

IICA



THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO



EXPORT DEVELOPMENT CORPORATION
TRINIDAD & TOBAGO

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Affaires Étrangères



Fonds Interministériel
Caraïbes-Guyanes

By
Christine Rives
ENSIA-SIARC

September 1993

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IICA OFFICE IN TRINIDAD AND TOBAGO

"WHAT IS IICA?"

The Inter-American Institute for Cooperation on Agriculture (IICA) is the specialized agency for agriculture of the inter-American system. The Institute was founded on October 7, 1942 when the Council of Directors of the Pan American Union approved the creation of the Inter-American Institute of Agricultural Sciences.

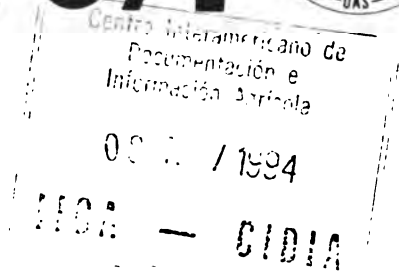
IICA was founded as an institution for agricultural research and graduate training in tropical agriculture. In response to changing needs in the hemisphere, the Institute gradually evolved into an agency for technical cooperation and institutional strengthening in the field of agriculture. These changes were officially recognized through the ratification of a new Convention on December 8, 1980. The Institute's purposes under the new Convention are to encourage, facilitate and support cooperation among its 33 Member States, so as to better promote agricultural development and rural well-being.

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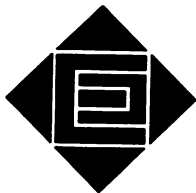
The contributions provided by the Member States and the ties IICA maintains with its 14 Permanent Observer Countries and numerous international organizations provide the Institute with channels to direct its human and financial resources in support of agricultural development throughout the Americas.

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The Member States of IICA are: Antigua and Barbuda, Argentina, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St Lucia, St Kitts and Nevis, St Vincent and the Grenadines, Suriname, Trinidad and Tobago, the United States of America, Uruguay and Venezuela. The Permanent Observer of IICA are: Arab Republic of Egypt, Austria, Belgium, European Communities, Federal Republic of Germany, France, Israel, Italy, Japan, Kingdom of the Netherlands, Portugal, Republic of Korea, Romania and Spain.



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FOREWORD

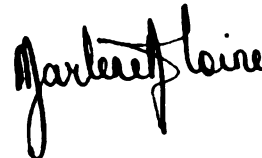
This study was conducted by Christine Rives, a French student as part of the requirements for her Master of Science degree at the Ecole Nationale Supérieure des Industries Agro-Alimentaires (ENSIA), Section Industries Agro-Alimentaires Régions Chaudes (SIARC), Montpellier, France.

Ms. Rives has had previous overseas experiences in England, Guatemala and Nicaragua. She has been involved in dairy farming, coffee production, grain storage and socio-economic studies.

In Trinidad and Tobago she was attached to a joint project between the Export Development Corporation (EDC) and the Inter-American Institute for Cooperation on Agriculture (IICA) to identify problems limiting the development of passion fruit cultivation as well as processing and marketing problems related to the industry of this fruit.

Ms. Rives' work was supervised by Mr. A. Pantaleon, Research and Development Director of EDC, Dr. R. Marte, Director of IICA's Regional Project "Supporting the Development of Tropical Fruits in the Caribbean" and Mr. G. Barbeau, Agronomist/Fruit Specialist seconded to IICA by the French Government.

We are pleased to present the results of the survey and hope that it will be helpful in solving some of the problems as identified.



Marlene Antoine
Officer in Charge
IICA Office in Trinidad and Tobago

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ABSTRACT

When compared to citrus, papaya and other similar fruits, Passion fruit is not as popular in Trinidad and Tobago. However, since 1988, the Ministry of Agriculture (MALMR) identified this crop as a priority. Moreover, a study of the passion fruit industry conducted by the Export Development Corporation, in 1991 showed that passion fruit was a viable option. Despite this fact, the acreage of passion fruit, which had increased to 100 acres during the 1980's, as a result of a successful prototype processing line which demanded large quantities of this crop, was down to about 15 acres in 1992. The present study was conducted to analyse the commodity system of passion fruit from production to marketing and to identify the specific constraints which limit its development in Trinidad and Tobago. The present study showed that diseases, cost/benefit margin, labour constraints, limited technical assistance, quality of the processed products and market organization were among the main reasons for the slow development of the crop on this island.

(Keywords: Trinidad and Tobago — Passion fruit — Production — Processing —Market)

RESUME

A Trinidad et Tobago, le fruit de la passion n'est pas aussi populaire que les agrumes, la papaye et autres fruits similaires. Cependant, depuis 1988, le Ministère de l'Agriculture (MALMR) a identifié cette culture comme prioritaire. De plus, une étude réalisée en 1991 a montré que le fruit de la passion est une culture viable. Malgré cela, la superficie plantée, qui atteignit 40 ha pendant les années 1980 suite à l'installation d'une unité de transformation qui nécessitait de grandes quantités de fruits, fut réduite à 6 ha en 1992. La présente étude fut réalisée afin d'analyser la filière du fruit de la passion (de la production à la commercialisation) et d'identifier quelles sont les contraintes spécifiques qui empêchent le développement de cette culture à Trinidad. L'étude a montré que les principaux facteurs responsables du lent développement du fruit de la passion dans cette île sont des problèmes de maladie, les faibles marges obtenues, des contraintes de main-d'oeuvre, le manque d'assistance technique, la qualité des produits transformés et l'organisation du marché.

(Mots-cle: Trinidad et Tobago — Fruit de la passion — Production — Transformation — Marché)

RESUMEN

En Trinidad y Tobago, el maracuyá no es tan popular como los cítricos, papaya y otras frutas similares. Sin embargo, desde 1988, el Ministerio de Agricultura (MALMR) identificó esta fruta como un cultivo prioritario. Además, un estudio de la industria del maracuyá realizado en 1991 mostró que es una opción viable. A pesar de todo esto, la superficie sembrada con maracuyá, que llegó a ser 100 acres (40 has) en los años ochenta como resultado de la instalación de una línea de procesamiento que requería grandes cantidades de fruta, bajó a 15 acres (6 has) en 1992. El presente estudio se llevó a cabo para analizar la industria del maracuyá desde la producción hasta la comercialización y para identificar los problemas que interfieren con su desarrollo en Trinidad. El estudio demostró que problemas de enfermedades, márgenes de costos-beneficios, problemas de mano de obra, asistencia técnica limitada, calidad de los productos procesados y la organización del mercadeo son las mayores razones del lento desarrollo del maracuyá en esta isla.

(Palabras claves: Trinidad y Tobago — Maracuyá — Producción — Transformación — Mercadeo)

INTRODUCTION

Passion fruit (*Passiflora edulis*) grows as a vine and is native to Brazil. Introduced to the Caribbean more than 100 years ago, passion fruit is now becoming commercially important in some Caribbean countries such as Dominica, Guyana, Martinique, St Vincent and the Grenadines, Puerto Rico, Dominican Republic, Jamaica and Suriname.

In the region, the level of technology varies tremendously. Passion fruit may be found growing freely in backyard gardens without any cultural practice or in well organized orchards where all maintenance practices are being conducted with the latest technology available. Yields obtained in the region can reach up to 35 t/ha with good planting selection and cultural practices.

A total of about 1400 acres (567 ha) is under passion fruit cultivation in the Caribbean. There is a good market in the region for fresh fruit or processed products. Most countries have the facilities to process passion fruit. However, the processing facilities are often under-utilized or run with imported raw material due to inadequate supply of locally produced passion fruit.

Fresh fruits are mainly sold in the local markets. Restaurants and hotels have begun to serve the fruit but only on a small scale. The present supply does not meet the demand. There is an opportunity for farmers to increase production.

In Trinidad and Tobago, passion fruit developed in 1986-87, but the area cultivated has drastically reduced since then. Low prices paid for the crop and disease problems were blamed for the drop in interest in this crop.

In 1992, the Export Development Corporation (EDC) asked the Inter American Institute for Cooperation on Agriculture (IICA) to provide technical assistance for a project with the main objective to increase the production needed to supply the demand for raw material by agro-processors.

Consequently, IICA decided to conduct a study of the passion fruit industry in order to determine the factors that inhibit the development of passion fruit, in order to make proposals to improve the present situation of the industry in the country.

1. FRAME WORK OF THE STUDY

1.1. TRINIDAD AND TOBAGO

1.1.1. Presentation of Trinidad and Tobago

1.1.1.1. *Geographical and Human Description*

Trinidad and Tobago, is a twin island state that gained independence from Britain in 1962. The islands are situated at the South-Eastern end of the Caribbean Archipelago and at one point Trinidad is seven miles from the South American Continent.

Trinidad consists of rolling plains broken by the Northern, Central and Southern Ranges. The highest elevations, over 3 000 ft., occur in the Northern range. There is little costal plain between the Northern Range and the sea. The western and eastern coasts of Trinidad have extensive costal plains which are swampy in some parts. Tobago has generally rugged terrain with elevations up to 1 800 ft., the only extensive lowland is a coral platform at the south-western end. Trinidad and Tobago has a hot and humid tropical climate. The annual average temperatures range from minimum of 22°C to a maximum of 32°C (cf graph 1).

The complex geology of the island has given rise to a diversity of soils within short distances (cf map 2). The rocks of the Northern Range produce a poor, shallow soil best left in forest as well as the sands and clays of the Southern Range that are not very fertile. On the Caroni Plain, there is a marked contrast between the clays. Some areas are fertile and extensively cultivated, but there are larger areas of sands and gravels which

are poor and of little use for agriculture (J. Macpherson, 1985).

1.1.1.2. *Socio-economic Review and the Role of Agriculture in National Development*

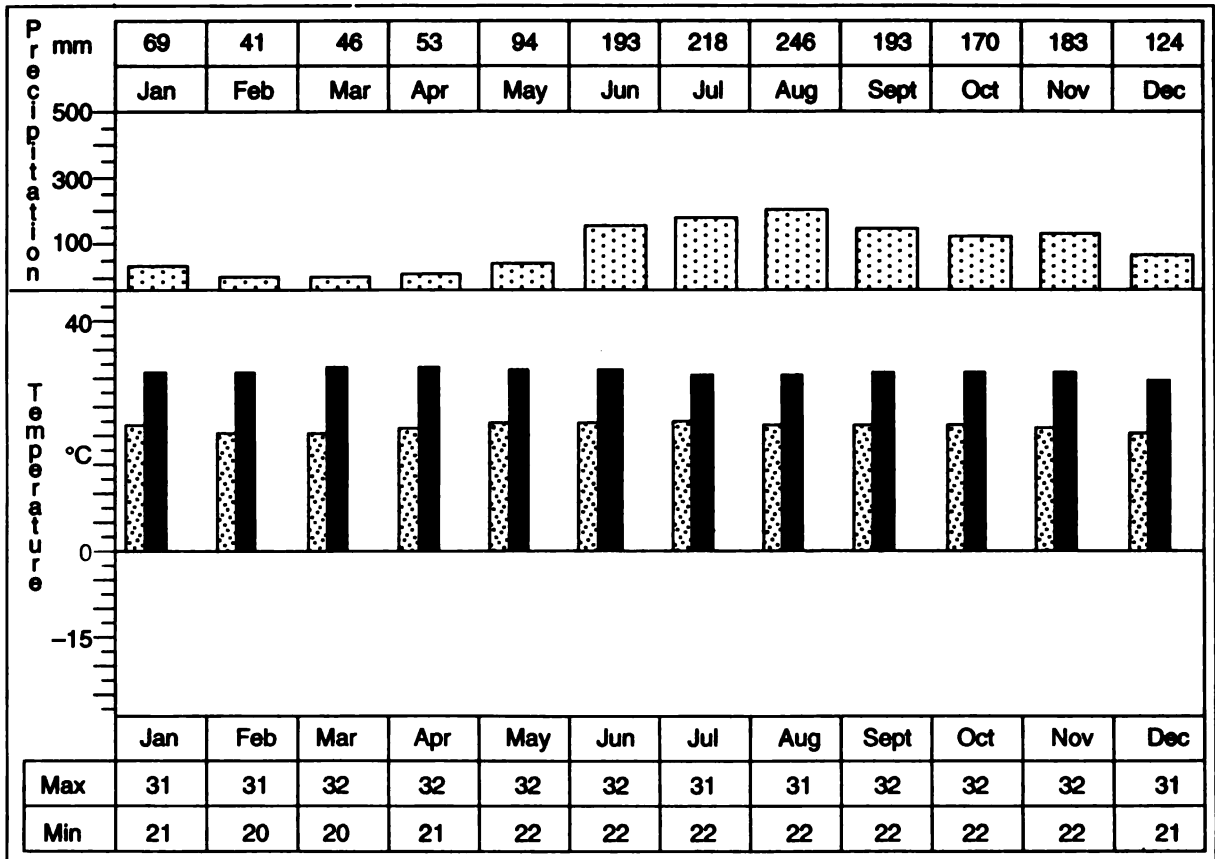
The economy of Trinidad and Tobago has for many years been dependant on export agriculture (sugar in particular) and petroleum. Like its sister Caribbean islands, Trinidad and Tobago developed initially as a plantation economy geared towards the almost exclusive cultivation of tropical crops for export to metropolitan markets. This caused the neglect of domestic food production.

The discovery in the 1920s of crude petroleum in commercial quantities led to the development of a thriving petroleum industry. Subsequent expansion in the petroleum sector resulted in a gradual decline in the relative importance of export agriculture, particularly sugar, as a major hard currency earner.

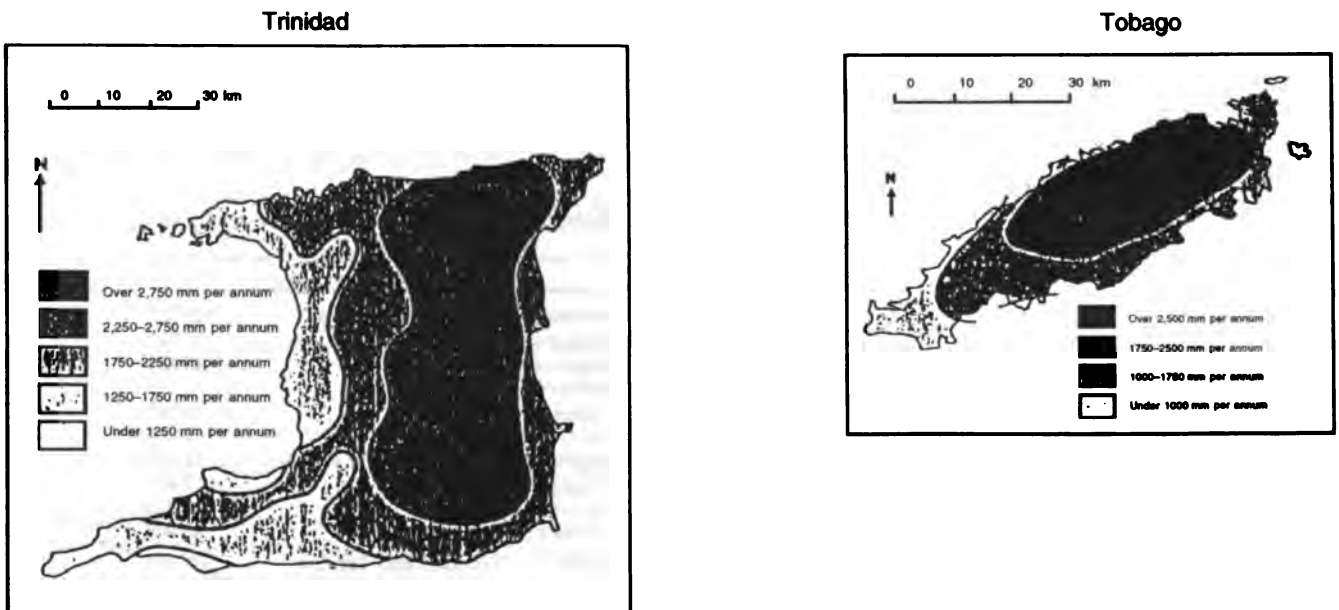
The Trinidad and Tobago economy experienced very rapid growth in the post 1974 period, with measurable improvements in the standard of living due to the performance of the petroleum sector. Gross Domestic Product increased from 65,9 million in 1976 to 16,4 billion in 1984 (TT\$).

