

Proceedings of the Caribbean Workshop on

TRADITIONAL AND POTENTIAL FRUIT TREE CROP DEVELOPMENT

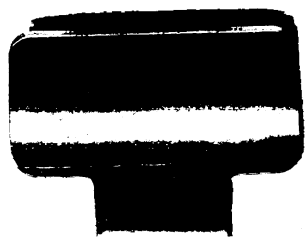
INTER-AMERICAN INSTITUTE FOR COOPERATION ON
AGRICULTURE AND
MINISTRY OF AGRICULTURE, TOURISM,
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Proceedings of the Caribbean Workshop on
**TRADITIONAL AND POTENTIAL FRUIT
TREE CROP DEVELOPMENT**

ST. GEORGES, GRENADA, 9 – 14 NOVEMBER, 1980

INTER-AMERICAN INSTITUTE FOR COOPERATION ON
AGRICULTURE AND
MINISTRY OF AGRICULTURE, TOURISM,
FORESTRY AND COOPERATIVES, GRENADA

Edited by

**Antonio M. Pinchinat
Lyndon McLaren**

**Rufo Bazán
Egbert Tai**

IICA
OFFICE OF THE ASSOCIATE DEPUTY DIRECTOR GENERAL
FOR RURAL DEVELOPMENT
SAN JOSE, COSTA RICA
1981

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TABLE OF CONTENTS

Foreword.	9
Introduction.	11
Programme.	13
Organizing Committee	17
List of Participants	19
List of Chairpersons.	23
List of Abbreviations	25
Names of Traditional and Potential Fruit Tree Crops	27
Opening Ceremony:	
Opening Remarks by Chairman, Mr. Denis Noel, Chief Technical Officer, Ministry of Agriculture, Tourism, Forestry and Fisheries, Grenada.	33
Address by the Director General of IICA, <i>Dr. José Emilio G. Araujo</i>	35
Address by the Prime Minister of Grenada, <i>Comrade Maurice Bishop</i>	39
Background Papers:	
Fruit Tree Crop Production in the Caribbean <i>E.A. Tai</i>	53
An Approach for a Research and Development Programme in Non-traditional Fruit Tree Crops in the Caribbean <i>L.A. Wilson</i>	63
The Processing Potential of Lesser Known Tropical Fruits <i>G.M. Sammy</i>	83
The Integrated Approach to Fruit Product Development <i>E. Skinner</i>	95

Organization of Regional Marketing of Traditional and Non-traditional Fruits and Fruit Products in the Caribbean	<i>B. Yankey</i>	109
Regional Policy Statements:		
Investment Policy of the Caribbean Development Bank in relation to Fruit Tree Crop Development	<i>A. M. Cruickshank</i>	119
Work Programme of CARDI on Fruit Tree Crops	<i>St. C. Forde</i>	133
British Development Division in the Caribbean	<i>D. L. Jackson</i>	137
Country Reports:		
Fruit Tree Crop Production in Antigua	<i>J. Maynard</i>	143
Fruit Tree Crop Production in Barbados	<i>A. A. Maynard</i>	151
The Present Status of Traditional and Potential Fruit Tree Crops in Belize	<i>R. A. García</i>	161
The Fruit Tree Crop Diversification Programme in Dominica	<i>J. McIntyre</i>	169
Frutales tropicales: Situación actual y Perspectivas en la República Dominicana	<i>R. Marte</i>	173
Development of Tropical Fruit Tree Production in the French West Indies	<i>J. Ganry</i>	193
Fruit Tree Crop Development in Grenada	<i>C. Joseph</i>	199
Tropical Fruit Tree Crop Production in Guyana	<i>C. S. Baichoo</i>	217
Fruit Tree Crop Development in Haiti	<i>G. Menager</i>	239
Government Plan for the Development of Fruit Tree Cropping in Montserrat	<i>O. S. L. Thomas</i>	245
Fruit Tree Crop Production in the Island of St. Kitts	<i>W. Welsh</i>	251
National Agro-economic Development of Traditional and Non-traditional Fruit Tree Crops in St. Lucia	<i>A. Satney</i>	257
The Development of Tropical Fruit Tree Crop in Suriname	<i>F. Soerodimedjo</i>	263

Work Group Reports:

Group 1. 271
Group 2. 273
Group 3. 282
Group 4. 288
Conclusions 293



FOREWORD

In this report on the proceedings of the workshop, the papers which were all presented in English are reproduced as far as possible in their original form. The presentation from the Dominican Republic appears in Spanish, the language in which it was originally prepared.

The order of papers in the Table of Contents is not identical with that of the Programme as it makes easier reading to have the Background Papers first, followed by Policy Papers and then the Country Reports. The latter are arranged in alphabetical order of participating countries.

The Editors



INTRODUCTION

The Workshop was organized by IICA in cooperation with the Ministry of Agriculture, Tourism, Forestry, and Fisheries of Grenada, in response to genuine concern in the region regarding the very limited exploitation of fruit tree crops in Caribbean agriculture. Although fragmentary, the information currently available on the subject suggests that the principal underlying causes of the problem are:

- 1. lack of appropriate incentive policies to stimulate fruit tree crop development*
- 2. scarcity of adequate production technology to optimize crop production and productivity*
- 3. scant knowledge of methods to expand and diversify the utilization of crop products*
- 4. poorly organized marketing, reducing the profitability of fruit tree crop production*
- 5. lack of relevant research and technology transfer systems to foster fruit tree crop production and utilization.*

These have combined to exert negative effects on economic development of all the major traditional fruit tree crops, except citrus. Furthermore, many non-traditional fruit tree crops, in spite of demonstrated capability for good ecological adaptation and high biological productivity, have not been commercially exploited. Innovative use of the species in both groups has, for all practical purposes, scarcely been explored.

Focusing on the need for increased and accelerated economic exploitation of fruit tree crops in the Caribbean, the Workshop brought together professionals from eighteen (18) countries, and specialists from four (4) regional and four (4) international organizations

Through presentation and discussion of country reports, of relevant background papers by leading experts in the field, and of policy statements from regional and international organizations, the following goals were attained:

- 1. A systematic review of the factors limiting agro-economic fruit tree crop development in thirteen (13) Caribbean countries.*
- 2. The identification of institutional bases with a potential for expanding production, increasing productivity, maximizing utilization, improving marketing, and strengthening research and technology transfer, in relation to fruit tree crops.*
- 3. The synthesis of project profiles which could be developed into financially viable projects to facilitate and accelerate the agro-socioeconomic development of a selected group of "traditional" and "nontraditional" fruit tree crops in the Caribbean.*
- 4. The identification of appropriate mechanisms for fostering exchange of valuable experiences among professionals engaged in tropical fruit crop development in the Caribbean.*

*Antonio M. Pinchinat
Rufo Bazán
Workshop Coordinators*

PROGRAMME

November 9

18:00 – 20:00 **Registration of Participants at the Holiday Inn Hotel**

November 10

**Opening Session:
Chairman, D. Noel**

08:30 – 09:30 Registration at the National Convention Centre (Dome)

09:30 – 10:45 Inauguration

10:45 – 11:30 Coffee Break

Session 1: Country Reports.

Chairman, St. C. Forde

11:30 – 12:00 Barbados – A. A. Maynard

12:00 – 12:30 Dominican Republic – R. Marte

12:30 – 14:00 Lunch

Session 2: Country Reports.

Chairman, S. Bharath

14:00 – 14:30 Grenada – C. Joseph

14:30 – 15:00 French West Indies – J. Ganry

15:00 – 15:30 Guyana – C. S. Baichoo

15:30 – 16:00 Haiti – G. Menager

16:00 – 16:30 Coffee Break

Session 3: Country Reports.

Chairman, M. Rahman

16:30 – 17:00 Montserrat – O. S. L. Thomas

17:00 – 17:30 St. Lucia – A. Satney

19:00 – 21:00 Cocktails at the Holiday Inn (Courtesy of IICA)

November 11

Session 4: Country Reports.

Chairman, A. M. Cruickshank

09:00 – 09:20 Suriname – F. Soerodimedjo
09:20 – 09:40 Antigua – J. Maynard
09:40 – 10:00 St. Kitts – W. Welsh
10:00 – 10:30 Belize – R. A. García
10:30 – 11:00 Coffee Break

Session 5: Policy Papers.

Chairman, F. Soerodimedjo

11:00 – 11:30 CARDI – St. C. Forde
11:30 – 12:00 CDB – A. Cruickshank
12:00 – 12:30 BDD – D. L. Jackson
12:30 – 14:00 Lunch

Session 6: Background Papers.

Chairman, R. Weddell

14:00 – 15:00 Production – E. Tai
15:00 – 16:00 Product Development – E. Skinner
16:00 – 16:30 Country Report: Dominica – J. McIntyre
19:00 – 22:00 Sailing on "M.V. Rum Runner" (Courtesy of Grenada Tourist Board)

November 12

08:30 – 16:30

Field Trip

November 13

09:00 – 10:30

Simultaneous Work Group Sessions

Chairman, A. M. Pinchinat

Group 1. National and Regional Plans for Fruit Tree Crop Production
E. Tai, Leader.

Group 2. National and Regional Plans to Improve Fruit Tree Crop Utilization— C. Mason, Leader.

Group 3. National and Regional Plans to Improve Fruit Tree Crop Products Marketing — A. Cruickshank, Leader

Group 4. National and Regional Research and Technology Transfer Plans to Support Fruit Tree Crop Development — R. Pierre, Leader

10:30 – 11:00	Coffee Break
11:00 – 12:30	Continuation of Simultaneous Work Group Sessions
12:30 – 14:30	Lunch
	Session 7: Presentation and Discussion of Group Reports.
	Chairman, R. Marte
14:30 – 15:00	Group 1. Production – E. Tai
15:00 – 15:30	Group 2. Utilization – C. Mason
15:30 – 16:00	Group 3. Marketing – A. Cruickshank
16:00 – 16:30	Group 4. Research and Technology Transfer – R. Pierre
16:30 – 17:30	Coffee Break
	Closing Session.
	Chairman, D. Noel
17:30 – 17:40	Conclusions and Recommendations – R. Bazan
17:40 – 17:50	Overview – A. M. Pinchinat
17:50 – 18:00	Comments – C. Joseph
18:00 – 18:10	Follow-up – L. McLaren
18:10 – 18:20	Acknowledgments – M. Franca
18:20 – 18:30	Remarks from the floor
18:30 – 18:40	Closing Remarks – D. Noel
20:00 – 22:00	Reception at Hibiscus Inn (Courtesy of the Government of Grenada)

November 14

06:00 – 13:00	Departure of Participants
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LIST OF ABBREVIATIONS

AMP	Agricultural Marketing Protocol
BBI	Barclays Bank International
BDD	British Development Division
CARDI	Caribbean Agricultural Research and Development Institute
CARDATS	Caribbean Agricultural and Rural Development Advisory and Training Service
CARIRI	Caribbean Industrial Research Institute
CARICOM	Caribbean Community (Commonwealth Caribbean)
CDB	Caribbean Development Bank
CDCC	Caribbean Development Cooperation Committee
CFC	Caribbean Food Corporation
CFNI	Caribbean Food and Nutrition Institute
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional para el Mejoramiento de Maíz y Trigo
DFC	Development Finance Corporation
EEC	European Economic Community
ECCM	Eastern Caribbean Common Market
ECLA	Economic Commission for Latin America
FAO	Food and Agriculture Organization of the United Nations
FIDA	Fondo Internacional para Desarrollo Agrícola
FTI	Food Technology Institute
FWI	French West Indies
GMC	Guyana Marketing Corporation

IDB	Inter-American Development Corporation
IDC	Industrial Development Corporation
IDRC	International Development Research Center
IICA	Inter-American Institute of Agricultural Sciences-OAS (now Inter-American Institute for Cooperation on Agriculture).
INDOTEC	Instituto Dominicano de Tecnología
INPA	Institut National de Recherches Agronomiques
IRFA	Institut de Recherches sur les Fruits et Agrumes
IRRI	International Rice Research Institute
IITA	International Institute of Tropical Agriculture
LDC	Less Developed Country
NACO	National Agricultural Corporation
NACDA	National Cooperative Development Agency
OAS	Organization of American States
ONUDI	Organización de las Naciones Unidas para el Desarrollo Industrial
PCL	Produce Chemist Laboratory
PIDFRU	Programa Integrado de Desarrollo Frutícola
PPA	Programa de Pequeños Agricultores
PRIDA	Programa Integrado de Desarrollo Agroindustrial
REAP	Rural Education and Agricultural Programme
RSFCP	Regional Small Farmer Commodity Plan
USDA	United States Department of Agriculture
USAID	US Agency for International Development
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
UWI	University of the West Indies
WISCO	West Indies Shipping Corporation
WINBAN	Windward Islands Banana Growers Association

**NAMES OF TRADITIONAL AND POTENTIAL
FRUIT TREE CROPS 1/**

FAMILY	NAME	
	LATIN	COMMON
Anacardiaceae	<i>Anacardium occidentale</i>	Cashew
	<i>Mangifera indica</i>	Mango
	<i>Spondias cytherea</i> (<i>S. dulcis</i>)	Golden-apple, otaheite-apple
	<i>S. mombin</i>	Hogplum
	<i>S. purpurea</i>	Jamaica-plum
Annonaceae	<i>Annona cherimola</i>	Cherimoya
	<i>A. diversifolia</i>	Monkey-apple
	<i>A. muricata</i>	Soursop
	<i>A. reticulata</i>	Custard-apple
	<i>A. squamosa</i>	Sugar-apple, sweet-sop
Apocynaceae	<i>Carissa grandiflora</i>	Natal-plum
Bixaceae	<i>Bixa orellana</i>	Annatto
Cactaceae	<i>Pereskia aculeata</i>	Barbados gooseberry
Caricaceae	<i>Carica papaya</i>	Papaya, Pawpaw
Caryocaraceae	<i>Caryocar nuciferum</i>	Swarinut, pekeanut, butter-nut
Combretaceae	<i>Terminalia catappa</i>	West-Indian-almond

FAMILY	NAME	
	LATIN	COMMON
Euphorbiaceae	<i>Phyllanthus acidus</i>	Gooseberry, damsel
Flacourtiaceae	<i>Flacourtia indica (F. ramontchi)</i>	Governor plum
Guttiferae	<i>Garcinia livingstonei</i> <i>G. mangostana</i> <i>Mammea americana</i>	Imbé Mangosteen Mamey, mamee-apple
Lauraceae	<i>Persea americana</i> <i>Cinnamomum zeylanicum</i>	Avocado Cinnamon
Lecythidaceae	<i>Lecythis zabucajo</i>	Sapucaia
Leguminosae	<i>Tamarindus indica</i>	Tamarind
Malpighiaceae	<i>Inga sp</i> <i>Malpighia glabra</i> <i>M. puniceifolia</i>	Whytee, inga, Acerola West-Indian-cherry, Barbados-cherry
Malvaceae	<i>Hibiscus sabdariffa</i>	Sorrel, roselle
Moraceae	<i>Artocarpus communis</i> <i>A. heterophyllus</i>	Breadfruit Jackfruit
Myristicaceae	<i>Myristica fragrans</i>	Nutmeg
Myrtaceae	<i>Eugenia jambolana</i> <i>(Syzygium cuminii)</i> <i>E. jambos</i> <i>E. malaccensis</i> <i>E. uniflora</i> <i>Pimenta acris (P. racemosa)</i> <i>Psidium cattleianum</i> <i>P. guajava</i>	Java-plum, jамoon Rose-apple, plumrose Malay-apple, pomerac Surinam-cherry Bay-tree Strawberry-guava Guava
Oxalidaceae	<i>Averrhoa bilimbi</i> <i>A. carambola</i>	Bilimbi Carambola

FAMILY	NAME	
	LATIN	COMMON
Palmae	<i>Cocos nucifera</i> <i>Guilielma gasipaes</i>	Coconut Pejibaye
Passifloraceae	<i>Passiflora edulis</i> <i>P. laurifolia</i> <i>P. ligularis</i> <i>P. maliformis</i> <i>P. quadrangularis</i>	Passion fruit Golden-apple, semitoo, water lemon Granaditta Sweet cup Granadilla
Polygonaceae	<i>Coccoloba uvifera</i>	Seagrape
Punicaceae	<i>Punica granatum</i>	Pomegranate
Rhamnaceae	<i>Zyzyphus mauritiana</i>	Malay jujube, dunks
Rosaceae	<i>Chrysobalanus icaco</i> <i>Eriobotrya japonica</i>	Fat-pork, cocoa-plum, coco-plum Loquat
Rutaceae	<i>Aegle marmelos</i> <i>Casimiroa edulis</i> <i>Citrus aurantifolia</i> <i>C. aurantium</i> <i>C. limon</i> <i>C. maxima (C. grandis)</i> <i>C. medica</i> <i>C. paradisi</i> <i>C. reticulata</i> <i>C. sinensis</i> <i>C. reticulata x C. Sinensis</i> <i>Fortunella japonica</i>	Bael fruit White-sapote Lime Sour-orange Lemon Shaddock Citron Grapefruit Tangerine, mandarin Orange Ortanique Kumquat
Sapindaceae	<i>Blighia sapida</i> <i>Litchi sinensis</i> <i>Melicocca bijuga</i>	Ackee Litchi Guinep, genip
Sapotaceae	<i>Achras sapota (Manilkara achras,</i> <i>M. zapota)</i>	Sapodilla, naseberry

FAMILY	NAME	
	LATIN	COMMON
	<i>Calocarpum mammosum</i> (<i>Pouteria sapota</i>)	Mamey sapote
	<i>Chrysophyllum cainito</i> <i>Pouteria campechiana</i>	Star-apple, caimito Egg-fruit
Solanaceae	<i>Physalis peruviana</i>	Cape-gooseberry

1/ Some species, although not strictly classified as tree crops, were referred to in the text and are included in view of their potential value in the Caribbean.

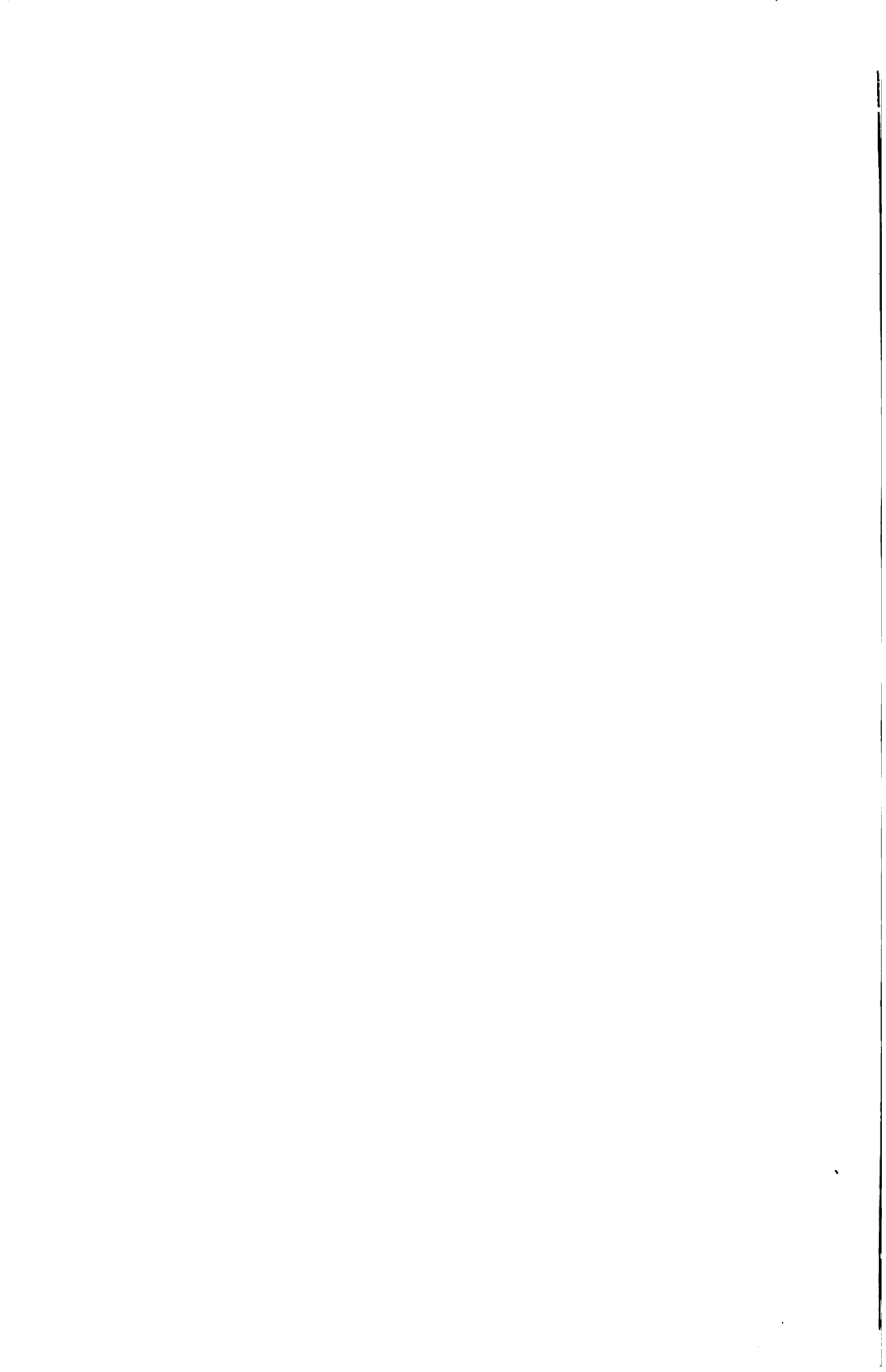
Reference: Trees of Puerto Rico and Virgin Islands.

Agricultural Handbook No. 449.

USDA. Forest Service, 1974.

OPENING CEREMONY





OPENING REMARKS BY CHAIRMAN

Mr. Denis Noel

Comrade Prime Minister, Maurice Bishop, Director General of IICA, Dr. José Emilio G. Araujo, Representative of the OAS in Grenada, Mr. Robert Cole, Distinguished Persons on the Platform, Fellow Participants, Invited Guests, Ladies and Gentlemen, Comrades all: as Chairman, let me welcome you all and, in particular, our overseas participants, to this opening ceremony of the Caribbean Workshop on Traditional and Potential Fruit Tree Crop Development.

I specially welcome the Director General of IICA who has taken time off from his Costa Rica Headquarters to be with us in Grenada.

I must also say a special word of welcome to our Prime Minister, Comrade Bishop, for being with us here this morning. This surely is indicative of the importance which Grenada attaches to this Workshop. We feel privileged, indeed, to be given the opportunity of hosting this Workshop which is being sponsored jointly by IICA and our Ministry of Agriculture, Tourism, Forestry and Fisheries.

The Inter-American Institute of Agricultural Sciences (IICA) is an Agency established in 1942 to promote the economic and social development of member countries through teaching, training of personnel, research, technical assistance, consultations and communications related to Agriculture.

Having identified fruit tree crop development as an area of common interest among Caribbean members countries, the Director General hinted to us, on the occasion of his first official visit to Grenada, of his intention to organize a fruit tree crop workshop in a Caribbean member country. We in Grenada showed much interest in hosting such a workshop and our Minister of Agriculture, Cde. Unison Whiteman, indicated this to the Director General. That Workshop is now a reality and we wish to thank the Director General and his staff

for giving us the honour to be host to the first ever regional meeting to be held on Caribbean Fruit Tree Crop Development.

The main objectives of the Workshop are to promote increased and accelerated economic exploitation of fruit tree crops in the Caribbean. It will also assist in the development of national and regional plans for the production, utilization, marketing, research and technology transfer relating to fruit tree crops. To provide for a high standard of discussion on the subject areas as outlined, IICA has been able to bring together some of the most able and knowledgeable professionals and technicians from all countries within the Caribbean and from several Caribbean based organizations. There are approximately eighteen (18) countries represented and eight (8) organizations. Apart from our CARICOM partners, we have representation from Brazil, Venezuela, Costa Rica, Haiti, Dominican Republic, the French and Dutch Antilles and Suriname.

The several organizations present include UNDP/FAO, IICA, CARDI, CBD, CARDATS, BDD, Barclays Bank International and the OAS. We regret that some participants are late for this part of the programme, due to difficulty with flight connections; they should be joining us later.

I must state here that several organizations have contributed funds for making this workshop possible. We gratefully acknowledge the generous financial support of IICA Headquarters and IICA Country Offices, IDRC of Canada, the CDB, Barclays Bank International, and CARDI, among others.

This opening ceremony has a double and special significance; not only are we honoured in hosting this first Caribbean Workshop on Fruit Tree Crops, we are also even more honoured by having with us the Director General of IICA. Dr. Jose Emilio G. Araujo, I am told, has held the Office of Director General of IICA for over ten years. And before this from 1965-1970, he was Director of the Inter-American Rural Development and Reform Center of IICA, based in Colombia. Dr. Araujo is not just an administrator but throughout his years in Office has always been an active participant in technical meetings. His speciality is soil science and, in fact, he is a life Professor at Universidad de Pelotas, Ríó Grande do Sul, Brazil. It therefore gives me much pleasure in calling upon the Director General Dr. Araujo to address us.

ADDRES BY THE DIRECTOR GENERAL OF IICA

Dr. José Emilio G. Araujo

Hon. Prime Minister, Distinguished Guests, Dear Colleagues, Ladies and Gentlemen: it was during the Annual Meeting of its Board of Directors, held in La Paz, Bolivia, in June, 1979, that IICA, at an informal gathering with the delegates from the participating countries of the Caribbean, expressed its concern about food production in general, and fruit tree crops in particular in the Region.

As a result of the keen interest shown by the delegates in the subject, on my first visit to this beautiful Island in March, 1980, I submitted to the Minister of Agriculture and through him to the Hon. Prime Minister of Grenada the idea of holding a Regional Workshop on Tropical Fruit Tree Crop Development here in Grenada. We felt that it was a meaningful way to express our satisfaction in Grenada's recent admission to our organization. We are indeed grateful that the Government of Grenada responded favourably to the idea and gave its fullest support to the materialization of the Workshop.

Although the importance of fruit tree crops in Caribbean agriculture has long been recognized, the comprehensive consideration of their development has been lacking. Thus, in cooperation with the Ministry of Agriculture of Grenada, we have sought to fill that void by promoting a broad-based discussion of the most relevant aspects of fruit tree crop development in the region, including production, utilization, marketing, research and technology transfer. To this end, we have called on and succeeded in bringing together outstanding professionals fully acquainted with the underlying development problems of and opportunities for traditional and potential fruit tree crops in the Caribbean.

Fruit tree crop development in the region has been characterized by low and scattered production, coupled with a limited level of utilization.

Furthermore, most of the studies on these aspects have been carried out mainly on a few major traditional species omitting many others of apparent high potential for socio-economic exploitation.

From a technical point of view, tropical fruit tree crops have played an important role in the economy of the countries where they are grown. Together with forestry plantation crops they allow the most appropriate land use in the tropics, especially where rainfall is high and soils are predominantly poor, since, from an ecological point of view, they have some obvious advantages over annual crops.

The most important of these is the good protection they offer against soil degradation caused by leaching, erosion and soil compaction. Leaching is perhaps the most serious enemy of agriculture in the wet tropics. However, nature seems to have created trees mainly to do the job of recycling soil nutrients, thus preventing their loss by leaching. It is no wonder that trees, fruit tree species among them, are always the predominant component of natural ecosystems in all regions where leaching is bound to become a problem. Another important advantage of perennial fruit tree crops over annual crops is their lower demand for soil nutrients and higher tolerance to abnormal soil conditions such as high acidity, which is so common in the tropics.

There are constraints that should be taken into account to explain why non-traditional fruit tree crops are not yet recognized as commercial plantation crops.

The diversity of these is enormous, although utilization appears to be largely restricted to the inhabitants of the region where they are grown. Thus in the majority of cases, they are almost totally unknown outside specific regions.

It is highly possible that native species, once improved, both genetically and agronomically, may become important sources of food as well as of agroenergy.

The lack of appropriate research and technical assistance to farmers may be other reasons for unsuccessful attempts at expanding their culture.

Another problem with fruit tree crops is the lapse of time between planting and production of economic returns. This is particularly inconvenient for the small farmers, who obviously need other sources of income during the initial years of their plantations. This problem is partially solved by growing cash crops or annual crops, for food and commercial use, prior to and during the early stages of the fruit tree plantations. In fact, in recent years and especially at IICA, there has been much interest in research to develop appropriate annual perennial crop production systems for the tropics. These sys-

terms are sometimes called inter-cropping, multi-cropping, multi-storied or taungya agriculture, which offer the possibility of optimizing the overall yield of an area by combining different crops (fruit trees and annual cash crops for example), simultaneously or sequentially in the same unit area being exploited.

We have been asking ourselves what does IICA have to do in the area of fruit crop development? In fact, in our programme for the decade of the 80's, two topics have been given major consideration in addressing two of the major problems affecting human subsistence:

- (1) food production to feed our increasing population; and
- (2) energy production to minimize the energy crisis caused by the continuous increase in the cost of petroleum and its derivatives, which has a tremendous negative effect on agriculture.

In contrast, agriculture nowadays is considered as a source of renewable energy, producing alcohol as a substitute for gasoline or vegetable oils as a substitute for diesel fuel and lubricating oils.

Fruit tree crop development will play an important role as:

1. a source of food for direct human consumption, since it is well known that most fruit species are valuable sources of vitamins and other nutrients indispensable for good health;
2. a basis for agro-industrial schemes for export purposes and to increase employment in the rural areas; and
3. a source of renewable energy, especially with those species high in oil content in the pulp or in the seeds, or for the production of biogas from plant biomass and organic residues.

Consequently, our participation in the workshop is aimed at developing together ideas and suggestions, to help us identify and design projects and strategies which can be implemented by the countries of the region. This aim is fully concordant with IICA's basic objectives of:

- (1) increased production and productivity;
- (2) higher levels of employment and income in the rural areas; and
- (3) reduction of the marginality of the rural sector in the development process.

I would like to conclude by thanking the Government of Grenada for having co-sponsored and hosted this workshop. I want to ex-

press my special thanks to the Ministry of Agriculture and its very capable personnel who have spared no effort to make this a successful Caribbean meeting. I also want to express my gratitude to all the participants for having responded positively to our invitation.

We want to thank CDB and IDRC of Canada for having generously provided financial support, thus facilitating the participation of delegates from most of the Caribbean countries. We are most grateful to CARDI, UWI, Barclays Bank, BDD, CARDATS, UNDP/FAO, the OAS, and all the other extra-national organizations which are represented at the workshop.

To all and each one of you, thank you.

ADDRESS BY THE PRIME MINISTER OF GRENADA

Comrade Maurice Bishop

Comrade Chairman, Director General of IICA, Distinguished friends on the Platform, Sisters and Brothers from neighbouring Caribbean Countries, Comrades All.

It is really a pleasure for me this morning to be able to welcome you to our country. It is a particularly great pleasure because of the number of countries and regional and international organisations which have come to this Workshop. In fact, I am told that according to the latest count we have eighteen (18) countries and twelve (12) regional and international organisations present; and that is of course a very significant thing, since it does say that a lot of people in the region are concerned, not just about agriculture in the sense of the traditional crops, but also about finding ways of diversifying agriculture and moving more and more into new areas of production, as this business of fruit tree crops has not been one of the more popular areas, certainly not in the English speaking Caribbean.

I am also very happy this morning, since the representation we have here today is not just from our sisters and brothers from the English speaking Caribbean, but also from the wider Caribbean and from Latin America. In fact, there are not only people who speak the English language, but French, Dutch and Spanish, and that is very important to us, because part of the thrust of the Grenada Revolution has been precisely in trying to develop and to widen contacts with our sisters and brothers throughout the entire region, regardless of what language they speak or from which country they come.

The third reason of course is highly significant, because we are dealing with extremely important areas; and this Workshop, hopefully, will help us to analyse in some depth, in some detail, some of the problems facing traditional and potential fruit crops in the region.

We do hope that out of this period of analysis and evaluation, this period of assessment, will come the beginnings of some solutions for the problems being faced in this area; and I am sure that the countries are going to spend a lot of time over the next few days, looking at this question. And no doubt, as there is a field component to this Workshop, there will also be some very useful suggestions for the development of fruit tree crops in Grenada.

May I make two apologies, Sisters and Brothers. The first is for the absence of Cde. Unison Whiteman, our Minister of Agriculture, who is unfortunately out of the country. He had to leave at fairly short notice, and I know he would have liked very much to be here with us all, this morning.

The second is for the lack of translation facilities; and I hope this will not affect some of you, by your not always being able to understand what is being said.

Agriculture is the motor, the very heart of the Grenadian economy. This fact is of course true for most countries in the Caribbean and indeed Latin America. For us it means jobs, more dollars, more earnings for our countries, more foreign exchange. For us it also means more food for our people. These are all very significant reasons why agriculture is so important to the economy. It is also, as we see it, the base, the natural base, for any industrialisation that will take place in a serious way in our country.

We see it therefore, as being the source and the future for the development of the economy in general, in our country. But of course agriculture has had its problems over the past years. Last year, for example, we imported fifty seven million dollars worth of food and food products, but in that same year from earnings mainly from nutmeg, cocoa and banana, we were only able to receive fifty eight million dollars. In other words, a balance in our favour of one million dollars, which is ridiculous.

More than that, last year we imported overall 117 million dollars, with a deficit of 60 million dollars. This had to come from remittances from nationals abroad, from earnings in the tourist sector, and also from external grants.

If we are to break this dependence of our economy, because we do have an open, capitalist economy, then it is going to be necessary for us to greatly improve production in agriculture over the next several years. We see the growing of food in particular, as being a key component of any agricultural strategy.

But we have found that the state sector in Grenadian agriculture has been largely dependent on export crops, mainly on the tree crops — nutmegs, cocoa and bananas. The state sector in our country comprises some thirty estates. The average of each estate is about 150 acres and the total acreage on all of these is just over 4,200. It is relatively small, but yet it has been subject to tremendous abuse over the years.

In 1978, for example, operating costs were in excess of one million dollars, while revenue was somewhere around 250,000 dollars. Thus the taxpayers had to subsidise the agricultural sector, the state sector in agriculture, with something like 0.75 million dollars.

Last year we were able to reduce that deficit somewhat. In fact, earnings went up to about 700,000 dollars and some state farms were able, for the first time, to make a small profit. We believe that, by a series of incentives for the workers, it will be possible to go on to increase these earnings for the state even more.

We have introduced, for example, a profit sharing scheme under which the agricultural workers, for the first time, will be able to share in part of the profits which they make. The basic plan is that one third will go back to the state, one third will be used on the estates or farms for the purpose of further increasing production and providing more inputs on the particular farm, and the remaining one third will be shared by the workers, and that incentive will be an important one.

Likewise, we have introduced the policy of equal pay for equal work for women, on the government estates, and we certainly hope that the private sector will follow this example as rapidly as possible.

A scheme has also been introduced, under which every month the agricultural workers get together to discuss the problems on the farm, look at the question of projections and targets, discuss why they are not reaching these targets, or if they are reaching them why they did reach them. In other words, they are fully involved and participate in the running of the particular state farm. Our principle is that there must be no secret kept from the workers of our country, that everything that is taking place in a particular work-place and in the economy of our country as a whole, must be open and subject to public and national scrutiny and debate. And part of this evaluation process is that these workers should choose or will begin to choose a worker of the month for each state farm. But that process has not yet begun.

In small areas like that, we believe it is going to be possible to make some impact and to begin to push forward at a more rapid and more meaningful pace, to further development of agriculture in our country.

In so far as the private sector is concerned in agriculture, you will find that all land holdings in our country, that is, agricultural land holdings, total about 40,000 acres. About half of these fall in the category of 100-500 acres.

Looking at the overall picture, of the total of some 87,000 acres of land in our country an estimated 55,000 acres can be cultivated. But with 40,000 acres in agricultural holdings, as I have already indicated, somewhere around 15,000 acres remain unutilized or grossly under-utilized.

The figures that we had about four years ago indicates that 32^o/_o, just under one-third of all the land in the category 100-200 acres, is unutilized. At the same time, in the 200-500 acres group, some 68^o/_o of all the land is unutilized. This is bad enough but what complicates it further is that we have had a continuous decline over the years in the amount of land actually being cultivated. This reduction has frankly been quite dramatic.

In 1961 for example, there were over 60,000 acres of land or 71^o/_o of the total land under cultivation. By 1972, eleven years later, this figure fell to 56,000 acres or 66^o/_o and by 1975, the figure had fallen to 46,000 or 54^o/_o of the land. At the same time, the pressure for land and equally the population/land ratio in the country has continued to get worse.

Thus in 1961, there were 140 Grenadians to every hundred acres of land. By 1972, eleven years later, this figure had become 168 1/2. By 1975 three years later, this figure was 217 3/4, and now in 1980, our estimate is that there are about 270 Grenadians to every hundred acres of land. That just tells us that not every Grenadian who would like to own his own piece of land is going to be able to achieve that ambition. Because, apart from the over 100,000 Grenadians in Grenada there are well over 400,000 scattered throughout the metropolitan centres and different countries in the Caribbean, and all of them also have deep aspirations, patriotic aspirations to own a piece of their mother land; but obviously that is not going to be possible.

That means that part of our strategy is going to be to have to find a way of bringing all of the idle land in our country under pro-

duction; and this we have in fact begun to pursue in a serious way. Our intentions, which have been publicly announced on several occasions, are to encourage private owners to bring their land which is unutilized or under-utilized into production. We are willing, of course, to provide as much assistance and incentive as possible. This we have been doing through the extension officers, through provision of seeds, planting materials, of greater marketing facilities and possibilities. We are also working on developing a common pool of services which includes tractors and other services, and we are hoping that more and more farmers from the private sector will take advantage of the training possibilities and training facilities which have been established or re-established since the Revolution.

In addition we believe that utilizing this idle land is one way of solving, or at least of really reducing the problem of unemployment in our country. We therefore established some months ago a Land Reform Commission, which was charged with the task of identifying how much idle land we had and how many unemployed people in the country are willing to join together in co-operatives to work that idle land. We were, in effect, seeking to bring about a marriage of idle hands and idle lands to end unemployment, to increase production, to earn more foreign exchange for our country.

And I can tell you that the Land Reform Commission, at this stage, has identified well over 4,000 acres of land, though we know that there must be nearer 10,000 acres. Consistent with the above policy and in order to fully implement it, we have at the same time established a National Co-operative Development Agency called NACDA. This organisation is really a package of services and does about six different things.

- i. On the one hand, once unemployed people identify lands that they are willing to work, a feasibility study is done first of all to test the question of suitability and capability of the particular land to do what the people hope to do.
- ii. As government, we begin negotiations with the owners to see if it is possible to arrange either freehold or leasehold purchase of the particular land. The land is in turn given, on leasehold, to the particular co-operative, micro and macro.
- iii. NACDA then begins a programme of training of the young co-operators. This is to teach them the principles and practices of co-operative management and to instil in them in a deep and concrete way, the importance of agriculture to our country.

- iv. Then there is the question of funding. NACDA makes available loans for seed, for fertilizer, for tools.
- v. Technical assistance also comes into the picture and this is provided by rental or loan of tractors, by use of the extension officers and also co-operative officers attached to NACDA, who work with the particular co-operatives to promote production.
- vi. Finally, NACDA is also involved in assisting these young farmers to get the best prices for their products; i.e. it provides assistance in the area of marketing.

Our overall view of a way forward for agriculture in our country is firstly to maintain the present acreage in the traditional crops, to move rapidly to increase the yield per acre, and at the same time to increase the amount of production per worker. That is the first part of the strategy.

The second is to move more and more into food crop production, for obvious reasons —for effecting import substitution, for ensuring that the base of the economy is widened, so that its current open dependent nature is gradually transformed as we disengage from the clutches of foreign control.

The third area of fruit crop production is precisely the subject of today's Seminar. We see it as being an essential component of the future agriculture in our country. Hence the particular importance to us of this Conference.

The fourth area is agroindustrialization, a question which the Director General himself spent so much time in stressing in his very brief but important address. We also believe that agroindustrialization is a large part of the key to any strategy that is aimed at promoting, at developing, at strengthening the agricultural sector in the countries in this Region. We of course have many problems which still need resolution.

There is firstly the burning problem of pest and disease control which many of the officials in the Ministry would characterize as being the biggest problem of all.

There is secondly the problem of praedial larceny, a problem which many farmers in our country would characterize as being the biggest problem.

There is thirdly the question of marketing which some of us in government believe to be just about the most important problem, because if agriculture is about people and the improvement of their quality of life, then one of the key questions if not the key question, must be the question of the price. If the price is such that the farmer, the agricultural worker is not able to enjoy a decent standard of life then agriculture must collapse. So, a large part of whatever strategy we employ for developing agriculture must have a long, hard, sustained look at this question of finding better markets, obtaining better prices so that the quality of life of the farmer and in turn of the agricultural worker will dramatically improve.

A fourth problem relates to the provision of some of the key inputs that are necessary for agriculture. Insufficient quantities of fertilizer, insufficient quantities of seed and plant materials, these are also problems which we inherited. In fact the four (4) cocoa propagators in our country were in such sad state of disrepair that much of our work for the first year had to be centred around just bringing them back up to some kind of level from which a takeoff would be possible. Fortunately this has been reasonably achieved and we are now able to embark more seriously on phase two, that is the provision of a much larger quantity of actual seeds and plants for the farmers.

A fifth problem is the question of inadequate, very often insufficiently trained expertise, whether in the area of extension officers, whether in the area of training facilities which we have, or research facilities that are available, whether in the area of appropriate technology that is possible in particular conditions; in all of these areas too we find that our country has been suffering, in common, of course, with most countries represented in this room.

The sixth factor is an intangible, but it is a very key intangible that we really have to begin to address more and more in a serious way, if we are to tackle this problem of finding the best ways of planning in an efficient and effective way for agricultural development. And that is the question of hurricanes, and bad weather. That is something in our limited state of technology we have not been able to do very much about. And of course it has been increasingly a problem. Last year, for three months for example, we had very severe rainfall which wreaked havoc on our crops. In one month alone, the month of November last year, we had 23 inches of rainfall, which is as much rain as some countries get for the entire year. We found too that Hurricane Allen struck these islands a few months ago, although only the tail winds got to Grenada; just the tail of the Hurricane was

enough to knock down 19 per cent of our cocoa crop, 35 per cent of nutmegs and 40 per cent of our bananas. We hardly wish to think what kind of damage it must have done to our Sisters and Brothers in Saint Vincent, in Saint Lucia, most of all to Dominica where they had three such occurrences just in the past year alone. This problem of hurricane and weather control is of course a critical one, and perhaps as part of our general concerted effort to get a new international economic order going, one of the key answers in this area must be for us to press the developed countries to put aside money for pro-rata basis assistance to countries that are in fact afflicted by hurricane and problems of weather generally. That call we ourselves have made most recently in the United Nations, at the Special Session called to look at the question of the new international economic order. And it is certainly a call which we believe that everybody should join in. But we feel too, that there must be some possibilities here for co-operation among ourselves. That those countries that are affected the least must find some way or the other to give immediate assistance to those countries that are really badly hit. We feel that is an extremely important thing. And we feel that is particularly important for us not to allow the opportunity of damage done by hurricane or weather to allow any policies of divide and rule to re-emerge in our Region. We noticed recently for example, that the USAID was making feverish and desperate attempts to keep Grenada out of the assistance to WINBAN, The Windward Islands Banana Association, following Hurricane Allen, notwithstanding the fact that the approach was made by WINBAN as one organisation comprising four countries. To the credit and to the integrity of our Sisters and Brothers in Dominica, Saint Vincent, and Saint Lucia, they have in fact spoken up against this divisive policy and have insisted that Grenada be in fact part of any assistance to WINBAN. But I am sure that this a problem that is going to arise in the future and it is necessary for us to ensure that we always maintain a consistent, united policy on these matters so that we are not treated as pawns and play things, as in the past. Our policy is to try to deal with these six problems that have arisen over several years.

On the one hand of course, we have spent a lot of time on the question of training. We have reopened the Mirabeau Agricultural Training Centre, and are desperately trying to find the necessary funding to open at least two more agricultural training centres. We have established NACDA which I have spoken about already; we are training the workers who are going to be employed at our agro-industrial plant which is to be opened in the next few weeks; and we have also opened a Fishery School, where our fishermen are now able to learn something about more modern techniques of fishing. At the

same time of course, we have been seeking scholarships and training assistance in countries abroad and have received offers. Now we have students studying for example in countries like Kenya, Cuba, Jamaica, Hungary, and in institutions like the University of the West Indies and in the Eastern Caribbean Institute for Agriculture and Forestry (ECIAF). So we do see training as being a key component in the way forward for the development of agriculture in our country.

There have also been substantial improvements in the area of plant propagation in general and more specifically in the area of cocoa propagation and rehabilitation. We have now been able to increase our annual output from about 150,000 to 400,000 seedlings a year, and our plan is, with the assistance of CIDA and the Canadian Government, to replant some 1,000 acres/annum over the next seven years.

Similarly, we have been seeking eradication of some diseases. FAO has given us the sum of US\$ 105,000 to help to fight the Moko disease in banana; for the nutmeg wilt-disease we have also received some assistance. In the area of cocoa we have also been attempting to obtain assistance particularly to deal with thrips and beetles, so that our programme in this area can be rapidly stepped up.

