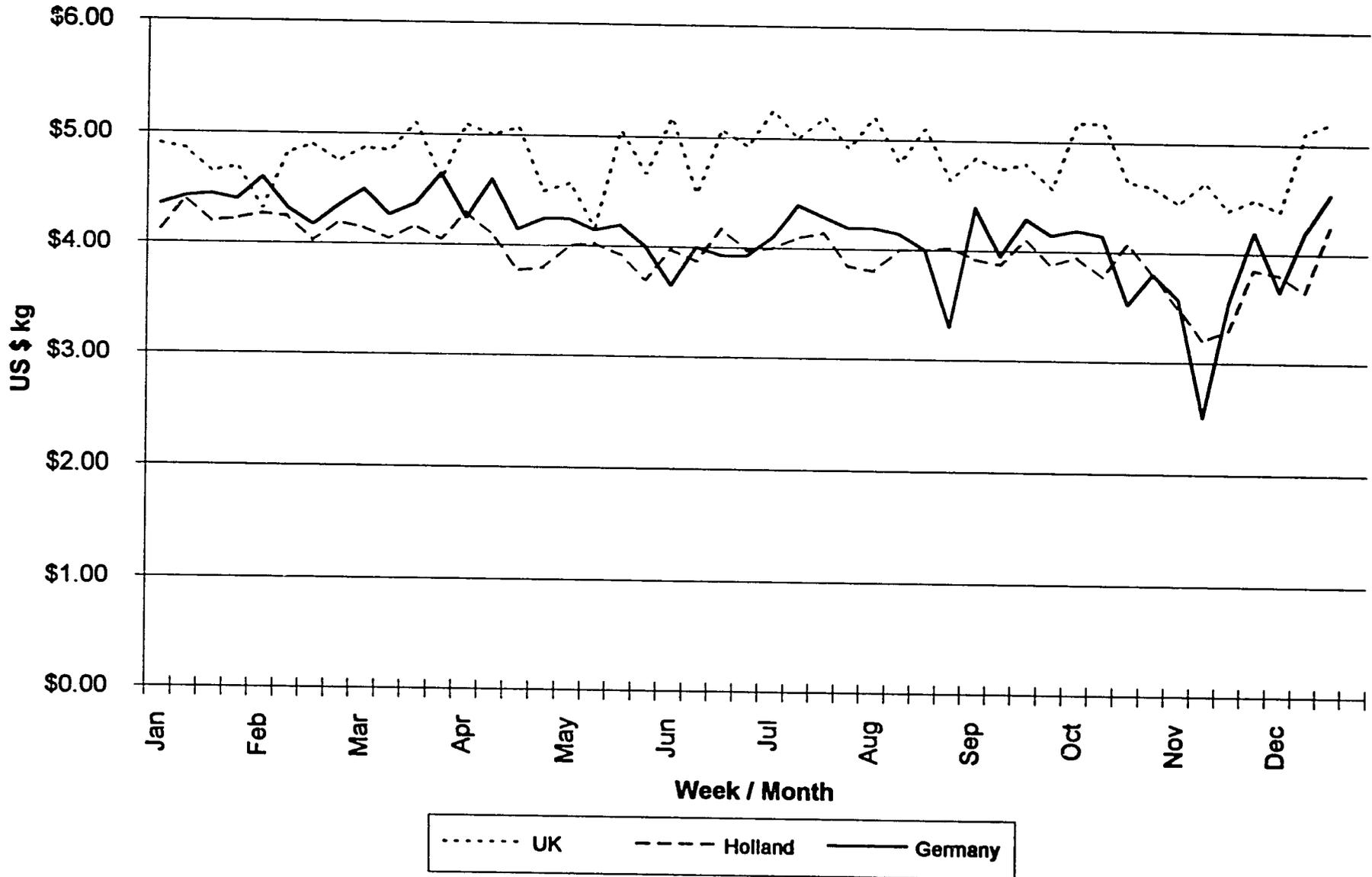


Median Prices For Rambutan 1990 - 1993



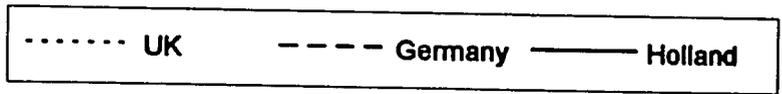
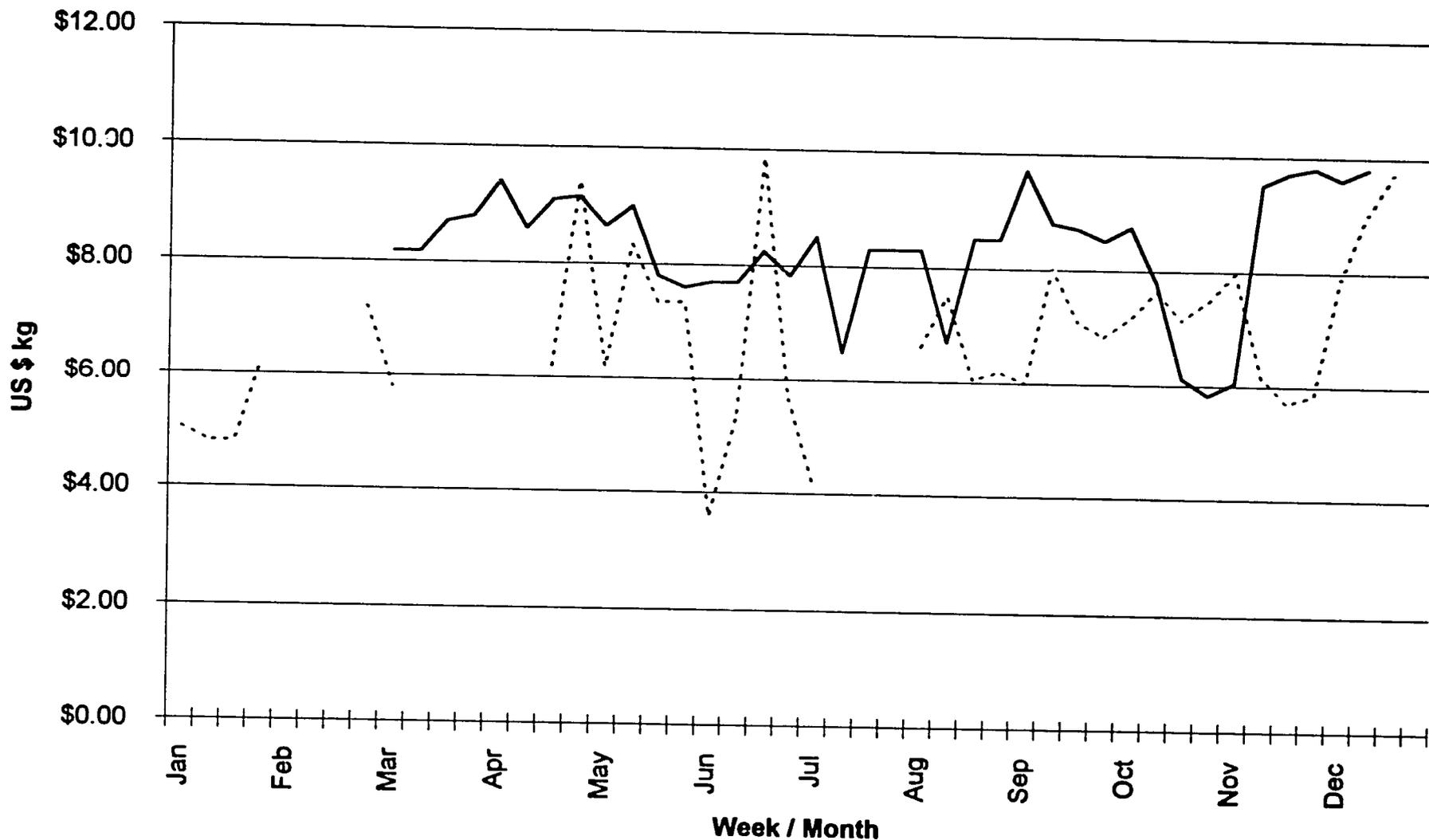
Median Prices For Carambola 1990 - 1993