Concurrently, there is marked expansion of social and physical infrastructure including health, education, water, electricity, transportation, communication and

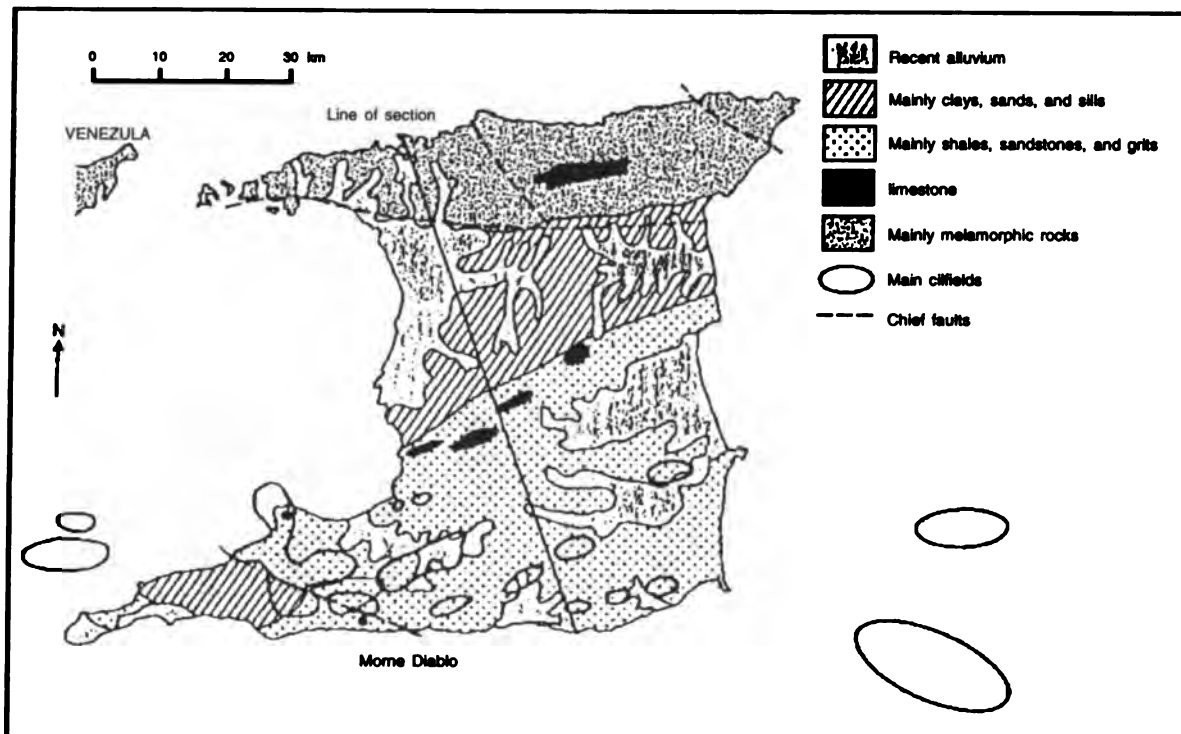
THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO



Graph 1: Average precipitation and temperatures in Trinidad and Tobago
Source: 1992 Broderbund Software (PCGLOBE).



Map 1: Precipitation distribution (Source: J. MacPherson in Caribbean Lands, 1985.)



Map 2: Geology of Trinidad (Source: J. Macpherson in Caribbean Lands, 1985)

housing. The combined effect of these interacting factors made Trinidad and Tobago rapidly become a more urbanized and industrialized society (cf table 1).

The transformation process has had both direct and indirect impact on agriculture. The creation of opportunities elsewhere in the economy for more attractive financial reward has diverted resources, including capital, arable land and productive labour, away from agriculture. Additionally the effect of urbanization and industrialization influenced the attitudes of society towards agriculture thereby accelerating the rural-urban drift. Further, taste and preference patterns have tended to become more metropolitan as evidenced by the composition and increasing volume of food imports (IICA 1986).

The principal problem affecting the development of Trinidad and Tobago today relate to the reduced revenues from petroleum on the world market. This has

Table 1: Human and geographical characteristics of T&T

Population	— in 1980	1 028 000
	— in 1991	1 285 000
	— in 1992	1 299 000
	— in 1993	1 313 000
	— in 2000	1 418 000
Population growth		1,1 %
Population density		251 hab/km ²
Urbanization rate		64 %
Natality rate		21/1000
Mortality rate		6/1000
Literacy rate		95 %

Source: 1992 Broderbund Software (PCGLOBE)

led to reduced economic activity. This situation will perhaps cause people to renew their interest in agriculture.

Agriculture only represents 3% of the Gross National Product (GNP), whereas the industrial sector represents 47% and the services sector 50%. The GNP has an annual growth of -5.8% and was of 2 762 US\$ per inhabitant (PCGLOBE, 1992).

1.1.2. Characteristics of the Agricultural Sector (IICA 1986)

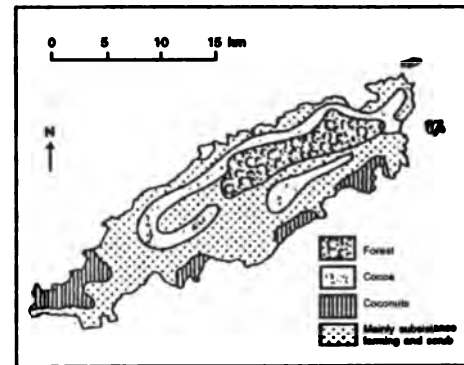
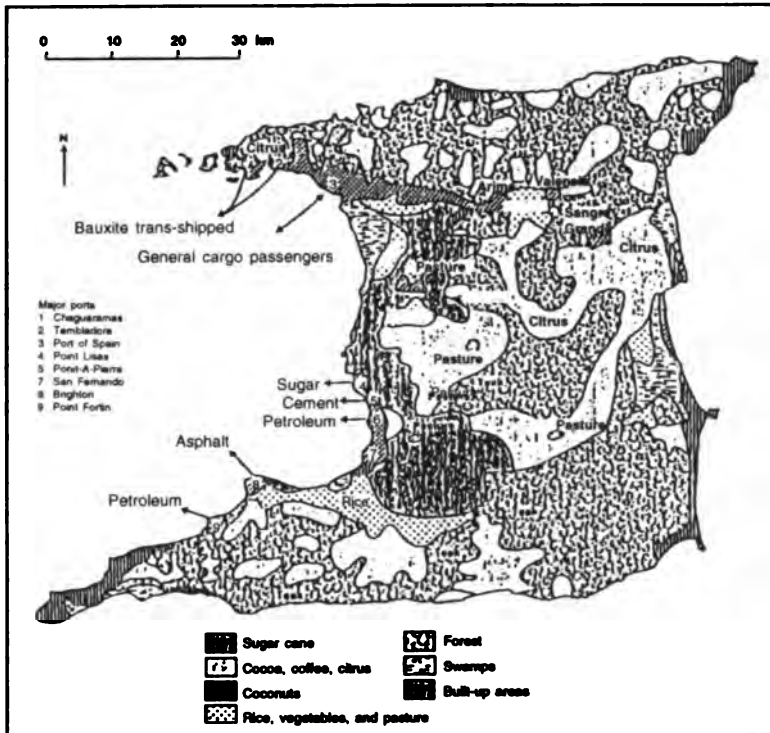
1.1.2.1. Land Resources and Use

The total land area of Trinidad and Tobago is 527 711 ha. Of this area, 68,4% is not involved in agricultural activity (cf table 2 and map 3)

Table 2: Land use in Trinidad and Tobago

	Area (ha)	Percentage
Natural vegetation and Forests	317 325	60.1
Tree crop ¹	87 942	16.7
Sugar-cane	47 481	9.0
Tobacco	415	0.1
Pulses and Grain	6 925	1.3
Root crops	2 208	0.4
Vegetables, Fruit and 'Food Crops'	11 290	2.1
Plantains and Bananas	2 474	0.5
Pasture and Coconut	7 746	1.5
Developped Areas	43 905	8.3
TOTAL — Trinidad and Tobago	527 711	100

¹Tree crops include Cocoa, Coffee, coconut, citrus and minor crops such as tonca beans avocado, guava, etc. The area comprises 8 495 ha abandoned (the most affected crop is cocoa)
Source: Land Capability Studies Phase II, 1973



Map 3: Land use in Trinidad and Tobago (Source: J. Macpherson in Caribbean Lands, 1985.)

1.1.2.2. Land Tenure

Many of the problems now besetting the agricultural sector have evolved from its historical legacy. The initial inequitable distribution of land between the plantation and peasant subsectors, aggravated by traditional systems of inheritance, led to fragmentation of holdings and proliferation of uneconomic sizes of agricultural holdings.

The 1982 Agricultural Census indicated that farms of 200 acres and over represented a mere 0.26% of all farms in the country, yet they controlled 32.7% of the total available farm land. On the other hand, farms under 5 acres in size were over 52% of all farms, but occupied only 9% of total acreage (cf table 5).

In addition, poorly developed land tenure systems, characterized by insecurity of tenure and unsatisfactory landlord-tenant relationships have mitigated against the more rational use of scarce agricultural land. This, too, has seriously impeded the development of the sector.

The state is, by far, the largest single owner of arable lands (tables 3 and 4).

There are significant economic implications of the average holding size which help to explain the relatively low per capita productivity and the phenomenon of part-time farming. This also suggests that the majority of farmers are under capitalized in land, especially in relation to their family labour resources.

On the other hand, there is under-utilization of farm land, particularly on the larger farms (in 70% of the

Table 3: State land ownership

	Constituted forest	Other arable and non-arable	Total
Trinidad	126 500	129 280	255 780
Tobago	3 930	6 840	10 700
Total	130 430	135 120	266 550

Source: MPF&ME: A new policy for land distribution and agricultural development, January 1989.

Table 4: Public and private agricultural holdings — 1982 Acreage (1000 ha) and percentage.

	Crop & pasture	Abandoned & fallow	Forest lastro	Built	Total
Public Holdings	18.3 21%	4.2 17%	0.2 3%	5.8 52%	28.6
Private Holdings	68.1 79%	21.3 83%	8.2 97%	5.4 48%	102.7
Total Holdings	86.4 100%	25.5 100%	8.4 100%	11.2 100%	131.6 100%

Source: CSO, Agricultural Census 1982 (1986)

Table 5: Private agricultural holdings

	Trinidad	Tobago	Total
Number of holdings as%			
< 5 ha	85	94	86
> 5 ha	15	6	14
Total holding size as%			
< 5 ha	41	40	41
> 5 ha	59	60	59
Average holding size (ha)			
< 5 ha	1.6	1.2	1.6
> 5 ha	13.9	27.1	14.3
Average	3.4	2.8	3.4

Source: CSO, Agricultural Census 1982, 1986.

farms of 10 ha or more) which are mostly under tree crops. This also explains the low productivity indicators for the sector. In the case of larger farms, under-utilization may also be associated with labour shortages, age of the holders, and other human factors.

Table 6 presents land tenure pattern for private land holding on an individual parcel basis. The more secure land tenure position of the larger farmers is illustrated by the fact that over 70% of their land parcels are owned, and only 13% are rented (almost all in the 5–10 ha category). Small farmers have had to rely on rental arrangements for over 20% of their land parcels.

Table 6: Private agricultural holdings — land tenure (%)

	Owned	Rented	Squatted	Other	Total
Total	71	18	5	6	100
< 5 ha	67	22	6	5	100
> 5 ha	77	13	2	8	100

Source: CSO, agricultural census 1982, 1986.

The amount of land under squatting appears to be relatively low even though it includes those farmers on government lands still awaiting regularization of their tenure. However, the degree of spontaneous squatting may well have increased since 1982. The government or its state enterprises are the primary source of both rented and squatted lands.

Urban, industrial and commercial expansion have, combined, to exert severe pressures on the agricultural economy. Urbanization and industrialization have virtually swallowed up large tracts of prime land. Moreover, the value of agricultural land throughout the country has sky rocketed in the light of rapid development of new housing and industrial estates.

1.1.2.3. Age Structure of the Farm Population

An examination of the age structure of farmers in Trinidad and Tobago shows that the concentration of farm operators is in the advanced age group. This accounts, in part, for increasing migration of rural youth in search of urban occupations. The natural consequences of an aging farm population are:

- progressively fewer acres under cultivation;
- increasing orientation towards subsistence levels of production;
- declining productivity;
- decreasing credit worthiness, especially for projects with long repayment periods;
- adherence to traditional systems of production and resistance to adopt innovations.

1.1.2.4. Institutional Infrastructure (IICA, 1980)

A major factor of concern has been the inability of existing institutional infrastructure to adjust to and implement new programs and innovations.

Marketing

Despite the reorganization of the marketing system, certain deficiencies still persist. These include inadequate facilities related to grading, packaging, storage and transportation; ineffective price support mechanisms, limited market intelligence, and minimal promotion of the consumption of locally produced food.

Credit

Great strides were made in increasing the availability of credit to the farming community. Nonetheless, collateral arrangements and approval and disbursement procedures tend to impede the timely release of funds.

Extension

Expansion of the Extension Services tended to increase the level of contact with the farming community. However, the wide geographic area still not under the control of Extension Officers, the expanded and increasing range of services demanded and the absence of effective inter-institutional coordination impaired the efficiency of the service and reduced its ability to act as a motivating force in the farming community.

Research and Development

Significant achievements were recorded in the research and development areas both in terms of traditional export crops and domestic subsectors. However, the efforts were largely uni-dimensional and did not provide the desired thrust in tackling the whole problem associated with the expansion of domestic agricultural production. Moreover, there is a lack of communication between research and the farming community.

1.1.2.5. Agricultural Labour Supply

Current levels of technology in the agricultural sector continue to place reliance on labour as a key input factor. However, rapid urbanization and industrialization have led to a continuous depletion of the available agricultural labour supply. The presence of high wages, particularly in the petroleum and construction sectors, has caused an increase in the cost of labour to agriculture. This is further aggravated by the inability of the sector to pay competitive wages and to offer regular year round employment.

1.1.2.6. Preadial Larceny

The prevalence of preadial larceny has had damaging and lasting psychological effects on agricultural development. This has severely deterred the productive efforts of even the most enterprising among the farming community.

1.1.2.7. Agricultural Organizations and Size of the Economy

A FAO review has included the lack of organized agricultural interest groups and the lack of competitiveness, as additional problems of the sector. This report states: "Lack of competitiveness has

contributed to declining output, low productivity and abandonment of estates. Increased competition from lower cost producers and stagnant demand for the country's main export crops have brought world market prices to levels lower than domestic production costs; in addition, the small size of the country's economy places it in the vulnerable situation of a "price taker" in world markets". Because T&T is small, it cannot compete against the large-scale producers of imported foodstuffs.

1.1.3. Agro-processing Sector

An examination of the supermarket shelves shows a wide range of locally manufactured products offered to the consumers. This range is typical of "middle income" food consumption habits that include a significant volume of processed foods. The agro-processing sector is the second largest sub-sector of the manufacturing industry after the hydro-carbon based industries. The sector consists of small-scale, non-sophisticated production units. According to the Industrial Development Corporation, there are about 90 plants in this sub-sector (FAO & MFPME, 1989).

Aside from the large-scale "sophisticated" beverage industries (rum, beer, carbonated drinks and reconstituted milk products), most of the major agro-processors use predominantly imported semi-processed raw materials.

1.2. PASSION FRUIT PROJECT

1.2.1. Background

In Trinidad and Tobago, seeds of the yellow type (*Passiflora edulis forma flavicarpa*) were brought in from Colombia around the mid 1960's. Commercial production of passion fruit began around 1982 at Palo Seco, but industry growth has been slow. During the mid-1980's, a joint venture involving Caroni (1975) Limited, Caribbean Industrial Research Institute (CARIRI) and the University of the West Indies (UWI) was formed to investigate the commercial production, and processing of passion fruit (EDC, 1991).

This study led to the installation of a processing line with a processing capacity of 2 mt/h, which consequently demanded large quantities of passion fruit. It resulted in a number of farmers cultivating this crop, the acreage reaching about 100 acres. In 1990, the Export Development Corporation (EDC) decided to conduct a feasibility study on "The Export Development Possibility of selected Tropical Fruit Products". It concluded that attention should be concentrated on passion fruit as the first step in the developmental process. Moreover, since 1988, the Ministry of Agriculture, Land and Marine Resources identified this crop as a priority.

In spite of the above, the area cultivated was drastically reduced. Low prices paid for the crop and disease problems were blamed for the drop in interest in this crop.

1.2.2. Objectives

In 1992, the Export Development Corporation (EDC) asked the Inter-American Institute for Cooperation on Agriculture (IICA) to provide technical assistance for a project whose main objective has to increase the production of fruit needed to supply the demand for raw material by agro-processors.

In order to define the necessary actions to reach this objective, IICA decided to conduct a study to:

- determine the present organization of the channel of production, processing and marketing of passion fruit in Trinidad and Tobago;
- obtain quantitative data concerning the areas and volume of production, yield levels, cost of production, labour required and qualitative information about cultural practices;
- assess the constraints that processors were facing to produce high quality products;
- determine the marketing channels, and the potential of markets for the product.

The main objective of the study was to determine the factors that limit the development of passion fruit, and to be able to make proposals to improve the present situation of the industry in the country.

To reach this objective, three institutions are involved in this project:

- IICA (Inter-American Institution for Cooperation on Agriculture)
- EDC (Export Development Corporation of T&T)
- MALMR (Ministry of Agriculture, Land and Marine Resources)

1.2.3. Material and Method

1.2.3.1. Production

• Identification and choice of the farmers

A list of the producers who were growing passion fruit by 1991, was used as a starting point. This list was complemented by:

- (a) Farmers' names supplied by a local processor
- (b) Names given by Extension Officers for their respective areas.

Since the number of farmers in passion fruit was very limited, the decision to interview all of them was made. Both farmers presently growing passion fruit as well as those who stopped growing the crop were interviewed. The aim was to include the latter to determine the reasons why they had stopped growing the fruit and, consequently, the problems they encountered during their experience with passion fruit cultivation.

A total of 19 farmers were interviewed. Of these, 7 were in the Central area, 5 in Penal and Rio Claro and 7 in the Eastern area. No farmers were interviewed in Tobago since passion fruit was not a crop of commercial importance there.

Of those 19 farmers interviewed, 10 are currently producing passion fruit, 6 were producing passion fruit but stopped (one still has two acres, but went down from 20 to 2 acres) and 3 have recently established a passion fruit plot.