I can tell the Director General as of now, that one approach we are certainly going to be making to IICA is for technical assistance of an Entomologist and a Plant Pathologist to help us in the area of control of pests and diseases.

We have also been making a drive to produce sugar once again in our country, because the monthly increases in the price of that commodity have continued to be a source of great headache to our people, all of whom need sugar. We intend therefore, over the next few months, to double the acreage presently under production; a substantial sum of money has now been set aside for sugar rehabilitation programme.

In the area of reforestation, likewise, the plan is to plant or replant over 2,400 acres of forest over the next fifteen years. We expect that once that process is completed we ought to be able to get at least 1,000,000 board feet per annum. That will represent just about one third of our estimated need at that time.

International agencies have of course been very important as sources of aid. It is precisely because we recognise the importance of technical assistance and other forms of assistance from these agencies

that we have joined IICA, we have joined IFAD, we have joined OLADE, over the past eighteen months. We continue, of course, to work with CARDI, CARDATS, with the Caribbean Food Corporation, the Caribbean Conservation Society, the Caribbean Food and Nutrition Institute, the Caribbean Development Bank, University of the West Indies, CARICOM itself, with the United Nations, the OAS, FAO, and several other regional and international organisations and agencies. We have found in practice that this work has been extremely important and has brought many benefits to this country.

To give an example, apart from this Workshop being opened today, another Workshop and Seminar will be opened tomorrow in Mirabeau. Sponsored by OLADE, this Seminar will be concentrating on the whole question of biogas and possibilities for developing a source of alternative energy. That will also be an extremely important Workshop.

From IICA itself, we have been able to get quite some assistance in the very short time that we have joined the organisation. Only last month we received the report of a study done by IICA which analysed our markets and marketing systems for fruits and vegetables; and that study is of the most fundamental importance to us. I am sure that participants at this Workshop will find it very useful to thumb through the study to see what might be there of value for your own countries.

So Sisters and Brothers this Workshop is of the greatest importance. The whole question of tree crop production is central to the development of our own strategy and I have no doubt the strategy of several other countries represented in this room. As possibilities for food, agroindustrialization, provision of more jobs, alternative energy, for developing feeds from fruit waste, fruit tree production is seen as having a lot of value in all of these areas. In Grenada their production area is very small, and tends to be scattered and dispersed over several different estates. We have found in fact, that most people who are in fruit tree production have been doing this more in the form of backyard gardening. It is therefore more by a combination of chance and of fertile soil and favourable growing conditions that any fruits are grown at all in the country. We are sure that out of this Workshop more of our people will find new incentives, new material reasons why they should see this area of production as being key and as having possibilities for material benefit to themselves.

I hope therefore, that over the next four days which your will spend in our country, that not only in your field trip, but in your

moments of leisure as well, you may perhaps enjoy our beaches or the friendliness, the warmth and the hospitality of our people. I hope that as result of that, your would wish to return for a holiday on some future occasion. We certainly would like to thank IICA and the other sponsors and contributors for allowing us the priviledge and the honour of hosting this Conference. We also want once again to thank you the participants, for coming from your own countries, for being here in our country.

We are very pleased to see you and hope to see you again, very soon.

I now formally declare open this Caribbean Workshop on Traditional and Potential Fruit Tree Crop Development.

Thank you very much.



BACKGROUND PAPERS





FRUIT TREE CROP PRODUCTION IN THE CARIBBEAN

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ABSTRACT

A large number of plants distributed over several families produce edible fruits in the Caribbean Region; relatively few however, are grown in organised orchard culture. In instances "crops" are harvested for domestic use or commercial purposes from scattered trees, not infrequently "wild", though they may be in backyard planting or mixed with other crops plants. Reliable statistics on production and trade are practically unobtainable.

Among the fruit crops that have been widely exploited are cashew and mango of the Anacardiaceae, papaya of the Caricaceae, avocado of the Lauraceae and guava of the Myrtaceae, but it is believed that their full potential remains to be developed. In addition, numerous others merit much more serious attention than has yet been accorded them: they occur in a wide range of botanical families with, possibly, the most promising being Palmae of the Monocotyledonae (pejibaye) and the Dicotyledonae, Annonaceae (soursop), Guttiferae (mangosteen), Lecythidaceae (sapucaia), Leguminosae (tamarind), Moraceae (breadfruit), Oxalidaceae (carambola), Rhamnaceae (jujube), Sapindaceae (ackee), and Sapotaceae (sapodilla).

It is considered highly desirable to select the most advantageous environment according to individual requirements, preferences and tolerances for each of these crops, and also to apply the most appropriate cultural technique and procedures in each instance in order to secure optimum production. Judicious zoning of production will

therefore, be justified: in this connection the accessibility of a profitable outlet cannot reasonably be overlooked.

The demand for tropical fruit and fruit products is known to be increasing both within the region and externally; the trend can be encouraged to the economic benefit of the countries involved by the application of enlightened technology in production and continuing improvement of the relevant practices through research.

ACTUAL SITUATION

It is estimated that representatives of more than fifty families of plants yield fruits that are eaten by humans out of hand, cooked or otherwise processed. The number of species must run into several hundred which include scores of tropical trees. At the present time production of these in the Caribbean Region, excluding the citrus fruits, cannot be regarded as well organised; and some "crops" are harvested from volunteers growing in the wild; a notable example is the pejibaye or pewa (*Guilielma gasipaes* (H.B.K.) Bailey). Quite frequently tropical fruit trees are found in back gardens or scattered in pasture land and fields of recognised commercial crops; rarely are orchards of tree crops seen in pure stand. It is understandable, then, that reliable statistics on production of tropical fruit in the region are not obtainable; such trade figures as are published can never tell the whole story. In Table 1 some exports from a number of countries in the region are listed. How then can the figures extracted from published Trade Reports be interpreted?

TABLE 1. SOME FRUIT EXPORTS (1975)

Product	Jamaica	Trinidad & Tobago	Barbados	Grenada
Cashew	6 214 lb	363 kg	—	7 tins
Avocado	62 766 lb	7 358 kg	—	5 450 lb
Mango	311 866 lb	21 965 kg	—	650 lb
Soursop	—	—	—	20 lb
Sapodilla	—	—	—	750 lb
Golden-apple	—	—	—	5 000 lb
				+ 600 tins
Other fruit ^{1/}	429 503 lb	476 230 kg	19 600 lb	—

^{1/} Not specified.

THE DEMAND FOR TROPICAL FRUIT

There can be little doubt of a steadily increasing demand for tropical fruit and fruit products to supply some of the food needs of growing populations in areas of production, and also to satisfy the sophisticated tastes of more developed communities elsewhere. Nutritive values of the individual fruits will therefore play a part in determining their potential for profitable exploitation. Also of importance in this connection is whether or not processing in any form is necessary prior to utilization for food; sight should not be lost of the fact that nearly all fruits which can be consumed in the fresh state are also useful for processing into juice, jams, jellies and other products. It may prove expedient to deal with two main groups:

- a) fresh fruit which consist of whole units and may be eaten out of hand; they may also be processed.
- b) processing fruit which may:
 - i) require simple cooking before consumption, or
 - ii) provide raw material for preparing fruit products

In Table 2 the tropical fruits and nuts considered to be most worthy of attention in the region are listed according to this grouping and also according to botanical family. The common names underlined indicate those fruits which are currently more generally accepted commercially but need not necessarily offer the best prospects for future development.

PRODUCTION PERSPECTIVE

Land

The development of agriculture in the region took place under the old colonial system and, inevitably, the best of the arable land on the plains and on gentle slopes were to produce plantation crops for export; fruit trees and other plants not of commercial importance in those early days were relegated to backyards (e. g. indigenous species like mango), and to locations on inferior land (e.g. indigenous species like cashew). Natural selection occurred under these conditions and strains of different species of fruit trees which were best adapted to the environment flourished and even became feral in the region, such as avocado, cashew, guava, mango and papaya among others.

Much land still remains so occupied, and in some instances efforts to carry our intensive arable cropping were made with discouraging results and the areas allowed to revert. It is reasonable to expect,

TABLE 2. LIST OF PRINCIPAL TROPICAL FRUITS AND NUTS IN THE CARIBBEAN, ACCORDING TO UTILIZATION POTENTIAL

FAMILY	COMMON NAME	SPECIES
	(a) Fresh Fruits	
Anacardiaceae	Mango	<i>Mangifera indica</i> L.
	Jew-plum (Pomme Cythere)	<i>Spondias cytherea</i> Lam.
Caricaceae	Papaya	<i>Carica papaya</i> L.
Guttiferae	Mamey	<i>Mammea americana</i> L.
	Mangosteen	<i>Garcinia mangostana</i> L.
Lauraceae	Avocado	<i>Persea americana</i> Mill
Rhamnaceae	Jujube	<i>Zizyphus mauritiana</i> Lam.
Sapindaceae	Ginep	<i>Melicocca bijuga</i> L.
Sapotaceae	Sapodilla	<i>Achras sapota</i> L.
	Star-apple	<i>Chrysophyllum cainito</i> L.
	(b) (1) Simple Cooking	
Moraceae	Breadfruit	<i>Artocarpus communis</i> Fost.
Palmae	Pejibaye (Pewa)	<i>Guilielma gasipaes</i> (H.B.K.) Bailey
Sapindaceae	Ackee	<i>Blighia sapida</i> Koen.
	(b) (ii) Raw Material for processing	
Anacardiaceae	Cashew	<i>Anacardium occidentale</i> L.
Annonaceae	Soursop	<i>Annona muricata</i> L.
Euphorbiaceae	Jimbling (Gooseberry)	<i>Phyllanthus acida</i> L.S. Keels
Lecythidaceae	Supucaia	<i>Lecythis zabucajo</i> Aubl.
Leguminosae	Tamarind	<i>Tamarindus indica</i> L.
Malgiphiaceae	Acerola	<i>Malpighia puniceifolia</i> L.
Myrtaceae	Guava	<i>Psidium guayava</i> L.
	Strawberry-guava	<i>P. cattleianum</i> Sabine
Oxalidaceae	Bilimbi	<i>Averrhoa bilimbi</i> L.
	Carambola	<i>A. carambola</i> L.
Rhamnaceae	Jujube	<i>Zizyphus mauritiana</i> Lam.

however, that application of sound horticultural practice with appropriate soil conservation measures should ensure profitable maintenance of those fruit trees which have already demonstrated the capacity to produce in the environment. There should, then, be no shortage of land space for tropical fruit production; even if it falls short of the ideal it can, at least, be suitable.

Technology

Although scientific knowledge and technology of tropical horticulture lag behind those of temperate horticulture, there exists an appreciable amount of information on tropical fruit culture and utilization. This can, with advantage, be applied directly to production in the region and, in addition, it is practicable to benefit from extrapolation of the results of investigations and observations in temperate horticulture. In the meantime institutions of the region —universities

and research organizations— are expected to apply themselves to enlarge our store of information on tropical fruits, through their research efforts, and, make new knowledge readily available to practising fruit growers.

Production Priorities

Of the many species of tropical fruit trees already grown in the region some thrive better than others although, theoretically, it should be possible to effect commercial development of any one. Several considerations must influence a decision on which crops should be given preference; national agricultural policy on food production and the potential of particular crops to earn foreign exchange rate highly.

Differences in detailed requirements, preferences, and tolerances of the various fruit crops determine their relative performance under any given set of conditions and also play an important part in selection. For this reason it should be good policy to zone the crops for production, growing those which require abundant moisture, like avocado and papaya, in the wetter areas and those which are drought tolerant, like cashew, guava, and mango, in the drier areas; availability of a good water supply for irrigation can extend the range of crops in this latter situation.

At present, there are some fruit trees which are commonly grown in most tropical areas, sufficiently so as to be regarded as "traditional". In the region, avocado, cashew, guava, mango and papaya may be listed in that category, if only for the reason that they enter more widely than others in the local trade. This does not necessarily make them the best prospects for economic expansion, as several of the 'non-trationals' have the potential for as great or greater profitable development, because they may not be as well known outside of the region which, therefore, can enjoy the advantage of a "head start" against possible competition.

It is considered reasonable that fruit crops in (b) (i) of Table 2 should be given top priority in the light of current world conditions. Besides providing valuable food directly, for the area in which they are produced, they can serve as a base for export trade in the same way as fruits listed in the other groups.

PRODUCTION SYSTEM

It is important that it be constantly borne in mind that each fruit tree crop should be expected to occupy the land unchanged for

an indefinitely long period, and it is vital for success that modern scientific orcharding procedures be followed at all stages of production. Adequate attention to selection of the orchard site can return dividends in the form of simplified maintenance operations; planting in sheltered locations reduces the need for expensive windbreaks, for instance.

Where practicable, for establishment, carefully selected clonal material should replace seedlings and at all times appropriate efforts directed at maintaining a desirable level of soil fertility, regulating the soil moisture and providing protection of the plants from natural enemies and unfavourable weather. It is good husbandry to intercrop young orchards with annual plants; at the first sign of their competing with the fruit trees for root space, nutrients, water or light, they should be removed, and possibly replaced with permanent ground cover.

Some orchard operations will be specific to the fruit tree being grown and must be devised *ad hoc*: training, pruning and crop harvesting are examples.

MARKETING AND UTILIZATION

It is largely in post-harvest operations that profitability of tropical fruit production is determined; handling from the time of reaping to ultimate disposal to the consumer must be given close attention in order to avoid loss. In this connection much can be learnt from procedures employed with temperate fruits, using modifications to suit local circumstances.

Frequently fruit is picked, particularly for distant markets, before peak maturity and ripening takes place during subsequent transport and storage. Rigid control of environmental conditions is then highly desirable; there must be avoidance of physical injury by giving due attention to the selection of suitable packaging methods and materials, storage temperatures and use of chemicals. National restrictions and particular preferences of the clientele to be served will also require special consideration.

No less exacting are the requirements for satisfactory use of fruits for processed products, preservation by drying, canning, preparation of juice, nectars, purees, jams, jellies and other preserves. Establishment of standards and grades and strict adherence to them are vitally important; different sets of rules will be necessary for different fruits, although the central theme remains the same.

Marketing arrangements for the tropical tree fruits and fruit products of the region do not at present measure up to those in force for banana and citrus because of volume considerations. It is believed that judicious co-operative effort on the part of producers can be of help in bringing about orderly, effective marketing for the general benefit. Organization of collection/distribution centres for produce can cut down overhead, especially in dealing with exports, and increase the profitability of fruit-growing enterprises. The advantages of unified marketing policies and actions can be readily appreciated by all concerned, from grower to consumer.

RESEARCH

The need for continuing investigation in all areas is self-evident. It is necessary to accumulate as much information as possible for transmission to the growers of tropical tree fruits; they will then be expected to translate the information into action. There exists an excellent pattern in temperate horticulture and this may be followed by us to great advantage.

Of prime importance should be work on selection, improvement and multiplication of cultivars to develop capacity for high yield, superior fruit quality and resistance to pests and diseases. Vegetative propagation to "fix" clones should be an integral part of the programme.

Improvement of cultural practices with attention to specific environments can lead to greater yields and higher quality thus bringing larger economic returns. The optima must be determined for land preparation, time of planting, population density, nutrition, moisture and other factors impinging on the requirements, preferences and tolerances of each fruit crop.

Communication of the results of research to the producers in the field is necessary to achieve desirable products, and provisions must be made for collection and dissemination of information on the different fruit crops. Literature in the field of tropical fruit growing is on the increase and there are now obtainable useful texts and articles in popular as well as scientific style. A short bibliography which may be of some value is given in Appendix 1.

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AN APPROACH FOR A RESEARCH AND DEVELOPMENT PROGRAMME IN NON-TRADITIONAL FRUIT TREE CROPS IN THE CARIBBEAN

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ABSTRACT

The role of fruit crops, with particular reference to those defined as non-traditional fruit crops, as alternatives in tropical cropping for energy, protein and vitamin food supply in the Caribbean is outlined. The limited available research investigations on these crops in the Region are briefly reviewed and an approach to a research and development programme for the crops, involving collaboration between research institutions, farmers, marketeers and processing houses towards development of viable agro-industries based both on fresh fruit and processed product commodities is presented. The UWI Faculty of Agriculture is proposed as the coordinating institution for such a programme.

INTRODUCTION

Tropical fruits are important in human nutrition as sources of vitamins and minerals and to a lesser extent of energy, protein and the polysaccharide carbohydrates, cellulose and pectin, which function as digestive aids. In the face of serious food production deficits in developing countries, research efforts in International Centres, e.g. CIMMYT, IRRI, CIAT, IITA, as well as in National Institutes have been directed to tropical cereals, root crops and legumes, almost to the exclusion of research on fruit crops. Arguments in favour of this approach usually cite the higher protein and calorie productivity of

the food crops as well as the claim that balanced diets based on these food crops would not only satisfy nutritional needs for proteins and calories but also those for vitamins and minerals, present in more concentrated levels than in fruit and vegetable crops. Yet another line of argument denies international support for research on traditional fruit crops e. g. bananas, citrus, coconuts, on the grounds that local industries are large enough to support research programmes from profits or surpluses. Although there is a measure of validity in these arguments, there are also cogent counter arguments in favour of support for accelerated fruit tree crop research programmes in the tropics. The arguments are here summarized as part of the scenario for discussion of a research and development approach for non traditional fruit tree crops in the Caribbean as follows:

1. Declining productivity and profitability of many citrus and banana industries in the Caribbean due to low prices and loss of markets to competition from developed countries have led to serious cuts in research and development programmes.
2. Dry matter (calories) productivity of banana fruit (13-35 ton/ha) is higher than that for maize (2-11 ton/ha) in many ecosystems in the Caribbean and in addition banana leaves and pseudostems provide additional sources of calories, minerals and proteins for livestock feeds.
3. Dry matter productivity estimates of breadfruit (2-15 ton/ha) are comparable with those of tropical maize. Commercial coconut and experimental peach palm oil productivities (e.g. in Brazil) are also comparable with soybean oil productivity under tropical conditions.
4. Recent development of large scale methods for isolation of coconut protein during oil extraction makes such protein available for human consumption and the coconut comparable with arable crops, eg. soybean, as a major source of protein for the tropics.
5. On the human nutrition side, there is a strong body of medical opinion which supports the need for megavitamin intake levels above those which could be provided by balanced diets based on food crops and which require either expensive preparation in pill form or fresh fruit consumption at much higher levels than hitherto envisaged.

6. Many tropical fruits, but particularly West Indian Cherry (*Acerola*) which has exceptionally high Vitamin C content, up to 4000 mg/100 mg., are suitable for use to substantially increase vitamin intake in tropical diets.

It should also be noted that expensive and well directed international research efforts on food crops have failed to achieve the "Green Revolution" expected for elite varieties because of their unsuitability to edaphic and climatic characteristics of the ecosystems as well as the socio-culturo-economic status of farmers for which they were designed. These new varieties often require high and specific inputs of nutrients, water and soil physical conditions together with costly and sometimes complicated management practices e. g. for crop protection, to achieve highest productivity. Many of these ecosystems are capable of more efficient support of tree crop cultivation.

Moreover, in the Caribbean, where substantial tracts of cultivable land are on steep slopes, the case for fruit crop rather than arable food crop cultivation as a soil conservation measure e. g. Jamaica, St. Vincent, is indeed a compelling one.

Therefore, on grounds of calorie, protein and vitamin productivities as well as on environmental suitability and as a soil conservation measure, fruit crop cultivation offers distinct alternatives and in some instances clear advantages over their arable food crop counterparts. But there is a need to re-examine our approach to utilization of tropical fruit tree resources to achieve their full potential.

In this paper, particular attention will be given to a neglected group of tree crops which might be described as non-traditional, i.e. excluding traditionally cultivated crops such as bananas, citrus, coconuts, pineapple. The case for research and development on these crops e. g. avocado, breadfruit, cashew, guava, mango, papaya, soursop, tamarind is based on their energy and protein contents, e. g. breadfruit and cashew nuts, vitamin contents, e. g. guava, mango, papaya, as well as on their high commercial value, based on food preference for fresh fruit e. g. mango, avocado, and processed products e.g. nectars (mango, soursop) and fruit preserves (guava), commodities. In addition, many of these fruits could occupy specific ecosystem niches e. g. steep slopes and poor soils (cashew, tamarind) unsuitable for other crops. However, since these crops are not now extensively cultivated, the general objectives of a research and development programme must be the creation of viable agro-industrial enterprises which would justify and indeed in time support research and development efforts. In turn, such agro-industrial viability depends on clearly demonstrable levels of productivity and profitability to

farmers, marketeers and processors, since establishment of fruit crop agro-industries could well involve competition for limited resources of land, labour, capital and entrepreneurial skills now applied to arable crops as well as to traditional fruit crops. This objective must also be achieved in the context of poor research facilities and programmes, and certainly much less funding for research and development in non-traditional fruit crops compared with traditional fruit and arable food crops. It is proposed in this paper that these constraints can be overcome only by close collaboration between Regional and National Research Institutes as well as farmers, marketeers and processors towards the development of enterprises in the non-traditional fruit crop sector.

Existing research in the crops is first reviewed and a suggested approach to research and development proposed in the context of general and specific objectives of the programme.

RESEARCH REVIEW

Existing production research on non-traditional fruit tree species has been limited in volume, without clearly defined objectives and geared for the most part towards "fire fighting" operations for solving problems in scattered fruit tree cultivation. Research on fruit storage in these species has not achieved any significant commercially applicable results, but in some cases processing investigations have led to establishment of commercial products. However, since processing varieties have not been specifically selected, processed products are of variable quality and have not gained general acceptance in the Caribbean Region. A brief review of selected Caribbean publications from Puerto Rico, Trinidad and Jamaica in illustration of the status of research is outlined by crop species:

Avocado: Collections of avocado varieties and clones with particular reference to extension of the cropping season and fruit quality have been made in Puerto Rico (1), Jamaica (2), and Trinidad (3,4) and classification of some 118 varieties according to flower behaviour (A and B types) done in Puerto Rico (1). Studies on pollination and fruit set (5) as well as on early vegetative root and shoot growth (6) and frame working (7) have also been carried out in Trinidad. Early work in storage (8, 9, 10) has been adopted for transport experiments (11, 12) in Trinidad and storage behaviour of refrigerated fruit investigated in Puerto Rico (13). Little work has been reported on the development of root stocks resistant to or tolerant of *Phytophthora* root rot, a major problem of avocado cultivation in the wet tropics. Nor is a reliable method of vegetative propagation available even if such a rootstock were identified. Fresh avocado fruit are high-pric-

ed in many parts of the Caribbean even during periods of relative glut and exorbitantly priced during the off-season because existing late bearing varieties are not extensively cultivated.

Cashew: A study of local cashew cultivars has been made in Trinidad (14) and types with high kernel/testa ratios identified and collected (15). A study on growth and development in cashew fruits (16) has also been completed. A reliable method for vegetative propagation of cashew does not exist but investigations towards perfecting a procedure are underway at the U. W. I. Trinidad. Very little cashew nut processing is done in the Caribbean although imports of canned and bottled nuts are quite high.

Guava: A small collection of table and processing guava clones and varieties exists in Trinidad and an improved high yielding variety for processing (Centeno Prolific) identified (17). There is a reliable technique for propagating guava by rooted stem cuttings (18) and the mineral nutrition of the crop with particular reference to leaf mineral content (19) studied. Investigations on *Colletotrichum* (20) and micro organism (21) infection of guava fruits and methods for their control have been undertaken.

On the processing side, screening of guava seedling clones for processing quality (22, 23), evaluation of processing characters (24) including stone cells (25), development of improved methods of nectar processing (26, 27) as well studies of pectin methylesterase (28) and polybasic acid content (29) of guava fruit have been reported. Consumer acceptance testing of two types of guava paste in Puerto Rico has also been undertaken and documented (30). Little work on storage of guava fruit either for the fresh fruit trade or for processing has been done, although a study on heat sterilization of fruit against fruit fly (31) has been reported. Attempts to establish a commercial guava nectar enterprise in Trinidad collapsed after a few years, apparently due to high fruit harvesting costs. A research programme toward development of a "meadow orchard", high density system of guava cultivation has recently been initiated in Trinidad (32). Guava nectar is successfully produced in Puerto Rico and guava jelly, jam and paste produced with various degrees of success in the Caribbean. This species seems to have high priority for development provided that high density cultivation could be achieved and commercially applied.

Mango: Small collections of selected local and introduced mango varieties have been established in Jamaica and Trinidad and a larger collection in Puerto Rico, but to the writer's knowledge a viable

commercial orchard exists only in Belize. Alternative methods of vegetative propagation (33, 34) are well known and commercially applied but grafting of selected high quality varieties on Julie seedling rootstocks and on Julie intergrafts to effect dwarfing has not been very successful (35). Agronomic investigations on variety evaluation (36) fruit set (37) and early vegetative growth of the shoot system (6) as well as heat tolerance of leaves (38) have been reported. Investigations on diseases including anthracnose (39, 40, 41), dieback (42, 43) and withertip (44) including control methods, have also been undertaken.

Studies on post-harvest problems including storage conditions (45), air and sea transport (46) and storage behaviour of different varieties (47) have been reported. The effects of hot water treatment of fruit on Anthracnose infection (48), heat sterilization in the control of fruit fly infestation (32) and gamma radiation of biochemical components and storage life (49) have also been documented. Mango nectar processing has been researched (50) and commercially applied in Puerto Rico and Jamaica. The potential for improved mango varieties in Puerto Rico (51), U. K. (52) and New York (53) markets has been investigated, but these markets have not been fully exploited.

The several local seedling mango clones and varieties in the Caribbean need to be evaluated for fresh fruit quality and storage life but particularly for processing capacity. It is known that many high quality local varieties are produced on huge trees and have poor storage qualities. Discovery of a dwarfing rootstock and improved storage will be a great asset in the development of mango enterprises.

Papaya: No comprehensive collection of papaya varieties exists in the Caribbean to the author's knowledge. Experimentation on growth and development (54), vegetative propagation (55), seed germination (56), mineral deficiency symptoms (57), population density and fertilizer requirements (58, 59, 60), yield performance (61) and variation in fruit characteristics in seedling populations (55), has been reported. Semi-commercial yield trials with papaya cv. Solo Sunrise have produced up to 36,300 kg/ha in Trinidad (62). Work in the area of disease control for root and collar rot (63), curly leaf (64), papaya mosaic (65, 66), bunchy top (67, 68) and insect transmission of disease (67, 69) has been well documented. Studies on virus diseases (70, 71, 72) have also been undertaken and a *Corynespora* leaf spot (73) reported.

Storage and ripening trials with papaya fruit (74, 75, 76, 77, 78) have not resulted in significantly improved methods for control of

post-harvest diseases or extension of fruit storage life. However, papaya nectar (79, 80) and jam (81) have been experimentally made and lye peeling of green papaya fruit for processing developed (82).

General: Very little recorded work exists on production of *Anonas* and tamarind although experimentation has been reported on the manufacture of nectars from tamarind (83), soursop (84), and a soursop/tamarind blend (85).

Chemical analyses for vitamin contents (86), and studies on factors affecting vitamin stability (87, 88) in processed fruit juices, nectars and fruit preserves have been documented. Analysis of fruit and processed commodities for water, energy, protein, fat, carbohydrates, fibre, calcium and iron and Vitamins A, B's (thiamin, riboflavin, niacin) and C collated in "Food Composition Tables for use in the English Speaking Caribbean" (89).

In view of the potential for high carbohydrate productivity in breadfruit mentioned earlier, a comprehensive research proposal (90) for the Caribbean Region including production, with particular reference to dwarfing rootstocks to reduce harvesting problems, and determination of physiological yield mechanisms, disease resistance, post-harvest storage and processing has been forwarded to the Inter-American Development Bank for funding.

It is concluded, therefore, that although research investigations on non traditional fruit do exist, gaps in the knowledge either in technological areas of production, storage or processing, or in market studies have limited establishment of agro-industries based on these crops.

AN APPROACH TO RESEARCH AND DEVELOPMENT

The formulation of a research approach for the non-traditional fruit trees crops is governed by at least ten major constraints to development of these crops in the Caribbean, as follows:

1. Production is for the most part from semi-wild and wild seedling lines e. g. mangoes, *Anonas*, guavas, and from backyard or small scale cultivation of improved types e.g. Julie mango, Pollock avocado, etc.
2. Production currently exists as scattered trees on gently to steeply sloping hillsides, and lands available for expanded pro-

duction are also of similar topography. Very few attempts at orchard development exist and the technology for orchard management is unknown.

3. In very few instances have varieties been separately selected for fresh fruit use and for processing. Exceptions include guava.
4. Although some pest and disease problems have been identified, no estimation of the seriousness of infection and infestation under orchard conditions has been possible, so far, except perhaps for mango in Belize and papaya in Trinidad and Puerto Rico.
5. Although some species have a shrub habit e. g. guava, *Anonas*, most are tall trees e. g. mangoes, tamarinds, avocados, cashews and the high cost of harvesting is a serious constraint to development of crop enterprises.
6. The storage and shelf life of individual varieties are quite unknown and strategies for extending such shelf-life have not been worked out.
7. Although processed products have been developed for all of the fruit species in question, little selection of clones and varieties suitable for processing has been done.
8. The local and regional markets for both fresh fruit and processed fruit are at present small and their capacity for expansion unknown.
9. International markets for both fresh fruit e. g. avocado, mango and processed products, e. g. guava cheese, are very competitive.
10. There is neither a centre nor are there funds available for accelerated research to remove the aforementioned constraints.

In the face of these constraints the following specific objectives are suggested for a research and development programme in non-traditional fruit tree crops within the earlier mentioned general objectives of creation of viable agro-industrial enterprises.

- A. Establishment of priorities for agro-industries based on fresh fruit and processed commodities on the basis of existing production and processing capacity and knowledge of the crops and their processed commodities.

- B. Encouragement of existing research and development institutions and private business houses to participate in production and test marketing of high quality fresh fruit and processed commodities for local, regional and international markets.**
- C. Selection of commodities for further study on the basis of market analysis.**
- D. Establishment of a mechanism for Research and Development Institutions to work together with farmers, fresh fruit marketers, and fruit processors towards the further expansion of selected agro-industries.**
- E. Development of a long term research programme for non-traditional fruit.**

On the basis of these objectives the following operations are recommended towards establishment of agro-industries.

A. Establishment for priorities based on existing production capacity

- (i) Existing national and regional production capacity for avocado cashew, guava, mango and soursop should be established by surveys of standing trees and fruit yield records.**
- (ii) Production capacity should be classified by location and variety where possible and rates of availability on a weekly basis established.**
- (iii) Species and varieties should then be ranked according to number of standing trees and yield estimates available for agro-industrial exploitation made.**

B. Production and test marketing of specific commodities

- (iv) Carefully harvested, graded and packaged fresh fruit of avocado, table guavas, mango, papaya, and soursop, including varieties selected for quality and maximization of seasonal availability, should be prepared by the best available methods.**
- (v) Some samples should be kept for experimental monitoring of storage and shelf-life, whilst others should be test marketed, at local supermarkets, weekend markets, and weekday markets. Regional and international trial shipments and market acceptability should also be tested.**

- (vi) Nectars and juices from selected varieties of guavas, mangoes, papaya, soursop and tamarind should be prepared and test marketed locally, regionally and internationally. Guava jelly, jams, and paste products should also be produced and test marketed.

C. Selection of commodities for further study

- (vii) With knowledge of production capacity and market acceptability for fresh and processed commodities, a Workshop should at this stage be held with farmers' representatives, Research and Development Institutions, marketeers, and processing houses towards:

- a) Discussion of organized production, marketing and processing of specific commodities.
- b) Discussion of research priorities for accelerated development of the selected commodities and drawing up of short term research proposals.
- c) Discussion of deadlines for completion of achievable research targets and provision of funding for identified research projects on a regional basis.

D. Establishment of stakeholder i. e. institutional, farmer, marketeer, business house cooperation

- (viii) A major function of the above-mentioned Workshop would be to develop a framework for collaboration between stakeholders in the envisaged non-traditional fruit agro-industrial sector.

The U. W. I. Faculty of Agriculture is prepared to coordinate the work of national and regional institutions and to participate in the operations involved in objectives A, B, C, D, i. e. Phase 1.

E. Development of Long Term Research Programme (Phase II)

- (ix) It is proposed that funds be sought at international, regional and local levels to enable the UWI Faculty of Agriculture to develop a long term research programme for non-traditional fruit in the Caribbean as well as for working out collaborative institutional arrangements for conducting such a research programme in Phase II.

The elements of such a programme will include:

- a) Germplasm collection and evaluation for productivity, fruit quality and disease resistance.**
- b) Development of propagation techniques including micro propagation.**
- c) Screening for rootstocks' with dwarfing character and resistance to disease.**
- d) Development of cultural practices to optimize productivity e. g. high density cultivation, fertilizer management, crop protection systems for location specific testing.**
- e) Investigation of alternative systems of production e. g. mono-culture and mixed cropping in suitable locations.**
- f) Investigation of methods and mechanisms to facilitate harvesting and handling of fruit.**
- g) Investigation of appropriate methods of post-harvest storage and physiological behaviour of fruit towards production of high quality fresh fruit capable of extended storage.**
- h) Development of methods to extend the processing range of selected fruit species as well as techniques for identification of cultivars suitable for processing.**
- i) Development of an information service for research literature and bulletins for farmers, fresh fruit marketeers and processors.**

The central characteristic of such a programme should be the maximization of the use of all the available research capacity and facilities in the region towards achieving defined research objectives. Such a characteristic could be achieved by entrusting to one Research Institution, provided with the necessary funds and facilities, the task of developing and coordinating a Regional Research effort on non-traditional fruits to be carried out by a network of national and sub-regional institutions.

It is proposed that the UWI Faculty of Agriculture could fulfil this role for the Caribbean and could liaise with other institutions in the South and Central American Region e. g. Universidad de Oriente, Jusepin, Venezuela; Instituto Agropecuario Colombiano, Palmi-

ra, Colombia; Instituto Interamericano de Ciencias Agrícolas, Turrialba, Costa Rica; Colegio Superior de Agricultura Tropical, Cardenas, Mexico, toward improvement of research and development in fruit crops in the Caribbean states.

The Faculty could seek funds internationally for implementing such an expanded programme as it has already done for breadfruit.

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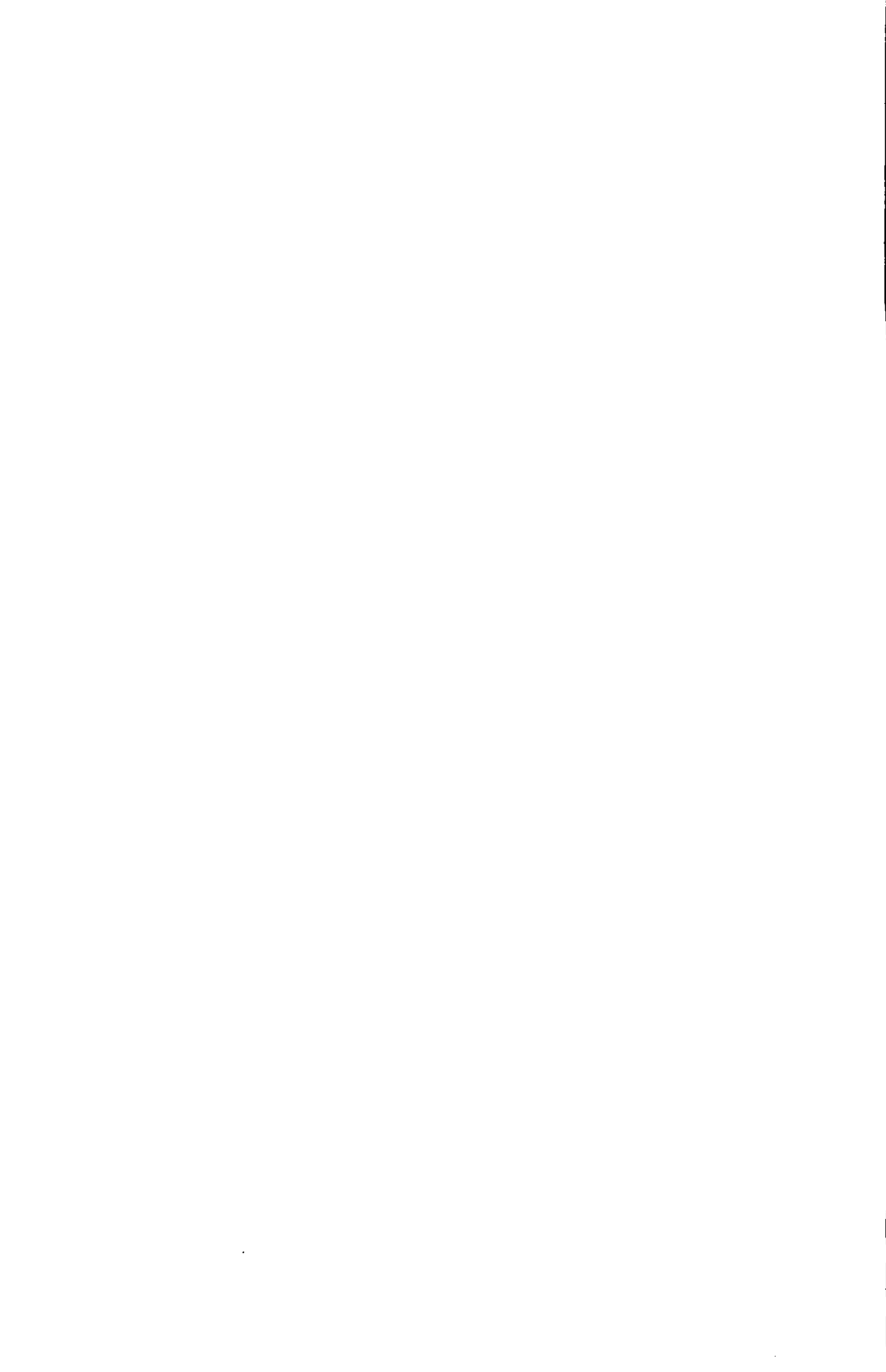
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THE PROCESSING POTENTIAL OF LESSER KNOWN TROPICAL FRUITS

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INTRODUCTION

In 1927, Popenoe (1927) observed that "Man has done little to improve the quality of wild tropical fruits". Twenty-two years later he (Popenoe, 1945) further observed, "Had tropical fruits in general received as much attention at the hands of skilful horticulturists as has been given to northern species, and had vegetative propagation been the rule rather than the exception there would be a different story to tell. In those instances where nature did most of the work where vegetative propagation was simple, as with pineapple and banana, superior varieties originating by chance were saved and passed on to succeeding generations. When this was not the case —when it was necessary for man to develop horticultural techniques such as grafting the tropics of the New World have brought up the rear".

With the passing of a little more than half a century, it would appear that with few exceptions, little progress has been made toward reaching goals projected by Popenoe, in that at present most underdeveloped countries import large quantities of apples, pears, grapes, etc., as fresh fruits, as well as large quantities of processed fruits, while the development of a tropical fruit industry lies dormant.

According to Stahl (1935) there are more than 600 edible fruits found in the tropics and sub-tropics, with less than 50 in general cul-

tivation and no more than 20 in commercial use. In the English speaking Caribbean only two of the many tropical fruits have been fully developed as commercial crops —citrus and banana. There are others that are either special crops such as nutmeg and allspice or the volume of production and trading is small as in the case of mangoes, avocados and pineapples.

For many years, the merits and potential of tropical fruits have been praised and touted. Yet a survey of the market place will show that little has been done to develop and exploit these long neglected resources. This is in spite of the considerable technological and developmental work done and being done on tropical fruit products by a large number of research institutions. In the Caribbean Region, Sanchez Nieva and Associates, at the Puerto Rico Agricultural Experimental Station, have been leaders in this field. Other institutions would include the University of the West Indies in Trinidad and Tobago, the Food Technology Institute in Jamaica and research institutions in Cuba, Venezuela and Colombia. Other well known research centers for tropical fruits are located in Brazil, Hawaii, India, Phillipines, U.S.A. and Britain. Although much excellent technological and development work has been done by these research centres, the market exhibits limited evidence of their achievements. Why? One may well ask.

The answer seems to lie in the uncoordinated approach to the development of any one fruit, where each area —agronomy, handling and transport, processing, packaging and marketing— seems to be conducted in isolation of the others.

Consideration of the problem would suggest that the successful exploitation and marketing of tropical fruits and their products are dependent upon such factors as:

1. Availability of raw material of satisfactory quality and in adequate quantity.
2. Availability of satisfactory preservation and processing techniques.
3. Acceptability by domestic and foreign markets.
4. Evaluation of the economics of production of raw materials, processing, packaging, shipping and merchandising.

RAW MATERIALS

In considering tropical fruits as a raw material it must be recognized that their characteristics and properties are different from

temperate zone fruits. For example, most temperate zone fruits can be picked appreciably before full maturity, refrigerated at 0 - 6°C for 2-3 weeks or even longer, then brought under controlled temperature and humidity to ideal maturity for processing. Tropical fruits, in general, do not readily lend themselves to this type of treatment. The majority of tropical fruits must be picked close to their optimum maturity and processed promptly (Seale, 1967).

Thus, tropical fruits call for special harvesting and handling practices to provide the quality of raw material needed for a successful operation. Further, fresh fruit marketing and processing on a commercial scale have several specific requirements, such as:

1. Continuous and orderly supply of raw material.
2. The raw material must meet the quality criteria for the particular operation.
3. Uniformity of shape and size. This is particularly important when mechanical handling and preparation practices are employed.
4. The economics of production and handling of raw material must be favourable to both the producer and the processor.

At present, most of the "lesser known" tropical fruits (Table 1) do not meet the above requirements of suitability for large scale marketing and processing operations. In most cases fruits that are available are of unselected wild varieties with their attendant variations and lack of uniformity in properties deemed important for commercial handling and processing.

It would appear that before limited research resources are more extensively deployed in such wild fruit development programmes, there is a need for demonstrated demand and need. On the other hand, large scale marketing and processing cannot proceed without at least a reasonable assurance of adequate supplies of raw materials which would meet the minimum criteria. Thus, we are confronted with a situation resembling the age old problem of which comes first, the egg or the chicken.

TECHNOLOGY OF PRESERVATION AND PROCESSING

In considering the development of commercial scale or even small scale preservation and processing enterprises for the "lesser

TABLE 1. NAMES OF MINOR AND LESSER KNOWN FRUITS OF THE ENGLISH SPEAKING CARIBBEAN WITH INDICATED POTENTIAL FOR PROCESSED PRODUCTS

BOTANICAL	COMMON
1. <i>Achras sapota</i>	Sapodilla
2. <i>Aegle marmelos</i>	Bael Fruit
3. <i>Anacardium occidentale</i>	Cashew-apple
4. <i>Annona reticulata</i>	Custard-apple
5. <i>Annona squamosa</i>	Sugar-apple
6. <i>Annona muricata</i>	Soursop
7. <i>Averrhoa bilimbi</i>	Bilimbi
8. <i>Averrhoa carambola</i>	Carambola
9. <i>Calocarpum mammosum</i>	Mamee (Mamey sapote)
10. <i>Carica papaya</i>	Pawpaw (Papaya)
11. <i>Casimiroa edulis</i>	White-sapote
12. <i>Chrysobalanus icaco</i>	Cocoa-plum (Fat-pork)
13. <i>Citrus maxima</i>	Shaddock
14. <i>Citrus medica</i>	Citron
15. <i>Eugenia uniflora</i>	Surinam-cherry
16. <i>Eugenia jambolana</i>	Java-plum
17. <i>Eugenia malaccensis</i>	Pomerac Chia (Malay-apple)
18. <i>Eugenia jambos</i>	Rose-apple (Pomme Rose)
19. <i>Flacourtia ramontchi</i>	Governor's Plum
20. <i>Hibicus sabdariffa</i>	Roselle (Sorrel)
21. <i>Malpighia glabra</i>	Acerola (Barbados-cherry)
22. <i>Mammea americana</i>	Mammee-apple (Mamey)
23. <i>Mangifera indica</i>	Mango
24. <i>Myristica fragrans</i>	Nutmeg
25. <i>Passiflora edulis var. flavicarpa</i>	Passion Fruit
26. <i>Pereskia oculeata</i>	Barbados-gooseberry
27. <i>Phyllanthus acida</i>	Damsel (Otaheite-gooseberry)
28. <i>Physalis peruviana</i>	Cape-gooseberry
29. <i>Psidium guajava</i>	Guava
30. <i>Spondias cytherea</i> , Sonn. (<i>S. dulcis</i> , Forst.)	Otaheite-apple (Golden-apple)
31. <i>Spondias mombin</i>	Pomme cythere
32. <i>Tamarindus indica</i>	Hog-plum (Yellow Mombin, Jobo)
33. <i>Zizyphus mauritiana</i>	Tamarind
	Dunks (Indian or Malay Jubube)

known" tropical fruits two approaches should be considered. The first approach would involve the complete handling, processing and packaging of a fruit or fruit product in final form for the consumer market. The second approach would consist of partial processing into a product such as canned or frozen flesh, juice, pulps, or puree for subsequent manufacturing into a final product such as nectars, blended juices, frozen desserts, jellies, preserves, etc. In the latter case the partially processed product could be stored and distributed for manufacture by domestic processors into the ultimate products or could be exported for final manufacture in the importing country.

Regardless of the approach taken, it would appear that, in general, technological and scientific development and "know-how" are already available or may be modified for the processing of tropical fruits. Significant research and development work has been done and is in progress at experimental centres, including those mentioned earlier.