C-5

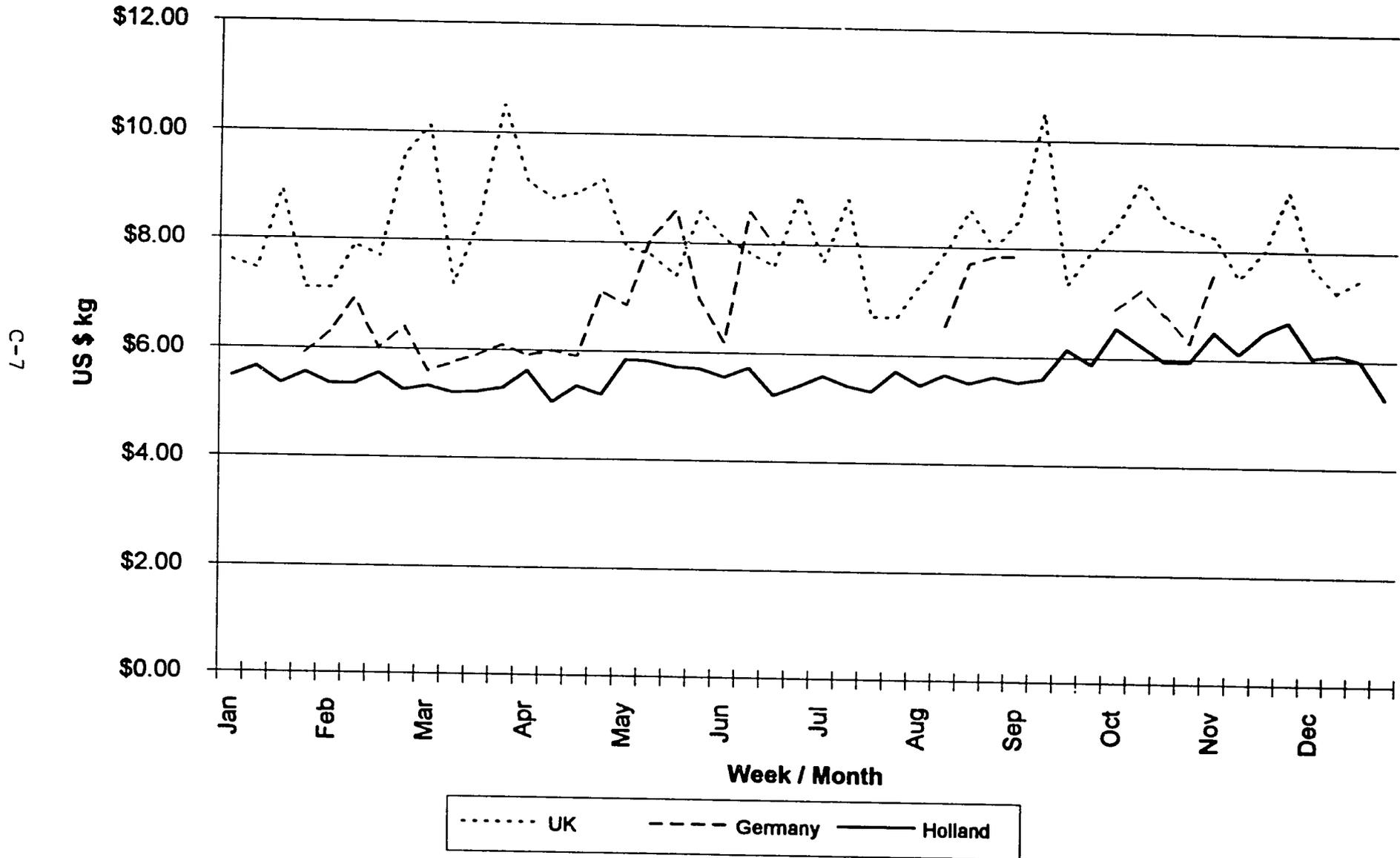


Median Prices For Durian 1990 - 1993

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Median Prices For Mangosteen 1990 - 1993



E.C.
IMPORT FRESH FRUIT COUNTRY OF ORIGIN
(excl. Intra-EC trade)

Source: Eurostat	in tonnes				
	1988	1989	1990	1991	1992P
Albania	31	39	1.336	871	642
Antiqua	1.243	1.622	835	1.166	4
Argentina	250.586	263.973	338.345	342.071	347.495
Australia	35.588	14.196	18.213	10.464	18.769
Belize	25.840	26.591	24.056	20.058	28.534
Brazil	94.848	119.724	107.315	140.35	170.135
Bulgaria	5.602	8.028	12.901	27.699	4.461
Burkina-Faso	759	596	1.040	1.202	1.233
Canada	12.892	8.176	10.966	15.515	16.748
Canary Islands	347.458	346.123	354.706	342.754	350.111
Chile	265.302	273.604	301.127	407.275	473.291
China	1.346	1.298	1.011	1.037	893
Colombia	344.518	331.440	403.590	515.101	596.063
Costa Rica	366.515	479.435	581.717	609.080	586.720
Cuba	21.821	14.847	14.412	28.390	31.193
Cyprus	150.278	140.552	139.286	120.629	132.374
Dominica	70.807	51.571	52.708	55.169	56.182
Dominican Republic	1.611	3.733	7.845	25.048	38.782
Ecuador	320.048	274.932	353.856	601.654	767.601
Egypt	10.222	8.864	15.916	21.601	26.757
Philippines	37.092	20.306	5.819	541	83
Ghana	3.418	4.762	6.173	7.410	228
Grenada	8.945	8.494	8.563	8.566	6.299
Guadeloupe	126.281	93.117	77.254	118.635	117.715
Guatemala	34.995	62.192	9.469	14.048	65.543
Honduras	202.761	168.535	154.517	170.820	223.668
Hungary	13.700	42.856	35.763	145.029	50.932
India	949	912	926	994	1.886
Iran	1.946	1.630	2.895	6.397	6.890
Israel	341.667	268.073	343.287	293.2736	286.758
Ivory coast	221.936	220.632	237.452	252.929	149.118
Jamaica	38.831	43.374	72.426	79.735	85.178
Yugoslavia 2)	30.338	50.140	11.069	21.453	7.995