*** Presentation of the questionnaire**

A questionnaire (Annex II) was developed to identify the following:

- the farmer's name and address and location of plot;
- the importance of agriculture in the family income;
- the importance of passion fruit in their agricultural activity;
- the trellis system used;
- the land preparation system;
- the varieties cultivated and the type of propagation;
- the cultural practices;
- the harvest and commercialization systems and channels;
- the main problems met by the farmers;
- the image that the farmers have of the crop.

Complementary to this information, element and data to determine the cost of production under low and high technology production systems were obtained.

The fact that most producers in Trinidad and Tobago were reluctant to answer questions on a survey format it has decided to conduct the survey by open discussion with the farmers.

1.2.3.2. *Processing*

Processors of passion fruit were identified in the EDC 1991 Report (EDC, 1991).

The processors were interviewed in order to obtain data concerning the industry and the main constraints. Technical information was gathered by visiting two processors during processing of fruit into single strength juice, and juice into cordial.

1.2.3.3. *Marketing*

Data concerning extra- and intra-regional markets were found in the most recent publications.

Local channels of distribution of passion fruit products were described by the producers and processors. In order to determine whether there was a demand for fresh passion fruit at the supermarket and the level of that demand, in terms of quantity, price and quality, a trial was conducted at the supermarket level with locally produced passion fruit.

2. PASSION FRUIT INDUSTRY

2.1. THE PRODUCT

The name 'Passion Fruit' has a Spanish origin and refers to the resemblance of the flowers to certain features of the crucifixion (cf figure 2). Passion fruit (*Passiflora edulis*) belongs to the family Passifloraceae, which contains twelve different genera and approximately five hundred species. The *Passiflora* genus contains about 400 species, 60 of which are edible but only few of them are of commercial interest (Lennox Andrews 1991, Jagtiani et al., 1988, A. Fouque 1972). Among these are the passion fruit (*Passiflora edulis*), the barbadine or giant granadilla (*Passiflora quadrangularis*), and the sweet-cup (*Passiflora laurifolia*).

In this report, we are interested in passion fruit produced on a commercial scale, and distributed as fresh or processed fruit. Figure 1 is a flow chart of the product in Trinidad and Tobago.

2.2. PASSION FRUIT PRODUCTION

2.2.1. Characteristics of the Production

2.2.1.1. Area under Passion Fruit and Importance of that Crop

*** Importance of agriculture in the family income**

As a result of the survey, we concluded that for most of the producers of passion fruit, agriculture is a secondary activity. Indeed, 55.5% of the producers have another job and, therefore, agriculture is only a part-

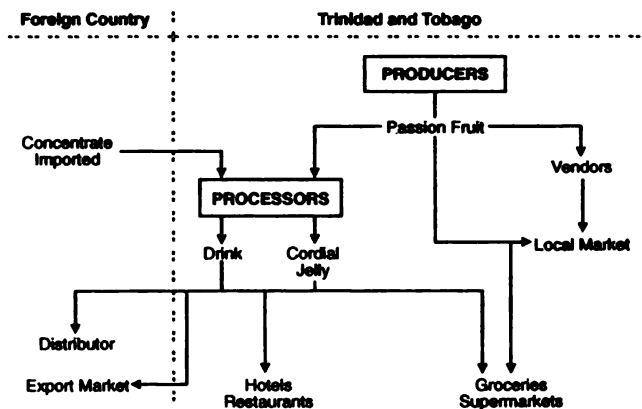


Figure 1: Flow chart of the product

time activity. Some of them (39%) resort to external labour to attend their cultures.

*** Importance of Passion Fruit**

The area under Passion fruit amounts to 30% of the producers' land, and 50% of the cultivated area.

Passion fruit producers are mainly fruit and vegetable producers (78%). Nevertheless for those farmers, passion fruit is an important crop within their agricultural activity in terms of area planted and income derived.

Among the passion fruit producers, there are 2 who also produce cocoa, one who produces flowers for export and one state agricultural estate (Caroni Ltd.)

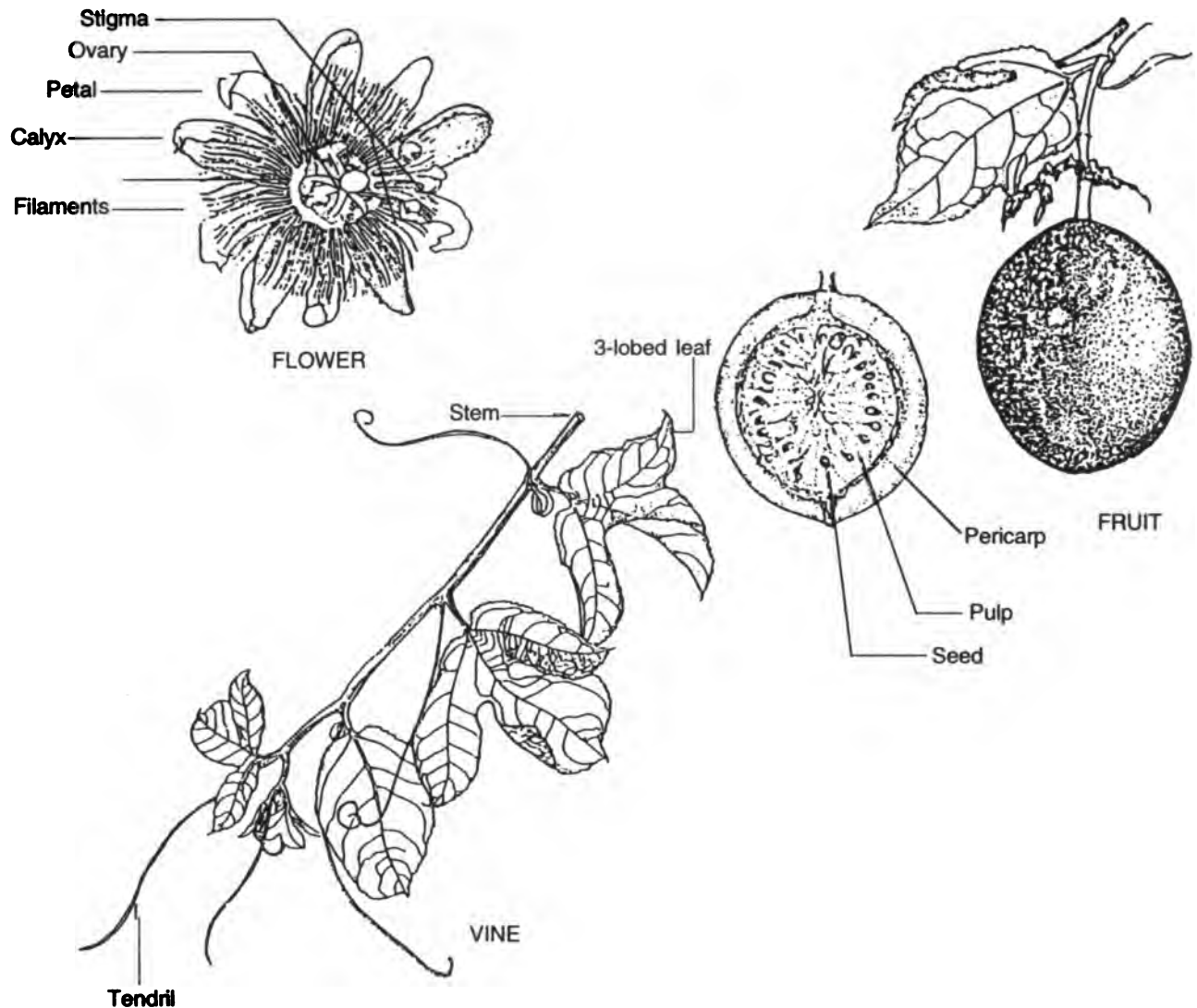


Figure 2: Flower, Fruit and vine of passion fruit (Source: IICA, 1987. Passion fruit production in Dominica)

which, in the past, used passion fruit as a diversification crop. These farmers are producing passion fruit as a secondary activity.

• **Area under cultivation**

The findings of the survey based on the 19 farmers visited represents:

- 17.25 acres in cultivation;
- 9 acres being planted in 1993;
- 69 acres of production now abandoned.

The actual area into cultivation is higher than 17.25 acres: 2 acres in the demonstration plot of Centeno, 1 other producer has 1 acre but has not been interviewed.

2.2.1.2. *Types, Varieties and Propagation*

* **Types and Varieties**

The original plant, found and grown in Brazil, bears a purple coloured fruit. It was introduced into Australia in the 1800's, and then taken to Hawaii in 1880. In 1923,

seeds of a yellow-fruited type were also introduced into Hawaii from Australia. According to several authors (Rajkumar, 1987, J.J. Guzman Perez, 1990, D.J. Casimir *et al.*, 1981), it is not clear whether this second type originated either in Australia or in Brazil.

The two types are distinctly different and have been given different scientific names. *Passiflora edulis forma edulis* refers to the purple passion fruit and *Passiflora edulis forma flavicarpa* refers to the yellow passion fruit (cf table 7). Hybrids (purple x yellow and yellow x purple), are frequently found, some of which are today recognized as important commercial varieties.

In Trinidad and Tobago, seeds of the yellow type were brought in from Colombia by Mr.L.de Verteuil around the mid 1960's. Around 1978, Mr.S.Bharath brought fruits of a purple type from Martinique. While the yellow is clearly *Passiflora edulis forma flavicarpa*, the botanical identity of the purple-looking type still has to be established, but it is known that it is not *Passiflora*

Table 7: Main differences between yellow and purple passion fruit

Factor	Purple	Yellow
Yield	Lower	Higher
Fruit colour	Purple	Yellow
Fruit size	Smaller	Larger
Fruit weight	Lighter (32-65 g)	Heavier (43-131 g)
Juice: — by volume	Less	More
— by weight	More	Less
Aroma	More	Less
Flavour	Higher	Lower
Sugar %	Higher	Lower
Ascorbic acid	Higher	Lower
Total acidity	Lower	Higher
Brix/acidity	Higher	Lower
Carotene	Lower	Higher
Vitamin A	Lower	Higher
pH	Lower (av. 2.8)	Higher (av. 4.2)
Seed colour	Deep black	Light black
Opening of flowers	Morning (before 12:00 noon)	Afternoon (after 2:00 p.m.)
Plant vigour	Less	More
Total dry matter	Less	More
Resistance to:		
— fusarium	Susceptible	Less susceptible
— nematodes	More susceptible	More tolerant
— woodiness	Very susceptible	Less susceptible
— low temp.	More resistant	Less resistant
— high temp.	Less adapted	More adapted
Economic life	Shorter	Longer

Source: First regional workshop on tropical fruit crops, IICA office in Dominica, 1991.

edulis forma edulis. Consequently, this second type is called "Martinique pink" in order to avoid confusion with the true purple one. The growth and fruiting of the "Martinique pink" seem very similar to that of the yellow. (Rajkumar, 1987)

In Trinidad and Tobago, producers grow these two different varieties as well as hybrids, with a predominance of the yellow.

One producer is growing a different type of passion fruit, which is not clearly determined as yet, but which has the following characteristics:

colour: light orange
 flavour: sweet
 skin: soft (easier to open)
 weight: very light (about 40 g per fruit)
 resistance to diseases: excellent

• **Propagation**

Passion fruit can be propagated by seedlings, cuttings and grafting. The major method of propagation in Trinidad and Tobago is by seed and all of the producers propagate their own plants.

Seeds are selected from the most productive and disease-free vines with the highest quality fruit. Seeds from these fruits are extracted, freed of pulp, and can be sown immediately. Germination begins within 14 days if watering is adequate. Seedlings can be ready for transplant into the field in 6 weeks (when the tendrils are first beginning to show) (L. Andrews, 1991). Although this practice is uncommon and not recom-

mended, 1 producer prefers to plant the seeds directly in the plot (4 seeds per hole).

Due to the method of propagation and cross pollination, the plants obtained are quite variable in terms of fruit size, shape, colour pulp characteristics and tolerance to diseases. Only 39% of the producers do a careful selection of the mother plants for their seeds.

2.2.1.3. *Establishment*

* **Trellis System**

Although three basic types of trellises are used in the region (I or fence, T or telephone, inverted U or shed: cf figure 3), of the producers in Trinidad and Tobago using trellis, all use the vertical I system. The amount of wire used varies from one to three (1 wire: 58%, 2 wires: 25%, 3 wires: 17%).

The posts are about 2,5 m high and are normally planted 0,5 m deep and spaced according to the strength of the material. The spacing varies between 3 and 4.5 m between the rows. Rows are established at 3 m apart in average.

The most common material used as posts in Trinidad are the following: concrete (7%), teak (40%) and different local woods available on the plot (53%).

One producer does not use the trellis system and chooses to grow passion fruit on old abandoned cocoa trees on his estate. Under one tree, he plants an average of 3 passion fruit vines. This solution drastically reduces the initial investment that the trellis system requires. The disadvantage of this system is the low quality (mainly external) of the fruit due to the high incidence of pests and diseases because it is difficult to prune and spray the vines (IICA, 1987).

• **Land Preparation**

The recommendations in terms of land preparation for passion fruit are generally to plough and harrow or rotavate the land. Where tropical clay or clay loam soils suffer restricted internal drainage, cambered beds may need to be formed. On sloping lands, the plants may be planted on individual mounds rather than on beds. Drains should also be made (L. ANDREWS 1991).

In Trinidad and Tobago, only 27% of the producers plough, 35% make beds and 47% establish drains.

• **Planting**

Plants are usually placed about 15 cm deep. In sites of low fertility, some manure or a little fertilizer is mixed with the soil in the planting hole. The average density of passion fruit present in Trinidad and Tobago is 397 plants per acre (980 plants/ha).

The more common spacing used is 3 m x 3 m, which is a good spacing in so far as it allows the possibility of intercropping, but we noticed the heterogeneity in term of techniques used seeing that the density varied between 70 and 725 plants per acre.

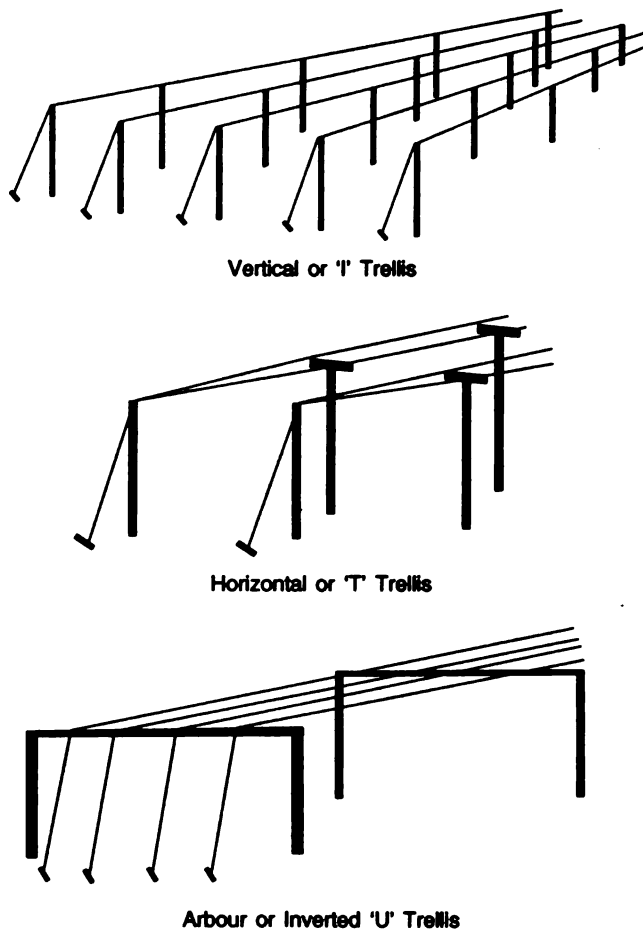


Figure 3: Trellis system (Source: L. Andrews, 1991)

2.2.1.4. Cultural Practices

* Training and Pruning

A piece of string or a stick is used for the vine to climb upon to reach the trellis wire. Two or three leaders are encouraged to go upwards and, on reaching the trellis wire, these are looped around the wire to encourage growth in both directions along the row. Any shoots appearing alongside the leaders below the trellis wire are removed (L. Andrews 1991).

All farmers are training their vines, but they use different amounts of time to do it (more or less regularly).

The objectives of the pruning operation are the following:

- to facilitate spraying for pest and disease control;
- to reduce vine weight on the trellis;
- to rejuvenate the vines;
- to facilitate the harvesting exercise.

Minimum pruning consists of:

- keeping vines off the ground by maintaining "skirt" at 15-60 cm;

- selective pruning, ie. periodically removing unproductive branches.

This is sufficient if vines are young and fruits are being grown for the processing market. However, for the fresh fruit market, more stringent pruning is required in order to obtain heavier, blemish free fruits.

In spite of the fact that it is considered as an important operation, in Trinidad and Tobago, 53% of the producers do not prune at all. This can be explained by two factors:

- some farmers do not know the importance of this practice (lack of technical assistance to the farmers);
- pruning is a labour intensive activity and they cannot do this regularly.

* Fertilization

Very few countries in the Caribbean have conducted conclusive research work on fertilization of passion fruit. The University of the West Indies (Rajkumar, 1987) was a pioneer in the area of fertilization of the yellow passion fruit in Trinidad and Tobago.

Rajkumar (1987) recommends 700 g/plant of N:P:K=15:5:10 three times per year. First: soon after the rain begins (May), second: late August and third: late October. Method of application: broadcast around the base, 1 to 1.5 m away from the trunk. Foliar application at the quantity of 10g/l of 20:20:20 in each crop protection spray.