An excellent and comprehensive review of tropical Fruit Technology was published by Czyhrinciw (1969).

METHODS OF FRUIT PRESERVATION AND PROCESSING

1. Cool Storage and Refrigeration

Feasible and practical cool storage, either common or controlled atmosphere, is a preferred method of preservation for fresh fruits; resulting changes from natural state and quality are minimal. While cool storage is widely used for temperate zone fruits and roots, the same cannot be said for tropical fruits, because the parameters for cool storage of tropical fruits have not yet been fully worked out.

There seems to be considerable potential for the export of fresh tropical fruits because of the advent of air freight transportation and improved techniques for refrigerated storage of perishable products. However, maximum benefits are limited by the high cost of transportation and the instability of tropical fruits to cool storage, thus resulting in loss of quality when mature fruits must be shipped and marketed over relatively long periods. The effects of fumigation also add to cost and reduces quality.

In addition to its use in the marketing of fresh tropical fruits, cool storage is also very important in keeping fruits between time of harvest and actual processing. The maintenance of a reservoir of raw materials in cool storage can be effective in providing a more orderly and continuous supply of raw material for the processor. With tropical fruits which deteriorate rapidly after harvest, the use of refrigeration and cooling to remove "field heat" followed by cool storage is probably the only way such fruits could be handled effectively for large scale operations. For small scale local operations it would be easier to handle the fruits rapidly.

2. Separation of Inedible Portions (Seed and Skins)

In most of the processing and preservation methods a final step in handling raw material is the removal of the inedible portions,

mainly the seeds and peels. This problem is accentuated in the case of many tropical fruits, particularly where wild varieties are concerned, because of the lack of uniformity of the size, shape and firmness of the fruit as well as other inherent characteristics in some cases, of which the sugar-apple might be cited as an example. Czyhrinciw (1969) has discussed the ramifications of this problem. He has pointed out the high waste index of typical tropical fruits as compared to temperature zone fruits belonging to the same families. Data on the inedible portion of tropical fruits, as presented by the above author, are summarized in Table 2.

In a report on the composition of miscellaneous tropical and subtropical Florida fruits, Stahl (1935) presented information on the percent of edible pulp as given in Table 3.

3. Preservation by Heat-Canning

The application of heat for the sterilization and preservation of foods by the so-called "canning" process has been employed for many years. This process consists essentially of packing the food product in hermetically sealed glass or metal containers and applying sufficient heat to destroy all organisms capable of growing in the product and causing spoilage or toxin production. The newer 'aseptic canning' or "H.T.S.T." processing methods consist of sterilizing the product for a few seconds at very high temperatures followed by

TABLE 2. PORTION OF INEDIBLE PARTS OF SOME TROPICAL FRUITS (FROM CZYHRINCIW, 1969)

FRUIT	PERCENT OF INEDIBLE PART
Avocado	46 – 58
Banana	37 – 40
Cashew	18
Guava	4
Mammee-apple	54
Mango	47
Papaya	25
Passion Fruit	67
Pineapple	41
Plantain	31
Sapota	45 – 53
Soursop	41
West-Indian-Cherry	25

**TABLE 3. PERCENT OF EDIBLE PULP IN TROPICAL AND
SUB-TROPICAL FRUITS OF FLORIDA
(FROM STAHL, 1935)**

FRUIT	AVERAGE PERCENT EDIBLE PULP
Sapodilla (<i>Acbras sapota</i>)	87.2
Sapote Mamey (<i>Calocarpum mammosum</i>)	77.3
Cherimoya (<i>Annona cherimola</i>)	58.3
Sugar-apple (<i>Annona squamosa</i>)	30.9
Soursop (<i>Annona muricata</i>)	70.0
Carambola (<i>Averrhoa carambola</i>)	80.7
Papaya (<i>Carica papaya</i>)	48.7
Natal-plum (<i>Carissa grandiflora</i>)	86.5
White-sapote (<i>Casimiroa edulis</i>)	79.0 – 84.6
Rose-apple (<i>Eugenia jambos</i>)	78.2
Java-plum (<i>Eugenia jambolana</i>)	69.9
Surinam-cherry (<i>Eugenia uniflora</i>)	75.9
Governor's Plum (<i>Flacourtia ramontchi</i>)	61.1
Imbe, Mangosteen (<i>Garcinia livingstonei</i>)	67.9
Mango (<i>Mangifera indica</i>)	69.1 – 80.0
Mammee-apple (<i>Mammea americana</i>)	52.0
Ceriman (<i>Monstera deliciosa</i>)	53.9
Barbados-gooseberry (<i>Pereskia aculeata</i>)	69.0
Guava, Strawberry (<i>Psidium cattleianum</i>)	89.7 – 94.0
Guava, Common (<i>Psidium guajava</i>)	80.0

filling into sterile containers and sealing under aseptic conditions. Foods packed by aseptic methods suffer a minimum deterioration in quality due to heat. For acid foods such as fruits and fruits juices, which are readily sterilized by a less severe heat treatment, such as pasteurization, the "hot fill, seal and hold" method of canning may be used.

Among tropical fruits and fruit products canning has been and is being successfully employed for items such as guavas, mangoes, papayas, as well as juices, nectars, drinks, purees and concentrates. When the material can withstand it, heat treatment provides an effective means of preservation for purees, pulps and concentrates as semi-processed raw material for export. It would appear that the canning process may also be used with at least some of the minor tropical fruits and their products. However, the increasing cost of tin cans as a packaging must be carefully considered.

4. Preservation as Sugar Concentrates

A combination of sufficiently high concentrations of acid and sugar plus heat treatment provides a useful and widely accepted method of preparation and processing fruit products such as concentrates, jellies, jams or preserves and syrups:

5. Preservation by Removal of Moisture-Dehydration

As Desrosier (1970) has observed, 'Drying is one of man's oldest methods of food preservation. It is a process copied from nature; we have improved certain features of the operation. Drying is the most widely used method of food preservation. . .'. A comprehensive treatise on food dehydration —product and technology (Van Arsdel and Copley, 1964)— covers in some detail the general methods of dehydration. Perez (1971) has reviewed various methods of dehydration in respect to tropical fruits. (Dehydration methods with particular application for tropical fruits and fruit products would include:

- 1) Drum drying
- 2) Spray drying
- 3) Freeze drying
- 4) Foam mat drying
- 5) Vacuum and vacuum foam drying
- 6) Osmo-vac drying

Foam drying would appear to be of considerable interest because of the simplicity of the method and equipment required and the ease of reconstitution of the dried material. In a discussion of 'Factors affecting foam production and stabilization of tropical fruit products', Bates (1967) pointed out that "There are a number of tropical fruit juices and purees whose preparation in powder form suggests a promising process for food processors of Hawaii. . .".

A recently described (Ponting et al, 1966) method for the dehydration of fruit pieces is the "osmo-vac" drying process. Slices or chunks of fresh fruit are exposed to high concentrations of sugar, and water is removed from the fruit by osmosis. The partially dried fruit is then further dried to a low moisture content under vacuum. Farkas and Lazar (1969) have discussed the relationship of the various factors concerned. Brekke and Ponting (1970) have described the preparation of osmo-vac dried banana. Slices of banana dried by this means gave a crisp, porous, flavourful product which contained 2.5 % moisture or less. According to these authors the product. . . "has appeal as a snack for eating out of hand, can be chocolate-coat-

ed by manufacturers, or find use as an ingredient in cereal or bakery products". This method of dehydration would appear to have considerable appeal for the processing of delicately flavoured fruits which are susceptible to damage by heat.

6. Preservation by Fermentation – Alcohol Beverages Liquor and Vinegar

In the opinion of Czyhrincwiv (1969) there are great possibilities for making wines from tropical fruits. He suggested that "Further study is warranted on the practicability of manufacturing wines, semi-dry and sweet, in a range of colour and having the specific flavour of fruits such as passion fruit and cashew apples". Other authors who have written on this subject include Sanchez Nieva (1951), Dyal Singh (1959) and Amerine and Cruess (1960).

It was also suggested that the production of a fruit vinegar from tropical fruits may be of interest in some countries.

7. Preservation by Chemical Additives

Additives can contribute substantially to the preservation of foods, particularly in economically under-developed countries where there is a lack of functional storage facilities and inadequate transportation and communication.

In tropical regions, where high temperature and humidities favour microbial attack and increase the rate of development of oxidative rancidity, a wider use of chemical additives and antioxidants may be justified than in the more temperate climates.

It must be recognized that the increased risks associated with the increased use of food additives must be weighed against the benefits to be gained from preventing food losses due to spoilage. In such circumstances, food additives could be used to supplement the effectiveness of traditional methods of food preservation rather than to replace them.

OPPORTUNITIES FOR COMMERCIAL DEVELOPMENT

At present, it would seem that the major problems facing the development of large scale processing of the "lesser known" tropical fruits are, firstly, the availability of suitable raw materials in adequate quantities and acceptable quality, and secondly, the development of markets for the end products. Thus we are back to the "egg and chicken" dilemma.

One method of solution to this problem would be to start on a relatively small scale and through this process attempt to develop both the raw material supply and the market. This was successfully done in the case of the development of Sorrel (*Hibiscus sabdariffa*) concentrate (Sammy, 1977). A very brief historical sketch will suffice.

The plant *Hibiscus sabdariffa* is called "sorrel" in the English-speaking Caribbean. From the red calyces a refreshing drink is made, but because the plant is light sensitive it fruits only around the Christmas season (November-February) and is traditionally known as the "Christmas drink". This crop was not of commercial importance, since only small quantities were grown for local consumption.

This project was started in 1966/67 when preliminary investigation was carried out to determine the possibilities of preserving this product for year-round use. Since no money was available for research work, the initial work was done by students as research projects at the University of the West Indies. The initial or laboratory scale research took four years (1966/67-1970/71), when it was established that both a solid and a liquid concentrate could be produced and stored for at least six months at ambient temperature or much longer (3 years) in cold storage. Acceptability tests showed that the product was highly acceptable by the local consumers. Some overseas testing in the U.S.A., Canada and Britain, showed considerable potential for export.

The next stage was the development of a pilot-plant which was jointly undertaken by the University of the West Indies, the Caribbean Industrial Research Institute CARIRI, the Industrial Development Corporation (IDC) and the Government of Trinidad and Tobago. The project was to design, fabricate and install a pilot-plant of such a size as would be utilizable in semi-commercial production. This phase took another three years (1970/74) and confirmed the original viability for commercial production.

The pilot-plant was then set up as a semi-commercial project. In the first year of operation it operated at 25 % capacity and made a loss; in the second year it operated at 50 % capacity and made a small profit; in the third year it operated at about 75 % capacity and again made a profit. The pilot-plant fully justified its commercial viability and introduced in the local commercial market a new indigenous product with great potential for export.

At present a much bigger plant (TT \$3 million) is under construction. It is the author's experience and belief that the devel-

opment of the "lesser known" tropical fruits will take place through small scale development which will provide the opportunity for the transfer of technology, establishment of a market, development of a raw material supply and, last but not least, upgrading of the native skill and building confidence in the local technologists and entrepreneurs.

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THE INTEGRATED APPROACH TO FRUIT PRODUCT DEVELOPMENT

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The problems and constraints which are retarding the growth of fruit product development have been well documented. Numerous papers have already been presented at other conferences of this type suggesting possible mechanisms to solve the many problems and overcome the constraints. This Workshop has identified the over-riding problems facing the fruit industry as low yield, scattered production and low or inappropriate levels of utilization.

A report entitled "Food Processing and Interdependence of Agriculture and Industry", by J. Cropper, G.M. Sammy and W.W. Wiltshire, and published by the Department of Agricultural Economics, U.W.I. St. Augustine in March 1974, identified some of the constraints inherent in the Fruit Industry in Trinidad and Tobago as follows:

1. Supply of Raw Material

- a) The prices offered to farmers are out of line with their production costs.
- b) Lack of coordination between producers and processors
- c) Information on improved cultivation of harvesting techniques and suitable varieties of fruit do not reach the farmer although such information is available.

2. Constraints in the Processing Industry

- a) Shortages of food technologists and technicians
- b) The technology of processing many local fruits has not been optimized

- c) The unpredictability of supply of local raw materials and their relatively high cost and poor quality.
- d) Unawareness by potential processors of the availability of small-scale processing equipment.

3. Marketing Constraints

The products obtained from local raw materials are not competitive with foreign products which are of uniform quality, and consumers are accustomed to their taste.

The paper recommended that this wide variety of problems could only be overcome by an integrated approach over a period of time, and also suggested a mechanism for implementation. Little has yet been done to overcome these problems.

From our experience, we believe that the recommendations put forward to solve these problems are too wide in scope, and, as a result, planners are faced with a multitude of alternatives and usually lose sight of the objectives of the project. The end result is inaction or failure of the project.

For example, a Workshop may recommend to Government the establishment of a Fruit Processing Plant using Mangoes, Pawpaw and Pomerac. However, when one gets down to the specifics, any implementing team would be faced with a number of alternatives, e.g.

- 1) **Raw Material Supply:** What variety of fruit or fruits? What method of procurement: contract, growing own orchards, cooperative farms?
- 2) **Processing:** What type of product or products? What type of process, size and type of machinery?
- 3) **Post-Harvest Handling:** What type of packaging, storage, transportation?
- 4) **Marketing:** What type of distribution system, markets, pricing policies, packaging, etc. ?

When all these alternatives are brought together there remains the extremely difficult task of selecting the best way to attain the desired objectives. However, this task can be made manageable by the systematic development of an Integrated Production Processing System through the Innovation Process used in New Product Development.

The Innovation Process involves:

- 1) The screening of possible products**
- 2) Product Development**
- 3) Preliminary Techno-Economic Analysis**
- 4) Pilot-Plant Production and Test Marketing**
- 5) Full scale Techno-Economic Analysis**
- 6) Commercialization**

The Integrated Production Processing System (Appendix 1) consists of four sub-systems which must be in harmony with each other. These are:

- 1) Production sub-system**
- 2) Post-Harvesting sub-system**
- 3) Processing sub-system**
- 4) Marketing sub-system**

STEP 1: SCREENING

The objectives of screening is to short list the large number of product ideas. This can be done by development of a set of criteria based on the Integrated Production Processing sub-system. An example of a set of criteria is as follows:

Production criteria or raw material criteria

- i) Are there existing supplies of raw material which are readily available at an economic price and good quality?**
- ii) Is there potential for development of an adequate supply of raw material?**
- iii) Can problems of low yield, pest and disease control, high harvesting and high production costs be overcome in the short run?**

Post-harvest criteria

- i) Does the crop lend itself to easy handling?**
- ii) Does it store well? If not, can technology improve its storage life through improved packaging, handling, or semi-processing?**

Processing criteria

- i) Is the technology for processing readily available?**
- ii) Is the technology easily adaptable?**

- iii) Can the technology be easily developed in the short run?
- iv) Can several fruits be processed using the same process technology?

Marketing criteria

- i) Is there excellent local sales potential?
- ii) Is there excellent export sales potential?
- iii) Can the market be easily penetrated?

Socio-Economic criteria

- i) Is there potential for saving on foreign exchange?
- ii) Is it labour intensive?
- iii) Will there be little disruption to the social and natural environment?

The above list is by no means exhaustive, but serves as an example. A Product Rating Form can be used as a tool in evaluating the criteria. See Appendix II for an example of this form.

STEP II: PRODUCT DEVELOPMENT

The second step in the Innovation Process involves Product Development on the laboratory scale. In this integrated approach, this is the development of an embryonic system, i.e. the identifying and quantifying of all activities in each sub-system necessary for the commercialization of the selected product or products. The following are some of the activities which may be included:

1) Activities in the Production sub-system

- a) Selection of suitable varieties.
- b) Selection and/or optimization of cultivation and harvesting practices based on small-scale field trials to estimate costs.
- c) Survey of population to estimate existing raw material supply with respect to variety, quantity, quality, cost and seasonality. See Appendix III for typical questionnaire used in such a survey.

2) Activities in the Post-Harvest sub-system

- a) Selection and/or development of transportation system.
- b) Selection and/or development of materials handling sys-

tem, e.g. types of packaging/and storage or preliminary processing/to increase the shelf life of the raw material from field to processing plant.

3) Activities in the Market sub-system

Preliminary market analysis:

- i) Estimation of market size.
- ii) Price of competing products.
- iii) Analysis of distribution system.
- iv) Trade barriers.
- v) Packaging requirements.

4) Activities in the Process sub-system

Actual product development on a laboratory scale to:

- i) Develop standard product.
- ii) Carry out shelf life tests.
- iii) Carry out in-house consumer tests.
- iv) Estimate conversion ratios.
- v) Selection and testing of process technology.

STEP III: TECHNO—ECONOMIC ANALYSIS

At the end of this product development stage, there should sufficient information to carry out Step III, the Preliminary Techno-Economic Analysis. This analysis involves costing of all activities in each sub-system required to produce the final product or products.

STEP IV: PILOT-PLANT PRODUCTION AND TEST MARKETING

The development of the system at pilot-plant or semi-commercial level is the fourth step. This is a very important step since the parameters for processing many of the local fruits have not been optimized. At this level, procurement systems to supply raw material to the processing plant at an agreed quantity and time must be tested. This step will be based on knowledge acquired in Step I. It may involve:

- i) Contractual arrangements based on the results of the survey, and

- ii) Establishment of orchards based on the selected cultivation practices.

These are more easily done for crops with a short gestation period; however, it may be necessary, certainly advisable, to establish orchards for crops with long gestation periods to meet the needs of any intended commercial outlet whose capacity would have been identified in the preliminary Techno-Economic Analysis.

The development of the Post-Harvest sub-system at the pilot-plant stage involves selection and evaluation of packaging media and storage methods; this is an area where large losses of crops are incurred. Appendix IV gives some detailed techniques for improving development of the Post-Harvest System.

The development of the Processing sub-system at the pilot-plant stage is to optimize the process parameters. These include Materials Handling, Conversion Factors, Quality Control, Utilities Consumption, Labour Requirements, Shelf Life Testing and Process Technology.

The development of the Market sub-system at this stage would involve test marketing to estimate market penetration, to evaluate distribution systems, packaging design and pricing and advertising policies.

STEP V: FULL-SCALE TECHNO-ECONOMIC ANALYSIS

Information gathered at the end of the pilot-plant stage is then used to update the Techno-Economic Analysis (Step V). This involves:

- i) Detailed market analysis
- ii) Selection of plant and equipment
- iii) Selection of Process Technology
- iv) Plant layout
- v) Financial analysis

STEP VI: COMMERCIALIZATION

The final step, Step VI, is the actual commercialization. It is necessary to have harmonization of all the sub-systems to ensure the complete success of the Integrated Production and Processing System. This means that all sub-systems must be geared to meet each other's requirements. In fact, this harmonization is required at all stages of the Innovation Process, especially at its pilot-plant and commercialization stages.

There should be agreement on:

- i) Demand and supply requirements for each sub-system.
- ii) Price of products as it enters and leaves the system
- iii) Time period required for each sub-system to meet each other's demand.

This harmonization can only be achieved by proper management.

The project management team should consist of the following personnel, with support staff:

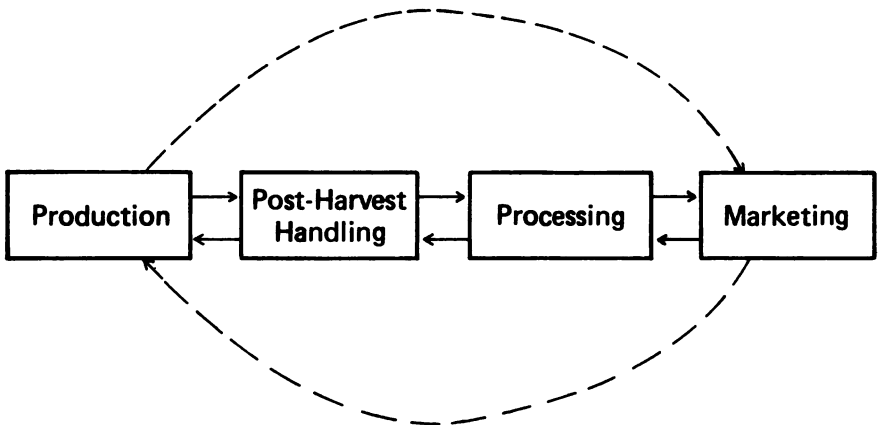
- i) Agronomist
- ii) Food Technologist
- iii) Chemical/Mechanical Engineer
- iv) Economist (Finance/Marketing)

This team would be responsible for development and management of the system through the total innovation process.

Following the above steps may not guarantee success but will minimise the risk of technical and economic pitfalls.

APPENDIX I

FLOW CHART OF INTEGRATED PRODUCTION PROCESSING SYSTEM



----- Information Flows
———— Physical & Information Flows

APPENDIX II

FRUIT PRODUCT DEVELOPMENT RATING FORM

CRITERIA	A	B	Rating AXB
	Relative Weight	Compatibility Values	
1. Production Criteria	(.30)	.1, .2, .3, .4, .5, .6, .7, .8, .9, 1	
i) Existing availability of supplies	.15		
ii) Production potential	.10		
iii) Few production constraints in the short run	.05		
2. Post-Harvest Criteria	(.30)		
i) Easy Material Handling	.15		
ii) Storage problems can be overcome in the short run	.15		
3. Processing Criteria	(.20)		
i) Technology readily available	.06		
ii) Easily adaptable	.02		
iii) Can be developed in the short run	.02		
iv) Similarity of process	.10		
4. Marketing Criteria	(.20)		
i) Excellent Market Sales	.06		
ii) Excellent Export Sales	.10		
iii) Easy Market Penetration	.04		

INSTRUCTIONS

Use a separate form for each product or product line.
For each criterion check a compatibility value.

The project team should come to a consensus on a compatibility value for each criterion.

**APPENDIX III
RAW MATERIAL SURVEY**

	Official use	Farmer's Code						Acreage						
Identification	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	3	12						16						
1) Name (Surname) (only)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
														32
2) Fruit code	<input type="text"/>	<input type="text"/>												
	34													
3) Acreage of Fruit	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>										
4) Pure or Mixed	<input type="checkbox"/>													
														39
5) Seed or Cutting	<input type="checkbox"/>													
	40													
6) Average Age of Field (years)	<input type="text"/>	<input type="text"/>	<input type="text"/>											
														43
7) Variety of Fruit %/o														
		(a)												
			(b)											
				(c)										
		<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
			46				49					52		
8) Current Average Yield per acre	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>										
														56
9) Quality of Fruit	<input type="checkbox"/>													
														57
10) Method of Disposal														
i) Percent Wholesale	<input type="text"/>	<input type="text"/>	<input type="text"/>											
														60
ii) Percent Retail	<input type="text"/>	<input type="text"/>	<input type="text"/>											
														63
iii) Percent left to rot	<input type="text"/>	<input type="text"/>	<input type="text"/>											
														66
11) Price														
i) Current Wholesale/unit	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>										
														70
ii) Current Retail/unit	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>										
														74

APPENDIX III (cont'd)

12) Peak period of production 13) Willing to go into Contract Agreement
78 79

IDENTIFICATION
12

14) Condition of present estate
13

(1) Excellent 90 % (2) Good 80 % (3) Fair 60 % (4) Poor 50 %

15) Intended acreage to be developed (ii) Estimated completion time (years)
17 19

16) Intended acreage to rehabilitate (ii) Estimated completion date
23 25

17) Estimated Maintenance Cost/Acre 18) Estimated Establishment Cost/Acre
29 33

19) Estimated Production over the last 5 years in crates or lb (specify)

1973 1974 1975
39 45 51

1976 1977
57 63

20) If fall in production, give reasons in order of importance

a) Disease problems
64

b) Transport cost
65

c) Poor marketing outlets
66

d) Poor wholesale price
67

e) Poor retail price
68

f) Praedial larceny
69

g) Labour problems
70

h) Other
71

EXPLANATION OF QUESTIONNAIRE FOR CITRUS RAW MATERIAL SURVEY

Identification Columns 3-12 list the farmer's registration number.
Columns 12-16 list the farmer's size of farm in acres.

- 1) **Name:** List Surname only in Columns 17-32
- 2) **Fruit Code:** Use the following fruit code index to obtain fruit code:

Fruit	Code	Fruit	Code	Fruit	Code
Guava	1	Pomerac	2	Passion Fruit	3
Pawpaw	4	Pomme cythere	5	Five Fingers	6
W.I. Cherry	7	Governor Cherry	8	Tamarind	9
Mango (Long)	10	Mango (Graham)	11	Mango (Peter)	12
Mango (Calabash)	13	Sour Cherry	14	Pineapple	15
Mango (Julie)	16	Avocado	17	Orange	18
Grapefruit	19	Lime	20		

- 3) **Acreage of Fruit:** List acreage of fruit in question.
- 4) **State whether fruit is grown pure stand or in a mixed cultivation.**
- 5) **State whether fruit was grown from a seed or from a cutting.**
- 6) **List average age of fruit trees in question.**
- 7) **List by % varieties of fruit under cultivation.**
- 8) **Current Average Yield Per Acre:** Obtain from the farmer his best estimate of current average yield per acre; for citrus, give quantity in crates; all weights in lb — if possible, specify unit of measurement.

APPENDIX IV

TECHNIQUES FOR IMPROVING DEVELOPMENT OF
POST-HARVEST SYSTEM

In the development of our integrated system, it was necessary for us to pay close attention at the outset to the areas of Post-Harvest Handling and the Packaging Systems. We use the term "Packaging System" since packaging is not only concerned with the type of material used to package the final product, it also considers handling, storage and transportation.

Professor Pantastico of the University of the Phillipines has estimated that in the Phillipines the Post-Harvest wastage of fruits is in the range of 14 % to 40 % and for vegetables the range lies between 22 % and 78 %; Dr. Iyengar, UNIDO Expert in Food Packaging attached to CARIRI in 1973/74, has estimated that the

losses incurred in Trinidad and Tobago are somewhere between 40 % and 80 % for agricultural products.

It is acknowledged that for any product, the stage of maturity at harvest is of vital importance, as any variations in maturity at harvest manifest themselves as differences in quality of the final product. The methods used for harvesting need to be examined since the crudeness sometimes encountered in these often result in damage to the fruits and to the leaves of leafy vegetables. Such damage does not only occur during the process of harvesting. The packaging of the fruits or vegetables for transport from the field poses serious problems and produces significant losses since both improper packaging materials and unsuitable containers are commonly utilized.

The wooden crates we use are in most instances too deep, so that fruits are crushed because of the excessive weight of other fruit above them. We have not yet learnt that we need to build containers to handle specific products; the "one for all" container can never be satisfactory. The use of such material as bamboo for the fabrication of baskets to transport and store perishable and fragile fruit is undesirable, as the edges of bamboo slats are sharp and always damage produce in contact with them. The shape of our baskets is normally round which precludes maximum use of the space available; the bottom of these bamboo baskets is not sufficiently rigid to allow safe vertical stacking. On the basis of the numerous inadequacies outlined, it is apparent that there is a need to consider from very early the availability and procurement of adequate crates and cartons that will offer the best materials handling.

One cannot overemphasize the point that in order to produce high quality processed products we must start with high quality raw material. The continuation of physiological activity in products after harvesting may be necessary if they are harvested before they are mature; a holding period may be required to allow the fruit or vegetable to reach the desired stage of ripeness and for this to occur there must be continuation of physiological activity. If the fruit or vegetable has been harvested at the desired stage of maturity, the continued physiological activity will be deleterious to quality and in such instances it is necessary to slow down the rate of physiological activity as much as possible.

The process that is most important in influencing quality deterioration is respiration, the rate of which is directly proportional to temperature up to about 40°C; the increase of rate is twofold for every 10°C rise until the temperature reaches 40°C. The storage

life and the market life of a product are inversely proportional to the rate of respiration and hence the temperature. It should be common knowledge that green leafy vegetables and perishable fruits such as berry fruits, bananas and mangoes have high rates of respiration and short shelf lives; pumpkins, potatoes and citrus have longer shelf lives and low rates of respiration. Bearing these factors in mind, we should always examine the possibility of cooling produce after harvesting so as to minimise post harvest losses.

Transportation of the produce from the growing area to the processing plant is another very important consideration for numerous reasons. If produce is too tightly packed, stacked or stowed in a vehicle, the build up of heat as a result of respiration would be very high. The increased temperature will further increase the rate of respiration and transpiration and also accelerate the growth of decay-causing micro-organisms as well as shortening the natural shelf life.

The control of transpiration rates is important in prolonging shelf life and maintaining quality since the freshness of the fruits and vegetables and their market value depend on retention of their original water content. The rate of water loss is influenced by the water vapour pressure gradient that exists between the near saturated internal atmosphere of the fruit or vegetable and the ambient air near the skin. The factors involved are the external water vapour pressure, the air velocity and the surface/volume ratio of the produce; the water vapour pressure depends on temperature and relative humidity.

In the case of lettuce and other leafy vegetables where the surface/volume ratio is very high, there is a rapid loss of water. Fruit such as oranges and grapefruit with thick skins and a low surface/volume ratio will not normally lose water rapidly but if the conditions are severe they can also lose water rapidly and shrivel.

Although we are focusing our attention on processing, we cannot resist the temptation to draw attention to some of the things we can achieve in the marketing of some of our local produce by applying suitable technology. It is possible to minimise the loss of saleable weight and maintain freshness by applying a wax coating; it can usually be applied as emulsions by dipping, spraying or foam coating. This method of reducing weight loss is effective over a wide range of temperatures and usually has little effect on respiration. However, while this technique works well with mangoes and citrus, it can cause the development of coloured spots on bananas. The use of low density polyethylene (LDPE) either in the form of film or bags of 0.1 mm thickness can also be used to reduce water loss in most fruit

and vegetables. When wrapped with LDPE, a controlled atmosphere is created around the fruit or vegetables. This can help to increase the post-harvest life of the produce since it reduces the rate of respiration.

Plastics in general and polyethylene in particular have the disadvantage of not being as permeable to carbon dioxide as they are to oxygen, the result being that a build-up of carbon dioxide can occur around the fruit. This build-up can damage produce. Fortunately, this problem may be solved by the use of an absorbent material or substance, such as fresh hydrated lime placed in the package, to scrub the atmosphere of carbon dioxide (0.5 kg of lime for 20 kg of fruit).

The importance of packaging can be adjudged from its functions

1. It protects the product, be it good or otherwise. The package must protect the product against the environment or at times the environment needs to be protected against the product.
2. It offers utility. It should offer ease of movement of the package through the distribution system.
3. It should encourage the purchaser to buy the commodity. It should help to sell the product through its design and graphics.

In processing agricultural produce and thereby conserving or adding value, it is important to avoid loss of that value as a result of inadequate and unimaginative packaging. We recommend that at the very outset of the programme special attention be paid to packaging. There is no danger of over-emphasis since packaging is expensive and it is essential to look for the right type of material to achieve the objectives listed above at the lowest cost. It must be borne in mind, too, that because the manufacturers of packaging materials are generally distant there is the need to plan far in advance the procurement of the materials which will be required.

We trust that the points outlined in this Appendix will help to stimulate some meaningful discussion.

ORGANIZATION OF REGIONAL MARKETING OF TRADITIONAL AND NON-TRADITIONAL FRUITS AND FRUIT PRODUCTS IN THE CARIBBEAN

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INTRODUCTION

The production system of agriculture in the Commonwealth Caribbean* which has emerged over the past decades has shown growing concentration on small-scale operations in most territories, with a production pattern emphasizing export crops. This has been influenced by:

- a) Reliable marketing opportunities for those commodities, with resulting favourable farm incomes or returns to labour for farm operations, in comparison with other crops;
- b) The relative stability of the established national organisations directly related to those crops; and
- c) The modest support services available to facilitate production and marketing on a commercial scale.

The emphasis on fruit development has so far been confined to the traditional fruits. Some (bananas and citrus and to a lesser extent, mangoes and avocados) are exported to metropolitan countries where they are consumed in their fresh form, with regional marketing

* Denotes countries of the CARICOM region.

being of much less importance. Alongside this, there has been the export of others (such as cocoa, coffee, nutmeg and coconut) as dried produce, which is processed in various oversea countries into manufactured products.

In the Caribbean there exists some variation between the various islands in what are termed traditional and non-traditional fruits. This paper defines traditional fruits as those which have entered the marketing stream at a commercial level, for example, banana, citrus, mango avocado, breadfruit, guava, passion fruit, soursop, sapodilla, as against those which have remained mainly as backyard crops with scattered, uncultivated trees, the yield of which is used for home consumption and for limited domestic trade. Tamarind, West Indian Cherry, mango-steen, cashew, custard and sugar-apple, kenip, gooseberry, and dunks are some examples.

From this broad definition, the traditional fruits have been examined in terms of what can be done to influence and improve marketing conditions, so that motivation and will can be harnessed in the drive to organise their production for achieving stable and competitive farm incomes. This would enable fruit cultivation to contribute more significantly to the small-resource country economies of the Caribbean. Such a development would be consistent with the public expectation of diversification of the agricultural base of the region where agriculture is a major economic activity. Besides, fruit tree cultivation is also particularly important in those territories where cultivable lands are generally sloping, rainfall distribution relatively high, both factors necessitating a soil conservation input into the cropping pattern, and farm labour is scarce. In such conditions, for their harvesting, some fruits can be allowed to fall and with the maturity periods of other types extending over three to four months, both circumstances provide some relief in a situation of labour shortage.

In the case of the non-traditional fruit crops where supplies are very small, but there is some potential for commercial production, the focus must be on the provision of the appropriate incentives (input subsidies, mainly planting material and fertilizers) and the use of suitable short-term intercrops which can provide some measure of income during the five-year development period of most fruit trees.

With such a programmed approach, production of non-traditional fruits can become commercially oriented and acreages in cultivation increased, given the opportunities for their consumption domestically as fresh fruit and for local processing based upon the

operation of small-scale multiple-product processing units and rural cottage enterprises.

The present somewhat lukewarm approach envisages some break-through in the development of mangoes and avocados in particular (large-scale orchard cultivation of mangoes having already moved forward in Belize and Jamaica) and some scientific initiatives for planning and organizing farm production aimed at the commercial cultivation of traditional and non-traditional fruits. The technocrats foresee a system of production which involves both medium and small-scale enterprises, but (based upon the existing structure of agriculture in most Caribbean countries) with public sector policies oriented towards small-scale farming. This could encounter some difficulty where Governments have decided to operate estate lands now in their ownership, as state corporations, although this alternative farming structure could facilitate a programmed approach to fruit orchard development.

In recent times, there has been specific interest in increasing production of short-term fruit crops such as passion fruit and sorrell, to name a few, to provide additional raw material for the existing underutilised small agro-industrial plants in the islands, as well as in processing fruit, which is now being exported fresh, to yield products like citrus fruit segments, lime juice cordial, nutmeg jams and jellies. Side by side with this, efforts are also being made to improve the quality of local processing of items as passion fruit and mango juices, guava jams and jellies. This represents a movement away from home and "Produce Chemist" laboratory production to small-scale plant operations, utilising proper machinery and equipment, modern management and marketing.

However, a development which can have significant impact on fruit processing and fresh fruit consumption, both locally and in regional markets, would be implementation of an aggressive action-oriented programme for classification of varieties, estimation of existing production performance, determination of the technical requirements for successful production by improving existing performance, completion of an inventory of producers and establishment of the scope for expansion of fruit cultivation, taking into account productivity and availability of opportunities for profitable marketing.

At present fruits are generally grown by rural people, eaten rather casually by nationals without much appreciation of such qualities as taste and with little emphasis on presentation. This

fruit if properly presented and advertised could be in great demand by tourists. In addition, fruit sales for domestic consumption are made in one-day per week local markets only, and those for export through the irregular, standards – deficient small trader operations. These factors limit the scope for expansion.

Meanwhile, in many territories of the region there are marginal lands which are available and suitable for the production of cashew, soursop, custard and sugar-apple, guava and some other species. With banana as a popular cash crop or perhaps more appropriately called the weekly wage earner, ideally, it could be intercropped with fruit trees in a permanent cropping mix, for four to five years, as a revenue earner until the fruit trees come into commercial production. In addition, in many territories, there are sloping lands which are suitable for tree production only.

Analysis of the current marketing situation

As an introduction, a scenario of some of the facts relating to production and marketing of fruit and fruit products in the Caribbean have been presented. However, the picture is incomplete without a specific but brief analysis of the marketing of these within the Caribbean basin.

A review of the regional marketing scene brings into focus the following activities:

- a. The hucksters/traffickers (small traders) operating in the Caribbean Region, including the French Territories and US Virgin Islands, on an irregular but frequent basis, selling non-standardized fruit;
- b. Arrangements between private entrepreneurs and commercial businesses in the major markets such as Barbados, for selling both fresh fruit and fruit products; and
- c. Marketing Board arrangements with other National Marketing Boards (for example, Dominica with Barbados or Antigua), and Marketing Board arrangements with private buyers, in the US Virgin Islands.

There now exists a small number of processors – private entrepreneurs in the ECCM States, especially St. Vincent and Dominica, who are unable to fulfil orders of buyers in the larger markets like Barbados due to unreliability of supply arising from a shortage of raw material (such as guava and passion fruit). Added to this are the relatively low prices paid to farmers for other types such as citrus. There is also the limited flow of canned fruit and fruit products from

Jamaica to the Eastern Caribbean, and the packaging of concentrated citrus juice from Jamaica and Belize in Barbados, for the local market. These activities apart, the real thrust of regional marketing in traditional and non-traditional fruits in the Caribbean Region is in the direction of the hucksters in the Eastern Caribbean (from Dominica, St. Lucia, and St. Vincent) and the traffickers (from Grenada). This is a real "growing" point on which to focus attention, although there are urgent problems to be solved.

Identification of special problems relating to the fruit trade

The special problems relating to the Caribbean fresh fruit trade are well known. What has so far been missing is the ability to solve them. Some of these relate to the pattern and system of production — the one usually leading to the other. The small farm system of agriculture in the islands is characterised by mixed cropping systems, *ad hoc* plantings of scattered fruit trees, deficiencies in the infrastructure serving agriculture, technical weaknesses and peculiarities of production. These latter include seasonality, high level of disease and pest damage, harvesting difficulties, since trees are tall and fruits fall easily, and variation in quality depending on the varietal, soil and climatic variables. A further very crucial aspect of the overall problem relates to the cultural background of the people engaged in the marketing, the poor traditional system of handling and use of fruits, and the social organisation which dominates marketing in a manner not strictly commercial.

For the development of the regional marketing of traditional and non-traditional fruit and fruit products within the Caribbean, these specific problems must be addressed to create profitable opportunities extending from production through to marketing and final consumption. The system must be one that allows scope for improvements to be made, on a continuing basis, by private initiative whether by individuals or groups (companies, cooperatives, partnerships).

The outlook

What, therefore is the scope for regional marketing of these fruits in both the fresh and processed forms, given the situation in the Caribbean as described? **What are the opportunities?**

In the entire business of marketing agricultural products, particularly when there is a considerable time lag between harvesting and final consumption, spoilage and wastage occur. In the Caribbean

where this is especially applicable, perishability, bulkiness and traditional bad handling techniques of fruit cause the issues of sensitivity to changing marketing conditions and of motivation to maintain an operating surplus, in order to stay in business, to assume very great importance.

The hucksters and traffickers (small traders) and middle-level marketing entrepreneurs are the operators dominating the structure of the regional marketing system. Given their motivation, as in other private sector groups, to stay in business, they provide the agriculture of the Caribbean with a real opportunity for development of the fruit subsector.

An attempt has been made to identify all the problems which relate to the regional fruit trade, but the evidence already indicates that so far we have not been able to solve many of them. Measures for solution of these problems have been articulated in many forums in the region but the fact is that action on them has not been taken. Probably too much is being attempted at one time, given the limited manpower and financial resources for implementation; or serious attention has not been paid to the key "growing" points for development, on the strength that these will produce a pull-effect towards improvement of services directly related to marketing activities.

Whilst the small trader and middle-level marketing entrepreneur operations are strong "growing" points in regional marketing of fruit and fruit products, there are deficiencies in the quality of their operations which are adversely effecting their growth potential. These need to be addressed. Certain measures will undoubtedly force these businesses into a more organised and regulated system of marketing. A few requiring mention are:

- a. Off-loading regulations which are being imposed by importing countries;
- b. Plant quarantine regulations;
- c. Entry provisions for licensed trading only, in effect in foreign countries; and
- d. Quality inspection regulations at point of entry.

It has already been estimated that heavy losses in the regional fruit trade occur at points of entry of importing countries. These relate quite logically to the storage conditions now existing in some regional transportation facilities for handling bulky and perishable fruits, the quality of packaging, the level of grading, and the treat-

ment received in exporting countries. With private entrepreneurs, all these can be remedied through specialized organisation of services such as packing, treatment and grading, on a "fee structure" basis, and by the provision of working capital credit in small amounts, based on performance of the entrepreneur. These two areas can be adequately dealt with by public sector involvement, as a "facilitator" rather than a "doer" in the system. Regional marketing can only be fully developed through private initiative, where people are free to engage in transactions, with the public sector solely as a "facilitator".

The appropriate action needed at this stage is careful selection of a few interested small traders, who, on the basis of evidence, are doing a relatively poor job in selecting, grading, treating and packing of fruit for regional export marketing, and the provision of appropriate credit facilities and technical services to these. This should be planned and managed as an operation to facilitate growth in the small entrepreneurs' regional fruit trade, through improvements in quality of product and arrangements which enable increasing flows of supplies from farms to final consumer.

The public sector as a "facilitator" can introduce a special fund approach in its financial intermediaries, to provide the working capital needs of the small trader, with conditions appropriately fashioned to take proper account of their customs, assets-worth and social environment. The technical services mentioned earlier can be made available, initially, through the injection of the necessary manpower, material and financial resources into an existing marketing operation which is suitable for this purpose. The public sector therefore, acting in this role, can make a positive contribution towards increasing the flow of standard quality fruits in regional trade, on the basis of expansion and new development in private sector transactions. With an upgrading of quality, the fresh fruit will undoubtedly reach the importing country at acceptable standards for the supermarket shelf and the hotel industry. These two sources of demand for fruits provide good regional marketing opportunities for the indigenous private trader who, up to this stage, has been supplying a limited clientele within the region.

A realistic "pilot" project which supplies these inputs to the small trader system on a positive and selective basis, and which works closely with the distribution channels of the importing countries, through the traditional supermarket and wholesale marketing firms (the established private sector importing businesses which control the distribution system) would be a step in the right direction. No matter how many regional trading arrangements are established on paper, success can only be achieved in regional marketing of fruit with:

- a. **Improvements in quality standards of fruit exported;**
- b. **"Facilitating" public sector involvement in the small trader system; and**
- c. **Direct Working Contacts** through private sector arrangements between the exporting country fruit marketing entrepreneurs and the established importing country distribution channels.

Regional marketing arrangements should therefore emphasize strong links with the distribution channels already developed in importing countries by private sector initiative, rather than through Marketing Boards, most of which are historical failures in regional agricultural trade. Private sector transactions must therefore be recognized and encouraged in regional marketing of fruit and fruit products and, as may be appropriate in specific cases, given priority ranking.

REGIONAL POLICY STATEMENTS



INVESTMENT POLICY OF THE CARIBBEAN DEVELOPMENT BANK (CDB) IN RELATION TO FRUIT TREE CROP DEVELOPMENT

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INTRODUCTION

The agricultural sector in the British Caribbean has been historically characterized by subsistence farming and the production of a narrow range of plantation crops essentially for the export market e.g. sugar, bananas, spices, cacao, citrus and to some extent rice and copra. Despite the dismantling of the plantation system and attempts by some governments to modify this pattern through programmes for land reform and diversification of the agricultural economy, this situation has not changed significantly.

Domestic food production is still mainly in the hands of small producers and the large gap between supply and demand is met from extra-regional imports, paid for from the foreign exchange earnings of the export crops.

Apart from bananas and citrus, fruit production has been given a low priority. Although there may be many reasons for this, it is suspected that there is a feeling in some quarters that attempts to increase food and fruit production might result in competition for land with the export crops, resulting in a fall in the export of these commodities through displacement. This view cannot be supported in the light of new technological initiatives for inter-cropping and other integrated production systems. In addition, recent surveys

have identified significant acreages of unutilized cultivable land in almost all member countries.

It does appear that for the foreseeable future member countries will continue to depend on traditional export crops as a foreign exchange earner; however, due to the acceleration of trade protection policies by some developed economies, regional producers will have to take effective steps to improve their competitive position on the world market. In this regard, the Bank will actively consider proposals for funding projects which seek to increase high quality exports of those commodities at competitive prices.

SOME CDB POLICY AREAS RELEVANT TO FRUIT TREE DEVELOPMENT

Non-Traditional Export Crops:

The Bank is of the view that the realizable potential for producing tropical fruits has not been adequately exploited in member countries. Conditions in many of the LDCs are conducive to the production of mango, avocado, pineapple, papaya, etc. once markets and transportation have been adequately developed. Loan financing is, however, required for orchard rehabilitation and expansion of these crops and the Bank will consider proposals for assisting with investment finance for these operations, if capable management is ensured and markets are identifiable.