Cape Verde	2.065	2.734	2.715	3.011	1.873
Cameroon	36.781	56.809	78.269	116.251	110.750
Kenya	21.865	7.093	4.847	7.317	7.887
Madagascar	1.668	2.772	4.206	4.431	5.641
Malaysia	1.395	1.836	2.299	3.464	4.298

Source: Eurostat	in tonnes				
	1988	1989	1990	1991	1992P
Mali	1.272	1.525	1.314	2.165	1.188
Morocco	396.162	406.092	330.198	445.737	370.982
Martin que	186.631	200.730	221.800	183.023	199.959
Mexico	15.243	16.669	16.136	15.876	34.374
Mozambique	3.784	7.200	12.441	7.734	3.544
Namibia 1)			225.464	2.055	1.423
Nicaragua	34.990	29.859	48.329	65.934	
New Zealand	212.360	181.202	240.114	250.802	238.055
Austria	4.183	4.500	5.759	7.683.	13.243
Pakistan	1.460	1.229	1.551	1.841	2.960
Panama	340.161	400.476	527.493	484.574	540.117
Peru	2.239	2.018	2.031	2.021	1.804
Poland	23.108	29.242	25.995	116.545	60.377
Romania	8.502	8.275	6.566	34.263	11.891
Russia 3)	2.095	2.953	2.519	3.802	697
Saudi Arabia	113	1.121	159	1.106	64
Somalia	52.416	58.537	60.639	8.833	181
St. Vicent	61.918	57.590	81.557	63.069	73.360
St. Lucia	117.929	116.491	128.158	103.899	125.146
Surinam	33.011	30.056	27.747	27.759	30.085
Swaziland	28.765	19.384	24.682	20.603	21.199
Thailand	3.177	2.982	2.662	2.1474	1.806
Czechoslovak	17.827	33.411	14.731	83.521	19.439
Turnisia	31.617	28.856	25.286	24.033	21.866
Turkey	64.524	72.933	80.682	134.722	130.634
Uruguay	30.279	16.855	43.464	52.272	70.508
Venezuela	4.647	4.605	4.638	4.450	4.824
United States	221.391	227.443	196.272	224.193	222.699
Zambia	1.167	716	265	243	5
Zimbabwe	8.923	14.615	11.623	9.414	6.958
South Africa 1)	545.322	574.358	356.558	601.174	640.529
Switzerland	2.515	3.771	1.858	1.819	5693
Other Countries	25.774	13.277	26.759	24.267	33.431
TOTAL	5.937.453	6.004.881	6.553.950	7.553.014	8.841.232