Interviews with the farmers showed that 40% of the producers do not fertilize at all, because they consider that the plant is bearing well or because of the cost of the fertilizers.

On the other hand, the foliar fertilizer (20:20:20) applied with the pest and disease control spray is used by 86% of the farmers.

The main fertilizers used by the producers are the following:

N:P:K=13:13:21 (20%)
N:P:K=12:12:72+2 (40%)

The dose applied varies from 455 to 910 g/plant per year divided in 4 to 12 applications.

* Pest and disease control

(a) Pests

The major pests are leaf eating caterpillars (*Dione* sp. and *Eucides isabella*). These can be particularly devastating in the nursery or early establishment phase. Plants are susceptible to caterpillar attack which can cause severe defoliation and set back vine growth in a very short time. Consequently, vines must be monitored very regularly (twice per week or more) for signs of caterpillars. These usually clump together and may be destroyed by hand or chemically. Good results are obtained using Sevin, Diazinon or Malathion.

(b) Diseases

Commonly found on mature vines, are foliage diseases caused by *Alternaria*, *Septoria* and *Colletotrichum*.

Brown spot disease, caused by the fungus *Alternaria* induces leaf spotting, leaf yellowing, leaf fall and vine death.

Anthracnose disease is caused by *Colletotrichum* which attacks the stem and fruits. Heavy losses may occur if this disease is not controlled.

Septoria leaf spot is caused by *Septoria*, which induces leaf spotting which may lead to defoliation.

These three diseases can easily be controlled by adequate cultural practices (weed control, drainage, pruning of vines) associated with chemical applications (mancozeb alternated with benomyl). "Collar rot" is the most serious disease problem occurring having had serious effects in Trinidad (and more recently in Dominica). The organisms identified in the affected plots are *Phytophthora* and *Fusarium*. The conditions of their development seems related to waterlogging conditions.

(c) Control realised by the producers

15% of the producers of passion fruit do not control pests and diseases.

The others usually alternate 2 insecticides (generally Malathion associated with Dimethoate or Diazinon) and 2 fungicides (Benomil with Copper, Dithane or Cuprosan).

The average frequency of spraying is one application every 6 weeks (8 sprayings per year).

• Weed Control

The base of the plant should be kept weed free by hand because passion fruit is a surface rooting vine.

The rest of the plot may be weeded manually or chemically. The weedicides used by the farmers of Trinidad and Tobago are Paraquat and Round Up.

A problem in term of weed control has been observed in the plots of passion fruit which used to be cocoa estates. Indeed, a "wild vine", called "wild potato vine" which is *Ipomoea Tiliacea* from the Convolvulaceae family, described by J. Fournet and J.L. Hammerton, tends to entangle itself with the passion fruit vines and it becomes difficult to control without damaging the passion fruit. Cutlassing and manual removal seem to be the only solutions, since the majority of the herbicides are totally ineffective. Moreover, this vine grows at a rapid rate thus the vines should be removed just after they emerge which is only possible with daily observation of the fields. Consequently, the control of this weed is a very costly operation (labour intensive).

• Pollination

There are two methods of pollination: natural or by hand. In Trinidad, none of the producers use hand pollination, because of lack of experience with this practice (technical assistance) and because farmers consider it a labour intensive operation.

(a) Natural pollination

Passion fruit is pollinated mainly by carpenter bees and honey bees but these are not always abundant enough to cause a high proportion of flowers to set fruit. Fruit set from open pollination averages 15-22%. Rainfall within two hours after pollination reduces fruit set. During rainy or overcast condition, pollination efficiency is also reduced due to low activity of carpenter bees (*Xylocopa sonorina*) which are the main pollinators. These bees are also less likely to visit flowers on branches close to the ground (L. Andrews, 1991).

Some producers, in order to increase the number of pollinators, have hives on their land (2 producers: 11%).

None of the producers mentioned a problem of pollination; there can be two reasons for this:

- no pollination problem;
- producers do not observe regularly if a large percentage of the flowers are pollinated.

(b) Hand pollination

This practice can increase yield greatly if done correctly (cf figure 4) and consistently since it results in 80-90% fruit set. Anthers are removed from flowers by use of forceps on the same day pollen is to be used. A small brush is used to apply pollen to the stigma of the flower. It is not necessary to apply pollen to all three lobes of the stigma. This exercise can be conducted from 1:00 pm to nightfall (L. Andrews, 1991, IICA, 1987). It is a labour intensive activity.

• Irrigation

Yellow passion fruit seems tolerant to dry conditions but yield is low and vines appear stunted. Severe water stress limits vegetative growth and potential yield in passion fruit. Irrigation should therefore maintain the soil close to field capacity especially during flowering. Irrigation needs for passion fruit have not been determined in the Caribbean (L. Andrews, 1991).

However, only 23% of the passion fruit producers in Trinidad and Tobago use irrigation during the dry season.

2.2.1.5. Harvest

• Yields

The yield reported in the literature varies from 5 to 60 t/ha, the final yield depending on the technology used (Jagtiani et al., 1988, etc...).

In Trinidad, the yields reported vary from 5,000 to 15,000 lb/acre (5.6 to 16.8 t/ha) which is relatively low

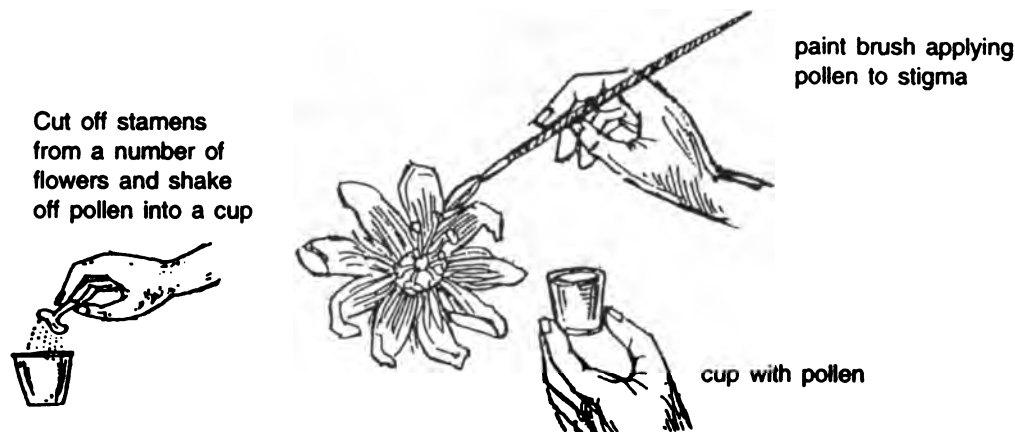


Figure 4: Manual pollination (Source: IICA, 1987. Passion fruit production Dominica)

when compared to other countries. This range of yields can be explained by the fact that there are different management levels. The current estimated production in Trinidad and Tobago is 60 mt/year.

• **Harvest and Post-harvest**

(a) *Season*

The first fruits are harvested about 9 months after planting. The normal harvest season runs from May through December (rainy season). However, some fruits are available for harvest year round if there is an irrigation system, or if the climate in the area provides some rain even during the dry season (East Trinidad: Sangre Grande, Rio Claro).

(b) *Method*

Ripe fruits fall from the vine and are then picked up (harvesting passion fruit is an easy operation compared with other fruits in so far as it consists of picking up the fruits from the ground). Fruits that are on the vine are not fully ripe and should not be harvested as they produce off-flavours (H.T. Chan, 1980, Mendez *et al.*, 1989, Jagtiani *et al.*, 1988).

In Trinidad, fruits are picked-up between one to five times per week, depending on the volume of production, the problems of praedial larceny and the availability of labour.

Furthermore, 50% of the producers harvest both off the vine and on the ground. This practice is used because premature fruits are heavier and consequently represent more income for the producers, and the problem of praedial larceny which does not allow them to wait for the fruits to fall on the ground.

Ripe fruits lose weight very rapidly, so they should be delivered as soon as possible. However, if the fruits are to be stored, they have to be kept in a cool place (the ideal being 6.5°C) and in aerated containers to avoid overheating, sweating and spoilage. Even well-stored fruits begins to wrinkle in a few days due to moisture loss, but this does not affect the quality and the flavour of

the fruit (H.T. Chan, 1980). However, the study showed that none of the producers interviewed possessed cold storage facilities although fruits may be kept 3 to 4 days before they are brought to the processors.

2.2.2. Problems of Passion Fruit Production

As mentioned before, yields of passion fruit production in Trinidad and Tobago are low. Moreover, the quality of the fruits is generally poor (external aspect, size, stage of maturity). This is related to technical and economical factors, labour constraints and praedial larceny.

2.2.2.1. Technical

• **Low Technology**

The technology used by producers in Trinidad and Tobago has been described above and could be defined as low technology.

This is related to the following factors:

- limited technical assistance available through the Extension Services. This aspect is a discouragement to the farmers;
- economical limitations and unavailability of credit line that do not allow the farmer to invest in chemical inputs or enough reliable labour;
- agriculture is often a part-time activity and the producers do not dedicate as much time to the crop as they should.

• **Pests and Diseases**

Out of the 6 producers who stopped growing passion fruit, 3 had to abandon production due to disease problems; this represents a total area of 36 acres. Indeed, "collar rot" problem appeared and no control solution was found. This disease occurred after waterlogging conditions.

Similar situations were reported in 2 other plots, but as the producers were not informed about that disease, they could not explain the reason why some of their vines were dying.

Caterpillars (*Dione* sp.) can destroy the foliage in 1 to 2 days. Consequently, they can cause serious damage if the farmer does not monitor his plot very regularly; this is the case of producers who have labour limitations. Caterpillar, was mentioned as a yield loss factor by 33% of the farmers. However, this pest can easily be controlled if attended to in time.

Another problem encountered by farmers is that of termites which damage the wooden posts of the trellis system. Then, posts often have to be replaced, leading to additional costs.

Table 8: Passion fruit production costs (TT\$ /acre) High technology. July 1993

Activity	Unit	Cost/ unit	Year 1	Year 2	Year 3
VARIABLE COSTS					
Contract					
Brushcutting	acre	200	200	0	0
Plough & beds	acre	400	400	0	0
Total			600	0	0
Equipment					
Sprayer		3300	330	330	330
Pruning tools		35	70	0	0
Total			400	330	330
Materials					
Plants	1	2	924	0	0
Fertilizer	kg	2.2	638	840	840
Foliar feed	kg	11	55	55	55
Insecticide 1	1	39.6	20	40	40
Insecticide 2	1	81	41	81	81
Fungicide 1	kg	182	42	164	164
Fungicide 2	1	65	29	117	117
Weedicide 1	1	96	480	480	480
Weedicide 2	1	38.6	135	135	135
Total			2364	1912	1912
Labour					
Drainage	MD	45	180	0	0
Digging & planting	MD	45	135	0	0
Trellising	MD	45	450	0	0
Vine training	MD	45	360	0	0
Pruning	MD	45	180	405	405
Fertilizer application	MD	45	270	270	270
Spraying	MD	45	338	405	405
Manual weeding	MD	45	405	405	405
Irrigation	MD	45	180	270	270
General maintenance	MD	45	180	270	270
Total			2678	2025	2025
Harvest					
Harvesting	MD	45	540	2340	2340
Bags	1	1.5	30	135	135
Transport		50	1200	2600	2600
Total			1770	5075	5075
MISC. & INTRESTED					
			1812	2167	2167
FIXED COSTS					
Posts	10 ft	9.8	1080	0	0
Wire	100 ft	12	270	0	0
TOTAL MANDAYS					
			71.5	97	97
TOTAL PRODUCTION COSTS					
			10973	11509	11509
GROSS OUTPUT VALUE					
			6000	16000	14000
NET REVENUE					
			-4973	4491	2491
CUMULATED REVENUE					
			-4973	-482	2009

2.2.2.2. Price/production Costs

Passion fruit is an interesting crop in terms of cash flow as it provides cash almost all year round. However, it is a plant that requires investment in labour and trellis.

An analysis of the cost/benefit margin has been carried out for both low and high technology practices (table 8-9 and Annex III).

The differences between high and low technology can be seen from the table overleaf.

Table 9: Passion fruit production costs (TT\$ /acre) Low technology. July 1993

Activity	Unit	Cost/ unit	Year 1	Year 2	Year 3
VARIABLE COSTS					
Contract					
Brushcutting	acre	200	200	0	0
Plough & beds	acre	400	0	0	0
Total			200	0	0
Equipment					
Sprayer		3300	330	330	330
Pruning tools		35	70	0	0
Total			400	330	330
Materials					
Plants	1	2	924	0	0
Fertilizer	kg	2.2	0	0	0
Foliar feed	kg	11	13	39	39
Insecticide 1	1	39.6	10	30	30
Insecticide 2	1	81	20	61	61
Fungicide 1	kg	182	42	127	127
Fungicide 2	1	65	29	91	91
Weedicide 1	1	96	193	193	193
Weedicide 2	1	38.6	0	0	0
Total			1321	540	540
Labour					
Drainage	MD	45	180	0	0
Digging & planting	MD	45	135	0	0
Trellising	MD	45	900	0	0
Vine training	MD	45	270	0	0
Pruning	MD	45	0	0	0
Fertilizer application	MD	45	0	0	0
Spraying	MD	45	90	270	270
Manual weeding	MD	45	270	270	270
Irrigation	MD	45	0	0	0
General maintenance	MD	45	180	270	270
Total			2025	810	900
Harvest					
Harvesting	MD	45	540	1800	1800
Bags	1	1.5	21	75	75
Transport		50	600	2000	2000
Total			1161	3875	3875
MISC. & INTEREST					
			1164	1289	1310
FIXED COSTS					
Posts	10 ft	9.8	0	0	0
Wire	100 ft	12	270	0	0
TOTAL MANDAYS					
			57	58	60
TOTAL PRODUCTION COSTS					
			6452	6844	6955
GROSS OUTPUT VALUE					
			4000	10000	8000
NET REVENUE					
			-2452	3156	1045
CUMULATED REVENUE					
			-2452	-704	1749

Characteristics	High	Low
Pruning	Yes	No
Fertilisation	Yes	No
Irrigation	Yes	No
Posts for the trellis	Teak	Wood available on the land

The conclusion is that, at the price of TT\$ 1/lb (paid by the processors), passion fruit is a valuable crop but the revenue obtained is low. Furthermore, the first year requires high investments in material and labour whereas the yield is low. At least one farmer went out of production because the price went down to TT\$0.50/lb when the acreage reached about 100 acres. The farmers need to have a guaranteed minimum price of TT\$ 1/lb.

Another conclusion was that unless the vines could last 4 years, the high technology practices were not more profitable than the low technology practices. Moreover, it requires a higher investment and the farmers have to be able to finance themselves during the first two years. The cumulated revenue is positive only in the third year.

2.2.2.3. Labour Constraints

55.5% of the producers practice agriculture as a part-time activity. This creates problems as they cannot spend much time on their plots.

On the other hand, there are producers (22%) who dedicate all their time to agriculture but, because of large acreage, available family labour is not always sufficient.

As a consequence:

- 17% cultivate their crop according to the time available (we know that passion fruit is a high labour consuming activity);
- 61% resort to external labour, but they complain that the work is not always adequately done.

One farmer almost stopped growing passion fruit because of labour problems. He went down from 20 to 2 acres. Indeed, the rapid urbanization and industrialization of Trinidad and Tobago has led to a shortage of available agricultural labour.

2.2.2.4. Praedial Larceny

33% of the farmers mentioned praedial larceny as a real problem. It has damaging and lasting psychological effects on the farmers who are making serious efforts to produce the fruit. As well, it influences some cultural practices such as harvesting. Incidence of praedial larceny exists mainly in areas where producers do not live on their estates.

2.3. PASSION FRUIT PROCESSING

2.3.1. Processors

There are 5 processors of passion fruit in Trinidad

and Tobago (cf table 10 and Annex IV): Nestle, Cannings, Superior Foods, Hackshaw, Mackies

2.3.2. Final Products

2.3.2.1. Drinks and Multijuices

Nestle and Cannings produce passion fruit drinks and multijuices reconstituted from concentrate (cf table 10). Those products represent about 50% of the industry's final products.

2.3.2.2. Cordial, Jelly and Pancake Syrup

Cottage industries accounts for two stages of processing:

- (i) process of the fruits into single strength juice; and
- (ii) process of the single strength juice into cordial, jelly and pancake syrup.

The single strength juice, whose characteristics are described in Table 11, is only a semi-finished product, but is sometimes commercialized among the processors.

The cordial, the jelly and the pancake syrup respectively represent 45%, 4% and 1% of the industry's processed products.

2.3.2.3. Concentrate

No concentrate is produced in Trinidad and Tobago, due to a lack of adaptable equipment. Indeed, only one factory (CCGA: Cooperative Citrus Growers Association) has an evaporator, but its capacity is not suited to the production possibilities of T&T (20 mt per day). Moreover, volatile flavoring constituents must be recovered from the vapors and added back to the concentrate with the help of a condenser, otherwise the reconstituted juice loses most of its distinctive flavor and aroma (Jagtiani *et al.*, 1988; Casimar *et al.*, 1981). CCGA does not possess the material required.

2.3.2.4. By-products

One processor uses passion fruit rind in order to produce pectins, which is then used in his process of jams, jellies and sauces.

The other processors do not use the rind or the seeds. These can, however, be used for animal feed.