Agro-Industries:

The Bank's policy for improving agriculture includes the development of agro-industries which support regional and national agricultural production. As regards the processing of tropical fruits, haphazard production or the utilization of seasonal gluts must give way to an effective system for providing an assured supply for processing. The problem of reducing post-harvest losses must be addressed as well as those of effective packaging and the need for support and advisory technical services.

The CDB will support both private and public sector (both corporate and co-operative) ownership and operation of these industries. It will provide investment financing where production and market systems are well organized and managed or could be so instituted with technical assistance support or otherwise.

Where supplies of raw material are insufficient to support the efficient operation of a feasible agro-industry enterprise, CDB will assist the private or public sector in developing production and marketing programmes to achieve the volume of produce required.

Agricultural Support Services:

The Bank recognizes that a serious constraint to agricultural development and productivity is the inadequacy, high cost, uncertainty and untimely supply of certain essential material inputs, as well as a deficiency in the available technical support services; it will therefore assist in the promotion of input supply/service industries which undertake to supply agricultural chemicals, small-scale agricultural equipment and farm machinery as well as packaging materials for agriculture and agro-industry. The development of specialist contract management and labour services in the private sector, for undertaking highly skilled farm operations will also be effectively supported when opportunity arises.

Transportation:

In most CDB regional member countries agricultural development is hampered by an inadequate system of roads suitable for motor transport in the farming areas. The relatively few existing feeder roads are often in a state of disrepair. The steep terrain and the high rainfall in many areas present serious difficulties to proper road construction and even greater problems to the road maintenance units which are poorly organized and managed.

A good system is necessary for the safe and efficient transport of both perishable (e.g. bananas and other fresh fruits) and nonperishable primary commodities from the farm to the marketing or processing centres. It also encourages the creation of new farming units by opening up additional agricultural lands and facilitates the injection of capital and new technologies into the farming system, thus increasing productivity and production. In addition, a good road system will promote more diverse economic activity, particularly in the agriculture service sectors and associated industrial development, thereby generating additional opportunities for rural employment.

The CDB has in the past provided and will continue to provide finance for feeder road improvement or development and maintenance where these are justified on economic grounds, as well as other areas of the regional transportation sector, such as port development, air and sea transport. Between 1970 and 1979 the Bank invested

US\$ 66 million in this sector, 42 0/0 of which was in port development and 29 0/0 in feeder road construction. The high level of investment in port development reflected the need for improvement in freight handling and the Bank's commitment to provide such facilities for regional and international trade. Current investments in sea and air transport will also assist in achieving this objective.

CDB funded port development has now taken place in Belize, Dominica, Montserrat, Cayman Islands and St. Lucía. Similar work is in progress in St. Kitts, with Grenada and St. Vincent next on the programme. It is of interest to note that refrigerated storage facilities have been provided in the St. Lucía port and it should not be difficult to provide this service at the other ports if or when desired. These investments are generally expected to further enhance intra and extra-regional trade including tropical fresh fruits.

Storage and Handling Facilities:

Adequate and suitable storage facilities for inputs are essential and urgently required in rural areas to minimize transportation costs to the farmer and to make these inputs available at timely intervals, without reducing the man-hours available for on-farm production activities. The Bank will support integrated projects which combine the installation of storage facilities for farm inputs with small centres such as banana boxing plants.

Rural Development:

Agriculture is but one aspect of rural life and the traditional approach to its development must give way to a more comprehensive and integrated programme of rural development, which must be sufficiently broad-based to confer a wide range of benefits on the entire rural community so as to improve the quality of life of this sector. The transfer of improved technology in farming should be accompanied by programmes to improve the social infra-structure.

The on-farm sector must be developed through the introduction of new industries, especially those based on local raw materials. CDB is committed to providing loan financing and technical assistance for the identification and appraisal of integrated rural development projects involving farm production and in which rural employment will be stimulated, with the support of essential economic infrastructure and other associated services.

Investment Studies and Agricultural Surveys:

Where necessary, the Bank on its own initiative, or in collaboration with individual governments, regional, bilateral or multilateral agencies, finances feasibility studies and surveys to provide a data bank for assisting the process of decision-making on investment possibilities in specific agricultural sub-sectors. Some of the studies completed or contemplated are relevant to the development of the tropical fruit tree sub-sector and reference is made to them below.

Technical Assistance:

This is provided within the competence of CDB's Agriculture Division to regional governments and agencies, as well as bilateral and multilateral institutions. The areas include crop production and marketing, training in agricultural credit, project identification, project formulation and appraisal, and in the general development of agricultural plans for the sector.

FINANCING TROPICAL FRUIT TREE DEVELOPMENT IN CDB'S REGIONAL MEMBER COUNTRIES

Direct loans to the sub-sector have been slow, but this is understandable as may be seen from the findings of two CDB studies carried out in 1978 and 1979 and summarized later in the paper.

Antigua:

At the request of the Government of Antigua, the Bank is examining a proposal for a farm settlement project which aims to settle about 25 farmers, each on 10 acres of land, principally for producing mangoes and limes as well as vegetables. Each 10-acre unit is expected to have 4 acres of mangoes, 1 acre of lime and 4 to 5 acres of vegetables. In addition, there will be a demonstration farm for continuous training of the settlers and a 30-acre central commercial farm. About 200 acres of hillside lands in the project area will be re-afforested.

The project will develop a total of about 112 acres of mangoes and 28 acres of limes. At full development, the annual output of mangoes and limes is estimated at about 480 tons and 130 tons respectively, in addition to over 1,300 tons of vegetables. The project output is expected to meet part of the local and export market requirements for these commodities in their fresh or processed state.

Alternative crops to lime may include avocado, grapefruit, cashew, soursop or guava.

The project management will provide a full range of technical and other support services to the farmers, including marketing. Credit will also be provided for farm inputs as well housing, where necessary, since settlers will be full-time farmers residing on their farms. Appraisal is almost completed but there are a few outstanding issues to be resolved.

Belize:

In 1973 the CDB funded a mango production project in Belize which was promoted by a company known as Tropical Produce Co., Ltd. This project sought to develop a mango orchard of some 1,000 acres over a five-year period, using such commercial varieties as Tommy Atkins, Keitts, Hayden and Zill. The loan was used for providing fruit handling and packing facilities, field equipment for crop-spraying, weed control, transport, and the improvement of on-farm roads.

Production, most of which is air-freighted from Belize via Florida, is targeted for the US market. Occasional shipments were made via México, by road, during the early life of the project and more recently it has been proposed to ship the fruit to Florida in refrigerated containers. All shipment must conform to USA phytosanitary requirements, including fumigation prior to shipment.

The project has been reasonably successful with present production fluctuating between 1,000 and 2,000 lb/acre: Harvesting extends from March/April to September. About 90 % of the fruits is exported and the rest sold locally. Consideration was given by the Company to pulp and freeze some of the project output for export to the US and this proposal is still under review. The 1980 crop is estimated to produce about 1,000 tons and c.i.f. prices are expected to range from US\$ 7.00 - \$ 7.50/box of 12 fruits each averaging about 0.75 - 1.0 lb.

Dominica:

The Bank is appraising a loan to the Government of Dominica to assist in the integration of the grapefruit industry. Funding will be provided to purchase major input requirements for the next two years for grove rehabilitation, the objective of which is to increase productivity through such measures as weeding, timely fertilizer application, pest and disease control and fruit quality improvement.

These inputs will be provided to farmers on credit and will form the basis of a revolving fund for subsequent purchases.

The loan will assist in the restoration of the existing citrus packing plant originally funded by CDB in 1972 and which was extensively damaged by hurricane David in 1979. The objective is not only to make the plant operational for the 1980 crop, but also to increase its packing capacity from 300 cartons/hr./to 740 cartons/hr. The capacity/carton is 33 lb. Two loans have been made to the private sector for farm improvement in which there was some element of fruit crop development: one made in 1971 contemplated the establishment of 40 acres of grapefruit, 10 acres of limes and 10 acres of avocados, in addition to on-farm roads and field transport; the other made in 1973 involved a mixed cropping operation, which included the establishment of tree and food crop species and about 23 acres of plantains.

Banana Development:

Although bananas are not classified as a tree fruit, it is interesting to note in passing that for the period 1970-79 out of a total investment of US\$ 78 million in the agricultural sector, over US\$ 9.0 million or about 12 % went into the development of the regional banana industry.

Indirect Aid to Fruit Development:

In its indirect operation between 1970 and 1979 CDB channelled some US\$ 25 million through the ten financial intermediaries (DFCs) in the LDCs, for on-lending to the small farm sector. Of this amount, it is estimated that over US\$ 1.25 million was used for small farm production of fruits, including bananas, citrus, mangoes, avocados and pineapples.

Under a partial USAID loan/grant, CDB has recently launched a multifaceted **Basic Human Needs Project** in the LDCs and Barbados, the aims of which include conservation of the economic and social infrastructure in rural areas, through employment generating activities. Of relevance to the tree fruit sub-sector is a facility for soil conservation and land use management, which will provide funding for establishing tree crops in erosion control programmes on some of the denuded hillsides in the LDCs. A start has been made in Montserrat to reforest over 30 acres by establishing a mixture of forest species and tropical tree fruits such as mangoes, pomegranate, cashew, etc. Provision is also included for a nursery and plant propagation

facilities. It is expected that other territories may be included, following a study funded by USAID for developing Intensive Orchard Crop Reafforestation projects in two Eastern Caribbean countries.

COMPLETED AND CONTEMPLATED SUB-SECTORAL INVESTMENT STUDIES

One of the Bank's functions as set out in its charter is to contribute to the harmonious economic growth and development of its member countries, through the financing of projects and programmes to enhance the development of these territories, providing technical assistance and the undertaking or commissioning of pre-investment studies to assist in the identification of possible development projects.

In 1978, CDB in association with USAID jointly funded a "Small Farmer Production and Marketing System Study"^{1/} with two objectives. The first was to determine the potential for the development of a regional market for agricultural commodities, including fresh fruit produced by small farmers in the Bank's LDCs and the second was to provide an operational plan for integrated production and marketing systems, to realize this potential.

The study was done in two phases, the first of which involved the development of a regional small farmer commodity plan (RSFGP) for fresh fruit and other small farm commodities. The second phase covered the production and marketing system including transport and handling options, an operational plan and the institutional framework of the implementing entity. The main findings were as follows:

- a) Despite the significant export potential offered by fresh fruits, between 1982 and 1987 the estimated level of export of this commodity is expected to range from 56,000 - 58,000 m.t. of which citrus will account for 50 %;
- b) The following countries offer the best prospects for exports in terms of intra-regional market penetration: Barbados, Trinidad, The Dutch Antilles, Martinique, Guadeloupe, The U.S. Virgin Islands and Puerto Rico. Penetration of the extra-regional markets of the EEC, U.S.A. and

1/ Ref. "Small Farmer Production and Marketing System Study" (1978) prepared for CDB by Louis Berger International Inc., 100 Halsted St., East Orange, N.J., USA in joint venture with Systems (Barbados) P.O. Box 16B, Bridgetown.

Canada is largely to be determined by competitive quality and price considerations;

- c) Increased production in the short term is expected to result from better land use, improved cultural practices as well as inter-cropping.**
- d) Certain territories were found to have comparative advantages for certain crops, e.g. Antigua (pineapple), Dominica (oranges, grapefruit, lemon, mango, papaya) Grenada (oranges, lime, avocado, golden apple, soursop), Montserrat (pineapple and mango), St. Lucia (mango, papaya), St. Vincent (papaya, soursop), Belize (orange, grapefruit, mango, papaya).**
- e) In the area of marketing, there is a lack of strong wholesale trading organizations and both the wholesale and retail trades are dominated by small private traders. Where Marketing Boards exist in no case do they play a major role in the domestic or export trade in fresh fruit. In fact, they all lack effective market intelligence and information systems so necessary in planning production to match market demand;**
- f) The small private traders lack capital and the technical expertise to improve their operations. Fruits are generally sold ungraded and inadequately packaged, giving rise to high losses from spoilage. This is further aggravated by lack of refrigerated storage and reliable shipping service;**
- g) Fresh fruit production is hampered by resource deficiencies and inadequate technical expertise at the farm level;**
- h) There is a lack of reliable estimates of crop acreage, moreso tree fruit crops, which are usually included under permanent crops. This is illustrated in Table 1.**

The second phase of the study recommended the following three entities to meet the stated objectives:

- a) Small Farmers' Supply/Service Centres in each LDC; the function performed by these will include input supply, local production and market intelligence, purchasing, collecting, grading, packaging and refrigerated storage of small farm produce, selling to marketing boards on contract, and transporting produce to market outlets;**

TABLE 1. ESTIMATED ACREAGE OF TREE FRUIT CROPS IN THE LDCs

TERRITORY	FRUIT TREE CROP	AREA (ACRES)^{1/}	REMARKS (BASED ON UNOFFICIAL INFORMATION)
Antigua	—	N/A	Future proposal to establish over 2700 acres in fruit crops; assistance from BDD in tree crop propagation.
Belize	Citrus Other	10000 N/A	Proposal to rehabilitate citrus industry.
Dominica	Grapefruit Limes Orange Others	2500 1300 300 N/A	Recent BDD/Govt. programme for further development of tree crops.
Grenada	Avocado Grapefruit Lime Orange Mango	800 400 240 600 1800	Recent proposal to develop a further 760 acres in mangoes, sepadillas, guavas, citrus, soursop.
Montserrat	—	130	Recent proposal to develop further 650 acres in limes, mangoes, avocados.
St. Kitts	—	N/A	Assistance from BDD to develop a 40-acre tree crop demonstration project (citrus, mangoes, cashew); proposal to expand development of these crops to 60"-80" rainfall area, in addition to 30 acres cashew-nuts in the drier areas.
St. Lucia	—	N/A	Recent BDD/Govt. programme for further development of tree crops; proposal to develop 10,000 acres over the next 10 years.
St. Vincent	—	N/A	Recent BDD/Govt. programme for further development of tree crops; proposal to develop additional 100 acres.

1/ N/A means Not Available.

- b) A Marine Transport Entity to provide weekly refrigerated or dry cargo roll-on/roll-off trailer service to ECCM states, Barbados and Trinidad, interfacing with other marine carriers such as Geest Lines and WISCO;
- c) A Marketing Coordination Agency (under CFC) which will collect and disseminate regional and extra-regional market intelligence to the Farmer Supply/Service Centres and Market Boards. It will also promote and negotiate trade agreements under the AMP, conduct market research and provide other trade support activities. Operating as a non-profit institution, it will derive its revenue from a levy on produce handled by the Farmer Supply/Service Centres.

The study found that both the Farmer Supply/Service Centres and the transport entity were technically, economically and financially viable if operated efficiently. Although the latter entity could be successfully operated in the absence of the former, since its primary objective was to assist production and export of small farm produce, all elements of the system should be established within a reasonable time if the objectives were to be achieved.

Following a decision of the 17th meeting of the Common Market Council to review the question of the AMP, it was decided to base the review on a technical study of the CARICOM fruit and vegetable sub-sector. CDB therefore provided a grant to the CARICOM Secretariat in 1979 to conduct a general economic study^{2/} into the marketing, processing and production of a list of fruit and vegetables to design an appropriate strategy for the improvement of intra-regional trade in these commodities. The list of fruits included pineapple, limes, oranges, grapefruit, bananas, avocados and mangoes and the study was conducted in all the Bank's member countries.

The main findings of this study are summarized below:

- a) Of an annual total regional import of some 50,000 tons of fresh produce, 85 % is from extra-regional sources; of 23,000 tons of fresh produce currently exported per annum, 80 % is shipped to extra-regional destinations.
- b) Levels of production and trade in fresh produce are low because of a number of weak or missing links, e.g. absence of seasonal advantages among member countries, similarity in the range of fruit crops, limitations of small farmers' production methods and their lack of development resources, praedial larceny and attitudes towards farming, ineffectiveness and inefficiency of many of the Marketing Boards and transportation problems.
- c) The future trade scenario for the mid 1980s suggests that the region's dependence on imported fresh produce is likely to persist unless some major new initiatives are taken. While the LDCs may approach self-sufficiency for most of the year, Barbados and Trinidad & Tobago will

2/ Ref. "An Inter-regional Integrated Production and Marketing System for the Caribbean Community" (1979) prepared by Stevenson & Kellogg, Management Consultants, 2300 Yonge Street, Toronto, Canada, for the Caribbean Community Secretariat.

experience deficits. However, the regional imbalance in production of some commodities could provide the potential for processing or additional exports.

- d) National initiatives would be needed to develop new structures, to refine existing ones e.g. the restructuring of National Marketing Boards and Corporations, to improve efficiency of operations.
- e) Regional initiatives are needed to complement the reforms in the National Marketing Boards and Corporations. These included development of a regional market to facilitate and promote free trade among member states, the development of a transportation network to support such a market and the creation of a Trade Facilitation Unit to provide support, coordination and facilitation services to national Marketing Boards and Corporation. (Note, these recommendations are similar to those in Phase II of the previous study).
- f) Investment opportunities were proposed for a number of CARICOM states to enhance their ability to produce and market additional quantities of fresh produce. The countries are Antigua, Belize, Dominica, Grenada, Montserrat, St. Kitts/Nevis, St. Lucia and St. Vincent (Jamaica, Barbados and Guyana were also mentioned for their comparative advantage in producing white potatoes, onions and pulses respectively).

It should be clear from these summaries that the two studies were market-oriented in scope and did not address the questions of farm production systems and methodology or the production requirements to implant these systems.

The Bank proposes to conduct in the very near future two complementary exercises which are considered relevant to these issues. One is to prepare "A technical manual for commercial tree fruit production in the Bank's regional member countries" and the other is "A survey of existing nursery resources and needs of selected tree fruit cultivars in CDB's regional member countries".

The objectives of the first exercise are as follows:

- a) To update and collate all relevant technical information on the production of a specified range of tropical fruit crops

with existing or potential commercial possibilities in CDB member territories.

- b) To design integrated farming systems involving fruit and other crops that can easily be adopted by small, medium and large farmers, having regard to the existing pattern of farming in the region and/or the possible changes in this pattern in the near future.
- c) To determine the levels of inputs and yield expectations which may be used under prevailing conditions in the region, for an assessment of the economics of production of pure stands of tropical fruits crops and the justification for possible adoption by farmers in those member states where the system appears to be economically and technically feasible.

The scope of the first exercise will include estimates of acreages and production of a selected list of different fruit crops by territory, general suitability of the different countries for sustained fruit production, an examination of existing agronomic and cultural practices, support services, (including input supplies, extension, marketing facilities, training, research) and a review of existing systems of harvesting, post-harvest handling, transport and storage. Dependent on the findings, recommendations are to be made on different production models including improved management packages, etc. A consulting firm has already been identified for this study.

The objective of the second exercise is the preparation of an inventory of existing nursery resources and needs of selected tropical tree fruit cultivars in CDB member territories, with a view to providing an additional data base for formulating and financing development projects in this sub-sector.

Its scope will include a survey of nursery stock primarily in Government nurseries or stations, identification and evaluation of the cultivars for desirable horticultural and commercial characteristics, recommendations for their preservation, demand and supply projections for planting material, identification and resolution of major constraints to rapid nursery production, etc.

CONCLUSION AND RECOMMENDATIONS

Generally there is a great deal of interest in regional member territories in the development of the tropical tree fruit sub-sector.

However, there are constraints to be removed. These include lack of proper statistical data, infrastructural deficiencies particularly in collection, storage, transport and marketing facilities, inadequate production technology in such areas as research and advisory services and varietal characteristics including their post-harvest behaviour. In many of the territories there is also absence of clearly defined objectives or a strategy for meeting these objectives at the national level, thus making it difficult to formulate and coordinate a regional policy.

Given the state of the economy of the LDCs, significant levels of funding will be necessary to develop and transform the tree fruit sub-sector. In this regard, development, bilateral and multi-lateral agencies undoubtedly have a role to play. However, in the absence of inter-agency cooperation or collaboration, national or regional initiatives are likely to be frustrated as a result of duplication and wastage of the available resources.

To avoid this situation, national and regional objectives must be clearly defined and some formal inter-agency mechanism should be established for reviewing the status and further development needs of the sub-sector and channelling assistance to it. Such coordination of effort will, to a large extent, remove some of the frustration now faced by most LDC Governments in mobilising the necessary assistance to their tree fruit industry.

WORK PROGRAMME OF CARDI ON FRUIT TREE CROPS

St. C. Forde

Caribbean Agricultural Research & Development
Institute, Trinidad

Up until recently, the work of the Caribbean Agricultural Research and Development Institute (CARDI) in the area of tree crops has been confined to specific problems that have affected the production of certain tree species in certain Caribbean Countries.

In 1979 work was started to elucidate the problem of Nutmeg Wilt disease which posed a threat to the nutmeg industry in Grenada. In investigations carried out thus far, the characteristic signs of two distinct *Rosellinia* species, one being *R. pepo*, were seen on diseased roots. However, attempts to isolate *Rosellinia spp.* in pure culture have so far been unsuccessful. A work programme has been designed to test the hypothesis that *Rosellinia* either alone, or in conjunction with another pathogen, is the incitant of the current wilt of nutmeg trees.

The recent introduction into Jamaica of the Coffee Berry Borer (*Hypothenemus hampei* Ferr) poses a serious threat to the coffee industry in that country. The Institute along with other agencies is engaged in research on the applied aspects of a control programme.

In its work programme for 1981-1985, the Institute plans for greater involvement in development-oriented projects in food forests.

In the Windward and Leeward Islands of the Caribbean there currently exists substantial opportunity to produce and market a range of tree fruits. Tree crops fit well into the small farmers' multiple cropping systems, are labour —rather than capital— intensive

and have relatively secure market outlets. Additionally, tree crops are suited to the steeper slopes where intensive cultivation of short-term crops by small farmers is resulting in severe soil erosion.

Many fruit tree crops are currently grown, but the varieties are often of a local type and, as such, are not generally suitable for export markets in the United Kingdom or the United States. Some of these local types are suitable for intra-regional trade however, and this market could well be expanded.

Throughout the islands there is a labour surplus, especially among younger men and women in the rural areas. Productive employment to develop basic skills which can lead to further career opportunities, is either scarce or does not exist. This is particularly evident in the agricultural sector.

Although market opportunities are known to exist, fruit tree crops may take five or six years to come into bearing. During this establishment phase they produce no income, yet require inputs such as weeding, fertilizers, and pest control; they however, assist in soil stabilization. The lack of return during this establishment phase deters most small farmers from undertaking serious planting of orchard crops. They may however, be satisfactorily introduced into a multiple cropping system in which income from short-term crops offsets the cost of establishment of those of longer term.

Some form of grant-funded technical assistance is needed to persuade farmers to embark on a programme of planting fruit and timber tree crops on land marginal for food crop production, to exploit the market opportunities and to combat soil erosion.

Specific "orchard/reafforestation" projects would have four basis goals:

- a) to introduce orchard tree crops on to farms to provide additional income in the medium to long term, thereby improving the economic viability of small farm agriculture;
- b) to plant such (tree) crops in a manner as to aid in the control of soil erosion;
- c) in areas unsuitable for orchard crops, such as upper catchment areas and other locations that are too steep and/or exposed, forest tree species should be established to pro-

vide a permanent vegetative cover to protect the lower catchment areas and serve as shelter-belts for the orchard crops.

- d) to provide constructive programmes of training and employment for both young men and women in rural areas.

Allied to the above, there is a need to prepare an inventory of existing nursery resources and need for a selected list of tropical tree fruits in member countries, with a view to providing a data base for formulating and financing development projects in this sub-sector.

The Institute has recently undertaken on behalf of USAID a study to design operational plans to implement labour intensive orchard crop/reforestation projects in St. Lucia and Nevis. This will form the basis for an implementation project in food-forest production that will have among its objectives the improvement of soil conservation and the increase in small farmers incomes by the organized planting of food and other useful trees.

Additionally, under the terms of the study, CARDI will:

- a) develop a list of marketable fruit tree crops and identify the varieties suitable for the growing conditions of the two countries;
- b) review current country programmes, specifically those sponsored by the British Development Division, and in consultation with the Ministries of Agriculture identify specific target areas where small farm holdings are dominant and suitable for orchard crop production and/or require reforestation to prevent soil erosion;
- c) prepare a plan of operation for each target area indicating inputs needed, planting schedules, estimated potential yields and revenues etc.

The Institute also intends to undertake on behalf of the Caribbean Development Bank a survey of existing nursery resources and needs of a selected list of tropical fruit cultivars in CDB regional member countries, with a view to providing a data base for formulating and financing development projects in this sub-sector.

It is recognized that the research base in tree crops must be strengthened. The Institute will seek funding for carrying out a programme of work in the following areas:

- a) Introduction and evaluation of exotic tropical and sub-tropical fruit species.
- b) The introduction and evaluation of forest species for fuel.
- c) Formation of small farm economic units as working models for diversified production.
- d) The study of *mycorrhizae* and better fertilizer efficiency.
- e) The use of soil and foliar analysis as a guide to fertilizer recommendations for tree crops.
- f) Support for a propagation programme utilizing tissue culture techniques.

BRITISH DEVELOPMENT DIVISION IN THE CARIBBEAN

D.L. Jackson

British Development Division, Barbados

The mainstay of many Eastern Caribbean economies is crop production. The Windward Islands in particular are characterized by having only limited areas which can be mechanised, but are blessed with an abundance of rainfall in most areas and are ideally suited to the production of tree crops.

Since 1977 the British Development Division in the Caribbean has concentrated much of its agricultural aid assistance to the development of tree crops, especially in the Windward Islands. Orchard crop development fits in well with a West Indian economy and society as in many ways it is simply an extension of an already established way of life, and farming practice. For centuries mangoes, avocados, breadfruit, guava and citrus have been grown in every backyard. Unfortunately many of the local varieties of these fruits have characteristics that are not wholly acceptable to an export-oriented market. The shipping qualities may not be suitable, the size of the individual fruit may be too large or too small for the consumer, the season of production may clash with other major exporting countries such as Israel and South Africa. However, these problems can be overcome and with sufficient genetic material available in the world today it is possible to plant tree crops in the Caribbean with the desired characteristics.

There is a tendency to rely too heavily on banana production with the result that if there is any interruption in the growing of the crop, as experienced from the recent hurricanes David and Allen, the farmer has few alternative sources of income. Again, bananas are sometimes grown in marginal areas not totally suited to them, thus

giving low yields and income. Orchard crops on the other hand are often better suited and greater returns can be realized.

To this end BDD gave grant aid assistance to the state of Dominica in 1978 for the commencement of a five year programme to plant 1,250 acres of tree crops. The main crops planted are oranges, grapefruit, mangoes and avocados. Similar projects have been started in St. Lucia and St. Vincent although the acreages involved and the tree crop varieties have differed.

The tree crop projects are managed and staffed by nationals in the various islands and come under their respective Ministries of Agriculture. Their salaries and transport costs are borne by BDD.

Each project is run on a basic formula whereby assistance is given mainly to the small farmer. In the initial years inter-cropping is encouraged until the trees reach bearing age. In areas where bananas are already established orchard crops are interplanted amongst the bananas and these then become thinned out to make way for the orchard crop as it develops.

Qualifying conditions for farmers to receive assistance under the project are:

- a) The location must be suitable for the tree crop to be planted.
- b) The applicant must have the right to use the land.
- c) The acreage must be in pure stands.
- d) The acreage must be between 0.5 and 5 acres.
- e) The applicant must agree in writing to follow the instructions of the Department of Agriculture in relation to the operation of the scheme.

If the above qualifications are satisfied then the farmer is entitled to:

- a) Labour assistance in clearing, conservation, drainage, lining, holeing and planting.
- b) Provision of planting material.

- c) Labour assistance in maintaining the new crop plantation up to year 5.
- d) Provision of free capital inputs, including weedicide and fertilizer, up to year 5.

At year 5, the tree will be at or near bearing and the grower then be able to continue normal husbandry practices from the receipts obtained from sales of produce.

The production of fruits is geared to both the Intra-regional and the European markets, for which there is a steady increase in demand for exotics. The actual working out of the details for grading, packing and shipment have yet to be finalized, but it is expected that a Regional Marketing Officer funded by BDD will soon be here and will be able to devote his time to this aspect of the projects.

Hand in hand with the growing of tree crops is the equally important task in the timely supply of healthy disease-free planting material produced at the propagation centres.

In general these centres have become rundown, buildings have deteriorated, irrigation equipment needs renovating or new equipment installing, and new shade areas need constructing. The British Development Division is currently involved with the reconstruction of propagating centres in Dominica, St. Lucia, Antigua and St. Kitts. In the Turks and Caicos Islands and the British Virgin Islands BDD is establishing propagation facilities for the islands' needs. The Division has also provided Technical Assistance in the form of professional horticulturalists to assist in the setting up and management of plant propagation centres, and training in propagation techniques in Antigua and Belize. Provision is also made for the purchase of seeds for rootstocks and scions for budding and grafting. These often have to be imported as the desired varieties are not always available on the particular island involved, at any time.

Apart from the propagation and growing of a crop there is the question of processing and sale of the final product. Here again BDD has given considerable assistance in the improvement of marketing facilities in St. Vincent, St. Lucia and Antigua and St. Kitts. This has resulted in larger and better equipped marketing buildings and technical expertise, as well as provision of vehicles to collect farm produce from the districts. Agro-labs have also been set up with British Aid in several Islands to process fruit juices and other commodities which have been put on display at the Fair constituting part of this meeting.

Built into the tree crops project is provision for farmer training. This mainly consists of day courses to which farmers participating in the project are invited and cover such topics as land preparation, planting, maintenance, fertilizer application, and disease and pest control. When the trees reach bearing age courses will be implemented in aspects of harvesting, grading and packing. Extension Officers are also invited to attend, and special courses are run for them detailing their part in the project.

In conclusion the BDD is receiving requests for other tree crops projects in Antigua and St. Kitts as well as involvement with coconut rehabilitation projects.

I would like to thank the organizers for the invitation extended to Mr. Waddell, Natural Resources Adviser in BDD, and myself to attend this Workshop, and trust this brief report will indicate to delegates how the British Development Division is seeking to help achieve the general objective of the workshop, namely "To promote the increased and accelerated economic exploitation of fruit tree crops in the Caribbean".

COUNTRY REPORTS



FRUIT TREE CROP PRODUCTION IN ANTIGUA

Jennifer Maynard

Ministry of Agriculture, Antigua

Antigua is an island of about 108 square miles located at latitude 17° and longitude of 62° West. It is comprised of three distinct areas; in the south west are old eroded volcanic mountains, with steep sides and narrow valleys, where small areas of fertile soils are found; adjacent to this area is the central lowland plain of reasonably quite fertile degraded alluvium; the third section of the Island is rolling terrain of the North where the soil is shallow calcareous clay. The mean annual rainfall amounts to forty-five inches (45") although there may be local precipitation of up to sixty inches (60") in parts of the central and south-west areas.

About 75 % of all agricultural land is owned by the Government. Up to 1972 much of this land was cultivated with sugar cane and cotton; since then, the sugar industry was phased out and tree crops and vegetables were introduced as a means of diversifying agriculture.

FRUIT PRODUCTION

There are about 350 farmers owning fruit trees. A rough estimate of the number of fruit trees on the island is given in Table 1.

Included in this count are 9 1/4 acres of established orchards of grafted mango trees, Julie and Bombay, approximately 17 years old, and a smaller area of mature citrus trees on the Government Stations at Green Castle and Christian Valley.

TABLE 1. FRUIT GROWING IN ANTIGUA

Crop	N^o of Trees on Island	N^o of Trees at Christian Valley
Orange	2175	370
Lime	2200	77
Grapefruit	650	87
Tangerine	N/A	21
Mango	15750	455
Avocado	1000	471
Cashew	N/A	172
Soursop	N/A	318
Sugar-apple	N/A	98
West-Indian-Cherry	N/A	14
Guava	N/A	500

PLANTING MATERIAL

The Christian Valley Plant Propagation Station was established in an attempt to meet the tree crop needs of the Island. It consists of about 23 acres of avocado, mango and citrus, and a number of minor fruit trees. The main purpose of the station is:

1. to propagate economic trees like mango, avocado, citrus, guava and others, for sale to farmers;
2. to evaluate local and newly introduced varieties for selection of good quality, high-yielding varieties suitable for the various potential markets;
3. to produce forestry plants and "difficult to root" ornamentals.

Listed below are the propagation methods now being used:

- 1) Budding Citrus
- 2) Grafting Avocado
 Mango
- 3) Seedlings Guava
 Soursop
 West-Indian-Cherry

Sugar-Apple
Custard-Apple
Malay-Apple
Cashew
Papaya

With reference to output there have been rough estimates of our potential. In Table 2 are shown production potential, actual production and comments on the actual production.

The only pure stands of fruit trees exist on Government Stations; all the other trees are scattered over the island in backyard gardens, at family plots, or in old abandoned plots. The trees on the station are not yet producing at a commercial level.

TABLE 2. PROPAGATION OF FRUIT TREES IN ANTIGUA

TYPE OF GREES	ESTIMATED PRODUCTION POTENTIAL		ACTUAL PRODUCTION		COMMENTS
	1979	1980	Up. to Nov. 1979	Up. to July 1980	
Mango	2000	2000	1483	3107	No production problem anticipated in the foreseeable future; unlimited rootstock and budwood supply situated on the project.
Avocado	1000	1000	1011	485	Shortfall in 1980 due to hurricane damage to fruit in 1979 and theft of fruit also a problem; budwood readily available but seed for rootstock may have to be bought from supermarkets, hotels, or hucksters.
Papaya	1000	1000	—	—	Lack of reliable planting material on island; need for selection of seed from local population and also importation of recognised good cultivars grown elsewhere. Careful watch to be maintained for occurrence of die-back, bunchy top and other diseases.
Orange	2000	2000	892	822	Severe shortage of root stock (sour-orange and rough lemon).
Lime	1000	1000	250	150	Probable need to import seed to grow rootstocks.
Tangerine	300	500	277	134	

TABLE 2. CONT'D PROPAGATION OF FRUIT TREES IN ANTIGUA

TYPE OF TREES	ESTIMATED PRODUCTION POTENTIAL		ACTUAL PRODUCTION		COMMENTS
	1979	1980	Up. to Nov. 1979	Up. to July 1980	
Grapefruit	600	800	190	134	Trees to produce material for rootstock have been established on the Stations, so this problem will be alleviated.
Guava	300	300	1000	—	Grows wild so plants are not bought at present; propagation of clones by cuttings and establishment of a demonstration plot will be of advantage.
West-Indian-Cherry	100	100	Small amt.		No apparent reason for low production; need to try vegetative propagation.
Soursop	50	50	1096	—	Plants are not purchased; Need for promotion.
Cashew	50	50	—	1096	Plants are not purchased; Need for promotion.
Malay-apple	50	50	—	—	Very few adult trees in Antigua although fruit well liked; very few seeds available; need to try vegetative methods of propagation.
Sapodilla	50	50	—	—	Great public demand; very few seeds available; need to acquire information on propagation methods.
Other (Golden-apple, Custard-apple, Plums, Carambola, Bilimbi Mammee-apple)	50	50	—	—	Need for information on propagation methods; none at present in practice.
Breadfruit	—	—	—	—	High demand for the fruit and Ministry presently working on producing up to 5,000 plants; very few trees exist and there is lack of root cuttings; need to import.

MARKETING

Most of the fruits on the market are from scattered trees; this makes it difficult to evaluate the potential for production, at present, from these so-called "wild trees". However, the figures given in Table 3 below are intended to provide an idea of minimum production levels:

TABLE 3. FRUITS EXPORT TO BRITAIN 1979

CROP	WEIGHT (lb)
Mango	80,000
Green Papaya	2,446
Sugar-apple	1,000
Lime	8,000
Guinep	1,600
Soursop	2,800

The Central Marketing Corporation has been taking advantage of the operation of British Airways in Antigua to air-freight fruit to British importers, and has been allowed the following quotas (lb):

Mango	25,000
Limes	25,000
Tamarind	12,480
Citrus	25,000

if the quantities can be made available.

With the increased development of the tourist industry further markets should be sought in the hotels for fruit crops. There should also be import restrictions on various fruits during their local bearing season.

Post-harvest handling of fruit for market currently leaves much to be desired. The small farmer and the huckster or other retailers, even the supermarkets sometimes, do not show appreciation of the value of quality, so this area needs much attention. There is urgent need to communicate to fruit-handlers the basics relating to quality, grading, handling and their effect on shelf life of fruit.

PROCESSING

Processing has been seen as a way to ease gluts. Pepper sauce in which papaya is used and fruit nectars have been prepared. It has been estimated that 48,000 lb. of lime juice per year is possible, with daily production of 62 lb for four months of the year.

Research will be necessary to evaluate varieties for processing and also to evaluate the part which a processing unit will play in initiating processing projects in Antigua, bearing in mind that a processing plant cannot be run on gluts or rejects of fresh produce.

THE FUTURE

In relation to fruit tree production in the future, despite the large number of farmers with fruit trees only a few have plots larger than one acre; most of the existing trees are scattered on Government-owned land or abandoned plots. In addition, the Government leases land to small farmers, in plots of up to five acres in size, on a year to year basis, and special permission is needed for planting trees on these plots. This could indeed be the main deterrent to expansion of fruit tree production. Other constraints are:

1. High costs of planting material, transport, labour to establish the crop, fencing to protect against roaming livestock;
2. Absence of incentives as subsidies or credit schemes;
3. Difficulty in providing security on present land tenure system;
4. Lack of tradition in fruit growing;
5. Low rainfall patterns in some areas;
6. General attitude towards trees, namely that once planted "God will take care of them".

However, the long gestation period which tree crop projects have is probably the most serious constraint. Here inter-cropping should help to alleviate the problem.

PROJECTS

The three main projects presently under consideration are:

1. Small Farmer Tree Crop Project being reconsidered by the British Development Division for funding, to assist farmers with land, fencing, buying planting material and other inputs.

2. The Body Ponds Project of over 250 acres with 13-acre plots is being seriously considered pending Government's funding commitments and the revision of tenancy agreements.
3. Arbour Day, a day on which a national distribution of planting material of fruit tree crops takes place.

CONCLUSION

Our potential is known to us, the constraints have been identified, but we need to formulate a simple, unsophisticated low cost project, to remove the stumbling blocks which are hampering tree crop development. Much research has been done in the region and outside. For this reason our own research needs to be geared to information retrieval and interpretation: the information needs to be studied and modified to meet our needs rather than launching out into research which may result in costly duplication.

We have spoken, but "action speaks louder than words".

FRUIT TREE CROP PRODUCTION IN BARBADOS

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INTRODUCTION

Fruit tree crop production in Barbados is organized and controlled to a large extent from seed to fruit production by the Scotland District Development Project — a government owned and operated agricultural station located at Haggatts in the Parish of St. Andrew in the Scotland District. Here there is an established nursery which produces around twenty five thousand (25,000) plants annually for sale to the farming community in Barbados: Production is increasing significantly each year as demand increases. Of the seedlings produced, there are about:

- 12000 citrus — mainly limes, oranges, grapefruits.
- 8000 mangoes
- 2000 avocados
- 1000 cherries
- 2000 mixed fruit — bananas, guavas, paw paw, cashews and grapes.

Traditionally, fruit tree crop production in Barbados has been essentially a back-yard operation and there are few private holdings amounting to more than half-acre. However, these back-yard holdings are given heavy inputs from our agricultural extension services with the aim of improving tree cropping on an agricultural and economic basis, as yields have been observed to be relatively low.

The largest established orchards are owned and operated by Government and are located in the Scotland District. These orchards totaled some one hundred and five acres (105) in 1980 with the following acreage distribution:

Coconuts	50
Citrus	15
Cherries	20
Avocadoes	10
Mangoes	5
Mixed fruit	5

In these Government-owned orchards much research work is carried out and supported by extension services to educate the farmer and general public in orchard cropping through various demonstrations.

PRODUCTION SYSTEM

In 1971 small holders produced 94 % of total fruits – small farmers accounted for 51 % and kitchen garden producers 43 %, while plantations produced the other 6 % (Table 1). The small holders produced the greater proportion of each fruit, although plantations seemed to specialize mainly in citrus and to a lesser extent coconuts.

TABLE 1. FRUIT PRODUCERS – 1961 AND 1971

CROP	10 ACRES PLANTATION (Nº OF TREES)		10 ACRES SMALL HOLDERS (Nº OF TREES)		% OF TREES ON PLANTATION		% OF TREES SCATTERED	
	1961	1971	1961	1971	1961	1971	1961	1971
Bananas ^{1/}	13 236	11 487	125 743	78 534	10	13	87	56
Avocadoes	956	544	7 134	6 003	12	8	97	97
Mangoes ^{2/}	628	525	4 893	4 148	11	11	99	97
Breadfruit	853	577	14 141	9 421	6	6	94	97
Limes	750	804	4 923	3 838	13	17	99	93
Grapefruit	508	665	1 218	1 724	29	28	95	80
Oranges	463	750	817	1 298	36	37	96	80
Coconuts	22 164	3 758	40 318	24 536	36	13	68	88

Source: Census 1961 and 1971.

1/ Bananas and Plantains.

2/ Mangoes - grafted and simple.

Between 1961 and 1971 there was a reduction in the number of all types of fruit trees except citrus (see Table 2) on both plantations and the small holdings. The increase in citrus trees could be associated with a rising demand and with the fact that the results of regional research on this group were available at this time; a programme of research and national distribution was also started with this crop.

TABLE 2. NUMBER OF FRUIT TREES AND ACREAGE 1961 AND 1971

CROP	NO HOLDINGS PRODUCING FRUIT		TREES PER ACRE	TOTAL ACRES		% TREES IN SCOTLAND AREA 1/	
	1961	1971		1961	1971	1971	1961
Bananas 2/	8 476	4 450	540	285	167	35	32
Avocados	4 895	3 199	50	165	40	20	16
Mangoes 3/	3 574	2 560	35	160	134	21	18
Breadfruit	6 762	4 392	35	450	286	24	28
Limes	3 028	2 251	200	28	23	10	7
Grapefruit	813	869	70	23	34	19	18
Oranges	542	636	100	13	21	14	15
Coconuts	6 011	4 967	70	1 170	404	17	34

Source: Census 1961, 1971.

1/ *Scotland District - St. Andrew, St. Joseph.*

2/ *Includes Plantains.*

3/ *Includes grafted and simple.*

A number of other findings on fruit production from censuses of 1961 and 1971 can be highlighted, as follows.

1. Fruit production in Barbados is of a scattered nature, which is in keeping with the fact that backyard production is dominant. However, the production of scattered coconut trees increased from 68 % of the total in 1961 to 88 % in 1971, while bananas and citrus experienced an increase in compact stand production.
2. The number of holdings producing citrus between 1961 and 1971 increased while holdings producing the other fruits decreased.
3. Between 1961 and 1971 the Scotland District showed increased production for a number of fruit crops – bananas, avocados, mangoes.

Since 1971 there has been an acceleration of research from which findings have been passed over to farmers and the distribution programme has expanded. Estimated total fruit production which varied little throughout the period 1960 to 1976 is given in Table 3.

Four characteristics of fruit production should be underlined:

1. Very low yields are obtained. In 1970 it was reported that in Barbados orange production was at a rate of 1,000 lb

TABLE 3. FRUIT PRODUCTION

YEAR	QUANTITY (MILLION LB)	VALUE (MILLION B\$)
1960	21.0	2.1
1966	21.0	2.5
1968	21.0	2.5
1969	21.0	2.9
1970	21.4	3.4
1971	21.4	4.1
1972	21.4	4.5
1973	21.4	6.4
1974	21.4	5.4
1975	21.4	6.2
1976	21.4	5.8

per acre compared with 40,000 lb per acre in the United States, and that other fruits yielded only 1/10 to 1/4 of what should be obtained^{1/}. These low yields may be associated with local ecological conditions —shallow soils, strong winds, uneven rainfall distribution— and lack of knowledge of proper fruit husbandry.

2. **Poor quality of fruits.** The poor quality of local fruits may be associated with four factors:
 - varieties
 - lack of water, shade and other production techniques.
 - poor harvesting methods. Fruits are usually collected after falling to the ground.
 - lack of grading and other marketing functions.
3. **Scattered production.** During 1971 it was found that around 80 % of fruit trees were scattered and this makes marketing very difficult.
4. **Seasonality of production.** Flowering in most tree crops occurs in response to the stress of a dry spell, so that production coincides very often with the wet season — June

1/ Analytical study of the Agricultural Sector of Barbados I.D.S., May 1971.

to December. Some tree crops, however, flower twice per year e.g. some mango varieties, while others produce all the year round, depending upon the availability of water, e.g. bananas, plantains and pawpaw.

IMPORTS

Imports of fresh fruits seem to have little relationship to the period of domestic production but more to the availability of supplies in the exporting country and the tourist demand. In both 1971 and 1974 over 60 % of citrus imports took place during the first six months of the year which is also the period of local production. In 1974, 77 % of the fresh fruits —mangoes, pineapples, pears and apples— were imported during the last quarter of the year, clearly the result of the high Christmas demand, and the beginning of the tourist season.

Between 1960 and 1976, the imports of fruits traced a remarkable pattern which is outlined in Table 4. Total imports of fruits increased from 11.6 million pounds in 1960 to 12.5 million pounds by 1976 (0.5 % per year) while the value of these imports increased from \$ 1.1 million to \$ 5.2 million over the same period — 23 % per year increase. Although total fruit import increased in volume, the volume of fresh fruit imports decreased from 9.8 million pounds in 1960 to 6.2 million pounds by 1976, while the volume of processed fruits increased from 1.8 million pounds to 6.3 million pounds. The volume of fresh fruits imported decreased, but the value increased from \$ 0.7 million to \$ 1.6 million during the 1960-1976 period representing a growth rate of 8 % per year.