1) Namibie t/m 1989 onder Zuid-Afrika opgenomen

2) Former Yugoslavia

3) Former Sowjet-Union

P= Provisional

PANAMA

IMPORT EC by Country of origin

	x 1,000 kg				x 1,000 ecu
	1988	1989	1990	1991	1991
FRUIT TOTAL	340161	400476	527493	484574	250444
Bananas	339960	400476	527463	484574	250444
Other fruits	201	36	30	0	0
Belgium	28825	32251	39919	37861	17781
Denmark	13155	14222	11535	5213	2301
Germany	224492	267516	321282	296757	161129
Greece	1331	261	4595	8791	3860
Italy	44239	50536	81855	104148	52699
Netherlands	20994	25899	3304	21642	9937
Portugal	667	6450	1448	6839	1267
United Kingdom	3507	1372	843	3252	1456
Other E.C. countries	2951	1969	2712	71	14
VEGETABLES, TOTAL	25	42	47	51	71

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Annex D

NICARAGUA

IMPORT EC by Country of origin

	x 1,000 kg				x 1,000 ecu
	1988	1989	1990	1991	1991
FRUIT TOTAL	34990	29859	48329	65934	30697
Bananas	34742	29072	47600	65218	29826
Mango	75	499	306	598	774
Other fruits	173	288	423	118	97
Belgium	10350	10900	5614	3491	1815
Denmark	3581	4152	2055	5657	1943
Germany	14542	10414	31615	37803	18831
Greece	34	4	17	378	150
Italy	20	36	207	13534	6217
Netherlands	6039	1499	1743	3174	1037
Portugal	228	2580	4862	1787	602
Other E.C. countries	196	274	2216	110	102
VEGETABLES, TOTAL	0	22	0	0	0

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Annex D

GUATEMALA

IMPORT EC by Country of origin

	x 1,000 kg				x 1,000 ecu
	1988	1989	1990	1991	1991
FRUIT TOTAL	34,995	400,476	527,493	484,574	250,444
Banana	34,634	400,476	527,463	485,474	250,444
Other Fruits	361	36	30	0	0
Belgium	347	32,251	39,919	37,861	17,781
Denmark	84	14,222	11,535	5,213	2,301
Germany	2,795	267,516	351,282	296,757	161,129
Ireland	1,516	261	4,595	8,791	3,860
Netherlands	381	25,899	33,304	21,642	9,937
United Kingdom	751	1,372	843	3,252	1,456
Other E.C. countries	29,121	1,969	2,712	71	14
VEGETABLES TOTAL	1,110	1,603	1,550	1,727	4,166
Sugar peas	1,050	127	1,455	1,622	3,894
Other vegetables	60	1,476	95	105	272
Netherlands	130	159	271	281	776
United Kingdom	938	1,237	1,149	1,324	3,078
Other E.C. countries	42	207	130	122	312

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Annex D

HONDURAS

IMPORT EC by Country of origin

	x 1,000 kg				x 1,000 ecu
	1988	1989	1990	1991	1991
FRUIT TOTAL	202,761	168,535	154,517	170,820	85,797
Banana	188,968	148,797	123,488	138,396	67,946
Grapefruit	10,248	12,308	11,058	12,358	8,523
Melons, others	58	97	227	913	666
Pineapples	3,286	7,169	19,447	18,748	8,375
Other fruits	201	164	297	405	287
Belgium	21,353	10,766	28,256	35,550	18,772
Denmark	5,262	6,989	6,290	4,041	1,914
Germany	91,558	87,748	71,663	68,676	37,671
France	2,441	298	1,831	1,342	1,050
Greece	281	115	1,380	972	376
Ireland	6,725	2,440	2,029	292	112
Italy	53,772	33,692	20,805	14,718	8,029
Netherlands	14,840	10,888	4,784	3,589	2,378
Portugal	4,021	9,703	3,629	28,233	10,159
United Kingdom	2,420	5,859	13,766	13,355	5,292
Other E.C. countries	88	37	84	52	44
VEGETABLES, TOTAL	0	1	0	4	2

D-6

Annex D

THE MARKET FOR TROPICAL FRUIT IN JAPAN
HIROTOSHI KITAGAWA, KAGAWA UNIVERSITY
MIKI, KAGAWA, 761-07, JAPAN

Table 1. Fresh fruits and nuts imported by Japan

Fruit	Volume (Metric ton)			Exporting country or area and % of total in 1992, 1991 or 1990
	1990	1991	1992	
Banana	757,520	803,340	771,175	(Phil. 70, Ecuador 20, Taiwan 8, Panama, Costa Rica, Honduras, Malaysia)
Pineapple	128,249	137,786	127,466	(Phil. 98, Taiwan 1, Thai., USA)
Mango	5,510	6,885	8,059	(Phil. 90, Mexico 9, Thai., Taiwan, Fiji)
Papaya	5,367	5,271	5,197	(Hawaii 100, Fiji, Mexico, Cook I)
Litchi	1,209	1,257	885	(Taiwan 100)
Durian	88	98		(Thai. 99, Phil., Singapor)
Cherimoya	71	28		(USA 89, Mexico 6, NZ 5)
Passion Fruit	14	16		(NZ 77, USA 17, Mexico 6)
Pitaya	0.8	1.5		(Vietnam 78, USA 11, Mexico 11)
Maracuja	1	0		(Mexico 100)