Table 10: Processors of Trinidad and Tobago, raw material used and final products

Processor	Raw Material used	Final Products
Nestle	Imported Concentrate	Drink
Cannings	Imported Concentrate	Drink and multijuice
Superior Foods	Fruits and single strength juice	Cordial
Hackshaw	Fruits and single strength juice	Cordial, jelly, pancake sirup, pectines
Mackies	Fruits and single strength juice	Cordial

Table 11: Single strength juice and concentrate characteristics

Characteristics	Natural juice	Concentrate
Degree Brix	15 ± 1°	50°
pH (15°C)	2.75 approx.	2.45 approx.
Density	1.06 approx.	1.23 approx.
Acidity	3.7-4%	12.5-13.8%
Ascorbic acid	38.0	111.0
Solids in suspension	32-45%	
Vitamine A	1073-1595 IU	
Bacteriological switchboards		
— fungus	Max 100/ml	-100/ml
— yeasts	Max 100/ml	-100/ml

2.3.3. Raw Material: Supply and Requirements

Nestle and Cannings import concentrate for their processes. Their need for concentrate is unknown as data concerning their processing capacity was not obtained. Cannings could use the locally produced passion fruit if the producers could provide them with raw material every month. (They would then need to equip themselves with cold storage facilities).

The processors who stock up with fresh fruits use two supply channels:

(i) Superior Foods and Mackies

These processors are providing contracts to the farmers at a guaranteed price (TT\$ 1/lb), delivery conditions (delivery at the factory for Superior Foods, whereas Mackies collect the fruits at the producers) and a market for all the fruits that can be processed.

(ii) Hackshaw

Hackshaw's situation is different because he is his own supplier with a passion fruit plot of 2 acres (0.8 ha). There is no transportation or supply problem since the processing lines of fruits to juice takes place at the production site.

The processing capacities of these lines are seen in table 12.

We noticed that there is a problem of under-utilization of passion fruit processing facilities in Trinidad and Tobago which has direct significance on processing costs.

2.3.4. Process

Figure 5 presents the process and the flow sheet of

Table 12: Difference between processing capacity and the volume really processed

Processors	Processing capacity	Needs in raw material ¹	Volume processed
Superior Foods	1 mt/h	10 mt/week	1 mt/week
Hackshaw	1 mt/day	1 mt/week	200 kg/week
Mackies ²	0.5 mt/h ?		0.5 mt/week

¹The difference between the processing capacity and the needs in raw material correspond to the fact that the processors are multi-fruit processors, consequently the share of passion fruit is about 1 day per week.

²It has not been possible to visit this processing line.

the production of passion fruit single strength juices and cordials.

The process of concentrate into drink will not be developed here, since we are mainly interested in processors using local fruits.

2.3.4.1. Reception, Washing and Sorting

Upon receiving the fruits, they can either be directly processed or stored. Superior Foods has a cold storage which allows storage of fruits in better conditions. The processing of passion fruit only takes place once a week, this means that the fruits must be stored between 1 and 6 days.

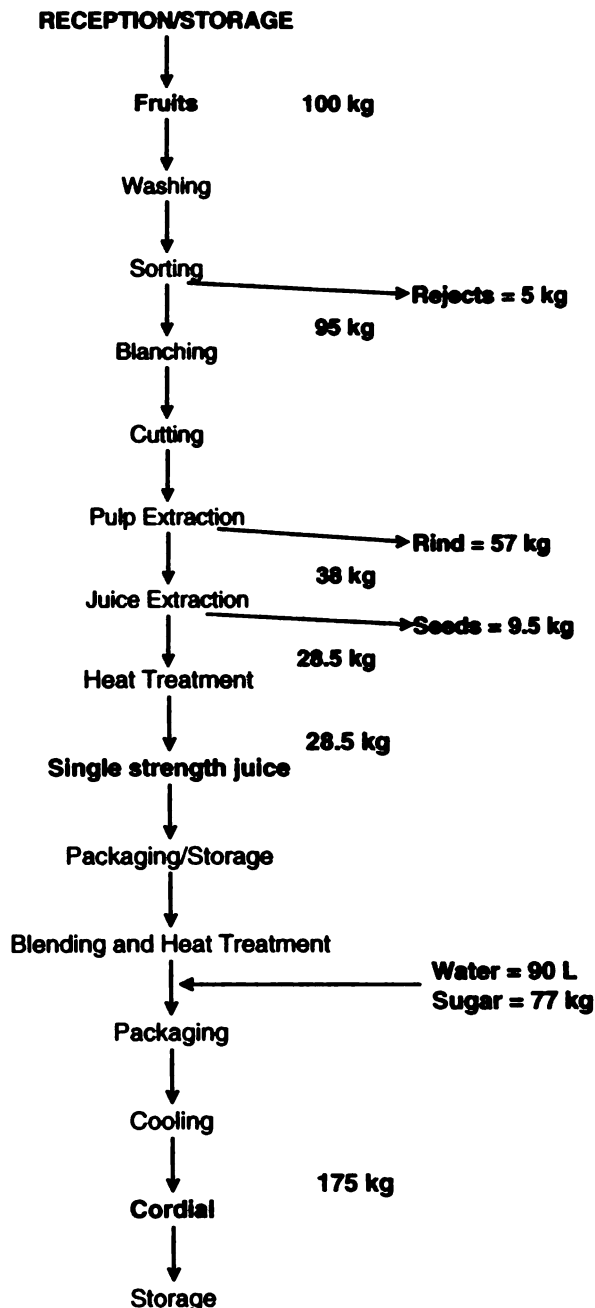


Figure 5: Process and flow sheet of the single strength juice and cordial

The washing operation is initially undertaken to eliminate dirt from the skin. It is done by spraying water. The fruits are then inspected to remove all unprocessable fruits. An average of 5% of fruit are rejected (long periods of storage resulted in rotting, too small or green fruits) This selection process is not systematic for all processors.

2.3.4.2. *Blanching*

After the washing and sorting operations, fruits are blanched. Two techniques of blanching are used: with water or with vapor. In the first case, fruits are immersed in boiling water for approximately 10 minutes, while in the second case, they undergo processing with vapor for approximately 3 minutes. It seems that the latter operation is not necessary for passion fruit processing.

2.3.4.3. *Juice Extraction*

Two methods are used

- extraction, using a three stage pulper (Superior Foods);
- fruit cutting, then pulping (Hackshaw).

• **Three Stage Pulper**

After the blanching operation, an elevator feeds the pulper. The extraction system is composed of:

- (i) a cutter;
- (ii) a drum, formed by a cylinder, separating the pulp from the rind;
- (iii) a pulper equipped with two filters, the first separating the juice from the seeds, the second refining.

This system has a processing capacity of 2 mt per hour. The major problem of this type of extraction is directly linked to the cutter. It incorporates matter coming from the skin and the seeds through grinding. This matter is difficult to eliminate and causes juice deteriorations (darkening, black spots...) (Bru, 1986).

• **Manual Cutting and use of a Pulper**

Fruits are manually cut; the pulp is then extracted by manual squeezing and put into buckets. The volume processed is limited by this operation, but seeing the quantities of fruits that are available for processing, the scale of this operation is suitable. Several operations are undertaken, as well as changes of equipment, which slows down the process and which facilitates microbial contamination.

After a heat treatment in a basin (the temperature is brought up to approximately 90°C), the juice is separated from the seeds in a centrifugal brush extractor. The pulper used is a tomato pulper, equipped with a passion fruit adapted screen (holes 0,8 mm in diameter).

2.3.4.4. *Heat Treatment*

The purpose of this operation is to eliminate the microorganisms responsible for the product's deteriora-

tion, as well as make the enzymes inactive. Passion fruit is very sensitive to attacks of fungus, bacteria and yeasts. In the case of the juice, the major part of the contamination occurs during the cutting of the fruits.

The heat treatment undertaken by two processors is to bring the temperature up to 90°C. This process does not benefit from precise controls, as pasteurization and sterilization techniques are not mastered.

Passion fruit product is very sensitive to heat; and heat treatments are usually detrimental to flavor (by volatile flavoring constituents evaporation) (D.J. Casimir and Al, 1981, H.T. Chan, 1980, Bru, 1986).

2.3.4.5. *Single Strength Juice Packaging and Storage*

The juice extracted is hot packaged in 32- or 100-litre drums which are sterilized beforehand with vapor. During the heat treatment, 1 ppm of Sodium Benzoate (preservative) is added.

The juice is then placed in cold storage before transformation into cordial or jelly.

2.3.4.6. *Cordial Production*

• **Blending and Heat Treatment**

Passion fruit cordial is obtained by blending the juice with sugar and water in the following proportions:

- 27 kg of juice
- 73 kg of sugar
- 90 l of water

It is then treated at 80°C until the desired Brix (42°Brix) is obtained.

In the mean time, Citric Acid, Sodium Benzoate (0,5 g/l of blend) as well as Vitamin C are added.

This operation is conducted in open steam heating kettles.

• **Packaging**

Depending on the destination of the products, the packaging used will be different:

- drums for export;
- glass bottles of 750 or 300 ml;
- plastic containers (4,5 l) for hotels and restaurants.

In one case, the filling is done manually: the cordial is extracted from the kettle and passed between two screens, then put in another smaller kettle (20 l) where, with a sluice, the operator fills the bottles or the containers.

In the other case, packaging is done by an automatic filling system.

The packaged cordial is then manually cooled by wetting or soaking in cold water.



(1) Rows of Passion fruit with manual irrigation



(2) Passion fruit experimental plot CV "Tamana 4" at CES/Centeno



(3) Detail of Passion fruit flower



(4) Fruits on the vine



(5) Yellow and pink cultivars



(6) Washing — Superior Foods



(7) Fruits introduced into the blancher — Superior Foods



(8) Fruits are going into the cooking system after blanching — Superior Foods



(9) Fruits go into the 3-stage pulper, by means of an elevator — Superior Foods



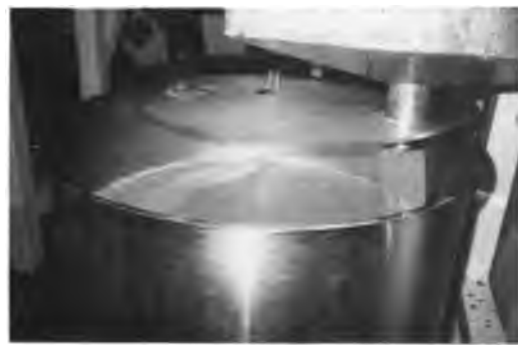
(10) Manual extraction of the pulp — Hackshaw



(11) Hackshaw's pulper



(12) Hackshaw's heat treatment of the rind for production of pectin



(13) Single strength juice — Superior Foods



(14) C. Rives packing



(15) Fresh fruit sales test



(16) Fresh fruit sales

2.3.5. Product Quality

2.3.5.1. Drinks

The products obtained are different in quality:

- Nestle puts on the market products that have lost a lot of the organoleptic characteristics of the passion fruit. This is due to the fact that the concentrate used as raw material for the production of drink has been stored for a long time (8 to 10 years), and the quality of this product is probably altered. They have decided to stop processing passion fruit due to a lack of markets (the problem is rather low consumer acceptance of the product).
- Cannings produces a good quality product and manufacture blends of tropical fruit juices that are exported.

2.3.5.2 Cordial

The cordial produced in Trinidad and Tobago, lacks aroma. This is due to the following factors:

- **Quality of the Raw Material**

As seen previously, many producers harvest part of their fruits off the vine, before they have developed their aromas; this can produce off-flavor.

- **Heat Treatments**

During the process, there are many operations and stoppages of the line that can generate the development of microorganism.

The product undergoes 3 heat treatments (blanching, single strength juice and cordial treatments). We have noted that passion fruit is sensitive to heat treatments (conservation by freezing is the less destructive method). Consequently, some volatile flavoring constituents evaporate. Treatments in open kettles, reduces efficiency.

- **Chemical Product Addition**

As mentioned earlier, cordials produced in Trinidad and Tobago contain citric acid and sodium benzoate.

Sodium benzoate is an active product, especially at low pH (inferior to 4, as is the case of passion fruit juice) which is mainly used to protect the product against yeast and mould given that the low pH is sufficient to inhibit most bacteria (Bourgeois and Al, 1988). Its innocuousness is not obvious, and the presence of sodium benzoate in fruit juices is forbidden in some countries (R.A. Dehove, 1984). The use of this preservative by processors could be justified by the fact that as passion fruit is sensitive to high temperatures, it may sometimes be better to use an additive. But in the present case, the cordial has undergone 3 heat treatments, and added preservatives. These precautions taken by processors are due to the fact that, for market constraints, the juice and the cordial have sometimes to be stored for long periods before they are processed or sold to consumers. Moreover, the addition of citric acid is not necessary (FAO 1973), and sometimes forbidden (R.A. Dehove, 1984).

2.3.6. Problems of the Process

2.3.6.1. Supply in Raw Material

Trinidad and Tobago has to face the problem of the under-utilization of the processing lines, because of the lack of regular and sufficient production on the island. Also, due to the harvesting methods used, the quality of the fruits is not always optimum for processing. Good prices are obtainable from the fresh fruit market; if they have the opportunity, producers are likely to use this market.

However, it is also necessary to ascertain what the possibilities are for processors to market their product if their lines could work to full capacity (cf 2.3.6.4.).

2.3.6.2. Processing Costs

Costs are increased by under-utilization of the processing capacity. Processors, therefore, cannot offer a better price for the raw material; while this would be a motivating factor for producers and processors would have the opportunity to work with a volume close to the nominal capacity.

2.3.6.3. Quality of the Products

Compared to imported products, passion fruit products made in Trinidad and Tobago are generally considered to be of low quality. However, given the above problems, it would be difficult to acquire equipment to improve the products' quality.

A consequence of this is the problem of acceptance of consumers and trade barriers for the export market.

2.3.6.4. Market

None of the local fruit processors has a stable and established market at his disposal. As a consequence, 2 of them do not wish to process larger quantities of fruit.

On the other hand, the use of chemicals can prevent Trinidad and Tobago's products from entering some export markets.

It is necessary, therefore, to be prudent and ascertain the importance of the lack of raw material in relation to factors limiting the operation of passion fruit transformation.

2.4. PASSION FRUIT DISTRIBUTION AND MARKETING

2.4.1. Fresh Fruit

Passion fruit producers in Trinidad and Tobago use 4 marketing channels (cf figure 1, p.7).

2.4.1.1. Process Market

Approximately 80% of passion fruit production is geared towards the processing market. Indeed it is a

reliable and regular market since producers have contracts with processors.

Producers deliver the fruits to the processor, who conduct a light sorting (rejects that are inappropriate for processing such as rotten fruit). However, rejects only represent 5% of the total production. The processing activity is less demanding than the fresh fruit market in regard to the quality of the fruit.

Fresh fruits are in competition with imported concentrates. Between 1981 and 1982, 91 tons of passion fruit concentrate was imported into Trinidad and Tobago (cf annex V), mainly from Brazil. Some processors have made drinks from this product; it is still used sometimes. Since 1992, no significant quantity of concentrate has been imported; some pulp came from Puerto Rico, Dominica, Jamaica and Brazil (Overseas Trade Report, CSO). However, processors using the concentrate do not have a line to process fresh fruits; consequently, one can not really speak about competition since they are not equipped to process the local fruit.

2.4.1.2. Supermarkets

Supermarkets receive approximately 15% of Trinidad and Tobago production. Supermarkets chain (Hi-Lo) irregularly stock up with passion fruit, according to the availability of raw material. On the other hand, one rarely finds passion fruit in the small groceries.

This market requires good quality fruit, because it caters for a select clientele; and prices obtained are higher (1,5 TT \$ / lb). Producers deliver their washed and sorted fruits to the supermarkets.

2.4.1.3. Local Markets

A maximum of 5% of fruit is delivered to the local markets. Two marketing channels are used:

- Direct

One member of a family sells the fruits, in general through the informal market (at the side of the road)

- Indirect

Fruit are sold to a vendor at the market who in turn sells to the consumers.

Local markets in Sangre Grande, Chaguanas and Port of Spain are supplied with passion fruit. In the regions of Penal and Rio Claro passion fruit used to be in the markets, but it has disappeared due to a lack of production in these areas.

55% of the producers use two marketing channels at the same time:

- a part of the production is sent to the processors, who provide them with a contract and accept a great part of the production.
- another part is sold to the supermarkets, or in the markets. This alternative is used because it is more remunerative.

We have noticed that market research activity is carried on by each producer since there is no organization or group of passion fruit producers.

2.4.1.4. Export

Between 1986 and 1990, Trinidad and Tobago had been able to export passion fruit. The largest quantities were exported in 1987, with 2 640 kg (cf annex V). Since 1990, there were no exports or imports of passion fruit. This corresponds to the drop in acreage cultivated.

2.4.2. Processed Products

2.4.2.1. Local Market

Passion fruit drink produced by Nestle is available in the large supermarkets. On the other hand the cordial and the jelly are rarely available on their shelves because these distributors have a policy of 90 or 120 days credit with their suppliers and small scale processors do not have a cash flow which allows them to accept these payment conditions. On the other hand, small groceries distribute passion fruit cordial and jelly.

On a small scale some hotels and restaurants use the cordial to provide their customers with passion fruit juice. This market is irregular as it depends on the orders.

2.4.2.2. Export

Cannings exports a passion fruit tropical drink to Europe, USA, Canada and Caribbean islands.