TABLE 4. FRUIT IMPORTS AND PRICE — 1960-1976

YEAR	FRESH		PROCESSED		PRICE 1/ (€/LB)
	QUANTITY (MILLION LB)	VALUE (MILLION \$)	QUANTITY (MILLION LB)	VALUE (MILLION \$)	
1960	9.8	0.7	1.8	0.4	9
1966	8.9	0.7	3.8	1.0	12
1968	7.8	0.8	5.4	1.5	12
1969	5.6	0.6	5.1	1.5	14
1970	6.1	0.8	6.8	2.2	16
1971	5.5	1.0	6.2	2.1	19
1972	6.2	1.2	7.9	2.7	21
1973	4.4	1.2	5.9	2.6	30
1974	4.9	1.2	5.1	2.7	25
1975	5.3	1.2	4.9	3.2	29
1976	6.2	1.6	6.3	3.6	30

1/ Average import price.

In 1960 processed fruits represented 16 % by volume and 36 % by value of total fruit imports, while in 1976 this item accounted for 50 % by volume and 69 % by value of total fruit imports. In 1975 fruit juices —mainly citrus— represented 71 % by volume and 59 % by value of the total processed fruits imported.

Therefore, assuming that production remained relatively constant, it appears that substitution took place between fresh and processed fruits. In addition, the high import of the processed product offers some opportunity for import replacement through local processing.

CONSTRAINTS

Soil: For good growth and production, it is believed that fruit trees require a soil which is loose, relatively free draining and having a minimum depth of six to seven feet; four feet may be sufficient for citrus varieties which are shallow feeders.

Barbados may be sub-divided into two areas in relation to soil, the Scotland District and the Coralline Limestone area. While the soils of the coralline limestone are loose and free draining, obtaining areas of over three feet in soil depth would be a problem. In addition, the soils of this area contain high levels of calcium which reduce the availability of certain nutrients, e.g. phosphorus. On the other hand, the soils of the Scotland District have the required depth but they are compact, impermeable to water, subject to erosion, and are of a sloping topography.

Although mitigating treatments are available, e.g. blasting to increase soil depth, mulching to improve water penetration, and contouring for handling sloping topography, and further research is being undertaken to solve these problems, soils must still be considered as a constraint to fruit production if only because of the cost for its improvement.

Rainfall: Water is essential for the proper growth and production of fruits trees. Citrus requires continual moisture throughout all stages of growth, avocados require water from flower initiation until fruit maturation, while mangoes which need a dry period to initiate flowering require water for fruit development and further vegetative growth.

Barbados receives between forty and eighty inches of rainfall annually, which is more than enough for successful fruit tree produc-

tion, since most fruit crops require between thirty and forty inches of water per year. However, around 80 % falls during the wet season —June to December— which makes water a limiting factor during the dry season. Additional water, therefore, is critical for the development of a commercial fruit crop sub-sector.

The problem is to assess the quantity of water required and then to assess the profitability of irrigation for various irrigation systems and productivity levels.

Wind: Fruit trees exposed to desiccating, salt-laden winds grow poorly, exhibiting such symptoms as bark splitting, browning and die back of foliage and young shoots, and exhibit increased susceptibility to scale insects.

Barbados is swept yearly by the salt-laden Northeast Trade Winds, and since the island is small in size and relatively flat, there are few natural shelters other than those in the Scotland District. Therefore, it is always advisable to establish wind-breaks when cultivating fruit trees. However, the three crops identified as being suitable for wind-breaks also have their problems. Barbados Olive has a termite problem, *Gliricidia* must be kept pruned to maintain flush growth, and Barbados Cherry, as a wind-break, is unsuitable for very tall trees like avocados.

Technical Knowledge: The research work completed so far in fruit cultivation is somewhat limited as fruit crops have a long gestation period and work only started about fifteen years ago with a small staff. However, Extension Officers are still able to make general recommendations on fruit production in such areas as spacing, preparation of holes, wind-break and water needs, mulching and disease control. Many other research areas still need to be covered — mixed fruit cultivation, inter-cropping fertilizer and irrigation needs. Commercial plantations will require new types of research and close liaison between researchers and producers.

Marketing: Like vegetables, marketing of fruits has to take into consideration seasonality, perishability, and numerous scattered producers. It is believed that the hawker trade developed as a result of production structure in fruit crops. Recently, technical efforts devoted to fruit production have changed the naturally developed structure without corresponding adjustments on the marketing side. Therefore, if future production is to include commercial plantations to cater for the export, tourist and processing markets, adaptation of the marketing system will be required.

Credit: This becomes important with the initiation of commercial production, since the backyard system is on a very small scale and production techniques —fertilizing, spraying, irrigation— are seldom used. Credit for fruit crop cultivation must take into account the nature of such enterprises, for example, long gestation period and higher fixed costs than other crops. Therefore, credit arrangements should provide for:

1. long repayment periods
2. long grace period
3. repayment preferably coincident with the harvest.

Pests and Diseases: In the past, fruit producers failed to recognize natural pests and diseases as serious constraints to production since losses from such sources were often not noticed —for example, retarded growth of trees— and attacks were not easily identified. There is reason to assume that fruit production can be greatly increased if backyard farmers pay more attention to pest and disease control.

Most of the fruit losses are due to attacks by birds, large animals (monkeys) and man (larceny), up to the point where producers are reluctant to improve or extend their orchards.

Processing: Import figures show that 80 % of all processed fruit consumed is imported; this clearly indicates the need for more processing of fruits in Barbados. There is a small programme, organized at the cottage industry level, involving the preservation of dried fruit; production is low and lack of capital and technical knowledge hinders further expansion and development in this area. Most of the preserves originate from dunks, gooseberry, grape, guava, pawpaw and cherry. Some of the products produced here include wine, cooking sauce, tenderisers, pickles, jellies and syrup.

Fruit Production Policy: Coinciding with the government policy objectives of agricultural diversification, the Ministry of Agriculture, Stanleys Associates Engineering Limited and Systems jointly conducted a study in 1979 —“The Scotland District Development Study 1979”— in which they examined the full agricultural potential of the Scotland District and made recommendations to Government for its development. Included in these recommendations are:

1. Further research and extension work in tree crop production.

- 2. The planting of an additional 800 acres of land in the Scotland District to fruit trees.**

These recommendations are to be implemented shortly on a project basis by the Scotland District Development Project.

THE PRESENT STATUS OF TRADITIONAL AND POTENTIAL FRUIT TREE CROPS IN BELIZE

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Ministry of Agriculture
Belize

INTRODUCTION

Belize is situated in the Caribbean Basin between 16° and 18° North Latitude and 86° and 87° West Longitude; it is bounded on the North by Mexico and on the West and South by Guatemala. The area of the country including the Cays is approximately 8,866 sq miles.

The annual rainfall varies between forty inches in the extreme North and two hundred inches in the South and the pattern of distribution is most significant with respect to the particular traditional fruit crops that are found growing in the country. The soils change from calcitic in the north and west to leached acidic in the south.

FRUIT PRODUCTION

A wide range of traditional fruit trees is distributed in the country-mango, cashew, avocado, anonas, blackberry (java-plum), craboo (dunks), guava, sapote, malay-apple (pomerac) star apple, sapodilla, velvet-apple, seagrape, cocoplum, gooseberry, jew-plum, breadfruit, and passion fruit. Of these, few have lent themselves to orchard production.

This paper examines the present status of traditional fruit crops in Belize, the incentives that are currently offered by the Ministry of Agriculture and finally suggest possible ways in which ef-

forts for the production of such fruit can be more relevant to making a viable contribution in the agricultural sector.

1. Mango

The year 1973 marked the start of a new era in the production of this crop.

The Tropical Produce Co. Ltd., under the leadership of Dr. Mc Leary, planted out some 1,000 acres with the help of a loan from the Caribbean Development Bank. Stocks were grafted *in situ* using commercial varieties from Florida (Tommy Atkins, Zill, Keitts, and Hayden). Today, Belize is the country with the largest commercial mango orchard in one location. Production for export in 1979 was estimated at 1,200 tons to which must be added figures for local sales. The bulk of the crop is marketed in Canada, Mexico and U.S.A. and rigid phytosanitary conditions of the USDA must be met.

There will be found a few small commercial orchards (less than five acres in size) planted with local varieties, but there is little evidence of work done to improve the practices associated with proper management. In the Stann Creek and Belize Districts most of the existing trees are old, debilitated and partially destroyed by continuous exposure to hurricane winds or severe damage from termite activity.

The main problems associated with Mango Production in Belize can be cited as:

- a) Cyclic production: yields are not consistent, in that one year there may be a profuse yield and a fall in production in the following year. This is most evident, however, in the local cultivars.
- b) Cold damage: flowering (production of blossoms) is usually from mid-November to late January. This period is characterized by cold, dry winds that desiccate the delicate flowers turning them black or, at later stages, cause fruit fall.
- c) Poor weed control: except for very few orchards, weeding is practiced only when fruits are maturing. However, when one considers the market price of local varieties and also the short season of fruiting, it is not difficult to arrive at the reason for the apparent neglect.

2. Cashew

Surveys conducted by the Land Research Division (U.K. team) and the Department of Agriculture estimate that there are over 100 acres of cashew, mainly in the following areas: Crooked Tree, Bermudian Landing, Burrell Broom, Gales Point and Mullins River.

Except for making wine and very little candied fruit, fresh fruit must be said to be poorly utilized. In the light of present evidence, the nutritional value of the fruit needs to be exploited to a greater degree. The nut, however, is collected since it commands a higher price on the market. A house to house survey conducted in Crooked Tree by the author in 1974 has shown that the quantity of nuts collected per family in most cases was directly proportional to the number of children in the family. Usually during collection the nuts (seeds) are removed from the fruit (peduncle) and the fruit is thrown away. One can visualize that not all trees would be reaped since they are in the wild and some areas may be inaccessible. These areas serve as potential sources of dissemination of the cashew.

Nuts are dried and subsequently roasted by batches. Whole nuts enjoy a higher price than broken nuts. At one time, a collecting agency in Belize City was concentrating the supply and marketing it outside the country. This type of operation is characteristic of speculative middlemen who thereby offer an incentive to collecting the nuts. There are now at least four farms in Belize that are growing the crop in conventional orchard layout. Trees are grafted with material from high yielding cultivars, in an attempt to establish 'clones' and allow for uniform crop plant characteristics later. Measures have been taken by the Ministry of Agriculture to obtain the seeds of a vigorous selected cultivar—"Big Boy"—from a Mr. Smith in Trinidad. Evaluation of yields from selected established trees has been hampered by the prevalence of praedial larceny.

The major problems that affect this "cottage" nut industry can be cited as:

- a) Inaccessibility to crop in Pineridge: better roads are needed to increase the proportion of time spent in actual collection of nuts and there is need to underbrush the areas where trees occur to make these safe from snakes and scorpions.

- b) **Low yields:** Yields are not consistent, and frequently one has to move far into the Pineridge or from one location to another to procure a reasonable collection.

3. **Avocado**

This fruit crop is well distributed on the lime-based soils of the North and Western districts of the country. In certain areas of Belize district, particularly, Bomba and Maskall, the avocado is also at home. The crop does well in the southern districts only if drainage and liming are effectively carried out; in these areas attacks by *Phytophthora* are rampant on both old and young trees; very often death ensues at the first or second flowering. This, to any man, is discouraging but shows unequivocally that the crop is most suitable in areas where the soils and moisture conditions are just right.

While large orchards are not laid out, the use of improved cultivars from Mexico (Los Mangos) and Guatemala is increasing. The propagation units at San Roman Agricultural Station, Yo Creek Agricultural Station and Central Farm are doing their best to meet outstanding orders made by farmers. As indicated earlier the predisposing factors that increase the incidence of *Phytophthora cinnamomi* are prevalent in the Southern districts and justify zoning to confine the crop to the North and West. This is a feasible solution to the disease problem, since it is more economical to buy fruit at market price than to have to cope with the dieback caused by *Phytophthora cinnamomi*. The main problems affecting this crop are:

- a) **Poor collection and handling methods:** these are responsible for fruit bruises leading to secondary invasion by *Rhizopus sp.*
- b) **Utilization problems:** the fruit is primarily consumed as fresh fruit. Evidence shows, however, that a very wide range of products, purees, butters, shampoos, are not made! As a result, there is a large wastage during the fruiting season and little or no fruit can be obtained throughout the remainder of the year.

4. **Anonas.**

There are three main species —soursop, custard-apple, sweetsop; in low lying areas can be found a wild species, the alligator apple. The first named two species are well distributed in the

country and the fruiting season usually begins in late September to January. There is continuous production of flowering structures on the tree. Fruits are used mainly fresh, for ice cream flavouring and to make a drink. The main problems are:

- a) **Moth borer:** This pest has caused considerable damage to young and mature fruits. The young fruits become misshapen and fall off while mature fruits show a large black hole and the surrounding flesh becomes hardened. Secondary attacks by beetles which bore into the seed ultimately give rise to a limited supply of premium seeds for propagation.
- b) **Waterlogging:** Trees in waterlogged areas (except for the alligator-apple) tend to shed their flowering structures; these become blackened and die-attributable to some sort of physiological stress on the tree.

The Ministry of Agriculture has distributed selected seedlings to farmers. A number of farmers have undertaken to treat the crops as a pure stand crop and it is envisaged that *Ananas* may soon play an important role as a commercial fruit crop.

5. Other minor fruit crops

Caraboo, guava, star-apple, malay-apple, sapodilla, blackberry, seagrape, coco-plum, rose-apple, are traditional fruit crops found in Belize. Except for guava, all are a one season crop. Caraboo dominates the market in the Belize and Stann Creek districts, from a limited number of trees harvested. There are at least four distinct varieties — Large Sweet (Hofius Caraboo), Sweet Sour, and Green Sweet. The sweet-fleshed types are consumed fresh while those with acid flesh are bottled in water and the bottles are placed in the sun. When cured the preserve has been known to remain for up to two years, as long as water is continually added to avoid drying out.

Guavas are found growing naturally in pastures or in other areas. Fresh fruits are collected and sold to the Pioneer Food Processors Ltd. which make jam and jelly. There is now a real need for planting out improved varieties so that the supply to the processing plant can be guaranteed.

Sapodilla, although widely known in Belize for its latex (chicle), has not been domesticated as in Trinidad and other countries.

Trees are found deep in the forest and are exploited only by 'chicleros' in the rainy season when the sap flows readily.

Blackberry is a very prolific fruit tree that is very widely distributed; it grows easily and rapidly. Except for wine making, this fruit is left unexploited.

Sapote, velvet-apple, star-apple, malay-apple, seagrape and coco-plum can be said to be found in limited areas. Their wider distribution, however, can be easily implemented.

INCENTIVES

1. Sale of grafted plants at subsidized prices at all Agricultural Stations.
2. The training of Home Economics personnel to increase public awareness of the nutritional value as well as the proper handling and storing of fruits.
3. The continued operation of Pioneer Food Processors to collect and process surplus fruits and vegetables.
4. The establishment of a Rural Education and Agricultural Programme (R.E.A.P) in the rural schools. This acts as a center for the dissemination of appropriate knowledge with particular concern for the food and fruit crops grown in the country.

POSSIBLE SOLUTIONS TO EXISTING PROBLEMS

1. Roads: There is a need for more feeder roads to allow access to the trees that are in the Pineridge areas.
2. Collection and handling units: Collection units allow for steady, sure supplies to the marketing area while suitable handling techniques ensure a fruit of higher quality to the consumer.
3. Credit Schemes to aid farmers: Establishment of pure stands involves a maintenance programme for the trees during the first three to four years before any substantial sale is made. Loans would alleviate the hardship during the waiting period.
4. Reassessment of soil data: There is a need for a proper assessment of soil data to allow the greater use of arable lands that were once designated infertile.

5. A need to educate the public on the importance of fruit byproducts that will definitely reduce the loss of foreign exchange.

CONCLUSION

The optimum use of traditional and potential fruits crop can only be exploited in Belize when efforts are directed at:

1. The use of agronomic techniques to domesticate the varied crops.
2. The development of feeder roads, to facilitate collection, aid in the development of viable farm units to make marketing more effective.
3. Maximizing the use of available crops, particularly mango, cashew, avocado.
4. The need for greater public awareness of the important role that fruits play in improving one's staple diet.
5. The provision of supervised credit to ensure proper fruit orchard development from the initial phase of the cropping programme.



THE FRUIT TREE CROP DIVERSIFICATION PROGRAMME IN DOMINICA

John McIntyre
Government of Dominica

"The mainstay of the Dominican Economy is crop production. Having limited areas that can be mechanised, but blessed with abundance of rainfall in most areas, the country is ideally suited to the production of tree crops".
Quote from the Dominica Sector Plan 1976 – 1980.

Traditionally, Dominica has been involved in the growing and production of tree crops for a long time; the topography and climate lend themselves to the expansion and development of these crops. The island has always been known for decades to be the 'fruit basket' of the Caribbean. Tree crops such as avocado, mango, and citrus are the main crops of economic importance, while the annonas, such as soursop, sugar-apple, custard-apple, although grown on the West Coast in small quantities, have not been developed and are only considered as backyard crops mainly for family use.

Very recently, in keeping with Government policy of crop diversification in agriculture, so as to move away from the present dependence on the one crop economy, which every year remains a target for the tropical disturbances and hurricanes, a Tree Crop Diversification Programme was submitted to the British Development Division and was funded, for the establishment of large acreages of tree crops (Table 1). Crops with high export value are to be established over a five year period in areas zoned for tree crop expansion. The crops selected for this first phase of the programme are avocado, mango, Ruby grapefruit, oranges and cocoa.

**TABLE 1: TREE CROP DIVERSIFICATION PROJECT (July 1978-
OCTOBER 1980).
SUMMARY OF ACREAGES ESTABLISHED**

PERIOD	No. of Farmers Participants	ACREAGES ESTABLISHED TO DATE					
		Oranges	Avocado	Grapefruit	Mango	Cocos	Total
Phase I 1978/1979	238	99.75	37.50	44.00	63.75	5.00	250.00
Phase II 1979/1980	272	113.25	31.00	32.00	68.75	5.00	250.00
Phase III 1980/1981	159	61.75	2.00	70.25	16.50	2.25	152.75
TOTAL	—	274.75	70.50	146.25	149.00	12.25	652.75

Farmers are offered financial and material incentives to help prepare the land and use specially prepared planting material produced by the Ministry of Agriculture. Assistance is provided in the maintenance of all plots established under the programme until they come into bearing. This project is facilitating Government control of the orderly rehabilitation of existing plantings and the establishment of new tree crops which have a high yield potential when optimum cultural and husbandry practices are applied during the establishment phase.

The main objective of the programme prior to Hurricane David was to expand the acreage of commercial high quality new tree crop plantings by 1250 acres over a period of five years.

A survey carried out by the Ministry of Agriculture after Hurricane David revealed that approximately thirty percent (30%) of old established tree crops had been destroyed and a further fifty percent (50%) of the new and old plantings damaged and partially destroyed. The Government is initiating and developing programmes to rehabilitate and re-establish those acreages damaged and destroyed. Other than those tree crops mentioned earlier, there has been no priority rating on fruit tree crops.

The Government of Dominica, however, sees and appreciates the need, not only for the establishment, but also the development, of an organized tree crop programme for the region. Such a program-

me should have a central association for coordinating the production, marketing and research aspects in the region.

Local research into fruit tree production is practically non-existent. The Government, however, has established throughout the state, over the years, a number of observational plots with those crops which fit into the Diversification Programme, and development of these is monitored closely with special reference to varietal behaviour, fertilizer response, fruiting habits etc. My Government sees an urgent need for setting up a Central Committee for research programmes of the region and for the dissemination of the technical information to the various countries.

Fruits grown in the state have been in very short supply, since Hurricane David. Normally there should be produce of these tree crops for marketing through various agencies for the local, regional and European market, in keeping with the usual trend of an abundance at one period, followed by shortage at another. In the Citrus Industry there exists well organized trade with the United Kingdom with Dominica's grapefruit and this is handled through a farmers' amounts of the other fruit crops are marketed on both the local and regional markets: the quality of the product at the market end leaves much to be desired and there is need for much work and organization to be carried out on this market.



FRUTALES TROPICALES: SITUACION ACTUAL Y PERSPECTIVAS EN LA REPUBLICA DOMINICANA

Rafael Marte

Secretaría de Estado de Agricultura
República Dominicana

1. INTRODUCCION

La creciente demanda de frutas para la dieta alimenticia tanto en el Mercado Interno de los países productores como por parte de aquellos importadores que observan un rápido crecimiento demográfico, así como el reconocimiento que hoy se hace de las frutas como fuente de vitaminas fácilmente asimilables, ofrece perspectivas halagadoras que hablan por sí solas de la conveniencia y necesidad de establecer programas dirigidos a la explotación técnica de los recursos potenciales de los Países Caribeños. A todo ésto se une la alta rentabilidad de este conjunto de cultivos.

El desarrollo de la Fruticultura Comercial en nuestro país ha observado un cierto incremento en los últimos años. Pero ha sido un incremento tímido, no ajustado a la demanda internacional, pese a que países con menos potencial producen frutas tropicales y subtropicales para satisfacer parte de sus demandas. Sin lugar a dudas, la baja oferta ha sido responsable de esta situación, ya que son conocidos los altos costos de producción determinados por las condiciones artificiales bajo las cuales se producen tales frutales.

Por otro lado, la generación de conocimientos y la transferencia tecnológica son aspectos que no han recibido todo el apoyo que requieren si se analiza al grado de desarrollo de estas actividades en los países del Caribe. El recurso humano especializado es uno de los principales factores limitantes al desarrollo de la fruticultura, pero

también lo es el poco interés que los sectores de decisión ponen en estas actividades, muy especialmente en las frutas, pues éstas, en su mayor parte son cultivos perennes cuyos resultados sólo se ven a largo plazo, contrario a lo que sucede con los llamados cultivos polícticos o cultivos anuales.

Estas y otras razones nos llevan a la conclusión de que los países caribeños debemos aunar esfuerzos para ejecutar programas comunes y de amplia cooperación, que incluyan tanto el intercambio de informaciones como de recursos humanos, resultados, material vegetativo, financiamiento regional, etc.; y nos permitan asegurar en el futuro, el sitio que de forma natural nos corresponde entre los países productores de frutas en el mundo.

Saludamos y felicitamos, pues, la iniciativa de los organizadores de esta "Primera Reunión-Taller de Fruticultura Caribeña" y auguramos desde ya, los mejores éxitos a la misma.

2. SISTEMAS DE PRODUCCION, POTENCIALES Y RESTRICCIONES.

La República Dominicana tiene una extensión de 48,442 km², y una población de 5,290,178 habitantes; o sea, una densidad de 109 habitantes por km². Su economía depende, básicamente, de las actividades agropecuarias, aunque, el aporte del sector PBI nacional ha disminuido porcentualmente en los últimos años.

Su ubicación geográfica, su ecología, la mano de obra abundante y barata, y la no presencia de ciertas plagas, enfermedades y virus que limiten la producción de frutas, colocan a la República Dominicana en una posición preferencial, potencialmente, dentro de los países productores de frutas en el mundo.

Los sistemas de producción en las diversas especies frutales cultivadas en el país, tienen mucho en común debido, principalmente, a que la mayor parte de la producción viene de plantas aisladas y no de rodales o huertos comerciales establecidos.

República Dominicana ha sido tradicional productor de frutas, pero esa producción es cuestionable desde el punto de vista de la calidad que se ofrece, ya que sus cosechas son de muy variados tipos y están constituidos por el fruto de segregaciones, dado que más de un 90 % de sus plantas provienen de semillas plantadas unas veces por el hombre y otras por animales que han esparcido los cultivos de frutas en una forma desorganizada. Estas características indudable-

mente dificultan los cuidados culturales que pudieran ofrecerse a las plantaciones, así como el acopio y mercadeo de las cosechas.

Sin embargo, en los últimos diez (10) años el auge de la Fruticultura Comercial ha alcanzado niveles sorprendentes, muy especialmente en los últimos dos (2) años. Un ejemplo de ésto lo constituye el hecho de que de 4 viveros oficiales existentes (1979) con una capacidad productiva total de unas 125,000 plantas/año, la Secretaría de Estado de Agricultura cuenta hoy con 30 viveros construidos y 27 en fase de construcción avanzada. Esto representa una capacidad instalada para producir 5,000,000 de plantas al año. Aunque la producción de plantas todavía no es suficiente para suplir la demanda existente, estimada en unos 10 millones de plantas por año, las cifras presentadas son auto-elocuentes.

Una transformación notable en los sistemas de producción es el cambio de plantas aisladas a plantaciones comerciales, lo cual ha favorecido la aplicación de técnicas de producción avanzada en algunos, y una modificación de prácticas en otros.

2.1 Factores que Contribuyen al Potencial del País en Frutales.

2.1.1 Ubicación Geográfica

La República Dominicana ocupa dos terceras partes de la Isla de Santo Domingo de Guzmán, la cual comparte con la República de Haití. Sus territorios están enmarcados entre los 18º y 20º de latitud Norte y 68º y 72º de longitud Este. Su localización le permite competir en los Mercados del Norte y Sur América, las Antillas Menores y Europa; así como en los grandes mercados consumidores orientales y el Japón, siempre y cuando se dispusiera de productos de calidad y ofertas contínuas, para lo ocal el País tiene un amplio potencial.

2.1.2 Ecología

Presenta la característica de un clima subtropical modificado por los vientos alisios del Noroeste y por la topografía del país. Las variaciones climáticas son marcadas, oscilando desde condiciones semi-áridas a muy húmedas.

La pluviometría anual varía de 450 mm a 2,743 mm, registrándose los valores mínimos en el período diciembre-marzo, y los valores máximos durante los meses de abril-junio y septiembre-noviembre, últimos que presentan las dos estaciones de lluvia.

La temperatura media promedio oscila entre los 17.7 grados centígrados y 27.4 grados centígrados. Los valores mínimos ocurren en el mes de enero y los máximos en los meses de agosto y septiembre.

2.1.3 Disponibilidad de Mano de Obra

Nuestro país es eminentemente dependiente de la agricultura y el desempleo es uno de los problemas sociales más graves que aquejan la economía del país. Por esta razón, la mano de obra es abundante y barata.

2.1.4 Relativa Carencia de Plagas, Enfermedades y Virus Limitantes

Son muchas las plagas, enfermedades y, quizás virus que afectan la agricultura en República Dominicana, sin embargo, pocos de ellos son limitantes a la producción de cultivos frutales. Por ejemplo, carecemos de la Mosca del Mediterráneo (*Ceratitis capitata*) temible plaga que hace imposible mercadear una gran proporción de las frutas producidas en el mundo; también carecemos de otras como el gorgojo de la semilla del mango (*Sternochetus mangiferas*) y no tenemos el peligroso taladrador del fruto del aguacate (*Stenomoma catenifer*) temible en México y otros países productores.

Y así, podríamos seguir enumerando muchas otras plagas, enfermedades y virus que son limitantes del cultivo de las frutas en muchos de los países productores del mundo y, que, por suerte la República Dominicana se encuentra libre de los mismos.

2.1.5 Amplia Gama de Material Genético

La mayor parte de los árboles frutales existentes en República Dominicana han sido propagados sexualmente. Esta condición mantenida por mucho tiempo ha hecho posible que las segregaciones producidas constituyan una fuente inagotable de material genético, unas veces de poco interés y otras con características sobresalientes. Ese material permanece en espera de que se destinen recursos para su selección y uso. Es un potencial inagotable que se pierde en la actualidad.

2.2 Aspectos Principales de los Sistemas de Producción

2.2.1 Grupo Cajuil (*Anacardium occidentale*), guayaba (*Psidium guajava*), tamarindo (*Tamarindus indica*), guanábana (*Annona muricata*) y otros exóticos.

Salvo raras excepciones no existen plantaciones comerciales de estos cultivos. La producción, casi en su totalidad, proviene de plantas aisladas y/o grupos de plantas con erráticos agrupamientos. Su propagación, en la mayor parte de los casos, fue por semillas y la siembra pocas veces se efectuó en terrenos propiamente seleccionados para los mismos. Sin embargo, debido al incremento en la demanda de estas frutas, la tendencia actual es a sembrar en huertos comerciales.

El Programa cultural para estas plantas se concreta a la limpieza de área cercana al tronco, fertilización esporádica con fórmulas completas (6-9-10-4; ó 10-5-7), todas de formación y mantenimiento y, raras veces, aspersiones contra plagas y enfermedades que, de efectuarse, se hacen como aplicaciones correctivas.

La cosecha de estas frutas se realiza manualmente en todos los casos, llegando a emplearse métodos rústicos poco recomendables.

2.2.2 **Mango (*Mangifera indica*)**

Aunque pocas, existen varias plantaciones comerciales y, además, grandes proyectos de siembras serán ejecutados en breve, especialmente en la Región Sur del país, la cual posee condiciones ecológicas que favorecen al cultivo. Los mangos cosechados en esta zona se diferencian de otros por las características organolépticas de sus frutas, especialmente en lo que se refiere a color, olor y sabor.

En los casos de plantas aisladas se aplica lo expuesto para los cultivos anteriores.

La limitante número uno del cultivo del mango es la Antracnosis, la cual, especialmente en las zonas húmedas del país, tiende a afectar considerablemente el mercado de frutas cosechadas; por esta razón nos vemos obligados a zonificar las plantaciones futuras.

Uno de los problemas que disminuyen la calidad de los mangos cosechados es la práctica, casi generalizada entre los agricultores dominicanos de cosechar antes de que alcancen la madurez fisiológica, para luego someterlos a tratamientos con carburos y provocar una madurez ficticia.

2.2.3 Aguacate (*Persea americana*)

De todas las frutas tratadas, ésta es, quizás, la que mayor importancia ha recibido en la República Dominicana.

Numerosas plantaciones comerciales con variedades de producción tardía se han establecido, y ya se empieza a paliar, por lo menos, en parte el déficit en la relación oferta-demanda tradicional en las épocas de escasez. Sin embargo, el déficit es muy marcado entre los meses diciembre-junio.

Es este, el cultivo frutal donde más se aplican las técnicas modernas de producción, siendo sólo superados por los cítricos. Aquí se consideran la apropiada selección del terreno, buena preparación del mismo, propagación asexual, correctos distanciamientos, programas definidos de fertilización, control de plagas y enfermedades, y otras prácticas. Sin embargo, al igual que los casos anteriores el grueso de la producción proviene de plantas aisladas, haciendo muy difícil la aplicación de técnicas de producción apropiadas en estos casos.

La limitante principal del cultivo es la podredumbre del pie, causada por el hongo *Phytophthora cinnamomi*, la cual diezma la planta en un período relativamente corto.

Al igual que en las demás frutas, la mayor parte de la cosecha en épocas normales de producción viene de plantaciones silvestres o aisladas.

Existen numerosos tipos de aguacates criollos que varían en calidad, tamaño, productividad del árbol, resistencia a plagas y enfermedades y épocas de cosecha. Todos ellos, sin embargo, tienen un bajo contenido de grasas y, raras veces sobrepasan el 2.5 %.

2.2.4 Lechosa (*Carica papaya*)

Este cultivo es característico en el sentido de que, contrario a todos los demás frutales, excepto la piña (*Annona comosus*) el grueso de su producción viene de plantaciones comerciales.

El tamaño de las plantaciones va desde 0.1 a 32 Ha. En la actualidad se siembran alrededor de 300 Ha en todo el país, un 80 % de las cuales se concentra en la Región Sur, donde las condiciones

ecológicas son caracterizadas por una baja pluviometría, pero donde la lechosa se cultiva con seguridad de riego.

Los programas culturales aplicados son relativamente propios al cultivo. Se tienen programas definidos de fertilización, control de malezas y aspersiones contra plagas.

La disponibilidad de lechosa es relativamente uniforme todo el año, a no ser que fenómenos naturales afecten las plantaciones existentes.

La renovación de plantaciones se hace obligatoria entre los 2.0 y los 2.5 años después del trasplante, como consecuencia de la alta incidencia de virus y enfermedades parecidas.

La limitante principal del cultivo es el Bunchy Top.

2.3 Información adicional

En el Cuadro 1, se ofrece información adicional sobre las plagas y enfermedades de importancia de los frutales en el país. Las distancias de siembra comunes se indican en el Cuadro 2 y los cultivares más importantes se citan en el Cuadro 3.

CUADRO 1. PLAGAS Y ENFERMEDADES DE IMPORTANCIA ECONOMICA EN CULTIVOS FRUTALES EN LA REPUBLICA DOMINICANA

CULTIVO	PLAGAS	ENFERMEDADES
Aguacate	Acaros (<i>Oligonychus punicae</i>) (<i>Eotetranychus sexmaculatus</i>) Trípidos (<i>Selenothrips spp</i>) Termita (<i>Aspidiotus destructor</i>)	Podredumbre de la Raíz (<i>Phytophthora cinnamomi</i>). Antracnosis (<i>Colletotrichum gloeosporioides</i>). Rofía (<i>Sphaceloma perseae</i>).
Mango	Escamas (<i>Coccus spp</i>) Moscas (<i>Anastrepha spp</i>) Trípidos (<i>Selenothrips spp</i>) Termita (<i>Aspidiotus destructor</i>)	Antracnosis (<i>Colletotrichum gloeosporioides</i>). Rofía (<i>Elsinoe mangiferae</i>). Pudrición del Tallo (<i>Diplodia natalensis</i>).
Cajuil	Termita (<i>Aspidiotus destructor</i>)	Antracnosis (<i>Colletotrichum gloeosporioides</i>).
Lechosa	Moscas (<i>Anastrepha spp</i>) Avispa (<i>Toxoptropana curvicanda</i>)	Bunchy top Virus de la distorsión Podredumbre (<i>Phytophthora sp</i>)
Guanábana	(<i>Cerconota sp</i>) (<i>Bephrata cubensis</i>)	Cercospora (<i>Cercospora purpurea</i>) Pudrición del tallo (<i>Diplodia sp</i>)
Guayaba	Escamas (<i>Coccus spp</i>) Moscas (<i>Anastrepha spp</i>) Trípidos (<i>Selenothrips spp</i>) Termita (<i>Aspidiotus destructor</i>)	Antracnosis (<i>Colletotrichum sp</i>) Cercospora (<i>Cercospora sp</i>) Pudrición (<i>Phytophthora sp</i>)

CUADRO 2. MARCOS DE PLANTACION USADOS EN REPUBLICA DOMINICANA

CULTIVOS	DISTANCIAS* (en metros)		
	MINIMA	MAXIMA	MAS USADAS
AGUACATE	8 x 8	11 x 11	8 x 8
MANGO	8 x 8	12 x 12	9 x 9
CAJUIL	6 x 6	9 x 9	8 x 8
TAMARINDO	8 x 8	11 x 11	9 x 9
GUAYABA	5 x 5	8 x 8	6 x 6
GUANABANA	5 x 5	8 x 8	6 x 6
LECHOSA	2 x 2	3 x 3	2.5 x 2.5
ZAPOTÉ	8 x 8	11 x 11	9 x 9
JAGUA	8 x 8	11 x 11	9 x 9
NISPERO	8 x 8	10 x 10	8 x 8
GRANADILLO	3 x 3	5 x 5	4 x 4
ANON	3 x 3	7 x 7	6 x 6

* En terrenos llanos la siembra en cuadrado es preferida.

En terrenos con pendiente se prefiere el sistema triangular o tresbolillo.

CUADRO 3. CULTIVARES DE FRUTALES MAS IMPORTANTES EN LA REPUBLICA DOMINICANA

ESPECIES	CULTIVARES IMPORTANTES	EPOCA DE COSECHA
Aguacate	Pollock Criollos Hall, Gripina 5, Meléndez 2, Booth 8 Semil 34, Choquette, Lula	Mayo-Junio Julio-Septiembre Octubre-Noviembre Diciembre-Enero
Mangos	Criollos (Banilejo, Mariposa, Cachimán, Colón, Yamagui, De a Libra, Hayden, Glenn, Carrie, Palmer, Julie, Zill, Kent, Keitt	Julio-Agosto Agosto-Septiembre
Tamarindo	Criollos	Febrero-Abril
Guanábana	Criollas	Todo el año
Guayaba	Criollas (Dominicana Roja y Dominicana Blanca) Supreme, Ruby Red, Ruby x Supreme, Blich, Patillo	Septiembre-Diciembre
Cajuil	Criollo Rojo Criollo Amarillo	Abril-Julio

3. COMERCIALIZACION Y SERVICIOS DE MERCADEO.

Si el mercadeo puede ser definido como el conjunto de actividades comerciales envueltas en el flujo de bienes y servicios desde el productor al último consumidor, y si el objetivo general del mercadeo es suplir bienes y servicios a los consumidores de la forma más eficiente, el mercadeo de frutas en la República Dominicana deja mucho que desear.

3.1 Importancia de Frutales en el Mercado Nacional.

El Grupo Frutas representa alrededor de un 3 0/0 del Índice de Precios al consumidor y de un 5 0/0 del Índice General de Precios de Productos Agropecuarios en la República Dominicana.

Según cifras publicadas por el Banco Central de la República Dominicana, desde 1973 a 1977, el valor de la producción de frutales a precios corrientes en finca aumentó desde RD\$ 35.0 millones a RD\$ 62.4 millones. Sin embargo, con referencia a los precios de 1970, la producción varió en valor de RD\$ 29.1 millones en 1973 a 31.7 en 1977. Esto significa, según esos datos, que la producción de frutales se ha mantenido prácticamente estancada, mientras que durante ese período, los precios se han incrementado rápidamente. La situación a partir del año 1978 al presente ha cambiado, notándose un ligero aumento en la producción.

3.1.1 Evolución de la Producción

Del Cuadro 4 se puede apreciar que, en general, la producción está creciendo, con excepción del cajuil, guineos y tamarindo. La tasa acumulativa anual de crecimiento de la producción más alta (9.5 0/0) corresponde a las uvas, cultivo en franca expansión, mientras que la tasa más alta en decrecimiento de la producción (15.64 0/0) corresponde al guineo.

3.2 Los Canales y los Márgenes de Comercialización

Los canales de comercialización de las frutas principales son bastante similares, diferenciándose básicamente en los porcentajes que fluyen por cada uno de los agentes de comercialización.

Los agentes más importantes en la comercialización de frutas en el país son el acopiador-camionero y los mayoristas de mercado, los cuales manejan el 98 0/0 de las lechosas que vende el productor, el 69 0/0 de los mangos y el 89 0/0 de los aguacates. Asimismo, en los

CUADRO 4. EVOLUCION DE LA PRODUCCION DE FRUTALES EN LA REPUBLICA DOMINICANA, 1974-1980

Producto	Unidad (1000)	1974	1975	1976	1977	1978	1979	1980	Tasa de crecimiento a/ o/o
Aguacate	Fruta	375306	380090	384875	389659	394444	397151	404000	1.24
Cajuil	Fruta	10052	9978	9904	9830	9756	6455	9000	1.83
Guayaba	T.M.	2618	2670	2727	2782	2838	2895	2900	1.72
Guanábana	Fruta	9333	9397	9462	9527	9592	9657	971900	0.68
Guineo	Recimos	13313	13467	13998	13837	13903	12107	4800	(-15.64)
Jagua	Fruta	340	350	360	370	380	392	400	2.75
Lechosa	Fruta	4864	4930	5212	5586	5542	5535	5400	1.76
Limón Dulce	Fruta	27078	17448	27818	28188	28558	27358	29300	1.32
Limón Agrio	T.M.	5085	6755	5212	5691	6901	7968	5700	0.98
Melón	Fruta	238	280	249	255	255	280	300	3.93
Naranja Agria	Fruta	105243	106275	107307	108339	109371	106126	111400	0.95
Naranja Dulce	Fruta	210306	197629	218041	221908	225775	255828	231460	1.61
Níspero	Fruta	2410	2482	2555	2631	2733	2812	2800	2.53
Piña	Fruta	18438	19355	19558	19609	20189	20786	21300	2.43
Tamarindo	T.M.	1392	1349	1307	1264	1222	1533	1200	2.44
Toronja	Fruta	6407	6588	6770	6951	7133	8067	7500	2.86
Uva	T.M.	464	595	716	724	733	760	800	9.50
Mango	T.M.	629187	636611	644034	651458	658881	666304	-	-
Zapote	T.M.	1539	1561	1583	1605	1628	1972	-	-

a/ Tasa Acumulativa Anual.

Fuente: Banco Central de la República Dominicana 1980.

mercados recibe el 26 o/o de las piñas, el 69 o/o de las lechosas, el 77 o/o de los mangos y casi la totalidad de los aguacates.

Un cambio importante se ha registrado en el mercado de la piña desde 1975. En ese año, la cantidad que se procesaba representaba un 26 o/o de la cantidad comercializada. Actualmente esta cifra se ha elevado a un 73 o/o, es decir un 180 o/o de aumento. Algo parecido podría decirse sobre las naranjas y la lechosa, aunque no se dispone de cifras actualizadas.

Con relación a los márgenes de comercialización, es decir, el porcentaje que el agricultor recibe del precio pagado por el consumidor, podemos decir que, con la excepción de la piña, la lechosa y la naranja de jugo, es muy bajo. Por ejemplo, el margen para el mango es de apenas un 33 o/o y para el aguacate un 38 o/o. Sin embargo, para la piña, actualmente, el margen es de un 63 o/o; para la lechosa y la naranja de jugo es de un 55 o/o.

Ultimamente se ha observado un aumento en el margen porcentual del precio que va a parar al productor. En junio de 1977 este porcentaje era de 44 o/o para la lechosa y a junio de este año es de 55 o/o. Para la piña era de 44 o/o y actualmente es de 63 o/o.

Sin embargo, el mercadeo de frutas no es eficiente en la República Dominicana. ¿Por qué se dice que no es eficiente el mercadeo de las frutas? A nuestro entender, las causas hay que buscarlas principalmente en el costo de los servicios de comercialización.

Es, pues, el costo de los servicios de comercialización lo que importa analizar y no solamente el margen de comercialización. De esta se incluyen los costos de comercialización incurridos no solamente por los intermediarios, sino también por los productores y consumidores.

3.3 Pérdidas Post-cosecha

Una gran porción de las pérdidas post-cosecha en frutas que ocurren en la República Dominicana se origina durante el transporte.

Las frutas son productos delicados. Los daños mecánicos que sufren se inician en el momento mismo de la recolección. Los empaques no protegen suficientemente las frutas contra la manipulación y el transporte, originando pérdidas que varían conforme la naturaleza de las frutas, su grado de madurez, el método de recolección y la duración y forma del transporte.

3.3.1 Deficiencias en el Sistema de Transporte

La forma tradicional de transportar frutas en el país es "a granel", especialmente cuando se hace a grandes distancias, utilizando camiones o camionetas. Los mayoristas (camioneros, acopiadores) y algunas veces los productores, se valen de este sistema para hacer llegar las frutas a los mercados locales y, especialmente a los mercados terminales en las grandes ciudades. Una vez en el mercado, el producto pasa generalmente a detallistas, algunas veces a otros mayoristas de mercado y por último a los consumidores, en la misma forma en que fue traído del campo.

3.3.2 Deficiencias en el Manipuleo y Empaque

Salvo muy raras excepciones las frutas en República Dominicana no son sometidas a un proceso de selección, lavado y empaque. Estas excepciones son los casos de exportaciones en donde la parte que demanda exige presentación y selección.

3.4 Nivel de Eficiencia del Sistema de Mercadeo

Aunque los costos de transporte y demás costos de los servicios de comercialización están creciendo, se estima que el precio a que los productos llegan al consumidor es demasiado alto, tomando en consideración que el valor agregado en cuanto a lugar, tiempo y forma no es acreedor del precio final.

En ese sentido, una alta proporción del dinero del consumidor va a parar a los bolsillos de los agentes de la intermediación, como beneficios netos.

En resumen, los servicios de comercialización se limitan básicamente a llevar los productos de un lugar a otro; de venderlos en lugares que muchas veces no son asequibles al grueso de la población y la ineficiencia en el manejo origina pérdidas que, de una forma u otra, se cargan al precio del consumidor.

4. AGROINDUSTRIA DE FRUTALES.

El desarrollo agroindustrial como parte de una política económica coherente ofrece buenas perspectivas para la solución de los problemas más importantes que afronta la economía nacional. El incremento y el desarrollo de la agroindustria puede provocar un efecto multiplicado. De allí la importancia que reviste el incidir directamente en los aspectos enunciados a continuación:

- 1) Favorece el aumento de la producción y productividad agropecuaria, como resultado de garantizar un mercado estable y precios más justos al agricultor.
- 2) Genera fuente de empleos ocasionales y permanentes a distintos niveles, trayendo como consecuencia, una mejor redistribución del ingreso y aumento de la calidad y nivel de vida.
- 3) Aporta significativamente a la balanza de pagos, pues con el desarrollo agroindustrial se incrementan las exportaciones y se sustituyen de manera efectiva algunas importaciones.
- 4) Mejora los niveles nutricionales de la población, al aportar productos alimenticios en cantidad y calidad requerida para el consumo.
- 5) Minimiza las pérdidas post-cosecha de alimentos de alto valor, al proporcionar el manejo y conservación más adecuado en dicha etapa.