ESTIMATED BUDGET FOR FIRST YEAR TROPICAL FRUIT CROPS

		US\$
1. <u>Rent of Land</u>		
1.1 One Hectare per year		200.00
	* Considering the cost of your site based on the feasibility renting for 15 years or more. If the land is owned, give the value of its use.	
2. <u>Inputs</u>		
2.1 Granular Insecticides		130.00
2.2 Fungicides		130.00
2.3 Application equipment		350.00
2.4 Fertilizers		<u>120.00</u>
		730.00
	Management that is oriented towards products that are favorable to the environment is recommended.	
3. <u>Seedbed</u>		
3.1 Treatment and bagging		
A . Treatment with Rootone, cleaning of sphagnum & light pruning of roots 5 workers		50.00
B. Soil preparation		20.00
C. Bagging with 10 workers		<u>35.00</u>
		105.00
3.2 Plant Care		
A. Using irrigation, fumigation and application for foliar fertilizers 4 months		120.00
4. <u>Land Preparation</u>		
4.1 Hole digging 125 trees/ha (8 x 10 m)		250.00
5. <u>Plant Purchase and Production</u>		

5.1	Purchase 125 plants in Hawaii or Florida. US 25.00 + shipping = 32.00 ea.	4,000.00
-----	---	----------

* Purchasing plants from overseas is recommended to ensure genetics & evaluate the adaptability of different selections.

In the third year one can begin propagation from the material which would require rooting hormone, sphagnum, bagging and later planting. For Honduras, which has 'Brewster' the quickest and least expensive process would be the creation of a broad production base.

6. Labor for Transplants

6.1	Planting 10 workers at US\$ 3.00	30.00
6.2	Replanting (25%) 4 workers	12.00
		42.00

7. Production

7.1	Application of insecticides & fungicides. 2 workers x 3 applications	18.00
7.2	Application of soil foliar fertilizers	36.00
7.3	Establishment plant coverage	18.00
7.4	Manual cleaning 3 cleaning with 6 workers	54.00
7.5	Periods watering per week. 56 workers 7 mo/year	576.00
		702.00

8. Irrigation System

8.1	Design & digging of ditches for furrow irrigation	500.00
8.2	Dig mechanical well in conditions similar to those in Guatemala Minimum 5 ha with alternate crops for the first 4 years	10,000.00
8.3	Water pump & irrigation system	10,000.00
8.4	Pump. Loam soil. Average 300 gal/min/ha. Consumes 32.4 KW/hr kw as US\$ 0.04 & 4.12 hrs in 4 waterings	21.36
8.5	For 500 ft well a 60 H.P. pump is needed. 45 kw/hr are used to run at kw 0.04 working 5 hrs per day	9.00
8.6	Auxiliary pump power of 40 H.P. with 30 kw/hr at 0.04 & 4 waterings	5.00
8.7	In summer, water when fruit is set & 2 times a weeks for 5 weeks	155.40

* Total cost of irrigation in winter, amortize the investment for 10 years		202.00
* Total cost of irrigation in summer, amortize the investment for 10 years		<u>336.00</u>
		21,228.76
9. <u>Various</u>		
* Security per month		125.00
* Extras (10%)	(677.40) ¹	700.28 ²
10. <u>Eringe benefits</u>		
Labor & Technical Supervision (35%)	(2607.99) ¹	2696.27 ²
11. <u>Administrative Expenses</u> (5%)	(502.97) ²	519.99 ²
12. <u>Financing</u>		
(US\$ 10,000 at 12% interest \$ 5 years)		53.33
<hr/>		
	(10,615.69) ¹	10,973.23 ²

- (1) When using furrow irrigation do not amortize.
(2) When using irrigation system amortize for 10 years per ha..

ESTIMATED BUDGET FOR SECOND YEAR TROPICAL FRUIT CROPS

	US\$
I. <u>Rent of Land</u>	
1.1 One Hectare per year	200.00
<p>* Considering the cost of your site based on the feasibility of renting for 15 years or more. If the land is owned, give the value of its use.</p>	
2. <u>Inputs</u>	
2.1 Insecticides	100.00
2.2 Fungicides	100.00
2.3 Fertilizers	
Foliar. Regarding the analysis	<u>200.00</u>
	400.00
<p>Management that is oriented towards products that are favorable to ecology is recommended</p>	
3. <u>Plant Purchase and Production</u>	
3.1 Purchase in Honduras US\$ 10.00	1,250.00
4. <u>Labor for Transplants</u>	
4.1 Transplant 1 Hectare	42.00
5. <u>Production</u>. Considering the ecological option: no pesticides	
5.1 Application of Pesticides 2 workers x 3 applications	18.00
5.2 Application soil fertilizers and foliage	36.00
5.3 Care of plant coverage 3 cleaning with 12 workers	108.00
5.4 2 Watering per week. 2 workers per 7 mo/year	<u>576.00</u>
	756.00
6. <u>Irrigation System</u>	
6.1 Repair of ditches for gravity irrigation	50.00
6.2 Total cost of irrigation	538.06
7. <u>Various</u>	

* Security per month		125.00
* Extras (10%)	(282.30) ¹	331.11 ²
8. <u>Fringe benefits</u>		
Labor and Technical Supervision (35%)	(1274.76) ¹	1274.76 ²
9. <u>Administrative Expenses</u> (5%)	(245.85) ¹	245.85 ²
10. <u>Financing</u>		
(US\$ 12,000 at 12% interest and 5 years)		53.33
	(5,216.11) ¹	<u>5,216.11²</u>

- (1) When using furrow irrigation do not amortize.
(2) When using irrigation system amortize for 10 years per ha.