Hackshaw has exported cordial to Barbados on an order basis. This did not involve a long term contract.

Superior Foods exports its cordial in bulk to the United States, where it is diluted and sold as passion fruit drink; this market is still not well developed.

To be able to export, it is necessary, after having obtained a market, to be able to supply it regularly with a constant and competitive quality. At the present time, Trinidad and Tobago possesses neither the volume or the quality required for this kind of market.

2.5. PASSION FRUIT MARKET

2.5.1. World Market

Passion fruit is not found in any commercial statistic in countries. Fresh fruit imports as well as deep-frozen or natural juices are mixed with other lesser important fruits in customs statistics.

2.5.1.1. The International Fresh Fruit Market

- European Market (A. Guyot, 1991)

Passion fruit was introduced 18 years ago into Europe from Kenya. It was the purple type. Since, then, the market has adopted others varieties, the most important being:

- *Passiflora edulis f.edulis* (Purple passion fruit)

- *Passiflora edulis f. flavicarpa* (Yellow passion fruit)
- *Passiflora ligularis* (Sweet Granadilla)

Importing Countries

The European market fluctuates between 1 000 and 1 200 tons per year, but it is impossible to know with any accuracy the real consumption. In relation to the market for the main tropical fruits, passion fruit represents very low quantities.

Passion fruit seems to be a necessary element among tropical fruit but the consumer does not buy them regularly, (unlike bananas, pineapple, mango and avocado).

The United Kingdom and France are the main consumers with imports between 350 and 400 tons per year in the 1990's.

Import Prices

Granadilla from Colombia is always bought at a higher price than the African purple passion fruit. Data mentioned in Table 13 shows an average of 60% difference.

Table 13: Maximum and minimum price by 1990/91 (in US \$/kg)

Country	Granadilla Columbia		Purple passion fruit Kenya/Zimbabwe/Burundi	
	Minimum	Maximum	Minimum	Maximum
France	4.74	6.35	2.60	4.50
U.K	6.00	8.80	3.05	5.65
Germany	4.20	4.30	3.05	3.95
Belgium	3.05	4.55	2.35	4.65

Source: El mercado Europeo de las Passifloras. Alain Guyot

Packaging

Standardization of packaging for passion fruit or granadilla does not exist.

Kenya exports in 2 types of cardboard cases:

- average weight 2 kg with 40/48 fruit on 1 floor;
- average weight 7 kg, only for the English market.

Colombia exports in net weight cases of 3 and 3,5 crude kg.

Brazil uses a case of 4 kg with 92/96 fruit on 2 floors.

The majority of retailers prefer small quantities, around 2 kg.

Import Duties

Passion fruit and the granadilla are classified under the number: 08010 909020 in the European Community statistics.

Duties are different according to exporting countries, but as Trinidad and Tobago belongs to the ACP countries, it benefits from free access to the market.

However, a tax on sugar is taken from the imports of products made with fruit, containing added sugar.

The Other Markets

USA Market

US imports of fresh passion fruit from the Caribbean basin are restricted because of fruit fly quarantine regulations. Although no fruit fly problem exists in Trinidad and Tobago, the production cannot be exported to the USA.

The Competition

Exporting countries can be classified in 2 groups: those that export the purple type (Kenya, Zimbabwe, Zambia, South Africa, Burundi) and those that export yellow fruit (passion fruit or granadilla) such as Ecuador, Peru, Colombia, Brazil, Venezuela, Ivory Coast.

Only a few countries separate passion fruit in their export statistics, and even less specify the destination of their merchandise. Only Kenya has very precise statistics.

Kenya

It is the oldest exporter of passion fruit to Europe and, until 1988, was its main supplier. Of a total of 368 exported tons by 1990, 90% went to Europe.

Zimbabwe

Zimbabwe, a more recent producer, over the last 5 years, made great efforts to improve the quality and presentation of the fruit. Consequently, they became the main supplier to the European market with 804 tons in 1989 and 666 tons in 1990.

Ecuador

Ecuador has exported, until in 1987, approximately 4 tons per year to American markets. The 1991 production is estimated at 17 000 tons, of which 70% is processed.

Venezuela

A recent producer that possesses approximately 1 200 ha of passion fruit and an estimate of the production of 1991 to approx. 20 000 tons, mainly destined to the fresh fruit market.

Peru

The estimated planted area was 1 200 ha in 1991 with a production of about 9 000 tons, of which ¼ is processed.

Colombia

Planted areas, up to 5 000 ha in 1991, thus production in 1992 could have surpassed 100,000 tons, which represents double of what was anticipated for 1991. Approximately 70% of the production is used for the juice industry.

2.5.1.2. The international market for juice and concentrate

The international trade of passion fruit juice began around 1980. Passion fruit is processed to obtain a single strength juice or a concentrate.

Official standardization of these two products does not exist, but the main characteristics are described in Table 11.

The juice destined for export can be deep-frozen to -18°C or pasteurized.

Imports

Passion fruit juice does not appear in any import statistic. It is indeed included in a group called "Tropical fruit juices and concentrates" that does not include either pineapple or citrus. The share of passion fruit in this group is estimated to be 70 - 80%. European import potential is estimated to be 25-30 000 tons (in equivalent juice of 13-15°Brix).

90% of passion fruit juice or concentrate is used to make multivitamin multijucies, or is destined for the dairy industry (yogourts or ice-creams).

Europe is the main buyer of passion fruit juice with 70% of total export. The United States market is evaluated at 10% of the European market, that is approximately 3 000 t.

Within the common market, Germany is the principal consumer of passion fruit juice, followed by France.

Exporters

The major exporting and producing countries are situated in South America: Colombia, Brazil, Ecuador and Peru represent more than 80% of exports.

The exports of concentrated juice (in tons) during the last 4 years are given in Table 14 according to the Association of Passion Fruit Juice Producers.

Statistics by country, exports of juice, concentrated juice and single strength juice (in tons) are given in Table 15 according to statistics by country as obtained from the Association of Passion Fruit Juice Producers.

Until 1987, exports increased greatly before stabilizing in 1988. Then, a very sharp decline (cf Colombia and Brazil) due to the reduction of production by producing countries in order to create a shortage and to favour the increase of prices was observed.

Prices

No organisation or enterprise centralizes prices. It is by a common agreement that the price is determined for a month, a period, a container. FOB average prices

Table 14: Exports of concentrate

Country	1987	1988	1989	1990
Colombia	2 487	3 286	2 068	1 889
Brazil	1 800	2 994	3 877	1 350
Ecuador	800	1 100	1 200	1 485
Peru	1 029	1 178	1 705	1 243
Total	6 116	8 558	8 850	5 967

Source: National statistics in each country.

Table 15: Exports of concentrate and single strength juice

	Colombia	Brazil	Peru	Ecuador	Sri Lanka	Kenya
1983	—	6 936	623	—	1 494	326
1984	—	5 116	2 392	—	444	329
1985	—	3 265	3 437	—	302	135
1986	1 985	5 370	1 988	—	—	174
1987	4 777	8 173	3 382	800	—	278
1988	7 215	8 382	2 032	1 110	—	—
1989	3 887	7 051	2 000	1 200	—	—
1990	1 800	2 469	1 975	1 485	—	—

Source: National statistics in each country.

from Brazil, per metric ton of natural juice, in 1985 were around US \$1 000, then they increased to more than US \$2 900 in 1987.

This high price combined with a high production, superior to the consumption possibilities of the different markets, have favoured a deep recession. Prices declined to US \$750/900 per metric ton of natural juice and US \$2 400 per ton of concentrate in 1989. Then, producers decided to organize themselves and reduced their exports. Consequently, by 1990 we observed a progressive increase in price for the concentrate from US \$3 000/mt at the beginning of the year to US \$4 800 at the end of the year and US \$5 000/mt at the beginning of 1991 to finally go back down to US \$2 000/mt (CIF) in November 1992.

Natural juices equally increased from US \$750/t at the end of 1989 to 1 300 in mid 1990 and US \$1 700-1 800/t at the end of 1990. But in November 1992, its price had gone back down to US \$800/t (CIF). It is hardly likely that the price in 1980 will return (approximately US \$10 000/mt of concentrate).

Prices appear to be very variable in the time as well as quality. Good quality products can obtain prices twice or three times higher than average quality products.

2.5.2. Regional Market

A total of about 1 400 acres (567 ha) is under passion fruit cultivation in the Caribbean.

The crop has a good market in the region for fresh or processed fruit. Most countries have facilities to process passion fruit. Often these are under-utilized or are run with imported raw material because of a lack of sufficient supply of locally produced passion fruit.

2.5.3. Local Market

2.5.3.1. Fresh Fruits

About 20% of local passion fruit production is consumed in the fresh fruit market while the remainder is used for processing.

• Processing Market

Processors are providing contracts to the farmers at a guaranteed price (TT\$ 1/lb) and a market for all the fruits that can be processed. This represents 95% of the

production because processing is much less demanding than the fresh fruit market in terms of appearance. This is the only aspect of the market which is organized. One processor is willing to buy the production of 100 acres of passion fruit; this is an indication that the demand of the processing industry is not being met.

• **Fresh Fruit Market**

The fresh fruit market is not well developed and passion fruits are seldom available in groceries or in local markets.

In order to provide farmers with an additional market, a study to determine the scope of the local market, by observing consumer acceptance of the fruit and the elasticity of the demand to the price in the supermarkets was conducted. As seen previously, farmers need a minimum price of TT\$1/lb; thus, it is better for them to have two market possibilities, to ensure that processors maintain the price. (This could not be ensured in case of a monopoly).

Purpose

- (a) To determine if there was a demand for fresh passion fruits at the supermarket; and
- (b) to determine the level of the demand in term of: quantity, price, and quality.

Strategy

Over a period of 4 weeks, each Friday (from July 2 to 23), the IICA Fruit Project supplied to a leading supermarket about 300 passion fruits from a local producer. The fruits were cleaned and any diseased fruit were discarded. Fruits were weighed and packed in transparent plastic bags at the following weights: 0.4–0.7 kg, 0.8–1.1 kg, and 1.4–1.6 kg.

Each week, the price per kg was increased as follows:

	To consumer	IICA pay	Super pay
July 2	TT\$ 3/kg	TT\$ 0.88/kg	TT\$ 1.32/kg
July 9	TT\$ 3.5/kg	TT\$ 0.55/kg	TT\$ 1.65/kg
July 16	TT\$ 4/kg	TT\$ 0	TT\$ 2.20/kg
July 23	TT\$ 5/kg	TT\$ 0	TT\$ 2.20/kg

The supermarket paid on consignment for fruits which were sold. All revenue went to the supermarket.

Two persons were on hand to talk with consumers and explain the advantages of buying the fresh fruits. (One passion fruit can make a glass of juice of better quality...).

The demonstrators recorded:

- the preferred bags
- how many consumers buy it
- the time required to sell all the fruits

Any fruit not sold were left in the supermarket's

refrigerated stand and a record kept of how many days were needed to sell them.

During the following three weeks (July 30, August 6 and 13), fruits were brought to the supermarket but no demonstration was done. However, the same records were kept. Due to climatic reasons (tropical storm), the August 6 and 13 trials could not be carried on.

This study showed that there was a demand for the product up to TT\$5/kg. Producers would earn TT\$1.25–1.50/lb while the supermarkets gained 50-80%.

80% of the consumer approached at the supermarket were not willing to buy passion fruit. The following reasons were given:

- taste and health factors (acid fruit);
- they have a vine of passion fruit at home;
- the majority of the consumers prefer to purchase juices directly;
- lack of knowledge of the fruit's uses. (Promotion of the product could increase sales.)

A supermarket can sell between 20 and 80 kg per week, according to its location and its clientele. This means that the big supermarket chains can absorb about 75 mt/year. This represents the entire production of 20 acres (considering the current yields obtained in Trinidad and Tobago). However, as the fresh fruit market concentrates on external aspects and size of the fruits, a selection of the largest blemish-free fruits is necessary. The trial showed that on the average only 15% of the fruit produced meet the quality required by the supermarkets.

2.5.3.2. *Processed Products*

Consumption of drinks in Trinidad and Tobago is oriented towards soft drinks (Coca Cola, Sprite and many others). Juices are also consumed, such as orange, pineapple, and grapefruit.

Is this situation due to a consumers' choice, or does the availability of products orient the purchase? The potential demand for passion fruit products was also affected by the quality of the products available.

Various supermarket managers said that the supply does not meet the demand, even though the market does not consume large volumes.

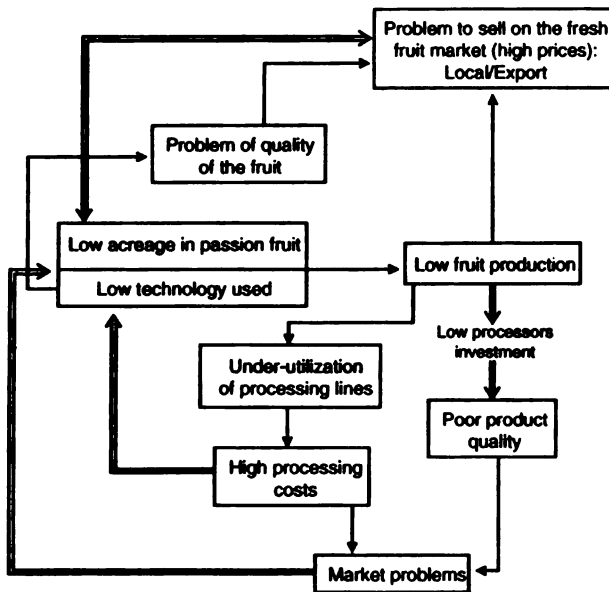
Thanks to the promotion and marketing efforts of one processor, it has been showed that there is a market in hotels and restaurants (mainly tourists-oriented ones).

The market for processed passion fruit products in Trinidad and Tobago is not well known; there is room for expansion. Promotional and marketing actions are needed. (This has to be done by the processors themselves).

3. CONCLUSIONS AND RECOMMENDATIONS

Passion fruit is a viable crop for the diversification program in Trinidad and Tobago. However, the industry needs both technical and economic assistance. It has been said that the main reason why local production of passion fruit decreased was due to the low prices paid by processors, which discouraged growers from continuing with the crop. Although this might have been one of the important factors, the study showed that the industry suffered from problems linked to production, such as quality of the processed products and lack of organization in the marketing area.

Below is a chart of the situation of the industry at present:



Farmers will have to be encouraged, if they are expected to continue to grow this crop. One processor already had an export market for his products but he could not get enough fruits. He was willing to provide contracts to the farmers for at least 100 acres of passion fruit at a reasonable price (TT\$ 1/lb). Undoubtedly, this would initially encourage farmers to grow passion fruit. But for them to continue growing the crop, they would have to make a profit. (It is well known that to secure a reasonable price, the farmers cannot rely on only one closed market. Alternatives must be provided otherwise over supply will cause a drastic drop in prices and once again, discourage farmers from growing this crop.) Nevertheless, it is recognized that to access new markets, the quality of the produce and the organization of the marketing channels must be improved.

The following are considered essential needs in order to boost the passion fruit industry in Trinidad and Tobago:

• **On the Side of Production:**

- (1) Provide farmers with good planting material for the fresh and the process fruit market:

The Ministry of Agriculture, Land and Marine Resources (MALMR) has selected a sweet variety (TM4: Tamana Pink 4) which is appropriate for the fresh fruit market. IICA has provided the MALMR with high yield material for the process market. These should be promoted, massively propagated and distributed to interested farmers. Research could also be done on the possible use of rootstock to overcome the problem of "Collar rot" (caused by *Fusarium* and *Phytophthora*).

- (2) Provide technical assistance to the farmers in order to increase yields and quality. This assistance could be given by trained staff of the Ministry (MALMR) and should mainly focus on:
 - selection of seeds for planting material.
 - pruning techniques;
 - appropriate harvesting practices;
 - pest and disease control (to obtain blemish free fruits);
 - hand pollination.
- (3) Promote the organization of producers to facilitate the technical assistance program and the organization of the market for fresh fruits.
- (4) Establish a constant and dynamic feedback between research (CES) and production (Extension Officers and producers).

• **On the Side of Processing:**

Reduce the number of heat treatments that the final processed product has to go through and the quantity of additives:

In order to increase their quality, the number of heat treatments that the final processed product goes through (blanching, heating of single strength juice and cordial) should be reduced. This can be achieved by reducing the duration of storage of the single strength juice, which may be possible if the market is better organized since the processors would be able to do better planning and management of their supply. A better control of the time and temperature of the heat treatments should also be done; this can be made without investment in material or equipment. Also, better cooling of the product after heat treatment is required.

In the long term, processors would have to equip themselves with pasteurizers because heat treatment in open kettles is not very efficient. The use of pasteurizers will decrease the use of additives.

• **On the Side of Marketing:**

- (1) Better organization of the marketing channels:

The Export Development Corporation (EDC) should provide information and assistance to farmers and processors to obtain or consolidate export markets. This operation would be enhanced by the organization of the producers. The Caribbean market has to be looked at as a first step to development, but the final product must be competitive.

(2) Promotion of the fresh and processed products at the local and export level.

• **Financing:**

Passion fruit requires high initial investment. Establishment accounts for 46% of the cost of product-

ion. Without an easily accesible credit line and reasonable interest rates, many potential farmers will not be encouraged to grow this crop. However, it has to be recognized that the land tenure system of Trinidad and Tobago is a handicap to the collateral required by most banks in the country.