4.1 Capacidad Instalada.

Se hace bastante difícil establecer la capacidad instalada de las agroindustrias, por tipo y categoría, debido al hermético manejo de

las cifras por parte de las agroindustrias, mediante encuestas directas realizadas (Cuadro 5).

Como se podrá apreciar, el uso de la capacidad instalada en las diversas plantas varía entre 53 % y el 77 %, lo que indica que se puede esperar una expansión si el mercado y la producción de materia prima lo permiten.

En el Cuadro 6 se indican los frutales industrializados y los productos que de los mismos se logran. Como se podrá apreciar la piña es uno de los rubros que tiene más diversificación en términos de productos al consumidor.

4.2 Planes y perspectivas de desarrollo de esta industria.

4.2.1 Proyectos en desarrollo.

En la actual coyuntura económica, es fundamental para el gobierno la aplicación de medidas de corto y mediano plazo encaminada a aumentar la oferta de alimentos, crear empleos productivos, incrementar el valor agregado de productos del agro, estimular la formación de pequeñas y medianas empresas y favorecer el desarrollo regional.

CUADRO 5. CAPACIDAD INSTALADA, PRODUCCION ANUAL Y RELACION DEL USO DE LA CAPACIDAD INSTALADA EN LAS PLANTAS INDUSTRIALES DE FRUTALES

PRODUCTO	UNIDAD	VOLUMEN POR AÑO		RELACION DE USO DE LA CAPACIDAD INSTALADA %
		CAPACIDAD INSTALADA	PRODUCCION PROCESADA	
Coco	nuez	3,185,093	2,260,781	71
Piña	fruta	1,966,350	1,310,900	67
Guanábana	quintal	605,169	403,446	67
Tamarindo	libra	52,530	30,900	58
Mango	fruta	30,931,200	25,776,000	83
Cajuil	libra	1,395,000	775,000	55
Guyaba	caja a/	2,793,248	1,643,000	58
Lechosa	quintal	520,390	400,300	77
Toronja	fruta	378,000	270,000	71
Naranja agria	fruta	2,210,000	1,700,000	77
Zapote	libra	909,000	505,000	55
Anon	libra	224,400	204,000	91
Higo	docena de frutas	27,000	15,000	55
Buen pan	fruta	34,200	18,000	53

a/ Caja de 24 libras c/u.

FUENTE: Secretaría de Estado de Agricultura, Encuesta sobre Capacidad Instalada para el Procesamiento de los Frutos. PIDFRU (mimeo).

**CUADRO 6. FRUTALES Y SUS DERIVADOS,
PROCESADOS ACTUALMENTE EN
LA REPUBLICA DOMINICANA**

FRUTALES	DERIVADOS FRUTALES
COCO	Crema de coco Coco rayado en almíbar Leche de coco Aceites Jabones Productos Artesanales
PIÑA	Piña colada (enlatado) Mermeladas Pera-Piña (jugos mezclados) Jugo de piña Piña en trozos (enlatados) Piña en rebanadas Piña molida Pulpa de piña
LECHOSA	Rebanada de lechosa Trozos de lechosa Pulpa de lechosa
GUAYABA	Pulpa de guayaba Mermelada Medio punto Cascos de guayaba Pasta de guayaba
TAMARINDO	Pulpa
MANGO	Pulpa Mermelada Rebanada de mango Pasta
GUANABANA	Pulpa Dulce
ZAPOTE	Pulpas (congeladas)
LIMON	Concentrado de jugo de limón Esencia de limón
NARANJA AGRIA	Mermelada Casco de naranja
NARANJA DULCE	Pulpa Jugo concentrado
BUEN PAN	Enlatado (salmuera)
TORONJA	Concentrado de jugo
CAJUIL	Dulce Pasta Cascos

Existen planes a mediano plazo entre los que se tienen el Plan Trienal de Inversiones Públicas (1980-1982); El Programa Integrado de Desarrollo Agroindustrial (PRIDA) del Departamento Agroindustrial de la Secretaría de Estado de Agricultura y el Programa de Agroindustrialización Nacional, con apoyo de la Organización de las Naciones Unidas para el Desarrollo Industrial (ONUDI).

Es preciso destacar que esos planes responden a la política de gobierno, que tiene como base elevar el nivel y la calidad de vida de las poblaciones de más bajo ingreso, generar empleos y desarrollar la actividad primaria (agricultura).

4.2.2 Incentivos para el desarrollo agroindustrial.

La falta de una política adecuada que restó importancia a la producción agropecuaria en su rol de factor de producción sostenida, capaz de suplir la demanda de las industrias instaladas y de las que se estaban estableciendo, motivó que varias empresas agroindustriales establecidas limitaran la elaboración de bienes y en algunos casos, que desaparecieran. Esa situación también ha favorecido la importación de materia prima y de bienes intermedios para la agroindustria, provocando una distorsión en la economía nacional.

La ley 299 es buena medida generadora del fenómeno mencionado, ya que orienta sus incentivos mediante exenciones arancelarias a los insumos (materias primas, bienes intermedios o semiprocesados), maquinarias agroindustriales y exoneración de impuestos sobre la renta, entre otros, que se suman a otros factores de apoyo fiscal que ha recibido el sector industrial para su desarrollo.

5. INVESTIGACION Y TRANSFERENCIA TECNOLÓGICA.

La Investigación Agrícola es responsabilidad directa del Departamento de Investigaciones Agropecuarias. Las Universidades nacionales también realizan investigaciones, pero con miras a satisfacer el requisito de Tesis de sus estudiantes de término.

Específicamente para frutales la investigación se organiza en el año 1973 con la creación de la División de Horticultura Tropical, cuya función principal fue la de planear, establecer y conducir las investigaciones que en materia frutícola constituyeran problemas limitantes a los cultivos. Sin embargo, pocos son los resultados de esas investigaciones, debido quizás a dos causas principales:

- 1) Pocos recursos humanos especializados.
- 2) Pocos recursos económicos.

Las investigaciones sobre conservación y pérdidas post-cosecha de frutas son realizadas por el Instituto Dominicano de Tecnología (INDOTEC) organismo especializado, dependiente del Banco Central. Esta institución posee tanto el personal como los recursos económicos necesarios para hacer un excelente trabajo, pero sus resultados son poco conocidos.

Es necesario crear conciencia sobre la importancia de la investigación a todos los niveles, pues es indudable el escaso apoyo que recibe este renglón lo cual se evidencia al analizar el Cuadro 7 comparativo del desarrollo de personal especializado en frutales:

De este cuadro se deduce que la Investigación en Frutales va en decadencia en el período 1974-1980. Lo inverso ocurrió en el área de fomento pues de dos especialistas con que contaba el sector oficial para 1974 hoy cuenta con 18.

La Capacitación técnica es otro de los obstáculos que limitan el desarrollo, no sólo de investigaciones sino también de cualquier programa tendiente a incrementar los frutales en el país. De cuatro universidades, sólo una ofrece cierta orientación sistemática sobre horticultura y aún ésta, en sentido muy general y poco especializado.

La transferencia de tecnología en nuestro país es tan deficiente como la investigación misma. Sin embargo, la misma promete un cambio inminente con la orientación de la investigación enmarcada en el enfoque de Sistemas de Producción y el esfuerzo del Sistema de Extensión "Capacitación y Visitas", el cual se apoya en una serie de principios que, aplicados en conjunto, traen como consecuencia una sistematización de la asistencia técnica. Esta sistematización puede producir a corto plazo resultados altamente satisfactorios, no sólo para el productor sino para la producción también.

CUADRO 7. PERSONAL TECNICO CON ESPECIALIDAD EN EL CULTIVO DE FRUTALES

Grado Académico	Número de Técnicos en todo el país	Trabajando directamente en Investigación		Trabajando directamente en Fomento de Frutales	
		1974	1980	1974	1980
Ph. D.	1	—	—	—	1
M. Sc. Ma.	6	2	1	—	2
Ing. Agrón.	20	4	—	2	15
TOTAL	27	6	1	2	18

El sistema "Capacitación y Visitas" se basa principalmente en capacitar periódicamente al extensionista para definir el mensaje técnico que será transmitido a productores especialmente seleccionados mediante visitas sistemáticas a sus fincas. Los cinco elementos básicos para la operación del sistema son los siguientes:

- 1) El técnico extensionista.
- 2) La Capacitación Sistemática.
- 3) El mensaje técnico relevante.
- 4) El productor especialmente seleccionado.
- 5) La visita Sistemática.

6. LOS PROGRAMAS NACIONALES DE APOYO A LA PRODUCCION Y SUS PROYECCIONES.

El Programa Integrado de Desarrollo Frutícola (PIDFRU) fue creado en septiembre del año 1971, con la idea de integrar, hacia la consecución de metas comunes, todos los programas frutícolas que las diferentes instituciones oficiales llevaban a cabo de manera aislada.

Con su creación nace el dinamismo en el fomento de plantaciones comerciales. Los cuatro viveros con que contaba el sector oficial en el año 1979, pronto fueron insuficientes para satisfacer la demanda por planta, cada vez más creciente. De tal manera que el presente, el PIDFRU cuenta con 30 viveros construidos y 27 en construcción avanzada, lo que suma una capacidad total para producir 5,000,000 de plantas al año. Sin embargo, la demanda actual es de unos 10,000,000 de plantas/año. El Sector Privado por su parte tiene capacidad instalada para producir 1,000,000 de plantas /año.

6.1 Proyectos en Ejecución

6.1.1 Paquetes de producción de alimentos del PPA-II

Este Proyecto, ya en su fase final, es realizado por la Secretaría de Estado de Agricultura con fondos provenientes de un préstamo de USAID. Envuelve las siguientes actividades:

- 1) Propagación y distribución de plantas frutales.
- 2) Construcción de viveros.
- 3) Reforzamiento de viveros.

6.1.2 Programa de frutales del Plan Operativo 1980-1982

De alcance Nacional, es llevado a cabo por la Secretaría de Estado de Agricultura, a un costo total de RD\$ 1,000,000, proveniente de fondos del Presupuesto Nacional. Envuelve las siguientes actividades:

- 1) Construcción de viveros.
- 2) Propagación y distribución de plantas.
- 3) Asesoría Técnica y Capacitación.

6.1.3 Plan Sierra

De alcance regional, es ejecutado bajo la supervisión de la Secretaría de Estado de Agricultura, pero dirigido por una Junta de Directores. El Plan tiene un costo total de RD\$ 20,000,000, pero envuelve otras muchas actividades, entre las cuales la siembra de frutales es una de las principales.

6.2 Proyectos en Fase de Aprobación

6.2.1 Proyectos de frutales del Planderisce

De alcance regional, será ejecutado por la Secretaría de Estado de Agricultura en un período de tres años. Tiene un costo total de RD\$ 3,240,000. Se gestiona el financiamiento a través del "Fondo Internacional de Desarrollo Agrícola" (FIDA). Envuelve:

- 1) Construcción y ampliación de viveros.
- 2) Propagación y distribución de plantas.
- 3) Crédito.
- 4) Asesoría Técnica.

El Planderisce envuelve otros muchos renglones dentro de los cuales se encuentran algunas agroindustrias, proyectadas para frutales.

6.3 Proyectos en Fase de Planeamiento

6.3.1 Proyecto vitícola del Sur

De alcance regional, específico para el cultivo de la uva. Envuelve las siguientes Actividades:

- 1) Fomento.
- 2) Investigación.
- 3) Capacitación.

- 4) Crédito.
- 5) Agroindustria.
- 6) Mercadeo.

6.3.2 Proyecto Frutícola Fronterizo

De alcance regional, envuelve los cultivos de: cítricos, aguacate, mango, cajuil, guanábana, y tamarindo, con las actividades siguientes:

- 1) Propagación y fomento de plantas.
- 2) Investigación y transferencia tecnológica.
- 3) Capacitación técnica.
- 4) Créditos.
- 5) Agroindustrias.
- 6) Mercadeo.

DEVELOPMENT OF TROPICAL FRUIT TREE PRODUCTION IN THE FRENCH WEST INDIES

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ABSTRACT

Tropical fruit tree crops in the French West Indies represent only a very small part of agricultural production. There is now an important development scheme to diversify crop production.

For fruit crops, this scheme concerns mainly "fresh fruit" such as lime, mango, avocado, papaya, for export.

The "Institut de Recherches sur les Fruits et Agrumes (IRFA) undertakes research on these fruit crops, mainly in the following areas:

1. Ecophysiology: blooming, biennial bearing
2. Diseases
3. Fruit physiology: pre and post-harvest
4. Technology

It would be desirable to develop scientific and technical co-operation with Caribbean and Central American countries.

INTRODUCTION

Agriculture in the French West Indies (F.W.I.) basically relies on two principal crops: sugar and bananas, and at a second level, pineapple in Martinique. The development of some economic constraints in

Guadeloupe and Martinique calls for some urgent restructuring in the agricultural sector. The aftermath of hurricanes David in 1979 and Allen in 1980 underscores the urgent need to re-orient agriculture towards a more diversified production.

The adjustment of agriculture will thus involve diversifying the crops while maintaining the production potential of sugarcane and bananas. This crop diversification plan should permit the F.W.I. to:

1. Satisfy local demand
2. Provide the European market with more tropical products
3. Create new jobs locally through the development of food agro-industries

FRUIT CROP DEVELOPMENT PROGRAMMES IN THE FRENCH WEST INDIES

1. Present situation

The importance of fruit tree crops is negligible in Guadeloupe and very weak in Martinique, as compared with that of traditional crops such as sugar-cane and bananas (Table 1).

TABLE 1. COMPARATIVE SITUATION OF FRUIT AND TRADITIONAL CROPS IN 1979

CROP	Area (Ha)	
	Martinique	Guadeloupe
Avocado	775	15
Limes	110	60
Citrus Species	70*	60*
Mango	15	55
Fruit Total (1)	970	190
Bananas (2)	10.300	7.300
Sugar Cane (3)	7.000	24.500
Total (1+ 2 + 3)	18.270	31.990
O/o Area of Fruit Tree Crops	5.30	0.59

* Estimate

2. Development Programmes

The diversification of fruit production cannot be effectively achieved unless certain economic peculiarities of the French West Indies are taken into consideration. Two of the most important ones are **higher production costs and small local market demand.**

To compensate for the higher production costs, it is necessary to aim at "fresh fruit" production of some commodities of high commercial value; and to counterbalance the smallness of the local market it is necessary to focus on exportation. In this context the fruit crop production which is going to be developed will include:

- 1) Large seedless limes
- 2) Mango (principally Floridian varieties)
- 3) Avocado (tough skin varieties)
- 4) Papaya (Solo variety)

Production of certain second-level crops such as passion fruit, granadilla, guava and coconuts, may also be promoted.

The programme's targets for 1985 are shown in Table 2.

TABLE 2. FRUIT TREE CROP AREA TARGETS 1985

CROP	Area (Ha)	
	Martinique	Guadeloupe
Lime	1.110	700
Mango	—	300
Avocado	800	200
Papaya	—	According to market demand
Others	300-500	—

PROBLEMS ARISING FROM THE DEVELOPMENT PROGRAMME FOR FRUIT SPECIES OTHER THAN BANANAS AND PINEAPPLES

1. Ensuing Questions

The questions arising from the proposed development programme involve determining means to:

- 1) Select from among the species of economic interest the varieties that are better adapted to the environment and capable of producing in the best periods (production costs, market adaptation).
- 2) Apply the best orchard management techniques to optimize production of each species (training, pruning, fertilization, irrigation).
- 3) Increase production value by:
 - i) Optimizing conditions for harvesting, transport, conservation, and processing;
 - ii) Looking for methods to evaluate grade differences.

2. How to Answer These Questions

To respond rationally to these questions the IRFA is undertaking a number of research activities on:

- 1) **Growth and development rates of different species, in relation to climate.**

This area of study essentially stresses the flowering fruiting problems. A better understanding of the basic mechanisms would allow rational intervention at the level of:

- i) establishment of species and varieties best adapted to the environment;
- ii) cultural practices: training, pruning, fertilization, and others.

These studies and particularly their practical application would minimize the problems arising from the phenomenon of biennial bearing frequently observed in tropical species such as mango, avocado and others.

2) Pest problems

To respond to these problems, several means are possible, among which two have been favoured:

- (1) Genetic means to develop varieties tolerant or resistant to bacteriosis in papaya, etc. In this area two research approaches are promising:
 - i) Cytogenetics (meristem culture and tissue culture *in vitro*).
 - ii) "Host-pest complex" studies, permitting the development of rapid selection tests (root stocks resistant to Gummosis in citrus).
- (2) Chemical means, in some instances the most effective short-term approach. Its correct application must pass through three research phases:
 - i) pest identification (crown rot in papaya and passion fruit).
 - ii) identification of the most effective chemicals.
 - iii) study of pest biology in relation to the environmental factors, so as to time treatments most effectively and economically (*Tarsonema* of lime and papaya).

3) Fruit physiology

The studies on pre and post-harvest fruit physiology, aim at improving fruit quality in:

- i) Normalizing harvest (reaping point)
 - ii) Defining the best storage and transport conditions (temperature, humidity, and conservation period).
- ## 4) Technology

Technology studies are carried out in IRFA/INRA (Institut National de Recherches Agronomiques) laboratories at Montfavet (France) to evaluate grade differences (avocado, mango) and develop food agro-industries in the F.W.I.

CONCLUSION

The leading research areas at IRFA in the French Antilles basically have been defined from the problems arising out of the local development of fruit crops.

We want to insist, however, on the fundamental aspects of the relations between research and development which should guide the technical and scientific exchanges among the countries in the Caribbean and Latin American Zone:

1. The results obtained by IRFA from the applied methodologies should contribute toward solving the problems posed for fruit crops in the countries of the Caribbean and Latin American Zone (Tropical and Subtropical regions).
2. It is also desirable for IRFA to be able to benefit from the "know how" attained in the neighbouring regions, on the other fruit species in which it is not conducting any study, to utilize that know-how in the French Antilles.

For practical reasons, it was necessary to establish some priority among the different fruit species studied by IRFA; as a result, a certain number of species of lesser importance have been left out, for the time being.

We can thus see the interest in technical and scientific cooperation among the different countries in the Caribbean and Latin American Zone, to promote the fruit tree crop production.

FRUIT TREE CROP DEVELOPMENT IN GRENADA

Cosmos Joseph

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BACKGROUND

The islands of Grenada comprise the main island (Grenada) which is 120 square miles, and two smaller islands (Carriacou and Petit Martinique) of 13 square miles, making a total area of 133 square miles or approximately 85,000 acres. However, it is estimated that there are some 84,420 acres of land in Grenada (Source: W. I. Census of Agriculture, 1961).

The country lies at approximately latitude 12 degrees north of the equator and longitude 61 degrees west. Two of its closest neighbours, Trinidad and St. Vincent, are only 90 miles to the south and 70 miles to the north-east respectively.

With only 6 % of flat land and 69 % of its total land area having slopes greater than 20 degrees, Grenada can be described as hilly. Apart from the eastern and southern coastal areas the island is rugged with numerous hills and valleys. Roughly 50% of the land area is over 500 feet above sea level with several peaks in excess of 2,000 feet. Mt. St. Catherine (2,756 feet) is the highest mountain.

Like most of the other islands in the Caribbean chain, Grenada is volcanic in origin. There are small areas of limestone deposits to the north, and limited areas of alluvial deposits are found along the lower course of rivers.

Thirty-six different soil types have been identified, but these are generally referred to under four broad groups:

1. **Brown Earths** (for example, Belmont Clay Loam) which are dark brown, well drained, and located in areas of moderate to high rainfall.
2. **Red Earths** (for example, Capitol Clay Loam) which are red to light brown, moderately well drained, and located in the areas of high rainfall.
3. **"Shoal" Clays** (for example, Perseverance Clay) which are very dark, poorly to moderately drained, and located in areas of low rainfall (less than 60 inches).
4. **Alluvial soils**, most of which are very well drained and are located along river banks at the lower course of rivers. They are therefore scattered in small patches throughout the island, and exist under different rainfall regimes.

The islands experience distinct "wet" and "dry" seasons; the former occurs from June to December, and the latter from January to May. The dry coastal areas experience an average annual rainfall of approximately 50 inches, but in the mountainous areas the average annual rainfall is about 160 inches. The mean annual rainfall of the area as a whole is taken as 97 inches. Temperatures range from a minimum of 65 F^o in the cool months of January and February to a maximum of 90 F^o in the hot months of August to September.

THE ECONOMY

The economy of Grenada has an agricultural base; and the economic environment is similar in many respects to that of many of the LDCs (Less Developed Countries) in the Caribbean. For example, reference may be made to high rates of inflation, an increasingly high adverse trade balance, relatively low levels of economic activity, and declining levels of output, particularly from the traditionally important agricultural sector, which continually experiences serious constraints to future development.

Prices of the traditional export crops (cocoa, nutmeg and banana) usually fluctuate, and when they rise they do so very slowly in comparison with the rapid and uncontrolled rise in prices of imported commodities. Thus, it is not difficult to understand why Government's Development Plan to lift the economy is based on agro-industrialization and diversification of export commodities. Thus the development of fruit tree crops becomes of great importance to the Grenadian economy.

LAND TENURE AND DISTRIBUTION

Land tenure bears a close relationship to the farmer's attitude as to whether or not he will plant tree crops, in the first place, and the amount of investment capital he will be able to acquire for development, in the second place. Related too, is the level of risk the farmer is willing to entertain. Tree crops in general have a long gestation period, and it is evident that their cultivation will be undertaken only by farmers who either own the land or are able to procure long-term leases.

In Grenada, in 1961, 88.3% of all farm holdings were owned by farmers (Table 1). Therefore, it appears that in 1961 land tenure did not pose a problem to tree crop development in Grenada. This statement is still true since there has been little change in the pattern.

It should be noted here that:

- 1) Of the total acreage (84,420 acres), 60,197 acres were utilized for Agriculture in 1961, but by 1975, this acreage has dropped to 46,577 acres (Sources: W. I. Census of Agriculture, 1961 and Ministry of Agriculture files).
- 2) In 1961, 28,000 acres (46.51 % of total agricultural land) and in 1975, 23,000 acres (49.38 % of total agricultural land) were under permanent tree crops.
- 3) There was then a total of 14,096 holdings (Source: W.I. Census of Agriculture, 1961), and in 1975, 12,565 (Source: Ministry of Agriculture files).

TABLE 1. DISTRIBUTION ON HOLDINGS IN GRENADA ACCORDING TO LAND TENURE (YEAR 1961)

CATEGORY	Nº OF HOLDINGS	ACRES	PERCENTAGE
Holdings owned	9,740	53,132	88.3
Holdings rented	2,027	2,105	3.5
Rent-free Holdings	454	558	0.9
Mixed-tenure Holdings	1,875	4,402	7.3
TOTAL	14,096	60,197	100.0

- 4) In 1961, 12,510 of the 14,096 holdings (88.7 %) were in the grouping of 5 acres and under (Table 2).
- 5) Tourism, housing and general infrastructure accounted in the main, for differences between total land area and agricultural land area.
- 6) Ninety-two (92) holdings were in excess of 100 acres, and only 12 holdings were in excess of 500.

During the 1970s the previous Government acquired a total of 28 estates and thus became the largest single land owner in Grenada. Portions of some of these estates were parcelled out to some "land-less" farmers. The present Government still remains the largest single land owner through its inheritance of more than 3000 acres of agricultural lands from the previous regime.

**TABLE 2. DISTRIBUTION OF HOLDINGS IN GRENADA
ACCORDING TO FARM SIZE (YEAR 1961)**

FARM SIZE (Acres)	Nº OF HOLDINGS	PERCENTAGE
less than 1	6,458	45.81
1 – 5	6,052	42.93
5 – 10	934	6.63
10 – 25	418	2.97
25 – 50	100	0.71
50 – 100	42	0.30
100 – 200	28	0.20
200 – 500	52	0.37
500 +	12	0.08
TOTAL	14,096	100.00

Source: West Indies Census of Agriculture, 1961.

GOVERNMENT POLICY

1. Previous

Highlights of the previous Government policies towards agriculture centered on a land acquisition and distribution programme. More than 4,000 acres of agricultural lands were acquired. In most cases, land was distributed in uneconomical units which were unable to maintain their prior levels of productivity as

parts of larger units. Even the remaining undivided portions of State Lands showed a marked drop in production and profitability. It appeared that all that took place as a result of Government policies was a change of ownership and a sense of irresponsibility among both managers and workers of the Government-owned farms. There appeared to be clear strategy to develop and diversify production on those farms so as to get the economy moving.

2. Present

The Government, in formulating its policy for future growth and development of the economy, has placed special emphasis on the development and expansion of its agricultural sector. Increased productivity of the worker and a greater degree of worker participation in the production process are highlights of this programme.

It is being sought to create institutions, for example the National Co-operative Development Agency, whereby the worker can use his skills, within a co-operative framework, to raise his standard of living. Credit for the purchase of necessary inputs is made available through the facilities of the Grenada Development Bank and the National Commercial Bank. Marketing facilities are being upgraded to meet the needs of the farming co-operatives as well as those of private farmers. Of course, the National Co-operative Development Agency is designed to help solve the growing problem of unemployment especially among the youths of the Country. From an agricultural point of view it is heartening to acknowledge such an institution designed to encourage unemployed youths to cultivate "idle" lands. Youths wishing to participate in co-operative agricultural production are first being trained in the principles and methods of co-operative enterprise and agricultural production.

Government policy on agriculture relies heavily on the development of an Agro-Industrial sector which is soon to become a reality. Urgent consideration is being given to the diversification of agricultural export commodities, and the establishment and maintenance of new regional and international markets for fruits and vegetables.

PROPAGATION FRUIT TREES

The Mirabeau Agricultural Station is the centre of propagation for all fruit trees; there are no privately operated nurseries in Grena-

da and the Government of Grenada subsidizes the sales of all plants produced. A wide range of fruit trees is propagated at the Station (Table 3), including citrus, mango, avocado, sapodilla, guava, sugar-apple, soursop, papaya, pomeac (*Eugenia malaccensis L.*), which is also known locally as French-cashew, and golden-apple (*Spondias cytherea Sonn.*).

**TABLE 3. SUPPLY OF PLANTING MATERIAL
(FRUIT TREE CROPS) 1975 – 1979**

CROP	1975	1976	1977	1978	1979
Citrus	2 200	990	2 159	1 500	7 251
Mango	305	480	172	880	1 996
Sugar-apple	194	726	720	291	88
Avocado	280	Nil	887	1 243	2 680
Sapodilla	186	747	560	230	530
Soursop	190	325	623	Nil	327
Guava	480	571	Nil	431	650
Pomeac	Nil	Nil	210	170	613
Papaya	Nil	Nil	Nil	Nil	600
Golden-apple	94	Nil	Nil	Nil	Nil

In late 1976 an electronically controlled mist propagation unit was installed at the Station to assist in the accelerated propagation of some of the fruit trees. The unit has four "stations" or eight benches. Each bench is 15 feet long, 4 feet wide, 1 foot deep and 3 feet 2 inches above floor level; the walls are four inches thick, the distance between consecutive benches is four feet. The entire unit is enclosed with sarran netting, which allows 60% of the incident light to diffuse through; the sarran is approximately eight feet above the benches and drapes to 2 feet from ground level on all sides.

The four stations are each controlled by electronic leaves with the misting frequency being adjusted by potentiometers. A solenoid switch is fitted to each bench to control the water flow through the five mist sprayers on each bench. There are, to complete the unit, a three thousand five hundred gallon reservoir, a centrifugal pump with electric motor, and a constant pressure tank.

At the bottom of each bench there are several outlets and a layer of stones to facilitate drainage. The rooting medium is 1:1 ratio (by volume) of sawdust and fibre dust. All cuttings, after standard

preparation are dipped in proprietary IAA (Indoleacetic acid talc) at 1^o/o, 3^o/o, or 8^o/o dependent on the type of cutting, i. e. whether soft, semi-hard, or hard.

The initiation in 1976 of the accelerated propagation of fruit tree crops was long overdue; available figures indicated that from as early as 1968 the demand for fruit tree crops by farmers had far exceeded production output at the Mirabeau Agricultural Station and the demand for planting material up to the present time has continued to be in excess of production. The accelerated propagation scheme of 1976 was meant to narrow the gap between supply and demand of planting materials. The number of plants actually sold to farmers from 1970 to 1979 is shown in Table 4.

**TABLE 4. NO OF PLANTS ACTUALLY SOLD TO FARMERS
1970 - 1979**

CROP	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Citrus	2 678	1 571	771	1 160	1 101	2 104	985	840	1 472	4 556
Mango	955	401	341	527	348	204	458	149	879	1 928
Avocado	396	155	161	234	228	116	414	203	1 020	2 536
Pomerac	Nil	Nil	Nil	20	37	Nil	Nil	15	168	219
Golden-apple	8	20	2	4	17	19	24	7	Nil	Nil
Sapodilla	240	216	99	91	4	183	55	245	214	444
Guava	28	22	10	17	36	51	10	66	87	644
Sugar-apple	167	129	110	94	39	108	141	360	272	85
Soursop	72	94	36	57	6	182	30	141	145	312
Papeya	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	27	538

Source: Files of the Agronomy Division, Ministry of Agriculture.

3. Timing/Distribution

The time period between initial propagation and actual planting out in the field (distribution to farmers) is more a function of the method of propagation used rather than the type of crop being propagated. For example, guavas propagated by seed require a period of five to seven months before the plants are ready for setting out in the field; but when propagated by cuttings (dipped in 1 ^o/o IAA talc) the period required for planting out is reduced to 1 1/2 to 2 months.

At the Mirabeau Agricultural Station the time periods (months), between propagation and planting out in the field of some fruit tree crops are:

Citrus fruits (<i>Citrus spp.</i>)	15	— 16	(Budding)
Mango (<i>Mangifera indica L.</i>)	16	— 18	(Grafting)
Avocado (<i>Persea americana Mill</i>)	8	— 10	(Grafting)
Pomerac (<i>Eugenia malaccensis L.</i>)	1 1/2	— 2	(Cuttings)
Guava (<i>Psidium guajava L.</i>)	1 1/2	— 2	(Cuttings)
Soursop (<i>Annona muricata L.</i>)	1	— 2	(Cuttings)
Sapodilla (<i>Manilkara achras Mill</i>)	6		(Seed)
Sugar-apple (<i>Annona squamosa L.</i>)	6		(Seed)

3. Propagation Difficulties in some crops

1) Soursop:

Cuttings of the soursop root with difficulty under the mist unit, but quite readily in the humidity chamber. A small observation trial has been set up to try to determine the reasons for this behaviour.

2) Sugar-apple:

To date, only limited success has been achieved in the vegetative propagation of sugar-apple.

3) Sapodilla:

Attempts at grafting sapodilla have been made, but with limited success. Descriptive literature on grafting techniques (Florida) has now been obtained and these techniques will soon be tried.

PRODUCTION SYSTEMS

Generally speaking, the Grenadian farmer traditionally perceives fruit tree crops as being for windbreaks, backyard plantings, or interplanting with the traditional export crops (viz. cocoa, nutmeg and banana).

Large acreages of pure stand fruit tree crops are non-existent. Scattered plantings of fruit tree crops do exist (Table 5), but fruit production on the whole has decreased during the period 1973-1979 (Table 6).

With the present Government's policy on agriculture, it is necessary to increase the present acreages of the fruit tree crops, aiming at both the fresh fruit export markets (Table 7) and the agro-industrial sector, with the object of limiting the importation of fresh and canned fruits of European and North American origin. Only a small frac-

**TABLE 5. ESTIMATES OF TOTAL
ACREAGES OF FRUIT TREE CROPS IN
GRENADA, 1978**

CROP	ESTIMATED AREA (Acres)
Avocado	380
Mango	565
Citrus	1 085
Guava	40
Sugar-apple	76
Sapodilla	90
Soursop	65
Tamarind	233
Pawpaw	6

TABLE 6. PRODUCTION (POUNDS) OF FRUIT IN GRENADA, 1973 - 1979

TYPE OF FRUIT	1973	1974	1975	1976	1977	1978	1979
Avocado	4 500 000	3 759 900	3 030 900	3 000 000	2 180 000	2 734 000	2 725 800
Mango	4 433 700	350 570	2 474 400	2 783 700	3 204 600	3 186 400	3 344 000
Citrus	9 228 250	5 745 900	8 108 000	7 937 000	8 330 800	9 687 150	7 950 800
Guava	315 000	306 000	300 000	292 000	285 000	261 450	245 635
Sugar Apple	485 000	510 000	502 000	480 000	425 000	420 680	139 252
Sapodilla	375 000	378 000	381 000	390 000	394 000	381 000	419 280
Soursop	608 075	569 700	585 325	572 000	583 000	680 000	590 879
Pawpaw	N.A.	N.A.	N.A.	N.A.	185 000	168 800	121 302
Tamarind	560 000	520 000	500 000	465 000	460 000	386 000	44 280

**TABLE 7. QUANTITY (LB) OF FRESH FRUIT EXPORTED
FROM GRENADA 1976 - 1979**

TYPE OF FRUIT	1976	1977	1978	1979
Avocado	650 830	16 750	587 003	417 790
Mango	14 180	3 450	44 253	193 938
Citrus	17 440	6 520	64 014	195 402
Guava	N.A.	N.A.	N.A.	160
Sugar-apple	56 475	8 400	161 277	197 470
Sapodilla	26 000	19 300	63 760	570 655
Soursop	209 865	67 950	326 256	473 867
Pawpaw	12 150	1 405	56 880	34 438
Tamarind	1 900	8 292	19 150	40 900

TABLE 8. QUANTITY (LB) OF FRUIT SOLD ON THE LOCAL MARKET IN 1978 AND 1979 IN GRENADA BY DISTRICT

TYPE OF FRUIT	NORTH		SOUTH		EAST		WEST	
	1978	1979	1978	1979	1979	1979	1978	1979
Avocado	Nil	230	52 655	28 271	48 345	7 440	7 375	623
Citrus	19 198	2 317	335 720	330 720	130 148	35 830	58 045	5 527
Mango	3 335	310	94 000	106 996	44 310	23 990	9 060	955
Pawpaw	Nil	Nil	37 220	40 623	2 650	2 360	1 850	466
Sapodilla	Nil	N.A.	48 516	N.A.	11 780	N.A.	1 025	N.A.
Golden-apple	Nil	N.A.	Nil	N.A.	4 645	N.A.	1 200	N.A.
Pomerec	Nil	N.A.	28 957	N.A.	400	N.A.	Nil	N.A.

Source: Statistics Division, Ministry of Agriculture

tion of the fruits produced is sold on the local market (Table 8). There is much wisdom in the establishment of pure stand fields; however, attention should be still given to the intercropping of fruit trees, backyard plantings, and the establishment of windbreaks using fruit trees.

At present there are an estimated 5,000 acres of unused (idle) agricultural lands in Grenada. Most of these idle lands are either inaccessible on steep slopes, or are marginal in nature. Some fruit tree (e. g. soursop, sugar-apple) thrive well on marginal lands, and fruit trees will help solve the soil erosion problems associated with steep slopes. Therefore, the idle lands in Grenada (and other Caribbean islands) present an acceptable challenge towards the establishment of pure stands of fruit tree crops.

Of course, side by side with the agronomic development of fruit tree crops there should be a conscientious effort towards the removal of constraints (technological, financial, marketing and others) which have hitherto retarded the economic development of fruit tree crops.

1. Inter-Cropping

Inter-cropping is the norm in Grenada. In the dry coastal areas (especially the north-eastern and southern parts of the islands) coconuts are sometimes interplanted with soursop, sugar-apple, sapodilla, guava and tamarind. Cocoa and bananas predominate in the moderate to high rainfall areas, and these crops are normally interplanted with fruit trees such as avocado, mango, golden-apple, citrus and guava. Nutmegs in the very high rainfall areas (more than 90 inches per annum) are sometimes interplanted with citrus. It is unusual to find areas with fruit tree crops interplanted among themselves to the exclusion of the traditional export crops and coconuts.

The large farmer attaches little monetary value to his numerous fruit trees, they are sometimes scattered throughout two or three hundred acres of cocoa, nutmeg, or banana cultivation. To him, no expenditure was involved in the establishment of those fruit trees, and so long as he gets sufficient fruits for home use and to offer his social friends he seems satisfied. Things are different with the small farmer who must place a value on each tree as his field. To him, his fruit trees are a sort of insurance against the often unpredictable drop in prices of the export crops and the key area of supply to the "huckster" trade. Earnings from the sale of fruits also help to cushion the financial hardships generally experienced by small farmers during the off-season (or low production period) of the traditional export crops.

Because of the recent discovery of new export markets, and the relatively good prices received for mangoes exported to the United Kingdom over the past two years, farmers in general have now begun to pay closer attention to their fruit trees.

2. Backyard Planting

In Grenada there is the general tendency for people living in the urban and sub-urban areas to plant fruit trees around the house. This tendency is increasing as the prices of fruit at the local markets keep increasing. Backyard planting of fruit trees is also very common among professionals and public workers who live in rural areas but work in the towns and therefore have time enough only to cultivate fruit tree crops which are sometimes referred to as "no-work" crops. Fruit trees such as sugar-apple, guava and pawpaw are planted very close to the house; the other fruit trees are planted farther back. Mango is the most common backyard fruit tree crop.

3. Windbreaks

Mango windbreaks are very popular among both small and large farmers. Pomerac windbreaks are also gaining prominence. However, pomerac trees succumb easily when attacked by a disease caused by *Rosellina sp.* which also attacks nutmeg trees. Guava and soursop windbreaks are sometimes cultivated in the drier, wind-swept areas where it is difficult to grow mango or pomerac.

4. Pure Stand

As has already been noted, pure stand cultivation of fruit tree crops is rare. However, there is much wisdom and foresight in immediately cultivating all (or most) of the "idle" lands with pure stands of fruit tree crops. Moreover, on most of the estate holdings there are large areas of uncultivated lands which can be cropped with fruit trees in pure stands.

The Government, the largest single land owner, will probably set the lead in this respect; in fact, establishment of pure stands of fruit tree crops on some Government Farms has already begun. Mardi Gras, part of an Agricultural Development Project, represents one such area.

5. Potential

Under the existing system of production the potential for development at a commercial (fresh and processed) industry is at present limited. Now that new export markets have been identified, and an agro-industrial plant has been established by Government, there is need to re-organize the production systems to meet the market and agro-industrial requirements. There is need for large-scale production of fruits of a homogeneous type and high quality. To achieve this, there is need for the introduction of improved varieties (wherever practicable), improved husbandry practices, and the use of appropriate harvesting techniques.

Figures obtained from the Statistics Division of the Ministry of Agriculture indicate that in 1978 and 1979 only 1.4% and 5.8% respectively, of the estimated mango production was exported. These figures tend to suggest that either there is a high consumption of mangoes locally, or there is much wastage. It is believed that both are true. Agro-Industry is now geared to utilize most of the mangoes that generally go to waste. However, there is the need for the increased production of mangoes and other fruits to meet the growing export market and the increased consumption of a growing local population.

6. Constraints

The following constraints are identified:

1) Low yield

This is mainly due to the nature of the production system which precludes the implementation of good horticultural

practices in the particular crop. For example, recommended planting distances, shade management, windbreaks, and pruning are difficult to implement.

2) Heterogeneity of primary product

This interferes with the fresh fruit export market as well as with the processing of certain products, the quality which may be adversely affected by a heterogeneous primary product. Thus, there are many mango cultivars in Grenada, which are unsuitable for both the export market and for processing.

3) Lack of appropriate credit facilities

The local financial institutions are apparently not geared to lending money for the development of fruit tree crops. For example, the period allowed for the repayment of loans is sometimes shorter than the gestation period of some of the fruit tree crops such as avocados and mangoes. Moreover, the farmer is made to bear the burden of interest accruing on funds borrowed for the establishment of his fruit tree crops.

4) Labour

Low wage rates have been keeping the youths away from the land. In some parts of Grenada it is sometimes difficult to employ labour to harvest crops.

5) Unreliable and insecure marketing

The Grenada Marketing and National Import Board is not yet fully operational.

6) Transport

Transport costs are sometimes prohibitive in relation to the prices paid for the commodities transported. This is especially so because of disorganized production from small and scattered units, several of which are inaccessible to motorised transport. Fruits cannot be classified as high-price, low-volume commodities, and so this rules out air transport which is very costly. Sea transport to Trinidad is not always reliable and the ships/vessels are improperly

designed for the fresh fruit trade. Transport of fresh fruits to the U. K. by the Geest boats is dependent on the availability of space after bananas have been loaded. So Government has recently purchased a vessel which will soon be equipped with refrigeration facilities for inter-island transport of fruits and vegetables.

7) Poor handling techniques

Harvesting methods are crude. As a result, a high percentage of fruits fall to the ground during harvesting thereby impairing quality. In the field, fruits are generally placed in sacks, carried on the head, and thrown on to the unpadded tray of a truck for transport to either the market place or the waiting or expected vessel. Losses due to poor handling are staggering.

POST-HARVEST HANDLING

Increased production of fruit tree crops must of necessity be associated with well-developed markets and reliable marketing outlets. Research must be conducted so as to ascertain the demand patterns and quality standards in existing and potential markets. This must be done as a means of meeting these demands and quality criteria so as to capitalize on high prices and to maintain a competitive hold on the market.

1. Markets

For many years Trinidad has provided a ready and reliable market for most of Grenada's fruits; the trade, conducted by "hucksters" is not regarded as well organized. Over the past two years a market for high quality table mangoes (viz. Ceylon) has been developing in the United Kingdom. At present, other regional and European markets are being sought for the sale of other fruits. The local market also provides a considerable outlet for fresh fruits.

2. Packaging

There is still a long way to go in the area of appropriate packaging techniques. Much assistance is needed in this area.

3. Marketing Organization

This is the "Achilles'heel" in all production endeavours. Provisions were made for the establishment of marketing support to farmers with the Marketing Board Act. No. 40 of 1973; however, as stated earlier, the Board is not yet fully operational. Recently, the facilities of the Grenada Marketing and National Import Board were greatly improved, and it is hoped that they will soon be providing the long awaited efficient service to farmers in general.

4. Agro-Industry

The Grenada Fruit and Vegetable Processing Plant is expected to be in full operation soon; it will be geared to produce fruit juices, nectars and paste, as well as fruits in syrup, and pickled fruits. Already, small sample batches have been produced and tested for consumer acceptability with encouraging results. Sample products have also been sent to North America.

5. Raw Materials

An indication of the potential of Grenada produced fruit is given below:

- 1) Chutney, juice and nectar can be made from mangoes and here it is interesting to note that mangoes most suitable for making these products are at present the non-exportable types most of which normally go to waste.
- 2) Ripe avocados can be used for making avocado paste; availability of fruit for this purpose will depend largely on increased acreages for production of the crop, since it is now estimated that 77.1% of all avocados produced are being exported as fresh fruit, according to the Ministry of Agriculture files.
- 3) Candied and crystallised fruit can be made from green pawpaw; the ripe pawpaw can be used for making pawpaw juice, pawpaw nectar and pawpaw in syrup.
- 4) Guava can be used for making pulp-juice, guava nectar, confectionery and pericarp-fruit in syrup.
- 5) From soursop can be made juice and nectar; as with avocado, increased acreages and production will play a

decisive part. Fresh soursops fetch a good price on the Trinidad market, so at present production levels there is little encouragement to divert fruit for processing.

- 6) Tamarind can be used for making juice and nectar, and also as a base for condiments and sauces.
- 7) Ripe sapodillas, pomerac, and golden-apples can be canned in syrup; green golden-apples can be pickled. All these fruits have a high demand on the local fresh fruit market as well as on the Trinidad market.

6. Processing Plant

The following objectives are considered necessary in the initial stage of the operation of the plant:

- 1) Development and standarzation of formulations.
- 2) Organization of adequate and reliable sources for the procurement of suitable varieties of locally produced raw materials at reasonable prices.
- 3) Selection of suitable packaging materials.
- 4) The identification of domestic and international market demands for the processed products.
- 5) Providing specialized training for fruit processing staff.

It has been estimated that the quantities of fruit required for the first year's operation of the Processing Plant may be stated Lb:

Mangoes	300,000
Soursop	60,000
Paw Paw	200,000
Avocadoes	20,000
Guavas	50,000
Golden Apples	60,000
Tamarind	20,000
Sapodillas	20,000

DEVELOPMENT INCENTIVES AND CONSTRAINTS

To promote the development of fruit tree crops there is need to offer appropriate incentives to farmers and also to identify and remove whatever constraints that may tend to hinder or reduce production. There are at present (as was in the past) no meaningful incentives offered to farmers who cultivate fruit tree crops. Some that may be offered are:

1. Guaranteed markets
2. Premium prices for top quality fruit
3. Reasonable prices which compare with those received for traditional exports crops.
4. Fertilizer subsidies
5. Appropriate credit facilities
6. Specialized extension service to promote improved cultural practices among farmers with established minimum acreages.

Two very serious constraints restricting fruit tree crop development are the highly disorganized marketing system and praedial larceny. It is believed that any incentives given for the increased production of fruit tree crops will be negated in the absence of effective measures to ensure the protection of those crops against praedial larceny. Crop protection against pests and diseases must also receive attention to remove a major constraint to production.