ESTIMATED BUDGET FOR THIRD YEAR TROPICAL FRUIT CROPS

		US\$
I. <u>Rent of Land</u>		
1.1 One Hectare per year		200.00
	* Considering the cost of your site based on the feasibility of renting for 15 years or more. If the land is owned, give the value of its use.	
2. <u>Inputs</u>		
2.1 Insecticides		100.00
2.2 Fungicides		100.00
2.3 Fertilizers		
Foliar. Regarding the analysis		<u>200.00</u>
		400.00
	Management that is oriented towards products that are favorable to ecology is recommended	
3. <u>Plant Purchase and Production</u>		
3.1 Purchase in Honduras US\$ 10.00		1,250.00
4. <u>Labor for Transplants</u>		
4.1 Transplant 1 Hectare		42.00
5. <u>Production</u>. Considering the ecological option: no pesticides		
5.1 Application of Pesticides 2 workers x 3 applications		18.00
5.2 Application soil fertilizers and foliage		36.00
5.3 Care of plant coverage 3 cleaning with 12 workers		108.00
5.4 2 Watering per week. 2 workers per 7 mo/year		<u>576.00</u>
		756.00
6. <u>Irrigation System</u>		
6.1 Repair of ditches for gravity irrigation		50.00
6.2 Total cost of irrigation		538.06
7. <u>Various</u>		

* Security per month		125.00
* Extras (10%)	(282.30) ¹	331.11 ²
8. <u>Fringe benefits</u>		
Labor and Technical Supervision (35%)	(1274.76) ¹	1274.76 ²
9. <u>Administrative Expenses</u> (5%)	(245.85) ¹	245.85 ²
10. <u>Financing</u>		
(US\$ 12,000 at 12% interest and 5 years)		53.33
	(4,675.91) ¹	<u>5,266.56²</u>

(1) When using furrow irrigation do not amortize.

(2) When using irrigation system amortize for 10 years per ha.

STATUS REPORT ON PROEXAG'S TROPICAL AND EXOTIC FRUITS PROGRAM AS OF AUGUST 1993

**By Jose R. Mondoñedo, Ph.D.
Production Advisor**

I. Background

Demand for fresh tropical fruits in the world market is on the increase. Because most tropical fruits are fruit fly hosts, however, the US fresh market is not open to these fruits unless the appropriate conditions are satisfied for their entry. For this reason, PROEXAG had taken the initiative to make it possible for the Central Americans to export these fresh fruits to the US market. Efforts included support towards the establishment in the Central American countries of hot water treatment facilities for mangoes and of hot air treatment for papayas destined for the US market, plus requests for inclusion of certain tropical fruits in the enterability lists of crops from Central America for the US market. Reports on each of these efforts are presented separately.

European and Canadian markets are not as sensitive to the entry of fruit flies through fresh fruit imports, so they are open to Central American exporters of fresh tropical fruits. The European market, especially Holland, is very strong for the tropicals and exotics because of colonial ties and large ethnic populations in these countries.

The increasing demand for fresh tropical exotic fruits could be seen in the markets of Europe, North America and Japan. Central America with its extensive tropical region, geographical location advantage and availability of labor, could supply part of this demand. Because many of these exotics are practically unknown to the general Central American public, there would be a strong domestic market to start with. Initial target crops selected by PROEXAG for the fresh market are rambutan, litchi, longan, mangosteen, atemoya, starfruit, durian and pitahaya. A list including other potential exotics fruit plants is included as Appendix 1.

Because many of the promising tropical exotic fruits for export are still relatively new entries in the world market and still practically unknown to Central American farmers and the public in general, a program of orientation on these potential crops was PROEXAG's first priority. For the exotics such as litchi, rambutan, mangosteen and carambola, they should be given top priority for promotion and development, even just initially for local consumption and for the export market in the future when sufficient production volume is achieved. As most of these crops are perennial with first returns on investment not occurring until the 4th to the 6th year of establishment, long term financing is needed.

PROEXAG I proposed and started to implement a developmental strategy which included the following lines of activities:

1) Survey on the status of the industry

Review the stage of development in each country.
Review the production and marketing information available in each country and region.

2) Develop interest in the tropical exotic fruits

A program of seminars to get the public acquainted with the crops - recognize the plant, fruits and processed products; general production and market information. Identify interested parties and agencies.
Define the need for more detailed feasibility studies.

3) Establishment of trial plantings

Identify sources of planting materials, select and set up introduction of cultivars and monitor trial plantings.
Establish a commercial pilot project.

4) Development of a research program

Details on the activities carried out during PROEXAG I are available in a report entitled "Status Report on PROEXAG's Tropical and Other Fruits Program (As of July 1991)".

II. Activities of PROEXAG II/EXITOS project

The tropical exotic fruits program of PROEXAG II followed essentially the strategy developed for these crops in PROEXAG I. Additional surveys and promotional seminars were conducted in the countries (Belize, Panama and Nicaragua) that recently joined the project and other areas in the other countries. The primary activities of PROEXAG II on these tropical exotic fruits are outlined as follows:

1. Introduction of commercial cultivars

Although there are some scattered plantings here and there from original

seedling introductions made by individuals and multinational companies (such as United Fruit, Standard Fruit and DelMonte there has been no systematic selection and multiplication of desirable clones of export quality. As there are already standards of quality of these crops in the world market, introductions and trial plantings of the quality cultivars of these crops as well as local selections have to be established. They will serve as the nuclei for commercial planting in the region, products harvested from which could then compete in quality in the world market.