ANNEX I

LIST OF PRODUCERS AND PROCESSORS CONTACTED

PASSION FRUIT PRODUCERS

- Manhim, Bert
Ambrosia farm, M. Douglass, Arima
Tel : 652-7882
- Rodriguez, John
Ming Hong Street, Brazil village
Contact Tel: 623-1125
- Stroude, Knolly
Emerald Garden, Arima
Tel: 646-3566
- Bridgelal, Khadar
Coal Mine, Hay Trace, Sangre Grande
Tel: 668-2381 (work); 668-2350 (home)
- Nagassar, R.
Bolasaw Trace, Rio Claro
Tel: 644-2274
- Cooper, Kelly
11/2 M/P Quarry Road, Morne Diablo, Penal
Tel: 647-3578
- Roopnarine, Harrinath
Couva
Tel: 636-3352
- Ford, John Carl
2 M/P Warden Road, Sangre Grande
Tel: 665-0015 (contact number)
- Ramlal, Tulsie
1/4 MM Guayaguayare Road, Rio Claro
Tel: 644-2316 (contact number)
- Hackshaws'
Factory address: 15 Hamilton Street, Woodbrook ,
Port of Spain
Tel (in factory): 622-3884
- Gabriel, Dickson
22 Semp Avenue, Tumpuna Crescent, Arima
Tel: 667-0106 (after 4 p.m.)
- Biskam, Bally
Nelson Road, Freeport
Tel: 673-1589 (home) / 623-4414 (work)
- Sankar, Gaya Persad
Jerningham Road, Chaguanas
Tel: 665-1880 (contact)
- Sankar, Paul
Main Road, Tods Road, LP # 63
Contact number: 672-3714 (Moham Singh)

- Roopchand
11/4 mile Toco Road, Sangre Grande
Tel: 668-3072
- Redman, Alvin
8 Balata Avenue, Santa Rosa Heights, Arima
Tel home: 667-3061 (after 5 p.m.)
- Singh, Diah
Batchyia Trace, Penal
Tel: 647-6068 (contact, after 3 p.m.) Spoke
- Mungal, Lloyd
CARONI (1975) Limited, Brechin Castle, Couva.
Tel: 662-2248
- Dookharan
Rochard Road, Penal
Dead
- Howell, Maillard (not interviewed)
Plot in Lopinot, 1 acre
Tel: 625-0769 (work) Week-end

PROCESSORS

- Hackshaws' — Stephen and Jennifer Hackshaw
15 Hamilton Street, Woodbrook, Port of Spain
Tel: 622-3884
- Superior Food Processors Ltd. — Persad, M.
Deosaran
18-J, O'Meara Industrial Estate, Arima
Tel: 642-1270
- Mackies
Roopnarine, Harrinath M.
Couva
Tel: 636-3352
- Nestlé — Rampersad, Georges M.
P. O.Box 172, Port of Spain
Churchill Roosevelt Highway, Valsayn
Tel: 663-1284
- Cannings — Mohammed, Ferid M.
Churchill Roosevelt Highway, Valsayn
Tel: 662.38.83
- Chase Foods Ltd.
109 Southern Main Road
Tel: 665-3029
(No meeting has been possible)
- National Food Processors (Disappeared)
M. Dowlath was interviewed
Tel: 671-2354 (M. Dowlath)

ANNEX II

SURVEY OF PASSION FRUIT PRODUCTS

Name of farmer: Date:

Geographical situation of the passion fruit plot:

1. IMPORTANCE OF THE AGRICULTURE FOR THE TOTAL INCOME OF THE FAMILY AND USE OF FAMILY LABOUR.

NAME	AGE	PARENTAGE	ACTIVITY		AGRICULTURAL ACTIVITY
			1ARY	2ARY	

2. LAND TENURE AND UTILIZATION

- How many acres do you have?
- How many are:

	OWNED	LEASED	CONTRACT	OTHERS
Acreage				
For how long				
How many are:				
Forest				
Construction				
Abandoned				
Sugar cane				
Tree crop				
Tobacco				
Root crop				
Plantains/bananas				
Pasture/cocoa				
Vegetable/fruit				

3. PASSION FRUIT CULTIVATION

- Acreage in passion fruit: Now: _____
Before: _____ When: _____
- Types:
- Intercropping: Yes: _____ No: _____
With: _____
- Nursery stage
 - Did you buy the plants? Yes: _____ No: _____
From where: _____
 - If yes, are they seedlings, cuttings or grafted plants?
 - If no:
 - How do you obtain the seeds:
from where
fruits or seed
preparation
- Pruning: No: _____
Yes: _____ Number of leaders: _____
- Application of fertilizer:
- Spraying:
- Weed Control:
- Stage of transplanting:

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

• **Establishment**

— Date of establishment:

— How many plants can a man plant during a day:

— Planting: Spacing _____
Size _____

— Trellis: Type _____
Material live _____
Common _____ wooden _____
concrete _____
other _____

Spacing

Cost of the different components

post
wire

— Number of man-day/acre to install the trellis?

— Wind breaks:

- Type:
- Cost:

— Land preparation:

- Clearing
- Ploughing (number of passes)
- Drainage
- Construction of beds _____ or cammels _____
- Size of the hole

— Other activities:

— How do you finance this investment:

- Proper financing _____
- Loan _____

Characteristics:

• Husbandry

How long is the life of a vine?

CULTURAL PRACTICES	PERIOD	NO. OF MD/ACRE	IMPUTS		OBSERVATIONS
			TYPE	QUANTITY	
Application of fertiliser					
Pruning					
Spraying					
Weeding					
Hand pollination Irrigation					
Repair of trellis					

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

- **INPUTS:** where and to which supplier do you buy your inputs:

- **Harvest**
 - Period (peaks):
 - How: on ground _____ on plant _____
 - how many times/week:
 - Time to harvest the area:
 - Number of persons:
 - Average yield/acre: 1st year
 - 2nd year
 - 3rd year

- **Post harvest/commercialization**
 - Containers
 - Wood
 - Baskets
 - Plastic bags
 - Plastic crates
 - Polyethylene bags
 - Others

 - Do you store them:
 - No _____
 - Yes _____ where _____
 - How soon do you store them (days): _____
 - Do you use passion fruit for home consumption:
 - How much do you consume/week:

	FRESH FRUIT	FRUIT FOR PROCESSING
How much do you sell as:		
Where do you sell it		
How often do you sell them		
How is the price fixed		
Who fixes it		

- Do you have problems in selling the production?
 - Why
 - market
 - price
 - transportation
 - other

- **Equipment Needed**

TYPE OF WORK	EQUIPMENT/COST	% OF USE IN RELATION WITH THE OTHER CROPS

4. Constraints to the production

- Is the production of passion fruit a high labour activity?

Are there periods during which you have labour problems?

Do you need to resort to external labour?

- Does this activity bring you income?
- Do you have big pests and disease problems?

TYPE OF PROBLEMS	RATING SYSTEM (1-5)
Drop of fruits Die back of vine Spots on fruits Destruction of foliage Birds eating flowers/leaves lack of bees Invasion of scales	

- What are for you, the main advantages and disadvantages of the crop?

Advantages	Disadvantages

- Accessibility to technical assistance:

ANNEX III

PRODUCTION COSTS

Passion Fruit Production Costs — High Technology — Updated July 1993

1. Contract

The producers usually pay somebody to plough and construct the beds. This is done by contract on the acreage basis.

2. Equipment

- **Sprayer**

It is a Jacto Mistblower. We recommend that the producers use it at 50 % for passion fruit and on a depreciation basis of 5 years (20 %). Consequently, only 10 % of the price is allocated to each year (50 % of 20%).

- **Pruning tools**

There is a need for two pruning tools per acre for the three years of the crop. The cost of one pruning tool is \$35.00 (\$30.00 + VAT).

3. Materials

The chemicals are from Caribbean Chemicals at retail prices.

- **Passion fruit plants**

The average spacing of (10 ft × 10 ft), and a 10% resupply will result in 462 plants per acre.

The price is the price of the plants produced by the farmers themselves (labour, bags...).

- **Fertilizer**

The fertilisers considered here are N:P:K=13:13:21 or N:P:K=12:12:72+2 which are almost the same price.

The dosage applied is 1.5 lb per plant in 4 applications ($\frac{1}{4} + \frac{1}{4} + \frac{1}{2} + \frac{1}{2}$ lb) for the first year and 2 lb per plant in 4 applications for the following years. This results in 290 kg/acre the first year and 382 kg/acre the second and third years.

- **Foliar feed**

The recommended dosage is 10 g/l of spray; to spray one acre, 15 gallons are needed. Farmers spray an average of 8 times per year, and the quantity of foliar feed required is about 5 kg/acre (600 g × 8). The foliar feed used is 20:20:20.

- **Insecticide 1 = Malathion**

The dosage applied is 15 cc per gallon, and we need 15 gallons per acre. Consequently, we will use about 250 cc/acre/application. As this insecticide is alternated with another one, 8/2 = 4 applications are carried on (only 2 the first year). Quantity required: 1st year: 0.5 l/acre; After: 1 l/acre/year.

- **Insecticide 2 = Perfekthion**

The dosage applied is one pint for 2 acres i.e. 0.25 l per acre and per application. As it is alternated with malathion, only 4 applications are necessary (2 the first year). Quantity required: 0.5 l/acre the first year, then 1 l/acre/year

- **Fungicide 1 = Benomyl**

The dosage is 0.5 lb/acre/application. As we alternate 2 fungicides, 1 applications of benomyl is applied the first year, and then 4 applications/year. Quantity required: 1st year: 0.5lb= 0.23 kg/acre; 2 lb = 0.9 kg/acre/year

- **Fungicide 2 = Daconil**

The recommended dosage is 30 ml/gallon, which represents about 450 ml/acre/application (15 gallons). 4 applications are done (except the first year: 1 application). Quantity required: 1st year: 0.45 l/acre; 2nd & 3rd year: 1.8 l/acre/year

- **Weedicide 1 = Round Up**

The recommended dosage is 2 l/ha, which is about 0.8 l/acre. 6 applications are necessary. Quantity required: 5 l/acre/year

- **Weedicide 2 = Paraquat**

The recommended dosage is 1 to 2 l/ha which represents 0,6l/acre/application. 6 applications are required. Quantity required: 3.5 l/acre /year

4. Labour

An average of \$45.00 per day is paid for agricultural work.

- **Drainage**

The drainage is hand made. 4 man-days are required to complete the main drainage.

- **Digging and planting**

One man can dig and plant about 20 plants per hour. Considering 7 hours of effective work, 140 plants are planted per manday. Consequently, to dig and plant 420 plants, 3 man-days are required.

- **Trellising**

In order to install the trellis, 2 weeks of work for two men are necessary. This represent 10 man-days.

- **Vine training**

This activity has to be done regularly. An average of 8 man-days are required, but only during the first year.

- **Pruning**

This activity is a labour intensive activity. The first year, it only requires about 4 man-days because the plant is growing. The second year, the plant has reached its full development, and pruning has to be done every 2 weeks. A man can prune 3 acres per day. Consequently, the labour required is 26/3 = 9 man-days/acre. The third year, the requirements are the same.

Labour requirements:

1st year: 4 man-days/acre

2nd year: 9 man-days/acre

3rd year: 9 man-days/acre

- **Fertiliser application**

4 applications of fertiliser are done per year. In order to fertilise 1 acre, 1 person needs 1.5 days. Labour requirement: 6 man-days/acre/year

- **Spraying**

Two sorts of spraying are necessary:

— spraying of the foliar feed, insecticide and fungicide, 8 times per year. In 1 man-day, 1.5 acres can be sprayed. Labour requirement: 6 man-days/acre/year (1.5 the 1st year)

— spraying of the weedicides, 6 times per year. Labour required: 1 man-day/2 acres.

Labour requirement: 3 man-days/acre/year (0.5 × 6). Total labour to spray: 9 man-days/acre/year except the 1st year: 7.5

- **Manual weeding**

This has to be done 6 times per year around the vines (because passion fruit is a surface rooting plant). 1.5 man-days/acre is necessary for every manual weeding. Labour requirement: 9 man-days/acre/year

- **Irrigation**

There is a need for irrigation every 10 days during 4 months, which represent 12 applications. Labour required: 1 man-day/3 acres. Labour requirement: 4 man-days/acre/year

- **General maintenance**

2 man-days are required to clean the drains during the rainy season, and 2 man-days to repair the trellis or other activity. Labour requirement: 4 man-days/acre for the first year.

5. Harvest

- **Harvesting**

The farmers harvest, on average, 2 to 3 times per week (3 times in the peak season). This represents 1 man-day per week. The first year, there is production during three months. The second and third year, there is year round production thanks to irrigation. Labour

requirement: 1st year — 12 man-days; 2nd year — 52 man-days; and 3rd year — 52 man-days

• **Containers**

The more commonly used container for commercialisation is the feed bag. If the producer sells his production twice per week, he needs 5 bags (can contain 60 lb). Considering that he has to replace them every 6 uses, he needs:

- for the 1st year: 20 bags
- for the 2nd year: 90 bags
- for the 3rd year: 90 bags

• **Transport**

Assuming that production has to be transported once a week to the factory, the groceries or the market, at an average distance of 40 km, a contract for transport will be needed.

Need for transport:

- 1st year: 12 times
- 2nd year: 52 times
- 3rd year: 52 times

6. Fixed Costs

• **Trellis posts**

The posts chosen are teak posts (a majority of the farmers use them). The posts should be 10 ft high. We can assume that they will last 6 years (2 crops). Consequently, we depreciate the cost of the posts as follows: 50 % the first year, and 50 % the fourth year.

One post of 10 ft costs 9.77 \$ at TANTEAK. Between each posts, 2 vines are planted. Therefore, the number of posts required is $(420/2) + 5\% = 221$ posts.

• **Wire**

A majority of farmers use only one wire. In that case, the length of wire necessary is 1500 m (or 4500 ft). The type of wire appropriate to grow passion fruit is the following: 12 1/2 guage and costs: 12 TT\$/100 ft.

It is believed that the trellis system can last 6 years (2 crops). Consequently, 50% of the price is allocated to the first year (the other 50%: the other crop, which means the fourth year).

7. Gross output value

• **Price**

The processors for passion fruit pay \$1TT/lb. As most of the production is destined for the process market, this price is taken as a reference.

• **Yield**

First year: the first year, the vines are at their optimum of production, but they only produce 3 months. The yield obtained with a high technology is, in average 6 000 lb/acre (8.4 t/ha).

Second year: average yield in Trinidad with high technology practices: 16 000 lb/acre (18 t/ha).

Third year: the vines are not as prolific as during the 1st and 2nd years. Average yield: 14 000 lb/acre (15.5 t/ha).

Passion fruit Production Costs — Low Technology — Updated July 1993

1. Contract

In the low technology, farmers practice neither ploughing nor make beds.

2. Equipment

There is no difference in term of equipment between low and high technology practices.

3. Materials

- Farmers do not fertilise.
- In term of foliar feed, insecticide and fungicide they use the same products but they spray only 6 times per year (2 times the first year).

Quantities required:

- Foliar feed: 3.5 kg/acre
- Malathion: 0.75 l/acre
- Perfekthion: 0.75 l/acre
- Benomyl: 1.5 lb = 0.7 kg/acre
- Daconil: 1.4 l/acre

- Weedicides: Producers use only paraquat, 4 times per year. Quantity required: 5 l/acre

4. Labour

• **Trellising**

As the farmers do not buy posts but make use of trees that are available on their land, the labour necessary for trellising is higher than for high technology. 10 more mandays are necessary to make the posts (30 posts per day). Labour required: 20 man-days.

• **Pruning, fertiliser application and irrigation**

None of these activities are required in low technology.

• **Spraying**

As the farmers spray 6 times per year for pest and disease control, 4 man-days/acre/year is required. To spray the weedicide 4 times/year, 2 man-days/acre is required. Total labour required: 6 man-days/acre/year.

• **Manual weeding**

In low technology, manual weeding is required 4 times per year. Labour required: 6 man-days/acre/year.

5. Harvest

• **Harvesting**

Farmers still have to spend an average of 1 day per

week to harvest the passion fruit. However, as no irrigation is done, during the second and the third year the vines will produce only 8 months.

Labour required:

1st year: 12 days

2nd year: 40 days

3rd year: 40 days

- **Containers**

The production being lower, the quantity of bags required is lower. Only 7 bags are necessary to transport his production, the bags are used 6 times.

Quantity required:

1st year: 14 bags

2nd year: 50 bags

3rd year: 50 bags

6. Fixed Costs

- **Trellis posts**

Posts made from strong trees available on the land are used. Consequently, the only cost is a labour cost. The number of posts necessary depend on the strength of the wood used. The spacing used is in general 10 ft × 15 ft, ie 3 m × 4.5 m which correspond to 300 posts/acre. Posts have to be replaced every 4 to 5 years.