RESEARCH AND TECHNOLOGY TRANSFER

This is an area in which there could be tremendous assistance to farmers, particularly in food technology to complement efforts in marketing. Over the past eighteen months much research has been done in food processing by the Ministry of Agriculture in the Produce Chemist Laboratory; new technology has been introduced, tested, modified, and adopted. There is now need for carrying out market trials on the products developed. Thorough evaluation of processes and effects at every stage, with modification of product formulations where necessary, should follow, as well as market feasibility studies so as to determine:

- i. scope of market
- ii. market requirements
- iii. other related aspects of marketing.

The development of fruit tree crops in Grenada will demand much in the area of production-oriented research. This received inadequate attention in the past mainly because of the nature of the production systems relating to fruit tree crops and the relatively little importance attached to those crops.

TROPICAL FRUIT TREE CROP PRODUCTION IN GUYANA

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INTRODUCTION

In Guyana, the changing patterns in the social, political and economic spheres have some influence on the relative importance of the perennial crops (fruit crops). Research activities have been devoted almost exclusively to the two main crops —sugar and rice. Thus, there is very little work done on the fruit crops.

The seasonal glut of most fruits presents a problem to farmers. Some of these fruits can be manufactured into acceptable products for both home consumption and export markets. Such crops could have the two-fold advantage of reducing the import bill for food which is very high and earning valuable foreign exchange.

With advanced technology, improved transport and refrigeration facilities, there are lucrative oversea markets for tropical fruits, and these avenues must be explored. There is also a new outlook towards the increased commercialization of a wider range of tropical crops, especially the lesser utilized tropical fruits crops e. g., carambola.

This new and optimistic outlook on the potential of the lesser known tropical fruits is hardly justified on the basis of our knowledge and experience of these crops. Very little is done in this country to improve the large range of fruits which are commonly eaten with relish. It is worth noting that the small fruits are becoming very important to the housewife who increasingly utilizes them in the dried form and for production of local preserves, wine, etc.

Guyana has a multitude of fruit types (Table 1), with the most important being citrus, pineapple, mango, carambola, and a few others.

TABLE 1. FRUIT PLANTS IN GUYANA

COMMON NAME	BOTANICAL NAME
Almond	<i>Terminalia catappa</i>
Annatto	<i>Bixa orellana</i> L.
Avocado-pear	<i>Persea americana</i> Mill
Banana	<i>Musa paradisiaca</i> Linn.
Bilimbi	<i>Averrhoa bilimbi</i> L.
Carambola	<i>Averrhoa carambola</i> L.
Cashew-nut	<i>Anacardium occidentale</i> L.
Cherry (Surinam)	<i>Eugenia uniflora</i> L.
Cherry (W.I)	<i>Malpighia puniceifolia</i> L.
Coconut	<i>Cocos nucifera</i> Linn.
Custard-apple	<i>Annona reticulata</i> L.
Dunks	<i>Zizyphus mauritiana</i> Lam.
Fat-pork	<i>Chrysobalanus icaco</i> L.
Genip	<i>Melicocca bijuga</i> L.
Golden-apple	<i>Spondias cytherea</i> Sonn.
Gooseberry	<i>Phyllanthus acidus</i> Skeels
Granadilla	<i>Passiflora quadrangularis</i> L.
Grape (vine)	<i>Vitis vinifera</i> L.
Guava	<i>Psidium guajava</i> L.
Jackfruit	<i>Artocarpus heterophyllus</i> Lam.
Jamoon	<i>Syzygium cumini</i> L. Skeels
Malaca-apple	<i>Eugenia malaccensis</i> L.
Mamey-apple	<i>Mammea americana</i> L.
Mango	<i>Mangifera indica</i> L.
Monkey-apple	<i>Annona diversifolia</i> Staff
Pawpaw	<i>Carica papaya</i> L.
Passion Fruit	<i>Passiflora edulis</i> Sims.
Peach	<i>Diospyros discolor</i> L.
Pineapple	<i>Ananas comosus</i> L. Merr.
Plum	<i>Spondias mombin</i> L.
Plumrose	<i>Eugenia jambos</i> L.
Pomegranate	<i>Punica granatum</i> L.
Psidium	<i>Flacourtia indica</i> L.
Sapodilla	<i>Manilkara achras</i> Mill.
Seagrape	<i>Coccoloba uvifera</i> L.
Semitoo	<i>Passiflora laurifolia</i> L.
Soursop	<i>Annona muricata</i> L.
Star-apple	<i>Chrysophyllum cainito</i> L.
Sugar-apple	<i>Annona squamosa</i> L.
Sawarinut	<i>Caryocar nuciferum</i> L.

TABLE 1. (CONT'D) FRUIT PLANTS IN GUYANA

COMMON NAME	BOTANICAL NAME
Tamarind Whytee Grapefruit Lemon Lime	<i>Tamarindus indica</i> L. <i>Inga</i> spp. <i>Citrus paradisi</i> Macf. <i>Citrus limon</i> (L) Brun <i>Citrus aurantifolia</i> (Christman) Swingle
Mandarin (Tangerine) Orange Shaddock King Orange Ortanique	<i>Citrus reticulata</i> Blanco <i>Citrus sinensis</i> (L) Osbeck <i>Citrus grandis</i> (L) Osbeck <i>Citrus nobilis</i> Lour. <i>C. reticulata</i> X <i>C. sinensis</i>

TRADITIONAL AND POTENTIAL CROPS

1. Mango (*Mangifera indica* L.) :

1) Production Systems

At the moment there are no large scale commercial mango orchards in Guyana; trees are found scattered throughout the coastlands, and the fruits are sold in the local markets. The areas of concentration are the Essequibo Coast, East Coast Berbice, East Coast Demerara and the Rumpununi districts. The mango does not perform well either in the riverain areas or along the East Bank Demerara where the humidity is high.

There are only few well known varieties; the rest are local cultivars. The best variety is the Julie originally imported from Trinidad; slightly differing strains are now observed. Some have fruit of a brighter colour than others, along with slight variation in the amount of fibre. The tree is the dwarf type suited for back yard cultivation.

It is estimated that the area under mango cultivation is 390 acres spread throughout the country, and yield is put at 8,000 to 10,000 lb/ac, based on a population of forty-eight trees per acre.

The mango is not cultivated as a pure stand crop to any great extent.

Farmers usually plant along the dams, banks of trenches and canals or interplant with other fruit in a mixed orchard. Although budded plants are offered for sale, some farmers still continue to plant seedlings.

2) Utilization

The mango is used mainly as fresh fruit sold on the local market.

Recently some work was started in canning mango juice, but this is still considered to be in the experimental stage.

3) Constraints

Some constraints to development of mango production are listed below:

- (1) Farmers are not keen on establishing pure stand plantings because there is always the difficulty of selling the product.
- (2) A grave problem exists in certain places where mango is grown in areas of high humidity e. g. the riverain areas, East Bank, Demerara and the Ebini Savannah; there anthracnose caused by *Colletotrichum gloesporioides* is one of the main diseases producing heavy loss.

4) Proposed research and development strategy

As part of a strategy for improvement, the following may be advisable:

- (1) The introduced varieties planted at Ebini (Table 2) should be evaluated.
- (2) Research should be conducted on root-stocks so as to take advantage of the better root systems for the best varietal performance.
- (3) Additional introductions should be made from mango producing areas, especially India, e. g. the Cepano variety, one of the better types; Joe Welch, Ono, Georgiana and Gouveia can be imported from Hawaii.

**TABLE 2. MANGO VARIETIES PLANTED
IN EBINI**

Foreign	Local
1. Hayden Florida	1. Dor
2. Zill	2. Haden Relfield
3. Van Dyke	3. Bombay
4. Tommy Atkins	4. Colonial Bank
5. Kent	5. Puerto Rico
6. Keitts	6. Graham
7. Kensington	7. Julie
8. Vauraj	8. Number 11
	9. Peter

- (4) The Rupununi District should be the main producing area in the hope that a cannery could be established to produce mango juice and nectar.
- (5) All unused, suitable lands on the Essequibo Coast should be placed under mango.
- (6) Wherever possible state farms should be established for mango cultivation.
- (7) Planting material should be readily available to farmers at all times and in quantities required.

2. Avocado Pear (*Persea americana L.*):

(1) Production systems

Avocado cultivation is concentrated mainly in the North West District, at Hosororo. This area is suitably drained and plants seem to thrive with little or no care. The West Demerara area is also noted for growing avocado but some of the trees have been subjected to flooding, causing their death.

A few farmers have sacrificed the trees to plant sugar-cane which they claim to be more profitable. Avocado is also produced to a lesser extent in the Pomeroon area, but the quality of the fruit is poor.

Yields vary from area to area; estimates based on trees that are eight years and older with fifty trees per acre, are as follows (1b/ac).

(1) West Demerara Area	3000	—	5000
(2) Hosororo	4000	—	8000

In most instances trees are planted at random since farmers do not plant for an organized market. However, occasionally farmers have planted in an organized manner with the hope of commercial production. The system of cultivation is to plant in rows and intercrop for the first two years.

In 1973 an eight acre block of pure stand was planted at the Government Research Station at Kairuni. This consists of eighteen imported varieties of which budwood was introduced from U.S.A. and Trinidad and eight local varieties selected around the countryside (Table 4).

Land was cleared with a bulldozer and lined out 24' x 24'; mounds were prepared by incorporation of limestone, triple superphosphate and leaf mould with the soil at each site. When these had settled sufficiently, the plants were set during the rainy season, and for the first two years the area was inter-cropped with black-eye peas.

The acreage under avocado in 1977-1979 is shown in Table 3.

2) Utilization

Avocados always fetch a premium price when they reach the consumer in excellent condition. Generally speaking,

**TABLE 3. AREA UNDER AVOCADO (ACRES),
IN 1977 – 1979**

DISTRICT	YEAR	
	1977	1978
Hosororo	363	102
West Demerara	43	96
TOTAL	406	198

TABLE 4. AVOCADO SELECTIONS PLANTED AT KAIRUNI

Trinidad Selection	US Introduction	Guyana Local Selection
C R C 4-16	Simmonds Florida	Khan
Simmonds Trinidad	Dade	Chanasue
Monroe	Donaldson	Hercules
Jamaica	Rueble	Matthew's Ridge
Trinidad 3	Waldin	Pierre
Trinidad 22	Fairchild	Hosororo 5
Nishikawa	Lula	Hosororo 6
SR 1396	Booth 7	Mahabir
	Booth 8	
	Choguette	

the quality of fruit offered for sale is poor because these are not harvested at the right time, or the packing is not done in the accepted manner, the result being that they reach the market in poor condition.

At the moment the Pomeroun farmers find it difficult to market their avocado because the Guyana Marketing Corporation (GMC) does not handle this produce, but the Corporation is now being encouraged to purchase the farmers' produce.

The avocado fruit is utilized only as a fresh fruit, sold in the local market. Chemical analysis of the fruits that were harvested from the eight acre plot at the Kairuni Research Station is given in Table 5.

3) Constraints

Constraints to development are listed hereunder:

- (1) Farmers are not interested in growing the crop, mainly because there is no assured market.
- (2) Transportation is a problem since the produce has to be transported long distances.
- (3) There is lack of an adequate supply of crates.

**TABLE 5. AVERAGE ANALYSIS OF AVOCADO GROWN AT
KAIRUNI (IN %)**

Variety	Protein	Fat	Crude Fibre	Ash
1. Trinidad Selection				
Simmonds Trinidad	8.00	46.39	44.30	0.20
Monroe	---	---	---	---
Jamaica	7.19	54.40	46.90	0.10
Trinidad 3	---	---	---	---
Trinidad 22	7.37	49.57	37.80	0.45
S.R. 1396	7.31	47.28	38.40	0.10
Niskikawa	---	---	---	---
Murieta	5.00	53.00	43.50	0.10
2. US Introduction				
Simmonds Florida	7.25	48.88	43.00	0.00
Dade	9.00	53.42	37.00	0.00
Donaldson	5.28	58.23	39.30	0.00
Rueble	5.94	45.52	37.50	0.00
Waldin	7.19	49.64	40.00	0.00
Fairchild	5.75	54.48	39.10	0.00
Lula	3.94	38.00	44.70	0.00
Booth 8	7.44	61.94	54.70	0.40
Choquette	5.19	52.44	39.70	0.70
3. Guyana Local Selection				
Khan	5.00	51.96	47.40	0.40
Chanause	4.81	52.66	45.80	0.50
Hercules	5.46	52.89	39.20	0.30
Mattehws' Ridge	5.69	62.15	48.60	0.00
Hosororo 5	4.60	48.24	42.20	0.10
Hosororo 6	4.69	45.95	39.10	0.70
Mahabir	4.59	46.36	38.50	0.30
Pierre	5.78	52.00	39.60	0.10
CR C 4-16	---	---	---	0.10

(4) There is also no incentive given to farmers to encourage them to plant larger areas.

(5) Supply of planting material is limited.

4) Proposed research and development strategy

To create conditions for expansion

- (1) Research is needed to identify varieties which can tolerate the damp conditions of the peat soils in the Pomeroon area.
- (2) Fertilizer requirements of plants growing on the brown sands on the area of Linden Highway need to be determined.
- (3) Further introductions are needed to find a variety that is high in oil content and can be used for oil extraction.
- (4) There is the pressing need for a root stock which is resistant to *Phytophthora*.
- (5) An organized system of harvesting, packing and marketing is necessary.
- (6) Establishment of two more orchards—one on the Essequibo Coast and the other on the Hosororo Agricultural Station for production of planting material.
- (7) Planting materials should be available to farmers at all times.
- (8) Encouraging farmers to establish half-acre, or larger orchards, of pure stands in the main avocado producing area i. e. at Hosororo (North West District).
- (9) Setting up a major project to grow avocado on a commercial scale in this area; it is suggested that at least 100 acres be planted in pure stand. With this acreage it will be possible to establish a small processing plant to extract the avocado oil. The best quality fruit should be exported to the West Indies, and the rejects can be utilized for the oil production. It is possible to start this programme at Hosororo by planting at least 20 acres almost immediately as the land is available. This will entail some land clearing of small trees and scrub in the abandoned orchard.

3. Guava (*Psidium guajava*):

1) Production Systems

The guava has always been a popular fruit in Guyana, because it is found growing in very marginal lands and even

in swampy locations in the riverain areas. The fruit is used fresh and also in the jam industry. The two main sources of supply are the Essequibo Coast, where the plants seem to thrive well, with little or no care, and in the Black Bush Polder area where the crop is cultivated in farmers'home-steads. Trees are also scattered all along the Coast.

There are several cultivars distinguished by shape, colour, taste, juiciness and Vitamin C content. Those found are classified as:

- (1) Pear shaped pink
- (2) Pear shaped white
- (3) Round white
- (4) Oval pink
- (5) Round pink
- (6) Oval white
- (7) Lucknow white

The last named is essentially a dessert type, large-fruited with few seeds.

A total of approximately 215 acres is estimated to be under guava in Guyana. Mature trees six years and older at a density of 200 trees per acre will yield 5000 – 8000 lb/ac.

After the crop is planted, not much attention is paid to it, apart from some measure of weed control. Fertilizing is infrequent, and few farmers really pay attention to this aspect of management. Pruning is almost never done.

A single farmer on the East Bank, Demerara, maintains an acre of guava mainly for canning; this is probably the only cultivation in the entire country where the orchard is managed as a business enterprise.

2) Utilization

Guava sold as a fresh fruit on the local market reaches the consumer in bad condition, because of poor packaging, handling and transportation.

The main products of processing are guava jam, guava cheese and guava jelly.

3) Constraints

There are several constraints to development:

- (1) Only few grafted plants are produced and sold to farmers; mainly seedling planting material is available.
- (2) No source of selected planting material for vegetative propagation is available.
- (3) Lack of mist propagating facilities limits the vegetative propagation of plants.
- (4) A homogenous product cannot be assured since the mixture of fruits of different cultivars and types are not separated in the processing operations.

4) Proposed research and development strategy

Suggestions for research and development are:

- (1) Selection and analysis of the best local cultivars.
- (2) Propagation by vegetative means.
- (3) Upgrading of the nurseries at the Central Horticultural Station and the Central Agricultural Station with provision of efficient 'misting units'.
- (4) Introduction of the Centeno Early Prolific variety from Trinidad. Plants should then be multiplied and planted in orchards to serve as sources of cuttings for further propagation. At the same time the best local varieties should also be propagated.
- (5) Research work must be done on the potential of the local varieties for resistance to disease, yield and quality of product.
- (6) The cannery should purchase fruit of known varieties so that the end-products can be homogeneous.
- (7) It is suggested that the cannery should enter into contracts with the main producers so that a supply of fruit is ensured for the factory.

4. Paw paw (*Carica papaya L.*):

(1) Production systems

The pawpaw is found scattered all over the country, with just few acres of pure stand. There are many local varieties,

all mixed. The size, shape, colour of flesh and amount of seeds serve to some extent as distinguishing features. Seeds of 'Solo', a recognized hermaphroditic cultivar, were obtained some years ago from Trinidad. It is estimated that 150 acres of pawpaw are grown and a yield of 4000 to 6000 lb/ac is generally obtained by the few farmers practicing pure stand cultivation of the crop. The majority of the trees in some farms are grown from seed dispersed by birds.

2) Utilization

The pawpaw is utilized mainly as a fresh fruit. Because it is a very delicate fruit, often there is much spoilage and it reaches the consumer in poor condition. It is also used to a limited extent by a few farmers, in the making of dried local fruit.

3) Constraints

Constraints to development are:

- (1) Poor handling, packing and marketing arrangements.
- (2) Lack of proper seed material of the Solo variety for example.

4) Proposed research and development strategy

The following should be given consideration:

- (1) Research in breeding for improving fruit quality and hermaphrodite trees.
- (2) Acquisition of seeds of the various types of Solo varieties.
- (3) Fertilizer trials to determine the nutritional needs of the plant when grown on the white and brown sands along the Linden Highway.
- (4) The propagation of seedling plants of the Solo variety for sale to farmers.
- (5) Encouragement to farmers to establish pure-stand orchards.

- (6) Teaching farmers how to handle and pack their produce for the market.
- (7) Arrangements for a reliable marketing outlet.

5. **Carambola (*Averrhoa carambola. L.*):**

1) **Production systems**

This crop has assumed great importance over the past five years. It is grown in scattered patches mainly in the Pomeroun, West Demerara and the East Coast of Demerara. Fruits offered for sale come from old trees as the new areas which were recently planted are not yet in full production. There are several farmers who have planted a substantial number of plants, and so within a few years production will increase.

Two types of fruits are offered for sale; these are known as the sweet type sold at premium price mainly as fresh fruit in the local market, and the acid type sold for the making of local drinks and dried fruit. The bulk of the fruit from the Pomeroun area now goes to the Guyana Marketing Corporation.

It is estimated that 72 acres are in production and the yield is commonly 5000 to 8000 lb/ac. A few farmers in the Pomeroun plant pure stands of carambola; others do inter-cropping. This can only be tolerated for a year or two at the most because of plant competition for light. Frequently farmers in the Pomeroun plant the trees in single lines along the dams.

2) **Utilization**

The carambola is utilized for dried fruit manufacturing in a cottage industry. It is also used for preparation of jam. On a commercial basis two types of products are made and sold in external markets. These are candied carambola and rum flavoured carambola.

Other products manufactured and sold locally are table sauce, barbecue sauce and carambola cordial.

3) **Constraints**

Constraints to development are:

- (1) The unavailability of planting material of recognized varieties. Mostly seedling plants and only few grafted plants are available to farmers. The procedure for grafting is tedious, and this adversely affects the supply of grafted plants.
 - (2) The lack of a misting unit, severely limits the vegetative propagation by rooting cuttings.
 - (3) No commercial orchards are being planted as a source of planting materials.
- 4) **Proposed research and development strategy**

As a base for desirable development:

- (1) It is necessary to have two orchards for supplying planting materials, one at the Central Agricultural Station and the other on the Essequibo Coast.
- (2) It would be useful to collect the three cultivars of carambola found in Guyana.
 - i) green skinned (slightly sweet) type
 - ii) tart, large yellow type
 - iii) small, yellow acid type
- (3) Vegetative propagation and cultivation of the three types in plots, trials on spacing, fertilizer response, yield, fruit quality should be carried out.
- (4) It is also necessary to import foreign varieties such as Tean Ma, Mih Tro, Dah Pon and Golden Star from Florida. The fruit of these should be analyzed so that the best cultivar can be used for specific products.
- (5) Farmers should be encouraged to plant only vegetatively propagated plants of known cultivars, in specific blocks.
- (6) Fruit for processing should be purchased according to variety.
- (7) The cannery should aim at producing a homogenous end product.

- (8) It is necessary to introduce a satisfactory system of crating for transport of fruit to the market.

6. Citrus

1) Production systems

Citrus fruits have been grown in Guyana for the past one hundred years. The early history dates back to 1883 when some grafted plants were obtained from England. Although citrus collectively is supposed to be the most important fruit crop in the country, we find that there is a shortage of citrus in the market, save at the peak periods.

A few well organized citrus farms exist, scattered in the different regions and the dividends from such enterprises are handsome. On an average, 30,000 budded citrus plants are sold yearly to farmers and this has been the trend for the past decade. Most of these are used to rehabilitate old plantations.

A wide range of types of citrus is being grown in Guyana; included are the many varieties of sweet orange, tangerine, grapefruit, lime, shaddock and citron. There are five propagation stations, spread out over the country to supply budded plants to farmers.

The total area under citrus amounts to approximately 3,901 acres and estimated yields of mature trees, seven years old, are (1b/ac).

Orange	5000 – 8000
Grapefruit	6000 – 9000
Lime	4000 – 8000

Citrus trees are usually planted in a pure stand, sometimes with intercropping for the first two to three years. It is the standard practice for farmers to make mounds in the dry season and plant these at the start of the rains and reasonable care is usually given to the plants during the early stages of growth. The main problem facing the farmers then is the rank growth of weeds and often at this stage the orchard really gets out of hand.

2) Utilization

At harvesting it is customary to sell the entire crop on the fresh fruit market.

3) Constraints

A list of constraints to development follows:

- (1) The main constraint affecting the citrus industry is the availability of planting material in sufficient quantities. This has been the trend for some time and farmers find it very discomfiting when they cannot have plants on request.
- (2) The nurseries producing these plants also have constraints mainly internal factors such as availability of inputs, etc.
- (3) A serious limiting factor is a source of reliable parent trees for obtaining budwood.
- (4) Weed control is one of the problems affecting the farmers as it is difficult to obtain labour for weeding and weedicide is not always available and is very expensive.
- (5) Pests and diseases severely affect the trees.

4) Proposed research and development strategy

Solutions to existing problems may come from:

- (1) Root-stock testing for resistance to virus diseases.
- (2) Indexing of parent trees from which budwood is collected.
- (3) Introduction of citrus budwood to start "source" orchards so that there is a guaranteed supply of scion material.
- (4) Organization of the citrus producing nurseries so that all the operations are standardised e. g. producing budded citrus plants in plastic bags.
- (5) Upgrading of all the citrus nurseries with renovation and repair of structures, plant sheds and buildings.
- (6) Fertilizer studies to determine the needs of the citrus plants grown on the brown and white sands, along the Linden Highway.

- (7) Studies on foliar sprays for plants grown in the Intermediate Savannahs on the 700 and 810 soil series.
- (8) A rehabilitation programme to encourage farmers to do the necessary clean-up operation in their orchards.
- (9) All citrus farms should be rehabilitated; farmers should be encouraged to weed their plantation, prune the trees, spray fields. It is recommended that duty-free inputs be available to farmers so that this task can be executed.
- (10) There should be a massive education programme to inform the farmers on the rehabilitation programme. Field Days in all the citrus producing areas should be an essential part of this.
- (11) All the nurseries should step up production so that adequate supplies of budded plants become available. The requested funds should therefore be provided to purchase inputs such as planting material and plastic bags, etc.
- (12) It is recommended that the Central Agricultural Stations and Central Horticultural Station embark now on a complete rehabilitation programme for the citrus orchards.
- (13) Improved facilities are needed at the Central Agricultural Station for virus indexing.
- (14) Although some work has been done recently, it is still necessary to make some more improvements on the green house.

7. Pineapple (*Annanas comosus* L.)

1) Production Systems

Up to the middle of the 1960's pineapple production was mostly of sporadic nature and only in the Canals area and Boerasirie districts in the country of West Demerara was there any intensification of production. With the opening up of the Soesdyke-Linden Highway in the late 1960's it

was soon discovered by the settlers that pineapple was among the few crops that could be grown on the white and brown sands of that area with relative ease and moderate success. Cultivation expanded steadily to an estimated 1600 acres in 1977.

The bulk of the crop (90^o/o) is of the Monsterrat variety which is not particularly suited for processing; another variety, sugar-loaf, is grown to a lesser extent. There are also a number of local cultivars found in remote areas, but the fruits have not been analysed nor have their adaptability been studied.

An estimate of pineapple growing in December 1979 is given in Table 6.

The yield from the Canals Polder is 8,000 to 10,000 lb/ac. the crop usually lasts for four ratoons, with about 5^o/o yield decrease per crop.

On the Highway the yield is very low, about 5,000 lb/ac.; the ratoon crop does not last more than two harvests and the yield goes down drastically by some 25^o/o per crop. The production occurs over two seasons, April-July and December-January.

In Upper Demerara the predominant type of spacing is the double row system which gives approximately 7.260 plants/

TABLE 6. ESTIMATED AREA PLANTED IN PINEAPPLE (1979)

Location	Acres
Upper Demerara Linden Highway	1.530
Canals Polder – West Demerara	254
Essequibo Coast and Islands	46
Hosororo and North West	50
Total	1.880

ac. The crop is planted mainly in pure stand and weeding is done three times per year.

In the Canals Polder the crop is frequently inter-planted with other crops and rarely planted in pure stand. Single row planting system is mainly adopted and this system allows for approximately 4,000 plants/ac.

2 Utilization

The fruit is utilized mainly in the fresh form, although some processing is done. The products are pineapple juice, pineapple chunks, pineapple jam, bakers' jam.

3) Constraints

Constraints to development may be identified as follows:

- (1) High cost of fertilizer resulting in minimum or no usage.
- (2) The weed growth is prolific and its control is limited because of the high cost of weedicide.
- (3) The mealy-bug/ant complex is a serious threat, as in some other countries of the world, causing wilting and reducing yields by about 40^o/o.
- (4) Gummosis leads to spoilage of a large percentage of the fruit.
- (5) Poor cultural techniques such as use of poor quality planting material, improper treatment of this before planting and unsuitable spacing in the field.
- (6) Premature harvesting and primitive handling of fruits resulting in post-harvest losses.
- (7) Farmers' dissatisfaction at the marketing system and low price.
- (8) Inadequate transport facilities for conveying inputs to the field and produce to the market.

4) Proposed research and development strategy

Attention needs to be directed now to:

- (1) Introduction of the Smooth Cayenne variety in commercial quantities to be used exclusively by the canneries.

- (2) Introduction of the PR 165 which was bred in Puerto Rico and is resistant to the mealy bug (*Dysmicoccus brevipes*).
- (3) Further experimental work on chemical weed control.
- (4) Work on the nutritional requirement of the plants grown on the Linden Highway on white and brown sands.
- (5) Experiments with foliar sprays, especially iron sulphate.
- (6) Farmers must be educated towards adoption of the best cultural practices, including:
 - i) Planting of uniform slips and suckers in any one field
 - ii) Disinfecting all planting material before planting, using the method recommended by the Plant Protection Division of the Ministry of Agriculture.
 - iii) Fertilizing the fields
 - iv) Leaving only one shoot per plant to give a good ratoon.
 - v) Keeping the fields free of weeds.
 - vi) Controlling the mealy bug.

8. Cashew-nut (*Anacardium occidentale L.*)

1) Production systems

Cashew grows wild in the Rupununi Savannahs and for a long time there were no efforts to plant on an organized scale since little use was made of the 'fruit' and nuts.

Throughout the 1960's plans were under consideration for a cashew industry and, with the opening of the Soesdyke/Linden Highway, cashew was earmarked as one of the major crops for the white sand. The latest estimates (1980) show that there are in 150 – 160 acres of bearing trees and 100 acres of non-bearing trees in the Rupununi District and 260 acres of bearing trees with little or no fruit set, along the Soesdyke-Linden Highway.

In the Rupununi the nuts are customarily collected from fallen fruit under trees growing wild; attempts are now being made to cultivate the plant in an organized manner and already a few small orchards have been established. The average yield of nuts in the Rupununi is 1680 Kg/ha.

In 1979, the Ministry of Agriculture planted a small one-acre orchard with seedlings of the Jumbo variety at Ebini (Berbice River).

These seeds were obtained from Trinidad. On the Linden Highway, the planting was done in a better organized manner at a spacing of 30' x 30'. Inter-cropping with vine crops and pineapple was practiced for the first two years.

2) Utilization

In the coastal areas use is made of 'fresh fruit' but the supply is limited; in the Rupununi fruit is utilized for making a locally popular alcoholic beverage.

The nuts are roasted and sold on the local market. A method for processing cashew-nuts has been perfected at the Central Agricultural Station and farmers in the Rupununi district are advised to follow the technique.

3) Constraints

Anthrachnose caused by *Collectotrichum sp.* is the main constraint affecting the plants on the Linden Highway Region. Although there is prolific flowering, fruit set is poor.

4) Proposed research and development strategy

The main research and development needs are:

- (1) Solution of the problem of anthracnose on the trees in the Linden Highway area.
- (2) Research to find out the nutritional needs of the plant growing in the Linden Highway region and to recommend fertilizer treatment.
- (3) Equipment to process the nuts and to extract the oil.
- (4) Expanded cultivation in Rupununi and orchards organized in pure stands.
- (5) Improved seed material imported from Brazil and elsewhere.
- (6) Continued research at Long Creek (Linden Highway) on Anthracnose.

FRUIT TREE CROP DEVELOPMENT IN HAITI

Gustave Menager

Department of Agriculture, Natural Resources and Rural
Development, Haiti

It will doubtless be realized that the island from which two delegations have travelled bears the Indian name Aytí, meaning highlands or mountainous lands. Two sister Republics, the Dominican and the Haitian, share its conditions. Moreover, its flora reflects these conditions, lends itself to botanical and phytosanitary investigations, and possesses the agro-economic potential for fruit production which could serve to supply natural vitamins to its indigenous population. In these investigations the flavour of the fruit features.

Many informative communications have already been made at this meeting today; examination of these will not only lead to the establishment of a regional diagnosis, but will also provide an outline and indication of the kind of technical and political management needed for the development of fruit production. Our ability to perceive and understand the effects of national interest markets will in the near future facilitate equitable sharing in profits. We must therefore, appreciate the favourable and unfavourable influences of good years of production alternating with events resulting from the destructive effects of hurricanes. These must be taken into account in our commercial transactions.

With these guidelines our political decisions in respect of fruit production will permit the country to progress and even to stimulate advances in the field. These must include soil conservation programmes for checking erosion of hill lands where most of our rural population live (provided these soils have the potential). The task

also includes the need to attract the attention and interest of international and bilateral institutions.

With such understanding, we are pleased to present our modest contribution and to say that for the moment our total production is currently consumed locally as food for our population, feed for livestock and raw material for essential oil processing plants.

PRODUCTION

Several attempts to estimate the break-down of our gross fruit production have been unsuccessful. Extrapolations mainly based upon the consumption of our largest town, Port-au-Prince, are as follows (metric tons):

Citrus	12,000
Mango	9,700
Avocado	6,000
Coconut	5,000

This suggests realistic estimates of the national production to be (metric tons):

Citrus	33,000
Mango	80,000
Avocado	50,000
Coconut	7,000

Lemon production is estimated as 7.000 metric tons.

Based on these observations, fresh fruit consumed per capita among the most important categories is about 30 kg/year. Most of the fruits mature from May to September, with the exception of the northern citrus which matures in the colder months, and coconuts are harvested the year round. Since fruit preservation and canning have just begun, first with mango, the bulk of the fruits has to be consumed fresh or otherwise go to waste.

Under conditions in the Republic of Haiti where average farm size is small and subsistence farming is the norm, fruit trees are kept to provide food (sucrose, liquids, vitamins and minerals), as well as to bring in some cash. Therefore, for example, on the 4.000 hectares of coastal plain where plantain, banana and sugar cane are cultivated,

650 hectares represent the vertical projection of the fruit tree crown shadow. As a matter of fact, these trees are found on the boundaries of holdings or, oddly, in the middle, as a result of repeated sub-divisions of land among heirs. Rice lands apart, in a system of mixed cropping, about 16⁰/o of the area is given to tree crops, mainly fruit.

MARKETING

Marketing is centred on the towns which represent 16⁰/o of the population and consume 18.2⁰/o of the fruit produced. It is clear then, that the consumption capacity of the town largely determines the volume of sales. At the end of a fruit season, as has happened this year, a general inflation spreads like a sudden wave over the countryside and prices sky-rocket.

Marketable fruits generally go to towns where they provide supplies for the lemon oil processing plants, occasionally lead to resumption of activities in the sorting shed of the "Mango Francique" exporter and, to a lesser degree, are sold to canning plants.

Here again exceptional conditions exist in Haiti where fruit sellers are more numerous than buyers and so speculators or middlemen are very active because of the margins enjoyed on sales in the towns.

Essential Oil Processing Plants are located near the coastal towns of the south, the north and west central areas. Until very recently, the Quality Control Office controlled the sales contracts for fruit intended for export, but now processors are free to sell to their own contractors. These groups are anxious to examine the conclusions of this workshop, as they now compete with the Pacific and South East area producers in pricing.

Mango fruit exporters are few, but export sales are on the increase. These young entrepreneurs organize fruit production, transport, selection, packaging and meet the export laws, regulations and other standards demanded by the U. S. trade.

Canneries have newly begun operation and are encouraging the farmer to produce more since they have indicated their interest in buying. None have identified themselves as producers also, but they are providing seeds and other material for propagation. Some canneries have been successful with guava, mango, papaya as juice, paste or chunks.

POLICY AND PROGRAMMES

The Ministry of Agriculture, which I have the honour to represent, contemplates satisfying the majority of the population which has always been accustomed to fresh fruits at very low prices, and also the fruit processor by ensuring a regular supply of good quality products and seeing that prices remain attractive to small farmers, whilst job opportunities offered by keeping the factories in operation are maintained.

This Ministry recognizes the fact that emigrants who are active abroad promote consumption of exotic fruit by introducing others to the taste and aroma of these. It also appreciates the need to provide conditions for progressive increase in the quantity and improvement in the quality of fruit produced in relation to expanding opportunities.

It also recognizes the effort of the private sector in making investments in canneries which provide the incentive to boost fruit production, and it offers incentives such as tax exemption for the first few years of operation of enterprises. Among the incentives considered for promotion of tree fruit production in general, the priority is to establish structures capable of rapidly augmenting stable production based on an intensive cropping system to meet the growing local demand, resulting from increasing population density and improving purchasing capacity. Programmes are, therefore, being designed for location on the most suitable sites and appropriate land.

Although utilization of land is known by tradition and practice, research centres in the CARICOM area could indicate the best inputs and better knowledge of cultivars and the markets. Additionally, research efforts would not be unnecessarily duplicated and we would hope to collaborate within the scope of action defined in this workshop.

These fruit production programmes in Haiti will, as a policy priority, tend toward soil conservation and hillside stabilization in the following ways:

1. Contour planting of trees (wood for energy or construction).
2. Stimulating the planting of crops such as coffee and cocoa to restore soil fertility and to facilitate stabilization of our balance of payments.
3. Keeping land in fruit trees, either scattered or in orchards established along contour lines, regardless of the types

they represent (fresh edible fruits, canned or transformed) for local use and export.

Basic to our programmes, are preventive measures which will assure protection against admitting any kind of plant without appropriate safety controls.

Plant disease control is a source of concern, as recently Lethal Yellowing disease of coconuts wiped out the crop in the northern part of the country. Before we undertake propagation, even highly resistant hybrid strains are kept on a testing and observation trial. We assume that in the near future our plant protection programme will develop within a regional programme, very likely in harmony with that of the Dominican Republic.

Finally, let me add that people in Haiti and the Dominican Republic talk about the same fruit in two languages, French and Spanish, but here at this session the word we have utilized to name a fruit has a mere CREOLE meaning.

GOVERNMENT PLAN FOR THE DEVELOPMENT OF FRUIT TREE CROPPING IN MONTSERRAT

Omer S. Lloyd Thomas

Ministry of Agriculture, Montserrat

To preface presentation of the plan, a brief outline is given of the crops commonly grown and those which it is the intention of the Government to expand in both the short and the long term.

Those commonly grown are papaya, citrus, avocado, cashew, mango and the exotics.

From among them the Government plans to expand citrus, avocado, cashew, and mango.

Recently we embarked on a project for the development of macadamia nut on our high lands.

In respect of the National Plan it is desirable to have a look at the past.

Since 1971, the Government of Montserrat, as part of its development plan in agriculture, has identified Fruit Tree Cropping as a source of development. Such a plan, it was envisaged, would encourage landowners to put their lands under tree crops. Lucrative returns could be realized from the intercropping with vegetables and other short term crops.

The plan made provision for the supply of fruit tree plants free of charge to those who were willing to prepare holes for planting on unoccupied lands. In the plan also is a project to establish a labora-

tory for development of a Food Processing Industry with arrangements to offer advice and testing facilities to interested persons.

THE PRESENT SITUATION

On careful consideration of the cropping programme of the plan, the land tenure system was examined. It was ascertained that large areas of land on the island are unsuitable for intensive cultivation, due to the steep gradients and rocks embedded in the soil; however, some of those lands were well suited for the establishment of fruit tree crops. It was the Government's intention to establish and manage approximately four hundred (400) hectares of fruit crops, but the programme was not initiated due to lack of funds.

The British Development Division is now establishing demonstration plots in the sections of the island where maximum effort would be realized. The farmers are expected to participate in fruit tree crop development by establishing their own units on their land but with full supervision from Government. Incentives by way of fencing and the distribution of fertilizer by Government have been introduced so as to guarantee maximum interest from the community.

BENEFITS EXPECTED

The benefits expected to be derived from this programme can be summarized as:

1. Achievement of self sufficiency in most of these crops, and production of a significant surplus that would be available for local processing and export.
2. The processing of such fruits as mango, guava and cashew. This operation should offer significant scope for labour intensive employment.
3. The building of an export trade in fresh fruits will offer major economic advantage to the island.

Because Montserrat is a Colony dependent on Britain, it does not feel directly the agony of the asphyxiation, as a consequence of the debt obligation imposed on the other independent Third World Countries by the Developed Countries, but we are aware of them so we in Montserrat have to be sensible about our planning. We find we have to create logical and indigenous systems of production geared to ensure surpluses for export. That is why, taking cognizance of pro-

blems in respect of the size of our population and the volume of turnover that is required to attract and maintain transport facilities, we have planned to establish extensive orchards.

DEVELOPMENT OF TREE CROPPING

The development of the Tree Cropping Programme as it now stands has three parts:

1. District Demonstration Plots

Under this scheme ten (10) hectares of pure stand of mango, avocado and citrus are planted. The purpose of this programme is to introduce new varieties and better management techniques to farmers.

2. Social Tree Cropping Scheme

Under this scheme, fruit trees are provided by Government to farmers desirous of growing tree crops. The care and maintenance of the trees is supervised by Government for five years. Also, the nursery staff graft scions of desirable marketable varieties on to stocks of 'wild' types. This is done throughout the island on mangoes and avocados belonging to those desirous of having such an operation undertaken.

3. Government Commercial Plots

These should provide the nucleus of high quality fruit for export.

CURRENT FIVE YEAR POLICY

The Government will encourage productive land use especially for agriculture; it discourages land holding for speculative purposes.

Some estates will be purchased by Government and vested in the Land Development Authority which will develop the land on a commercial basis. These will provide a nucleus of high quality fruit and vegetables for export, supporting the production which is to be developed from private Montserratian farmers and small holders, and will also demonstrate the correct husbandry required to produce these crops.

MARKETING

The Marketing Organization will function to:

1. Purchase the supplies of materials required as inputs to the fruit tree crop development;
2. Purchase farmers' produce and arrange its disposal wholesale to internal and external markets;
3. Disburse and collect credit and loan monies to farmers;
4. Export lime juice (80 % of production) and all of the lime oil and bay oil.

MONTSERRAT INDUSTRIAL ENTERPRISE LIMITED

This Organization will be responsible *in toto* for the processing of the crops and the eventual canning of fresh fruits and juices.

There is in the Research Division a certified and adequately qualified Produce Chemist operating the Produce Laboratory. He is presently working on ways and means of preserving and processing our excess fruit and distilling oils from the lemons and bay leaves.

In the analytical section of the Research Division, the emphasis is on food preservation rather than food processing, the aim being to supply primary products to the major processors elsewhere in the Caribbean. We in the Research Division are currently involved in the setting up of a Canning Project and distillery for essential oils.

Mangoes and guavas are being preserved along with other suitable fruits as jams, jellies and chutney. However, most of the processing is done on the Cottage Industry basis.

11.

THE FUTURE

By the year 1984 the Government expects to be operating over 132 hectares of which 20 will be in limes – both the West Indian variety and the Persian triploid type. Montserrat has over 1,800 hectares of land suited to the establishment of orchards and it is also proposed to grow:

1. Ortaniques, predominantly for fresh market;

2. Bay, guava, papaya and the exotics for processing.

LIMITATIONS TO THE PROJECT

1. Lack of security of tenure;
2. Labour is expensive and scarce;
3. Untethered livestock cause heavy loss of established plants;
4. Praedial larceny.
5. None of the major diseases are endemic on the island but there are isolated cases of the RNA particle (VIROID), known as Exocortis, affecting citrus.
6. I can foresee a problem with mycotoxins, so some studies in the area of Mycotoxicology may have to be carried out.

FRUIT TREE CROP PRODUCTION ON THE ISLAND OF ST. KITTS

Wilfred Welsh

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HISTORY

As is probably well known, the island of St. Kitts proudly claims to be the Mother Colony of the West Indies.

In early colonial days, therefore, St. Kitts was very uniquely cultivated. This was so because of its very fertile soil. The Carib name "Liamigua", meaning fertile soil, is still being used today to tell the story. Because agriculture was "extensively" pursued, the plantation system became the way of life, and then all of the agricultural workers were subjected to the plantation owners. The agricultural patterns on the island, therefore, were greatly influenced by the plantation system.

St. Kitts is shaped somewhat like a guitar. There is the main body, which is the part that is extensively cultivated, and then there are neck and head which in recent times have become the focal points for tourist development. The capital, Basseterre, is conveniently situated at the junction of the neck and body, linking the two phases of development.

TOPOGRAPHY

A remarkable feature of the topography is that it has a central mountain range running through the island. From the foot of the mountain, the land, with its rich volcanic soil, slopes gradually down to the sea. The mountain chain, among other things, serves to

attract the rain, which provides the much needed moisture for the lush growth of the crops. The highest point, Mt. Misery, reaches 3711 feet.

CROPS GROWN

Sugar-cane is the chief crop and it is grown on about 80 % of all arable lands. The other 20 % is comprised of pasture lands, valleys, ghauts or ravines, on which fruit trees grow, and on some areas peasant farming is practiced.

I have now given you all the foregoing information, so that you can vividly paint a picture in your mind of what to expect by way of fruit-tree-crop production on St. Kitts even before I attempt to give you some details. However, I will still give some reflections on the past, before I come to the present. There was a time when St. Kitts had an abundance of fruit trees on certain slopes and in nearly all of the valleys, ravines or ghauts, whatever you chose to call them, planted as if it were the design of the people in agriculture many, many years ago. We used to refer to them as walks or gardens. Some areas grew avocados in long stretches, others mangoes of different descriptions and tastes, others still purely custard-apple or sugar-apple, breadfruit, mansiport or mammey-apple, the cashew, the soursop, guavas, genips, some citrus, some coffee and some cocoa, bananas and tamarind.

It seemed to me then, and I was of very tender age, that I was in a very pleasant world. There were a great many fruits to eat; one did not have to buy them, as it was really only necessary to make up one's mind to go in search of them. With the unfolding of time things changed; some areas have become overgrown with resulting death of the trees; some areas have been cleared, perhaps for false value or, indeed, for other motives.

To put it simply we were indeed blessed, but we took little or no care. We still have the remnants, but the rehabilitation work is indeed a big task.

Now, the list of fruit trees I have given is quite considerable; yet it does not include all the fruit trees that are grown on my island, even now.

However, it must be said that, whereas in the past private ownership, by and large, dictated the agricultural policy, my Government, through the arm of the National Agricultural Corporation

of which I am a part, is laying much emphasis on fruit tree crop production. It would have been an asset if someone had taken the trouble to propagate some of the very best of the so called indigenous varieties grown on the island before they were allowed to phase out.

WHO PLANTS OR GROWS WHAT

Let us take the least grown crop first:

1. **Papaya (Pawpaw)** is grown by householders as a backyard crop, and in small holdings; so is the banana, but NACO has in recent times been pushing the production of bananas. From a pilot project of 15 acres, we have now developed to approximately 80 acres.
2. **Cocoa** grows wild on some estates which formerly grew them and cared for them.
3. **Coffee** is being tried on a small scale again by NACO on 30-40 acres.
4. **Genip** is chiefly grown in the neighbourhood and is an excellent treat to young and old alike. So are the soursop, sugar-apple, custard-apple which can be found growing wild in some of the ravines of the estates.
5. **Cashew** used to be more plentiful many years ago, but there is a rapid decline in recent times resulting in a mere sprinkling of trees.
6. **Citrus** limes and sour oranges were in abundance once but are on the decline, and these were our main types of citrus, but this pattern is changing.
7. **Avocados** also are on the decline, whereas a few years ago, there were appreciable numbers of trees in orchards around the island. In many instances they have grown beyond the point of successful harvesting and the areas grown into forest.
8. **Mangoes, breadfruit and coconuts** still dominate the scene. The quality of the mangoes at present does not give me much to boast about except for the Polly, some strains of Round Ball, Rosy Cheeks and the Dumplin.