Sources of the commercial quality cultivars were identified and included nurseries in Florida, Hawaii, Australia and even Asia. Recent introductions of some of these plants in Belize (by BABCO) could also be potential sources. Initial introductions by PROEXAG were made, a summary of which is presented in Appendix 2 - Status of tropical exotic fruit crop introductions as of August 1993.

Plant materials of the original introductions that did not survive would be replaced with subsequent orders of plant materials later in the year or the following year.

2. Design and implementation of the field trials

To carry out the trial plantings in the region, PROEXAG II-EXITOS and its corresponding counterpart in each country, will be coordinating efforts of collaborators in each country as follows:

- Guatemala:** GEXPRONT, Fruticultura MAGA, farmers.
- El Salvador:** FUSADES, CENTA, farmers.
- Honduras:** FHIA, FPX, farmers.
- Nicaragua:** APENN, MAG, farmers.
- Costa Rica:** CINDE, CORBANA, UCR, E.A.R.T.H., farmers.
- Panama:** GREXPAN, MAG, farmers.
- Belize:** BABCO, CARDI, MAF, farmers.

Because of the limited number of materials of each cultivar for each country, some two to five original plants of each cultivar could only be planted in each selected location in each country. PROEXAG's counterpart in each country, in consultation with PROEXAG, has determined the locations of the permanent plantings of these materials. Pertinent records on the observations are being kept. Guidelines on the records to be kept were prepared and distributed to collaborators. A sample copy of the record sheet is included as Appendix 3 - Tropical fruit crop individual crop introduction record. Appendix 4 - Collaborator's list of plant introduction is also included and indicates the ecological conditions and the plant material introductions in each farm.

There are guidelines on responsibilities of each, including ownership and monitoring rights, multiplication and disposition of the nucleus and clones of the original materials. A copy is included as Appendix 5 - Guidelines on ownership and responsibilities of the introduced planting materials.

3. Propagation and multiplication for further trials and commercial production

As indicated in Appendix 5, the collaborators will be propagating the plant materials provided them for further trials in their farms. Additionally, each collaborator is obligated to return to PROEXAG's counterpart a graft or airlayer from each of the original plant provided them for distribution to new collaborators for more trial plantings. These original introductions will be one of principal the sources for expansion into commercial production for export of tropical exotic fruits.

4. The pitahaya project

Native to the Central American Region, this fuschia colored cactus fruit is attracting much attention in the European market and could give the brown skinned green fleshed Kiwi and the yellow skinned opaque fleshed Colombian pitahaya serious competition. The project is working towards its possible entry into the fruit fly sensitive US market. The project is also providing some technical and financial assistance in Guatemala and Nicaragua in improving production technologies such as varietal evaluation and trellising technologies.

5. Promotional, training and extension activities

Orientation seminars on the tropical exotic fruits were conducted since the advent of PROEXAG II, at least once in each participating country, in collaboration with the respective counterpart organizations. See Appendix 6 - Tropical exotic fruits projects activities timetable, for the promotional, training and extension activities already carried out and those planned for the future.

IV. Observations and Recommendations

The export of tropical fruits in the world market is on the rise, not only because of the increasing world population but also due to the increased per capita consumption of these fruits as people have begun to diversify and adventure into the new flavors and health foods. The increased population of the ethnic groups from the tropics in the more developed and affluent countries are in the market for these tropical and exotic fruits. As many of these fruits cannot be grown commercially outside of the tropical region, the

tropical countries should be supplying these increasing demands.

As many of these fruits (such as the Asian exotics) are still unknown to most tropical American farmers and consumers, a program of orientation and introduction should command top priority in these countries. As many of these fruits come from perennial trees that may take many years to establish before reaping the first return on the investment, government support to the private sector would be essential especially in the initial stages of introduction and financing of the pilot projects in these crops.

Efforts should continue towards making it possible for the entry of Central American fresh tropical fruits into the US, Canadian and Japanese market.

Many tropical fruits are exported as processed products in the form of dried fruits, paste, jellies, jams and juice. The technologies on these industries should be brought to Central America. Because much of the commercial acreage and technologies on tropical fruits are in Asia, it would be well for the Central Americans to look at these industries first hand by way of organized tours to the production and processing areas in these countries.

Research needs of each crop is outlined in PROEXAG's Status Report of Tropical Exotic Fruits as of July 1991. Trellising trials in Nicaragua were established this year.

	Lychee	Rambutan	Longan	Mangosteen	Carambola	Atemoya	Durian
1. Have you acted as a broker/receiver for any of the fruits listed?	YES	YES	YES	YES	YES	YES	YES
2. When in season, what quantities of these fruit have you handled?	250-300 T	35-50 T	50-100 Kg	35-50 T	250-300 T	5 - 10 T	1 ton per year
3. What quantities of these fruits do you think you could handle in the future?	10 - 15% increase annually	10 - 15% increase annually	SAME	5% increase annually	10% increase annually	5-10% increase annually	Maximum same
4. In which months do you normally receive these fruits?	Jan-Feb Apr-Sep Nov-Dec	year round	upon request	year round	year round	Sep-Oct	upon request
5. Would there be a demand for these fruits in off-season months from other sources?	YES	N/A	NO	N/A	N/A	Possibly	NO
6. What is an estimated range of prices for these fruits in season?	Depending on market HFL 3-7/kg	HFL 8-9/kg	N/A	HFL 8-9/kg	HFL 26-28/ box 3.3 mg	?	N/A
7. What is an estimated range of prices for these fruits in the off-season?	1 kg 2.25-5.25 HFL 10-15/kg	N/A	N/A	N/A	N/A	?	N/A
8. Please rate these fruits from 1 to 7 in terms of the future promise.	6	4	1	3	6	2	1
9. Would you be interested in new suppliers sources of these tropical fruits?	YES	YES	NO	YES	NO	NO	NO
10. Who are the retail buyers of the fruits you handle?							N/A