7. Gross Output Values

The yields obtained are lower than with high technology practices:

1st year: 4000 lb/acre (4.5 t/ha)

2nd year: 10000 lb/acre (11.2 t/ha)

3rd year: 8000 lb/acre (9 t/ha)

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

Passion fruit production costs (TT\$ /acre) High technology 1st Year (updated July 1993)

Activity	Unit	Cost/ Unit	Cost/ Unit	Cost Acre
VARIABLE COSTS				
Contract				
Brushcutting	/acre			200
Plough & beds	/acre			400
Equipment				
Sprayer			3300	330
Pruning tools		2	35	70
Total				1000
Materials				
PF Plants	1	462	2	924
Fertilizer	kg	290	2.2	638
Foliar feed	kg	5	11	55
Insecticide 1	L	0.5	39.6	20
Insecticide 2	L	0.5	81	41
Fungicide 1	kg	0.23	182	42
Fungicide 2	L	0.45	65	29
Weedicide 1	L	5	96	480
Weedicide 2	L	3.5	38.6	135
Total				2364
Labour				
Drainage	MD	4	45	180
Digging & planting	MD	3	45	135
Trellising	MD	10	45	450
Vine training	MD	8	45	360
Pruning	MD	4	45	180
Fertilizer application	MD	6	45	270
Spraying	MD	7.5	45	338
Manual weeding	MD	9	45	405
Irrigation	MD	4	45	180
General maintenance	MD	4	45	180
Total		59.5		2678
Harvest				
Harvesting	MD	12	45	540
Bags		20	1.5	30
Transport		24	50	1200
Total				1770
Miscellaneous	10%			781
Interest	12%	8582.11		1031
TOTAL VARIABLE COSTS				9623
TOTAL MANDAYS				71.5
FIXED COSTS				
6 Years Teak Posts		221	9.8	1080
(50%) Wire Rolls		45	12	270
Land Tax				0
TOTAL FIXED COSTS				1350
GROSS OUTPUT VALUE	lb.	6000	1	6000
TOTAL PRODUCTION COSTS				10973
Production costs/lb.				1.83
NET REVENUE YEAR 1				-4973

Passion fruit production costs (TT\$ /acre) High technology 2nd Year (updated July 1993)

Activity	Unit	Cost/ Unit	Cost/ Unit	Cost Acre
VARIABLE COSTS				
Equipment				
Sprayer			3300	330
Total				330
Materials				
Fertilizer	kg	382	2.2	840
Foliar feed	kg	5	11	55
Insecticide 1	L	1	39.6	40
Insecticide 2	L	1	81	81
Fungicide 1	kg	0.9	182	164
Fungicide 2	L	1.8	65	117
Weedicide 1	L	5	96	480
Weedicide 2	L	3.5	38.6	135
Total				1912
Labour				
Pruning	MD	9	45	405
Fertilizer application	MD	6	45	270
Spraying	MD	9	45	405
Manual weeding	MD	9	45	405
Irrigation	MD	6	45	270
General maintenance	MD	6	45	270
Total		45		2025
Harvest				
Harvesting	MD	52	45	2340
Bags		90	1.5	135
Transport		52	50	2600
Total				5075
TOTAL				9341.9
Miscellaneous	10%			934
Interest	12%	10276.1		1233
TOTAL VARIABLE COSTS				11509
TOTAL MANDAYS				97
FIXED COSTS				
Teak Posts		221	9.8	0
Wire Rolls		45	12	0
Land Tax				0
TOTAL FIXED COSTS				0
GROSS OUTPUT VALUE	lb.	16000	1	16000
TOTAL PRODUCTION COSTS				11509
Production costs/lb.				0.72
NET REVENUE YEAR 2				4491

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

Passion fruit production costs (TT\$ /acre) High technology 3rd Year (updated July 1993)

Activity	Unit	Cost/Unit	Cost/Unit	Cost Acre
VARIABLE COSTS				
Equipment				
Sprayer			3300	330
Total				330
Materials				
Fertilizer	kg	382	2.2	840
Foliar feed	kg	5	11	55
Insecticide 1	L	1	39.6	40
Insecticide 2	L	1	81	81
Fungicide 1	kg	0.9	182	164
Fungicide 2	L	1.8	65	117
Weedicide 1	L	5	96	480
Weedicide 2	L	3.5	38.6	135
Total				1912
Labour				
Pruning	MD	9	45	405
Fertilizer application	MD	6	45	270
Spraying	MD	9	45	405
Manual weeding	MD	9	45	405
Irrigation	MD	6	45	270
General maintenance	MD	6	45	270
Total		45		2025
Harvest				
Harvesting	MD	52	45	2340
Bags		90	1.5	135
Transport		52	50	2600
Total				5075
TOTAL				9341.9
Miscellaneous	10%			934
Interest	12%	10276.1		1233
TOTAL VARIABLE COSTS				11509
TOTAL MANDAYS				97
FIXED COSTS				
Teak Posts		221	9.8	0
Wire Rolls		45	12	0
Land Tax				0
TOTAL FIXED COSTS				0
GROSS OUTPUT VALUE	lb.	14000	1	14000
TOTAL PRODUCTION COSTS				11509
Production costs/lb.				0.82
NET REVENUE YEAR 3				2491

Passion fruit production costs (TT\$ /acre) Low technology 1st Year (updated July 1993)

Activity	Unit	Cost/Unit	Cost/Unit	Cost Acre
VARIABLE COSTS				
Contract				
Brushcutting	/acre			200
Plough & beds	/acre			0
Equipment				
Sprayer			3300	330
Pruning tools		2	35	70
Total				600
Materials				
PF Plants	1	462	2	924
Foliar feed	kg	1.2	11	13
Insecticide 1	L	0.25	39.6	10
Insecticide 2	L	0.25	81	20
Fungicide 1	kg	0.23	182	42
Fungicide 2	L	0.45	65	29
Weedicide	L	5	38.6	193
Total				1231
Labour				
Drainage	MD	4	45	180
Digging & planting	MD	3	45	135
Trellising	MD	20	45	900
Vine training	MD	6	45	270
Pruning	MD	0	45	0
Fertilizer application	MD	0	45	0
Spraying	MD	2	45	90
Manual weeding	MD	6	45	270
Irrigation	MD	0	45	0
General maintenance	MD	4	45	180
Total		45		2025
Harvest				
Harvesting	MD	12	45	540
Bags		14	1.5	21
Transport		12	50	600
Total				1161
TOTAL				5017.46
Miscellaneous	10%			502
Interest	12%	5519.21		662
TOTAL VARIABLE COSTS				6182
TOTAL MANDAYS				57
FIXED COSTS				
Posts		300	0	0
Wire Rolls		45	12	270
Land Tax				0
TOTAL FIXED COSTS				270
GROSS OUTPUT VALUE	lb.	4000	1	4000
TOTAL PRODUCTION COSTS				6452
Production costs/lb.				1.61
NET REVENUE YEAR 1				-2452

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

Passion fruit production costs (TT\$ /acre) Low technology 2nd Year (updated July 1993)

Activity	Unit	Cost/ Unit	Cost/ Unit	Cost Acre
VARIABLE COSTS				
Equipment				
Sprayer			3300	330
Total				330
Materials				
Fertilizer	kg	0	2.2	0
Foliar feed	kg	3.5	11	39
Insecticide 1	L	0.75	39.6	30
Insecticide 2	L	0.75	81	61
Fungicide 1	kg	0.7	182	127
Fungicide 2	L	1.4	65	91
Weedicide	L	5	38.6	193
Total				540
Labour				
Pruning	MD	0	45	0
Fertilizer application	MD	0	45	0
Spraying	MD	6	45	270
Manual weeding	MD	6	45	270
Irrigation	MD	0	45	0
General maintenance	MD	6	45	270
Total		18		810
Harvest				
Harvesting	MD	40	45	1800
Feed Bags		50	1.5	75
Transport		40	50	2000
Total				3875
TOTAL				5555.35
Miscellaneous	10%			556
Interest	12%	6110.89		733
TOTAL VARIABLE COSTS				6844
TOTAL MANDAYS				58
FIXED COSTS				
Posts		300	0	0
Wire Rolls 1		45	12	0
Land Tax				0
TOTAL FIXED COSTS				0
GROSS OUTPUT VALUE	lb.	10000	1	10000
TOTAL PRODUCTION COSTS				6844
Production costs/lb.				0.68
NET REVENUE YEAR 2				3156

Passion fruit production costs (TT\$ /acre) Low technology 3rd Year (updated July 1993)

Activity	Unit	Cost/ Unit	Cost/ Unit	Cost Acre
VARIABLE COSTS				
Equipment				
Sprayer			3300	330
Total				330
Materials				
Fertilizer	kg	0	2.2	0
Foliar feed	kg	3.5	11	39
Insecticide 1	L	0.75	39.6	30
Insecticide 2	L	0.75	81	61
Fungicide 1	kg	0.7	182	127
Fungicide 2	L	1.4	65	91
Weedicide	L	5	38.6	193
Total				540
Labour				
Pruning	MD	0	45	0
Fertilizer application	MD	0	45	0
Spraying	MD	6	45	270
Manual weeding	MD	6	45	270
Irrigation	MD	0	45	0
General maintenance	MD	8	45	360
Total		20		900
Harvest				
Harvesting	MD	40	45	1800
Feed Bags		50	1.5	75
Transport		40	50	2000
Total				3875
TOTAL				5645.35
Miscellaneous	10%			565
Interest	12%	6209.89		745
TOTAL VARIABLE COSTS				6955
TOTAL MANDAYS				60
FIXED COSTS				
Posts		300	0	0
Wire-Rolls		45	12	0
Land Tax				0
TOTAL FIXED COSTS				0
GROSS OUTPUT VALUE	lb.	8000	1	8000
TOTAL PRODUCTION COSTS				6955
Production costs/lb.				0.87
NET REVENUE YEAR 3				1045

ANNEX IV

PASSION FRUIT PROCESSORS

Nestlé (Trinidad) Limited

Nestle Limited is a multinational company with a wide range of products. Their Orchard brand fruit juices and fruit drinks are well established in the regional and domestic markets (EDC, 1991).

Nestle Limited began processing passion fruit in 1978, producing a passion fruit drink with imported concentrate from Brazil and Colombia.

- Products using passion fruit were:
- passion fruit drink, 1 L and ¼ L
 - fruit punch

The company currently uses its concentrate stock to produce a 25 cl size drink but is likely to stop producing passion fruit products because there is no market for these products.

It seems that Nestlé never really made efforts to develop the market. The quality of the product is also responsible for consumers not accepting these product.

The company, on average, consumed 5 to 6 mt of concentrate annually. Concentrate as raw material is used because the factory is not equiped to process fruits

into single strength juice, and the juice production from local processors is too low.

Cannings Limited

Cannings Limited, one of the leading soft drink and beverage manufacturers has since 1987 been conducting research to develop a popular passion fruit juice based beverage (EDC, 1991). The first product, launched under the brand name *Nutravera* did not gain the expected success. Finally, a passion fruit drink under the brand name *Tropical*, was formulated and has been well accepted by the domestic consumers (EDC, 1991).

The company exports most of its production to Europe, Caribbean countries, USA and Canada.

In 1990-91, the company bought and processed locally produced single strength juice (mainly from Superior Foods). Currently, given the increase in processing volumes, Cannings Limited imports concentrates from Porto Rico (of Brazilian origin) for a consumption of 1.5 to 2 mt/month. (Passion fruit drink but also blends of fruit juice.)

Superior Foods Processors Limited

Superior Foods Processors Limited is a medium size passion fruit processing unit, the principal products being single strength juice and cordial (EDC, 1991).

The processing line was originally set up by the Caribbean Industrial Research Institute (CARIRI) in 86-87.

This enterprise was Cannings Limited's main supplier of juice. The enterprise has secured a market in the United States of America for its cordial. It is proposed to provide producers with a contract for the production of 100 acres (40 ha). However, because this recently obtained market is not well established it would be better for producers to have an alternative outlet.

Hackshaw's

It is a small scale processing unit, producing cordial, jelly and pancake syrup from passion fruit, as well as pepper sauce, preserves and pickles.

All the processing possibilities provided by passion fruit are used: production of single strength juice; pectins from the rind and utilization of the "rind pulp" for pepper sauces.

Mackies

It is a medium size fruit processing unit. Little information was obtained from this processor and the processing line has not been seen.

ANNEX V

IMPORTS AND EXPORTS OF PASSION FRUIT PRODUCTS IN TRINIDAD AND TOBAGO

Imports of Passion fruit juice

Year	Country	Quantity (L)	Quantity (kg)	Value (TT \$ CIF)
1980	St Vincent	442	9	1,818
	Brazil*	1	3	95
	Colombia	14,461	1,360	73,607
	Total	14,904	17,460	75,520
1981	St Vincent*	221	375	1,151
	Brazil*	73,260	90,285	1,707,396
	Panama	8	10	150
	Total	73,489	90,670	1,708,697
1982	USA*	204	416	1,491
	Panama*	11	33	400
	Peru*	3	10	120
	Total	218	459	2,011
1983	Dominica	152	153	813
	USA	48	32	121
	Total	200	185	934
1984	Dominica	420	425	2,031
	Puerto Rico	19,771	16,321	35,151
	Total	20,191	16,746	37,182

Year	Country	Quantity (L)	Quantity (kg)	Value (TT \$ CIF)
1985	Dominica*	598	1,271	10,416
	USA	1	21	100
	Total	599	1,292	10,516
1986	—	—	—	—
1987	Germany Is*	84	175	1,116
	Total	84	175	1,116
	U.K.	220	207	62,886
	Total	220	207	62,886
1989	St Vincent	1		12
	Total	1		12
1990	Jamaica	1,156	1,156	6,469
	Brazil	1,522	1,522	19,033
	Total	2,678	2,678	25,502
1991	Dominica		3	65
	Total		3	65
1992		1,113	7,784	

Source: Overseas Trade, CSO (Central Statistical Office)

*by comparison between the weight and the volume of the imported product, we can conclude that it concerns passion fruit concentrate and not juice.

THE PASSION FRUIT INDUSTRY IN TRINIDAD AND TOBAGO

Export of passion fruit juice

Year	Country	Quantity (L)	Quantity (kg)	Value (TT \$ CIF)
1980	Barbados	15,370	14,832	28,010
	Total	15,370	14,832	28,010
1981	Canada	68	68	146
	Stores and Bunkers	329	326	849
	Total	397	394	995
1982	USA	8	6	15
	Total	8	6	15
1983	St Vincent	300	333	726
	St Lucia	315	333	717
	Barbados	3,950	3,990	8,046
	Total	4,565	4,656	9,489
1984	Total	0	0	0
1985	USA	4	4	30
	Total	4	4	30
1986	Jamaica	5	5	30
	Belgium, Luxemburg	16,519	15,00	153,743
	Total	16,524	15,005	153,773
1988	US Virgin Islands	228	125	1,376
	Switzerland		1	3
	Total	228	126	1,379
1989	Canada	10	10	85
	Dominica	300	675	3,265
	St Lucia	7	14	74
	Netherlands	18	18	90
	Total	335	717	3,514
1990	U.K.	30	30	250
	English Guyana	13,910	14,759	51,219
	Dominica	2,950	3,142	12,219
	Grenada	5,823	6,181	24,580
	St Vincent	6,719	7,157	27,743
	Antigua	13,400	14,286	55,944
	St Kitts & Nevis	880	931	3,116
	Barbados	110,054	117,276	466,331
	Bahamas	46	50	300
	USA	6	6	799
	US Virgin Islands	90	18	580
	Switzerland	20	28	30
	Aruba	80	85	435
	Stores and Bunkers	599	645	4,094
	Total	154,607	164,594	647,660
1991	St Vincent	205	207	6,512
	Antigua	30	67	412
	Barbados	105	105	10,085
	Total	340	379	17,009

Year	Country	Quantity (L)	Quantity (kg)	Value (TT \$ CIF)
1992	U.K.	590	590	3,138
	Canada	932	932	9,671
	Grenada	277	277	1,935
	St Vincent	350	350	1,195
	St Lucia	1,235	1,971	17,867
	Antigua	1,238	1,238	12,853
	Barbados	6,866	4,520	31,143
	Jamaica	72	80	377
	USA	4	4	403
	Deutch West Indies	60	64	125
	Total	11,634	10,026	78,707
1992	Canada		260	1,312
	USA		325	2,228
	Rest of the World		712	7,466
	Total		1,297	11,006

Source: Overseas Trade, CSO.

Fresh passion fruit

Exports Year	Imports Country	Quantity (kg)	Value (TT\$FOB)	Quantity (kg)	Value (TT\$CIF)
1986	U.K.	2	5		
	Canada	27	118		
	Total	29	123	0	0
1987	Canada	258	1,234		
	Grenada	2,272	2,000		
	Stores and Bunkers	10	65		
	St Vincent			68	75
Total	2,640	3,299	68	75	
1988	Canada	19	8		
1989	U.K.	292	580		
	Canada	14	60		
	Netherlands	470	924		
	St Vincent		455	597	
	Total	776	1,564	455	597
1990	U.K.	186	125		
	Canada	469	429		
	Total	655	554	0	0

Source: Overseas Trade, CSO.

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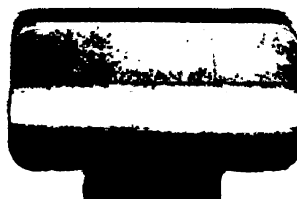
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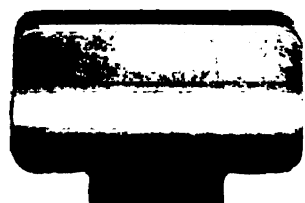
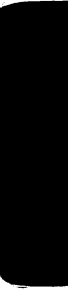
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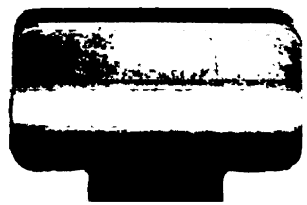
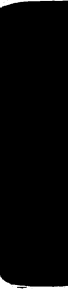
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