PRODUCTION

What I have so far pointed out is that there is a need to look at this whole business of fruit tree crop production in a meaningful way. We in St. Kitts have begun to make positive steps in this direction. The Windfall Fruit Tree Project which comes directly under my supervision covers approximately 40 acres funded by the British Development Division, starting with 12 acres of mangoes and 28 acres of citrus.

This project begun in 1976 with a member of the American Peace Corps as Project Director and in 1980 we were able to market some mangoes and citrus, chiefly limes. The oranges and grapefruits bore, but praedial larceny saw the fruits going prematurely. Our aim is to keep production at a high level with the hope that it will off-set the problem of stealing.

Inias Hosein who is a specialist in the field is now the new Project Director and we intend to establish a 6 acre plot of avocados in the spring of 1981.

Once again I must commend the plantation system of agriculture here, because the budget provided by the funding agency had to be supplemented to a large extent to keep pace with the tending of the crop to ensure the success which we enjoy up to this point. Small farmers except for a fairly well-thought out scheme would find the task extremely hard.

In St. Kitts, fruit tree cropping by the small farmer is purely for domestic use. There has always been the urge by the householders to have one or more fruit trees growing in their backyards as space would allow. To this end in every new housing site enough space is left to allow for gardens, and the agricultural station at La Guerite is the place for supplying the much-needed seedlings for all concerned — the big and the small.

Kittitians love a fresh, attractive, good-tasting fruit, and if a concerted effort is made to produce more, we will find that it will become necessary to go into the processing business as an economic proposition, for our fruit trees do produce very well. Sometimes we lament the many fruits that go to waste, particularly the mangoes and the breadfruit. In many instances harvesting of the crop is a very tedious exercise and the cost involved when related to present day labour rates is something to reckon with.

It will be noticed that I have not yet mentioned pineapples. This crop is also grown by the National Agricultural Corporation on about 30 acres of land and the effort has been very successful.

MARKETING

The local supermarkets take a limited quantity of fruits. Trade in fruits is left almost entirely to small vendors who are seen at the market places, side walks and entertainment spots selling their produce. The small export market to neighbouring islands shows signs of gradually increasing, according to the dictates of supply and demand.

CONCLUSION

In closing I would like to state that our aim is to restore St. Kitts to its past glory in fruit tree crop production, with greater emphasis on better quality fruit.

No direct mention has hitherto been made of the Sister Island of Nevis. That island has quite a lot of the same fruit tree crops that grow on St. Kitts, and peasant farming is more the way of life on Nevis than on St. Kitts, because of a different economic base. Owing to the abundance of fruit on Nevis the marketing is done to a large extent on the island of St. Kitts.

I am unable to provide you with the relevant statistical information because I am not from the agricultural department in the Ministry, but I think the global picture I have painted is enough to whet your appetite.

NATIONAL AGRO-ECONOMIC DEVELOPMENT OF TRADITIONAL AND NON-TRADITIONAL FRUIT TREE CROPS IN ST. LUCIA

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INTRODUCTION

There have been considerable efforts by the Ministry of Agriculture in St. Lucia to encourage farmers to diversify the agriculture. For this reason, the Tree Crop Diversification Project was drawn up in order to lessen our country's dependence on bananas and coconuts as the major export crops. There are rapidly expanding markets in the United Kingdom for certain varieties of fruit tree crops, and projected development of agro-industries in St. Lucia, in the near future, has also acted as a further encouragement for diversification.

In view of this potential for the development of our economy maximum emphasis is being placed by the Ministry of Agriculture on efforts to properly organize and increase the acreage of fruit crops. However, there are various factors which will be noted in this report.

PRODUCTION SYSTEMS, POTENTIAL AND CONSTRAINTS

The information presented here explains the reasons for the above-named factors, which, I am sure, will be or are the same with our Caribbean neighbours.

The situation here is caused mainly by our education system over the years. There is no organized production of fruit crops as occurs with bananas, which is our major export, followed by coconuts (copra). In St. Lucia, there are no areas with proper orchards;

fruit crops exist mainly on the large estates and are used commonly as wind-breaks. Avocadoes, mangoes, pawpaw grow scattered all over the the island, with the occasional trees growing on various holdings, whilst guava grows islandwide as a wild shrub.

There is need for a concerted drive on growing of fruit crops, since banana production has so far completely overshadowed these crops. However, one has to consider some of the factors that have led to the present position of bananas and coconuts in St. Lucia, such as the organized market system and the high level of research conducted in St. Lucia. Also, one has to take into consideration the fact that fruit production is seasonal (yearly) whilst banana can normally be harvested weekly, leading to a situation where the grower can have money weekly; whereas, with the seasonal production of fruit crops, such a farmer would have to wait longer. This is further compounded by the fact that there is, in season, usually a glut of fruits which cannot be alleviated because marketing and shipping are not organized and processing and storage facilities are very limited. These are some of the constraints to the fruit tree crop production in St. Lucia.

Further constraints are due to our consumer habits; exotic fruits such as apples and pears are highly appreciated and valued by our consumers, although their nutritional value may be much lower than those of locally available fruits. Consequently, these imported fruits usually sell on our local market regardless of price and each year thousands of pounds of mango, avocado and other fruits rot away.

MARKETS, MARKETING AND PACKING AND AGRO-INDUSTRIAL PROSPECTS

Our marketing problems have to be tackled at a local, regional, and international level to develop tropical fruit tree production.

Locally, there is need for education on the value of such food. Research done on the nutritional status of local fruits has to commence at the school level (all schools). Such an effort would cause an awareness in people of what they eat. The need also exists for education on the relative nutrient value of exotic fruits. When public education has succeeded, the following achievements will be made: our yearly glut of fruits will be removed because of increased local consumption; marketing of fruits locally will not be a significant problem, and this will be an incentive to our local farmers to increase and improve fruit production, because sales will be increased.

Shipping is very important for regional and international markets. Research work done by the CDB has shown that there is a guaranteed market in the U.K. for mangoes and avocados amongst other crops. The nature of tropical fruits, together with the weather (temperature), does not allow them to remain in a fresh state for too long after harvest. For our fruits to reach outside markets in a fresh state, proper refrigerated facilities are needed. The Geest banana boats are equipped with these and we are able to ship fruit (avocado, mango and others) to the U.K. Another means is by air transport, but high freight costs, due to an ever increasing price of oil, hardly makes this method of shipping feasible.

St. Lucia has the WINERA packing plant, which produces boxes for shipping banana to U.K. With proper trials, boxes could be made for packaging various fruits, to prevent bruises and other transportation damage and ensure that fruits get to the foreign markets in a desirable condition. Fruits could also be bought by an organized marketing agency, as in the case of banana, using the facilities of the St. Lucia Banana Growers Association's boxing plants located all over the island, to help in maintaining the quality of the fruits.

The Government of St. Lucia constructed a Produce Chemist Laboratory which became operational in 1974, with the aim of developing agro-industries. Work done by the PCL has resulted in developing methods of preparing:

1. Guava	Cheese, nectar, jelly, jam, stew
2. Passion fruit	Syrup, wine, jam, juice
3. Golden apple	Nectar, jam, chutney, jelly, stew
4. Tamarind	Syrup, jam, juice, balls, sauce
5. Lime	Syrup, cordial, powdered dehydrated peel
6. Sour-sop	Nectar
7. Mango	Nectar, jam, jelly
8. Hot pepper	Sauce
9. Cinnamon	Ground powder
10. Sorrel	Syrup
11. Hog plum	Juice
12. Grapefruit	Syrup, juice, marmajam, mixed peel
13. Siwette	Preserve (whole and seedless), jam, syrup

The above products are now available to consumers; tamarind and siwette are already known as material for good wines.

St. Lucia is an agriculture-based country and, with the many fruits available, a successful industry could be established. Storage of

fruits for use by factories when the production season has ended is very important; this can be done in various forms such as mango slices in brine. Agro-industries in St. Lucia would help in reducing our high import by local production of our jams, juices, nectars, etc.

DEVELOPMENT INCENTIVES AND CONSTRAINTS

As indicated in the introduction of this paper, the Government of St. Lucia has embarked on a Tree Crop Diversification Project which began early in 1980. This project will be for five years and is financed by the British Development Division in the Caribbean (BDD). Incentives provided by the project are:

1. Assistance in land clearing, land preparation, lining out and planting.
2. Labour assistance in maintaining the new tree crop plantation up to year 5.
3. Provision of free capital inputs, including fertilizers and agricultural chemicals for five years.

In addition to constraints already noted, there are others which include availability of planting material.

RESEARCH AND TECHNOLOGY TRANSFER

Efforts have been concentrated on processing of fruits by the Produce Chemist's Laboratory; there is need for organized research work, on the scale practiced by WINBAN on banana, on production of the following crops: mango, avocado, guava, pawpaw. There is also the need for the training of specialists in that field to help in production.

Feasibility studies have shown that there is need to zone areas for the various fruit crops. This has been done by the Ministry of Agriculture in the Tree Crop Diversification Project.

ECONOMIC DEVELOPMENT PROJECT PROFILE

The aim of the Tree Crop Diversification Project is to expand the acreage of orchard crops by some 1900 acres over a five year period, and the main tree crops identified are avocado, mango and Ruby Red grapefruit. The full production should amount to about 8000 tons of fruit per annum.

Areas will be zoned for the optimum climatic and physical areas for each type of crop. About half the acreage will be pure stand and half intercropped with existing banana stands or ground provisions. The project will initially be concentrated in the southern part of the island.

About 50 % of the fruit will be for the extra-regional market and the remainder for local and regional markets.

I hope that my contribution will give an insight into the position of St. Lucia in fruit tree crop production and development. This I am grateful to share with our sister islands and countries.

THE DEVELOPMENT OF TROPICAL FRUIT TREE CROPS IN SURINAME

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INTRODUCTION

The agro-climatic conditions existing in Suriname are ideal for growing of some fine varieties of tropical fruit trees. This can be judged from the healthy and vigorous fruit trees like mango, papaya, avocado, citrus, cashew, W.I. cherry, soursop and guava growing along the roads, backyards of houses and in many vacant plots in almost all the districts of the country, in spite of little care being given to these trees, at present.

The interior of the country is relatively uninhabited, except for the settlements of Bush Negroes and Amerindians along the rivers. These people practice systems of shifting cultivation for their subsistence farming.

Moreover, large parts of the rest of the country are very sparsely inhabited. Agricultural activities are mainly restricted to parts of the young coastal plain and to an area of the old coastal plain south of Paramaribo.

SITUATION AND CLIMATE OF THE COUNTRY

Suriname is situated on the north eastern coast of South America between 2° and 6° North latitude and between 54° and 58° West longitude. It covers an area of about 145,000 square kilometers.

Four zones can be distinguished. Along the coast lies the young coastal plain, which is on an average about 30 km broad and covers

approximately 10,000 km². The soil consists predominantly of marine clay, the surface of which lies below high tide level. Especially in the eastern part of the country, a large number of sandy reefs or ridges (called "ritsen" in Suriname), which may attain a height of a few metres above sea level, are found in this belt. The sand may contain variable amounts of shells. The reefs run mainly from east to west. This area is ideal for growing vegetables and some fine fruit trees.

Proceeding to the south, we find the old coastal plain, covering about the same area as the young coastal plain. It consists mainly of silty clay areas, parts of which are swampy. Between these areas, higher sandy plateaux are found.

South of this area lies the savannah belt, a rather narrow strip of about 5,000 km² in area, so called because in large parts the vegetation has the character of a savannah. The soil is comprised largely of quartz sand, which has been deposited by rivers.

The fourth and southermost zone forms the interior part of Suriname, comprising about four-fifths of the whole country. This is mostly hilly and there are some mountain chains which reach heights up to 1,300 metres. The soils overlie very old rock formations and bear mostly tropical rain forest. As can be expected from its situation, Suriname has a typically equatorial climate. During most of the year, the trade wind blows inland from the ocean and for this reason very hot spells are infrequent. The annual mean temperature is about 27°C, with a difference of no more than 2°C between the hottest and the coolest months.

The annual precipitation is rather high for a tropical lowland, amounting to about 2,250 mm at Paramaribo, and decreases from east to west.

The year can be divided into four seasons; a main rainy season from April to the middle of August, a main dry season from the middle of August to the end of November, a minor rainy season during December and January, and a minor dry season from the beginning of February to the end of March. The wettest months are May and June, when most stations have about 300 mm of rainfall. The driest months are September and October.

PRODUCTION DEVELOPMENT OF FRUIT TREES

Research and observations on fruit trees have proved that some of the finest varieties of mango (*Mangifera indica*), papaya (*Carica*

papaya), passion fruit (*Passiflora edulis flavicarpa*), W.I. cherry (*Malpighia puniceifolia*), soursop (*Annona muricata*), orange (*Citrus sinensis*) and also pineapple (*Ananas comosus*) are already in existence and that they can also be successfully kept in cold storage for two to three weeks, indicating therein that these fruits can be exported to foreign countries in good condition.

1. Orange

It is already known that the international market offers very good prospects for the sale of orange as both fresh fruit and orange juice. However, transporting this fruit in both fresh and pulp form by ship under refrigerated conditions from Paramaribo to European and other countries has met with some problems, because of the currently unfavourable situation of Suriname with regard to shipping.

2. Mango

Although many mango varieties are grown in Suriname, the country itself is not very suitable for growing this crop, because of the annual precipitation, which influences blossoming and fruitbearing. Some mango varieties can already be rated as first class and possess all the characters like better eating quality, good size and better keeping quality under refrigerated conditions, which are needed for export purposes. The varieties like Golek, Roodborstje and Aromanis can be considered for purposes of export to European and other countries, in fresh form for table purposes, and in the form of mango products like mango chutney, mango pickle, mango juice and mango pulp.

3. W.I. Cherry

Except with the method of manual harvesting, no problems have been arisen regarding the cultivation of the W.I. cherry.

4. Soursop

Soursop has been of little importance in Suriname till now, mainly because of severe infestation of the fruit by the soursop moth (*Cerconota anonella* Sepp.) and the soursop wasp (*Bephrata maculicollis* Cam.). As marketing prospects seem to be good, research to control these pests has been started.

5. Papaya

Regarding papaya there are over fourteen local and foreign varieties with yellow and red flesh growing well in different districts. Some of these varieties were introduced from Hawaii and Peru a few years ago.

Small scale cultivation of papaya started in 1963, with an experimental garden in the environs of Paramaribo. Various seeds were planted. In 1970, the selection studies started intensively. By self-pollination (hand pollination) of good starting plants nine (9) good varieties were finally created which seemed to be homogenous even after two generations of inbreeding.

The area and production of papaya at present is just sufficient for local consumption and there is not enough surplus fruit which can be exported. Except the experimental garden, most of the papaya trees are grown in the backyards of the houses and the fruits obtained from these plants are used mostly for home consumption. Whatever little surplus fruits there are, go to the nearby markets in the country for sale in fresh form.

When cultivated on a large scale, this useful crop can be an asset to the country and can bring in a fair amount of revenue through export to foreign countries.

It is necessary that the Government of Suriname should take up cultivation of this fruit on a larger scale under its own aegis, on government lands available in suitable areas.

In the plantations at the experimental gardens with roughly 1,600 plants per ha (planting distance 2.5 m x 2.5 m) the actual yield amounts to 30-80 ton/ha/year for the different selections. The yield under Suriname conditions should be from 90-170 ton/ha/year. According to the calculation all plants should be in full production, but actually only 60-70 % are fully producing. The rest often fail because of poor drainage or strong winds.

Although many areas with well drained soils in the country can be considered as suitable for cultivation of papaya on a large scale, the district of Saramacca seems to be the best for this purpose, on account of its comparatively more fertile soils and well drained sandy reefs or ridges. In this district most papaya is grown along the road of the East - West connection, nearby the houses, in subsistence farming.

In the experimental garden at Jarikaba, an agro-hydrological experiment field in this district, papaya of different varieties is grown on a larger scale on heavy clay soil, with a groundwater system regulated by pumps. An experimental garden of papaya on the coarse sandy soils of the so called Zandery formation in the interior was a failure because of the low fertility and drought sensitiveness of these soils. It is known, that papaya responds heavily to weather conditions in relation to fruitbearing. If conditions are too dry or too wet, sterility occurs.

UTILIZATION OF FRUIT PRODUCTS

All fruits obtained from the experimental gardens are regularly sent to the Agro-technology Division of the Agricultural Experiment Station for analysis and other purposes. At the same time the possibilities for utilization especially of papaya, W.I. cherry, guava, passion fruit and pineapple are examined with regard to canning, jelying and pulping. Good results have already been obtained with jams made from guava, W.I. cherry, pineapple and papaya.

At present there are already three local fruit industries converting the fruits to jams, juice and other fruit drinks, namely Tropica Food Industry, Canning Industry and Interfood N.V. The first two industries are under the aegis of the Ministry of Agriculture, Animal Husbandry, Fisheries and Forestry. The amount of juice produced from papaya, pineapple and guava has been increased remarkably by addition of a pectolytic enzyme during the processing and it is economically justifiable to make jelly from these fruits, through this process.

At present a new product known as pineapple and guava "cheese" made from the cleared sap of the above fruits is being processed and being improved upon. Now about 100 tons of papaya, guava, W.I. cherry and pineapple are being processed as jam and jelly. Besides, 25 tons of mango are converted into mango nectar.

In 1981, there are plans to produce fruit nectar from other fruits, for local consumption.

On a small scale pulp of papaya, W.I. cherry and guava is being already exported to Europe.

RESEARCH PROGRAMME ON FRUIT TREES

The research programme on fruit trees at the Agricultural Experiment Station in Paramaribo is restricted to only those fruits, of

which, among others, papaya, passion fruit, W.I. cherry, soursop and also pineapple, are the more important to commerce. In this framework intensive research on these crops, especially papaya, passion fruit and also pineapple has already been carried out in Suriname by the Pomology Division of the Agricultural Experiment Station in Paramaribo.

WORK GROUP REPORTS



GROUP 1. PRODUCTION

Representatives from all countries of the region took part in the group discussions. Participants in the other Work Groups attended for short periods, to contribute their views.

1. Availability Land

It was recognized by all participants that there was only a limited area of high quality land (Classes I and II) that might be found for fruit tree growing in the region and most of this occurs on the mainland territories of continental Central and South America. On the Caribbean islands resort to lower quality land (Classes II - V) is necessary. With this in mind, it is estimated that there should be 20,000 acres (8,100 ha) in the smaller inlands, 300,000 acres (121,500 ha) in the larger islands (Jamaica, Haití, Dominican Republic), and a relatively unlimited area in the mainland territories (Belize, Guyana, Suriname) suitable for establishing orchards. The micro-climatic conditions in different parts of the region vary from hot and dry to cool and damp but may be divided into wet and dry. The dry areas are estimated to cover about 25 % and the wet 75 % of the total land surface.

2. Production Technology

A wide range of fruit tree crops is grown in every territory, but the low commercial significance of the majority of species makes economic considerations of minor importance, and the practices employed are open to improvement. There is general agreement that organized production of selected species and cultivars will prove of appreciable value to the economy of the region, particularly if full cognizance is taken of the physical preferences of the crops concerned as well as the existing and potential market demand. Consequently it should be accepted that there should be effective zoning of the

crops, with those requiring high humidity for best performance (avocado, breadfruit, papaya) located in the wetter areas, and those preferring near-arid conditions (jujube, sugar-apple, tamarind) in the drier areas. The ambivalent types (cashew, guava, mango, soursop) should find their place mainly according to socio-economic considerations.

There is need for a defined regime of cultural practices incorporating soil and water conservation on a watershed rather than individual holding basis, and for interplanting during the early years with short-term crops of economic importance. Specific details such as land preparation and spacing must enter into the plan for each fruit crop, as the need arises; in this connection harvesting and post-harvest handling of produce require more attention than they have hitherto been accorded.

Vegetative propagation of fruit crops to ensure uniformity of the ultimate products is regarded as of the highest importance, where it is practicable. Where rootstocks are used these should be carefully selected with the aim of making the rootstock-scion combination more suited to the particular circumstances of production than own-rooted plants or seedlings e.g. selection of 'Kidney' and 'Long' mango seedlings for rootstocks in different parts of the Caribbean.

3. Coordination

In treating the region as a comprehensive unit it would be ideal to zone production of the different fruits in such a manner that overlapping of effort is reduced to the minimum; arrival at a firm, general consensus on how to arrange this did not, however, prove possible. Representatives from a number of territories were particularly desirous of developing certain potential fruit crops even at the risk of questionable economic or ecological suitability. The following table indicates stated preferences:

Country	Tree Crop Preferences
Antigua	Breadfruit, cashew, soursop, sugar-apple
Barbados	Acerola, soursop, sugar-apple, tamarind
Belize	Cashew, golden-apple, mamee sapote, soursop
Dominica	Cashew, sapodilla, soursop, sugar-apple
Dominican Republic	Cashew, mamee sapote, soursop, tamarind
Grenada	Golden-apple, sapodilla, sugar-apple, tamarind
Guyana	Carambola, cashew, pejibaye, sapodilla

Haiti	Cashew, mamee sapote, soursop, tamarind
Montserrat	Breadfruit, cashew, soursop, sugar-apple
St. Kitts	Breadfruit, mamey, sugar-apple

It appears, then, that the most popular selections of non-traditional fruit tree crops, for general promotion in the Caribbean are cashew, sugar-apple, soursop and tamarind.

4. Training

Transition from the current state of knowledge of fruit culture to one of greater enlightenment among growers must come primarily from local agricultural extension agencies. Demonstration plots and field days will help to disseminate suitable information on the recommended practices. Several organizations within the region can serve as reliable sources of knowledge. Among them are the University of the West Indies, the University of Puerto Rico, and CARDI. It is understood that the CDB has undertaken to sponsor preparation of a handbook on tropical fruit growing in the Caribbean, as its contribution.

5. Project Proposal

Establishment of a fruit production project consisting of sub-projects located in different parts of the region was considered to be desirable and it is suggested that its feasibility should be determined. Avocado, cashew, mango and soursop may well be the main commercial crops grown, with breadfruit, and pejobaye located in the wet areas, whereas sugar-apple and tamarind may be produced in the dry ones.

At this stage it may be worthwhile to identify a group of specialists to plan details of the project and outline procedures for establishing liaison between field operations and institutions of relevance and a two-way flow of information on tropical fruit crop production practices in the area.

GROUP 2. UTILIZATION

1. Aspects discussed:

1.1. Post-harvest management.

1.2. Quality standards for.

- 1.2.1. Fresh fruit production.
- 1.2.2. Processed products.
- 1.3. Fresh fruit production and processing technology for.
 - 1.3.1. National markets.
 - 1.3.2. Export markets.
- 1.4. Non-traditional use of products as sources of.
 - 1.4.1. Basic food (protein, carbohydrate, and fats)
 - 1.4.2. Agro-energy.
 - 1.4.3. Animal feed.
- 1.5. Training.
- 1.6. Regional system of information and documentation.
- 1.7. Project proposal.
- 2. Crops considered:
 - 2.1. Traditional.
 - 2.1.1. Mango.
 - 2.1.2. Papaya.
 - 2.1.3. Guava.
 - 2.1.4. Avocado.
 - 2.2. Potential
 - 2.2.1. Cashew.
 - 2.2.2. Anonas (Soursop, Sugar-Apple, Custard-Apple).
 - 2.2.3. Sapodilla.
 - 2.2.4. Tamarind.

2.2.5. Passion fruit.

3. Criteria used:

The criteria used in selecting the crops for serious consideration of their utilization were:

3.1. Availability.

3.2. Popularity.

3.3. Country specificity.

3.4. Apparent economic potential for fullest possible utilization.

4. Rating established:

On that basis the crops were rated as follows, in decreasing order of priority.

4.1. Mango.

4.2. Soursop.

4.3. Passion fruit.

4.4. Papaya.

4.5. Avocado.

5. Crops retained for a regional project on utilization:

For the preparation of a regional project the group gave detailed consideration to the following crops:

5.1. Mango.

5.1.1. Availability and popularity.

Large quantities of various varieties of mango are available in most, if not all, Caribbean Countries.

5.1.2. Utilization possibilities.

5.1.2.1. Fresh fruit, from "table" varieties in pure stand.

- 5.1.2.2. Juices, from many common types.
- 5.1.2.3. Chutney, from most common types.
- 5.1.2.4. Fruit in syrup, from selected varieties in pure stand.
- 5.1.2.5. Animal feed, from skins and seeds (with or without shell).
- 5.1.3. Requirements for optimal utilization.
 - 5.1.3.1. Development of pure stands of select or table varieties.
 - 5.1.3.2. Setting of quality standards for fresh fruit production and processed products for local and particularly export markets.
 - 5.1.3.3. Obtaining composite analysis data for animal feed production.

5.2. Papaya

- 5.2.1. Availability and popularity.

Papaya is a popular crop, easy to establish in pure stand.
- 5.2.2. Utilization possibilities.
 - 5.2.2.1. Fresh fruit, from select variety or varieties in pure stand.
 - 5.2.2.2. Juice, from select variety or varieties in pure stand.
 - 5.2.2.3. Filler for sauces, chutneys and condiments, from green fruit.
 - 5.2.2.4. Candied/crystallized fruit, from green fruit.
- 5.2.3. Requirements for optimal utilization.
 - 5.2.3.1. Development of pure stand.

5.2.3.2. Setting of quality standards of fresh fruit production and processed products for national and export markets.

5.3. Guava

5.3.1. Availability and popularity.

Guava is a common crop, characterized by a large proportion of seeds in the fruit.

5.3.2. Utilization possibilities.

The marketing potential of guava products is uncertain.

5.3.3. Requirements for optimal utilization.

More information is required on.

5.3.3.1. Utilization of seeds.

5.3.3.2. Possibilities for marketing products.

5.4. Avocado

5.4.1. Availability and popularity.

Avocado is a popular crop.

5.4.2. Utilization possibilities.

5.4.2.1. Fresh fruit, from improved varieties with good keeping quality.

5.4.2.2. Avocado paste.

5.4.3. Requirements for optimal utilization.

5.4.3.1. Establishment of suitable variety or varieties in pure stand.

5.4.3.2. Collection of information on marketing possibilities for paste.

5.4.3.3. Setting of quality standards for fresh fruit for local and export markets.

5.5. Cashew

5.5.1. Availability and popularity.
Cashew is not widespread nor a very common crop.

5.5.2. Utilization possibilities.

5.5.2.1. Nuts (Large quantity of high-priced nuts are now imported into the region).

5.5.2.2. Apple and shell (Optimal utilization possibilities are still uncertain).

5.5.3. Requirements for optimal utilization.
More information is required on:

5.5.3.1. Technology and economics of nut processing.

5.5.3.2. Apple utilization.

5.5.3.3. Shell utilization.

5.6. Soursop

5.6.1. Availability and popularity.
Soursop is a common crop with a lack of country specificity, but potential for increased utilization.

5.6.2. Utilization possibilities.

5.6.2.1. Fruit juice.

5.6.2.2. Flavouring. (e.g. for ice cream).

5.6.2.3. Animal feedstuffs, from skins and fibre.

5.6.3. Requirements for optimal utilization.

5.6.3.1. Development of orchards.

5.6.3.2. Setting of quality standards for processed products for export and local markets.

5.7. Sapodilla

5.7.1. Availability and popularity.
Sapodilla is uncommon and its fruit has an uncertain consumer acceptance.

5.7.2. Utilization possibilities: fresh fruit.

5.7.3. Requirements for optimal utilization: Information on fresh fruit acceptability.

5.8. Tamarind

5.8.1. Availability and popularity.

Tamarind is a common fruit tree crop but with limited popularity and use.

5.8.2. Utilization possibilities.

5.8.2.1. Confectionery.

5.8.2.2. Base for sauces.

5.8.3. Requirements for optimal utilization: to be defined.

5.9. Passion fruit

5.9.1. Availability and popularity.

The passion fruit is still uncommon but is gaining increasing popularity; so, although not a tree crop, it is included.

5.9.2. Utilization possibilities.

5.9.2.1. Fruit juice; in pure form or in blends.

5.9.2.2. Animal feedstuffs, from skins and seeds.

5.9.3. Requirement for optimal utilization: development of pure stands.

6. General requirements for product utilization.

6.1. Establishing a regional system of information and documentation.

6.2. Training, particularly in:

6.2.1. Post-harvest handling.

6.2.2. Storage.

6.2.3. Processing.

7. Project Proposal.

7.1. Title.

Optimal Utilization of Tropical Tree Fruits.

7.2. Background.

Fruits are of varying importance in the Caribbean whether for local or export markets, in fresh or processed form. Fruit tree crops having considerable potential for further development, in decreasing order of importance include:

7.2.1. Mango.

7.2.2. Soursop.

7.2.3. Passion fruit (not a tree crop but included because of its potential).

7.2.4. Papaya.

7.2.5. Avocado.

7.3. Definition of problem.

There is a need for self-sufficiency at the national and regional levels and few of the above mentioned fruits are used to their best advantage. For example, in the case of mango, relatively little work has been done on the utilization of the pericarp, endocarp or seed, some or all of which may have use for animal feed.

In considering the optimal utilization of tropical tree fruits one must bear in mind the need to optimize the use of labour and to develop secondary agro-industries.

7.4. Specific Objectives.

7.4.1. To optimize the traditional uses of tropical tree fruits.

7.4.2. To improve the quality of the fresh and processed product.

7.4.3. To examine and develop scope for the utilization of residues and by-products.

7.4.4. To develop techniques for such utilization.

7.4.5. To take account of the marketability of the end products.

7.5. Location.

7.5.1. Geographical.

The project should be based in a Caribbean country having appropriate facilities and sources of supply of the tree crops in question.

7.5.2. Institutional: to be decided.

7.6. Execution strategy.

7.6.1. Information gathering relating to work done to-date and on crops referred to above.

7.6.2. Project preparation.

7.6.3. Project execution.

7.6.4. Project evaluation and dissemination of findings.

7.7. Expected Outputs.

7.7.1. Acquisition of knowledge on development of appropriate technology specifically in:

7.7.1.1. Post-harvest management.

7.7.1.2. Quality standards for fresh fruit production and processing technology, for local and export markets.

7.7.1.3. Non-traditional uses as sources of:

- 1) Basic foods**
- 2) Agro-energy**
- 3) Animal feed**

7.7.2. Trained staff.

7.8. Potential beneficiaries.

Agricultural economies at regional and national levels including the primary producer.

7.9. Cost.

Estimates to be provided at time of project preparation.

7.10 Duration: to be defined.

GROUP 3. MARKETING

1. Traditional crops.

Mango, avocado and papaya are taken as the fruits of greatest commercial potential.

1.1. Handling, grading and packaging.

1.1.1. Fruits should be harvested when they attain a stage of maturity which provides for a minimum of 5 days shelf life.

1.1.2. Harvesting of mangoes and avocados should be done with a pole and a collecting sack which holds no more than five fruits. Pawpaw should be hand picked and collected.

1.1.3. In harvesting, field containers made of local materials should be used whenever possible.

Containers should be:

1.1.3.1. Lined so as to prevent mechanical damage, and

1.1.3.2. Of a size and weight which can be handled by one person.

1.1.4. Proper grading standards should be developed regionally.

1.1.5. Establishment of adequate labelling should include

1.1.5.1. Net and gross weights in kilograms.

1.1.5.2. Grade standard.

1.1.5.3. Origin of the product.

1.1.6. Establishment of regional and extra-regional wholesale packaging standards should be based on the use of local materials whenever possible.

1.2. Storage.

1.2.1. Farm level.

Simple sheds should be constructed to:

1.2.1.1. Avoid the effects of the weather (sun and rain).

1.2.1.2. Facilitate the cleaning, grading, packaging and loading.

1.2.1.3. Store packaging materials and other inputs.

1.2.2. Collection points.

1.2.2.1. Rural areas:

In some countries, small rural collection centres will be required to assemble local production. These collection centres can be managed by local farm organizations or marketing boards. Facilities should include:

- 1) Weighing scales.**
- 2) Grading equipment and quality control aids.**
- 3) Packaging equipment.**
- 4) Running water.**
- 5) Communication facilities with the farmers and.**
- 6) Storage space for at least one day's supply during peak operation periods.**

1.2.2.2. Central facilities.

Facilities should include packaging and cold storage with capacity to accommodate up to a week's collection in cold storage plus the normal warehousing for containers, other packaging materials, and inputs. Such centres should

also have similar facilities to the countryside collection points for grading, cleaning, and packaging. Cold storage at airports and at the docks should also be established.

1.3. Transportation.

1.3.1. Internal.

Internal transportation should be organized to cover the needs of farmers and the rural collection points. The vehicles used should be covered to protect the cargo from the sun and rain. There should also be an adequate system of agricultural feeder roads.

1.3.2. External.

1.3.2.1. Air.

In order to reduce the present prohibitive rates:

- 1) The volume should be increased as much as possible to permit charter of air freighters.
- 2) A regional medium-haul cargo service should be organized to provide a feeder service to external carriers.

1.3.2.2. Marine.

1) Schooner transport.

Government should introduce regulations to:

- (1) Compel schooner operators to provide facilities for protecting fruits and other perishables from the effects of the sun and rain in transit.
- (2) Introduce freight rates proportional to volume of fruit containers to facilitate the use of smaller ones, thereby preventing mechanical damage and providing easier handling.

2) Steamship.

The need for regular schedules covering the region should be emphasized. The service should interface with extra-regional carriers.

In this respect, the CDB/WISCO proposal to provide two fast vessels with cold storage facilities should be implemented as soon as possible.

1.4. Price policy.

1.4.1. Farm gate.

1.4.1.1. Prices for farmers should reflect:

- 1) Efficient cost of production.**
- 2) Competitive rate of return.**
- 3) Relevant market forces at both national and international levels.**
- 4) The need for incentives when appropriate.**

1.4.1.2. Farm gate pricing according to grade should be introduced whenever possible.

1.4.2. Wholesale and retail.

The official prices should reflect the efficient operational and administrative cost of marketing over the farm gate prices.

1.5. Local, regional and extra-regional trade policy.

1.5.1. Local.

1.5.1.1. Clearcut national policies and objectives should be established.

1.5.1.2. Government intervention through Marketing Boards should be viewed primarily as an alternative channel of distribution to protect the interest of farmers and consumers; it should not aim to play the dominant role at the local marketing level.

1.5.1.3. At the rural level government should provide supply and marketing services managed by lo-

cal farmers with technical assistance from the government.

1.5.1.4. Government should promote import substitution in fruits through comprehensive production and marketing schemes.

1.5.2. Regional.

There should be:

1.5.2.1. Unified market price and export policies.

1.5.2.2. A review of the CARICOM Agricultural Marketing Protocol (AMP) to include fresh fruits.

1.5.3. Extra-regional.

1.5.3.1. Trade Policies should be consistent with international trade protocol and/or agreements.

1.5.3.2. Countries of the region should have unified policies and speak with one voice at international meetings.

1.6. Training.

1.6.1. Farm level.

Practical marketing programmes should be developed to train farmers in harvesting, grading, packaging.

1.6.2. Institutional level.

1.6.2.1. Programmes should be developed to train:

- 1) Extensionists
- 2) Collection centre operators
- 3) Middlemen
- 4) Other marketing support service personnel.

1.6.2.2. Technical assistance should be given to train managers of the marketing boards.

1.7. Regional system of documentation and information.

1.7.1. A comprehensive system of market documentation and information should be developed within the region to:

1.7.1.1. Compile production statistics (pre-harvest projections and post-harvest stocks).

1.7.1.2. Compile market price information at cost on a regular basis and as frequently as possible.

1.7.1.3. Secure international market intelligence.

1.7.1.4. Collect inventory information on stocks, including cold storage, on a regular basis and as frequently as possible.

1.7.2. A communication network should be developed to feed information back to the farmers.

2. Potential Fruit Crops.

2.1. The following fruits were identified as having potential for further market development: soursop, cashew, sugar-apple, golden-apple, guava, carambola.

2.2. It was recognized that some countries had already developed export trade in soursop, sugar-apple and golden-apple, while cashew, tamarind and guava had potential for processing.

2.3. Efforts should therefore be made to determine:

2.3.1. Those countries which have comparative advantages for producing fruits in this category.

2.3.2. National policies.

2.3.3. Extra-regional and regional demand and other market requirements before formulating regional programmes for further development.

2.4. A regional project on marketing of potential fruit crops in there-by proposed. If it is developed, it is recommended that the Caribbean Food Corporation (CFC) should be its Executing Agency.

GROUP 4. RESEARCH AND TECHNOLOGY TRANSFER

The group noted the crops identified as potentially productive viz. mango, avocado, papaya and guava, in the traditional category, and cashew, tamarind, and soursop in the non-traditional category, but recognized that there might be other crops in which there was national interest.

Guyana, for example, expressed interest in carambola, bilimbi, gooseberry, West Indian cherry and jamoon, and Grenada was interested in pomegranate.

1. Research

The group recognized the need for research to be geared to the needs of the beneficiaries and agreed that socio-economic factors should be an integral part of any research programme aimed at fruit tree crop development. It was felt that both experiment station research and on farm research were essential but that, in the latter case, one should ensure that the farmer suffers no loss of income as a result of research activities carried out on his farm.

Owing to the large number of possible crops, it was considered unnecessary to identify specific constraints in each case. It was felt that a more realistic approach would be to await the findings of the other groups in regard to production potential, utilization, and market possibilities, both local and export, prior to the development of project profiles in research. However, a number of research topics of wide applicability were identified as follows:

1.1. Intercropping.

1.1.1. Fruit trees and annual food crops.

1.1.2. Fruit trees and fruit trees of different species or varieties.

1.2. Collection and evaluation of cultivars of traditional fruit tree crops.

It was felt that germplasm sources within the region should be utilized, whenever possible, and that particular attention should be paid to plant quarantine procedures when introducing vegetative planting material.

The Dominican Republic and Puerto Rico were regarded as two of the main germplasm sources in the region.

1.3. Improved cultural practices.

Particularly in regard to:

1.3.1. Pest management.

1.3.2. Tree architecture (by pruning, dwarfing rootstocks and/or scions, chemicals).

1.3.3. Fertilizer use in relation to the economic threshold of inputs.

1.4. Characterization of cultivars of non-traditional fruit tree crops.

1.5. Stage of maturity in relation to harvesting.

2. Training.

The group recognized the need for training of personnel involved in research and the need to identify agencies and institutions which could provide appropriate training. It identified three types of training as essential:

2.1. Reciprocal training:

This involves the short term exchange of personnel with expertise in fruit tree crop development.

2.2. Short term in-service training.

2.3. Formal training at Universities and other institutions of higher learning.

In this case it was felt that support should be given to thesis research on fruit tree crops whenever possible.

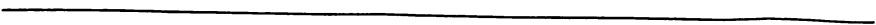
3. Information and Documentation System.

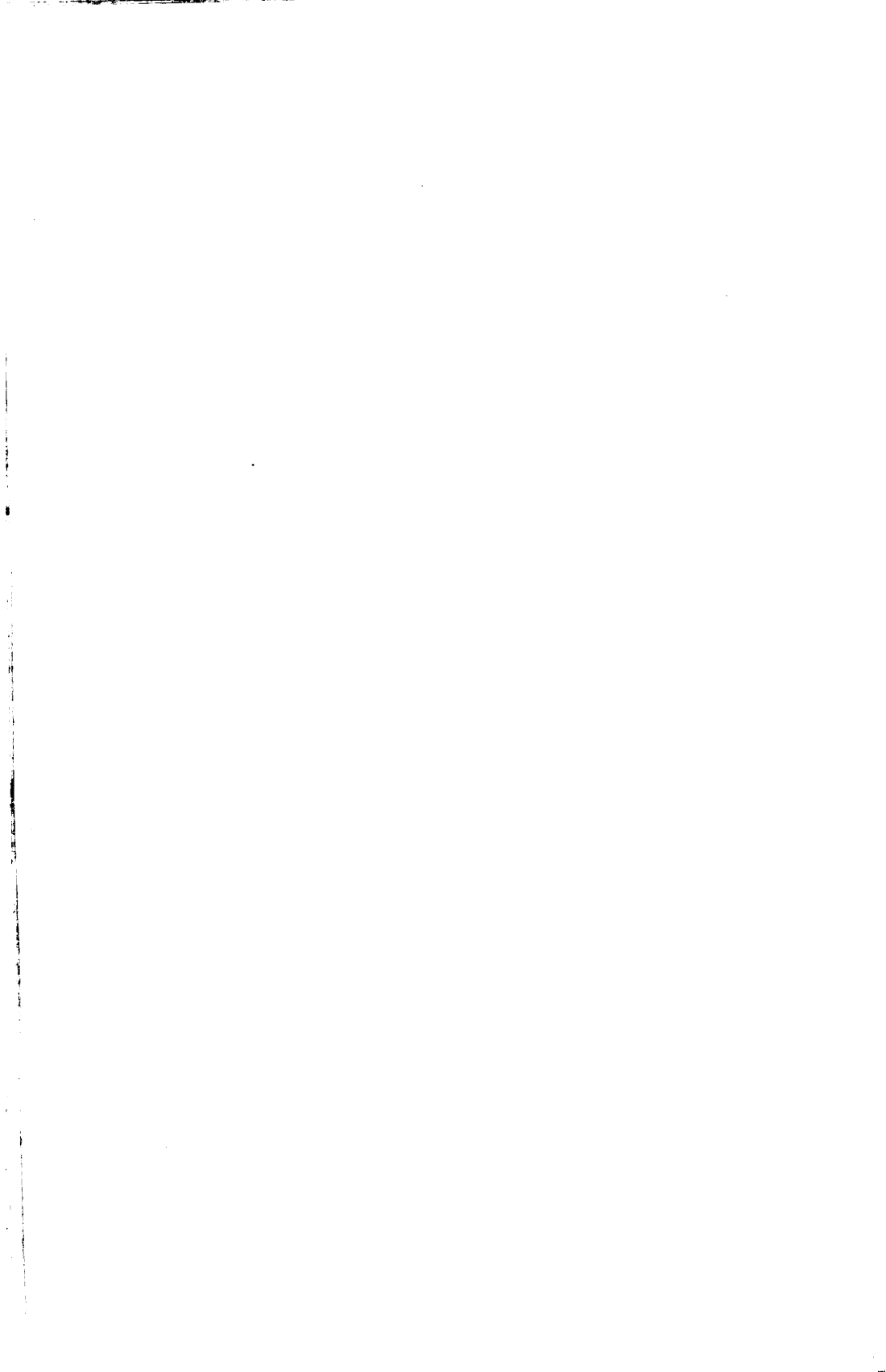
The group felt that a considerable amount of information already exists in the region, but that the main problem is associated with responsibility and resources for collating and disseminating this information.

Language was identified as an additional barrier in the region, but this was not considered insurmountable.

The current development of a CDCC/ECLA project in the area of information and documentation in the region was viewed as a positive step.

CONCLUSIONS





CONCLUSIONS

From the Work Group reports, which dealt with the four (4) subject areas of production, utilization, marketing, and research, several conclusions regarding fruit tree crop development in the Caribbean were drawn, as follows:

1. Organized production of selected fruit tree species and cultivars could be of considerable value to the economy of the region as a whole, but there should be effective zoning of crops based on their climatic adaptation.
2. The potential of fresh and processed products for both domestic and export markets should be fully exploited.
3. Among the better known traditional crops, mango, avocado and papaya have the greatest marketability, but with appropriate promotion the commercial potential of species such as soursop, cashew, sugar-apple, golden-apple, guava and carambola, could be realized.
4. The development of fruit tree crops on a regional basis should be undertaken, principally aiming at:
 - 1) Promoting the commercial production of selected traditional and potential species, including mango, avocado, papaya, soursop, cashew, sugar-apple, golden-apple, and guava.
 - 2) Investigating the potential of other species such as bread fruit, pejibaye, tamarind, carambola, and passion fruit (non-tree crop).

- 3) Promoting utilization of the products in various forms such as fresh fruit, dry nut, juices, pastes, fruits in syrup, candied or crystallized fruits, chutneys, and fillers in sauces.
- 4) Examining other areas of potential utilization such as agro-energy and animal feed; and
- 5) Conducting research on major relevant topics, including:
 - (1) the role of tree crops in soil and water conservation;
 - (2) inter-cropping with short term economic crops;
 - (3) improvement of cultural practices particularly in regard to pest management, tree architecture and fertilizer use;
 - (4) collection, characterization and evaluation of cultivars;
 - (5) vegetative propagation of selected cultivars;
 - (6) improvement of harvesting and post-harvest handling techniques including grading, packaging, storage and transportation.
- 6) The need to increase the availability of trained staff in the national institutions of the region was recognized. This objective could be achieved through in-service training, formal training and reciprocal technical co-operation.
- 7) A regional system for documentation and distribution of information on fruit tree crops should be developed and implemented.



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Betty Lewis