11. Do you have any comments or suggestions regarding the quality, shipping, receiving, seasonality, potential opportunities, demand, etc. of these tropical fruits?

1 = high

7 = low

	Lychee	Rambutan	Longan	Mangosteen	Carambola	Atemoya	Durian
1. Have you acted as a broker/receiver for any of the fruits listed?	YES						
2. When in season, what quantities of these fruit have you handled?	8-10,000 5 lb boxes						
3. What quantities of these fruits do you think you could handle in the future?	Depending on the season 3-5,000/wk						
4. In which months do you normally receive these fruits?	June 10 thru June 25						
5. Would there be a demand for these fruits in off-season months from other sources?	YES						
6. What is an estimated range of prices for these fruits in season?	High \$4.00/lb Low \$1.50/lb						
7. What is an estimated range of prices for these fruits in the off-season?	SAME						
8. Please rate these fruits from 1 to 7 in terms of the future promise.	7	1	7	1	5	3	1
9. Would you be interested in new suppliers sources of these tropical fruits?	YES	NO	YES	NO	YES	NOT REALLY	NO
10. Who are the retail buyers of the fruits you handle?	Supermarket & institutional dist.						

11. Do you have any comments or suggestions regarding the quality, shipping, receiving, seasonality, potential opportunities, demand, etc. of these tropical fruits?

Needs back up promotional material and provide lots of samples for people to try.

	Lychee	Rambutan	Longan	Mangosteen	Carambola	Asamoya	Durian
1. Have you acted as a broker/receiver for any of the fruits listed?	YES	YES	YES	YES	YES	----	YES
2. When in season, what quantities of these fruit have you handled?	6 weekly	1 weekly	very small quantity	1 weekly	10 weekly	----	very small quantity
3. What quantities of these fruits do you think you could handle in the future?	same	same	----	same	same	----	----
4. In which months do you normally receive these fruits?	winter/ spring	year round	year round	year round	year round	----	year round
5. Would there be a demand for these fruits in off-season months from other sources?	YES	----	----	----	----	----	----
6. What is an estimated range of prices for these fruits in season?	2 kg box 7-26	2 kg 17-20	----	2 kg 17-20	3.5 kg 16-30	----	----
7. What is an estimated range of prices for these fruits in the off-season?							
8. Please rate these fruits from 1 to 7 in terms of the future promise.	1	3	6	4	3	----	7
9. Would you be interested in new supply sources of these tropical fruits?							
10. Who are the retail buyers of the fruits you handle?							

11. Do you have any comments or suggestions regarding the quality, shipping, receiving, seasonality, potential opportunities, demand, etc. of these tropical fruits?

1 = high

7 = low

	Lychee	Rambutan	Longan	Mangosteen	Carambola	Atemoya	Durian
1. Have you acted as a broker/receiver for any of the fruits listed?	YES	YES	YES	YES	YES	YES	YES
2. When in season, what quantities of these fruit have you handled?	1000 boxes a week	700 boxes a week	400 boxes a week	200 boxes a week	1100 boxes a week	100-200 boxes a week	400 boxes a week
3. What quantities of these fruits do you think you could handle in the future?	3000 boxes a week	1200 boxes a week	600 boxes a week	500 boxes a week	2700 boxes a week	400-500 boxes a week	1200 boxes a week
4. In which months do you normally receive these fruits?	12 months	12 months	12 months				
5. Would there be a demand for these fruits in off-season months from other sources?	YES	YES	YES	YES	YES	YES	YES
6. What is an estimated range of prices for these fruits in season?	2 kilo £2.75-5.00 per box	2 kilo £3.00-5.00 per box	2 kilo £4.00-6.00 per box	4 kilo £5.00-8.00 per box	Count 20 £10.00-14.00 per box	Count 8-10 £6.00-10.00 per box	Count 4-8 £10.00-12.00 per box
7. What is an estimated range of prices for these fruits in the off-season?	2 kilo £3.00-6.00 per box	2 kilo £4.00-7.00 per box	2 kilo £5.00-7.00 per box	4 kilo £9.00-16.00 per box	Count 20 £8.00-11.00 per box	Count 8-10 £8.00-11.00 per box	Count 4-8 £10.00-14.00 per box
8. Please rate these fruits from 1 to 7 in terms of the future promise.	2	3	4	4	4	3	3
9. Would you be interested in new suppliers/sources of these tropical fruits?	YES	YES	YES	YES	YES	YES	YES
10. Who are the retail buyers of the fruits you handle?	All the major U.S. retail chains	All the major U.S. retail chains	All the major U.S. retail chains				

11. Do you have any comments or suggestions regarding the quality, shipping, receiving, seasonality, potential opportunities, demand, etc. of these tropical fruits?

The sales of nearly all these products can be increased a great deal by pre-packing into retail packs. This gives added value to the producer and reduced the importers costs.