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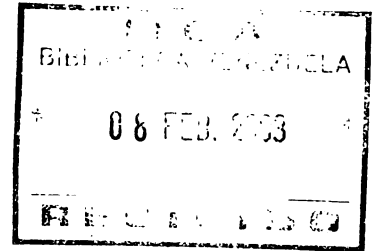


Caribbean citrus industry to get stronger and
resilient. Any initiatives to improve the citrus sector
should also take place within the context
of the citrus sector. In order to put the situation
into proper perspective, the global situation
is...

CITRUS DEVELOPMENT

via message processing and processing utilization





CITRUS DEVELOPMENT

Prepared by IICA
on behalf of CARICOM
for submission to the EEC

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1. Summary

The proposed project is intended to address deficiencies prevailing at the production level in the citrus industry by strengthening the industry's technology generation and transfer capabilities. Specifically, working through the University of the West Indies, national Citrus Grower Associations (CGA's) and Ministries of Agriculture, the project would provide staffing, equipment and vehicles, technical assistance and training and operating resources to strengthen existing research and extension services in the participating countries. To assist in the coordination of these activities and monitor their progress, a Project Coordinating Unit would be established.

The analysis indicated that the proposed project is technically, institutionally, financially and economically viable and, therefore, warrants preparation of the feasibility study.

The Project's logical framework is presented in Table 1.1.

2. Background

The Caribbean citrus industry is not isolated from the world citrus market. Any initiative to develop the citrus industries of the Caribbean will have to take place within the context of the global situation for citrus. In order to put the Caribbean Citrus Industry into proper perspective, the global situation is first discussed.

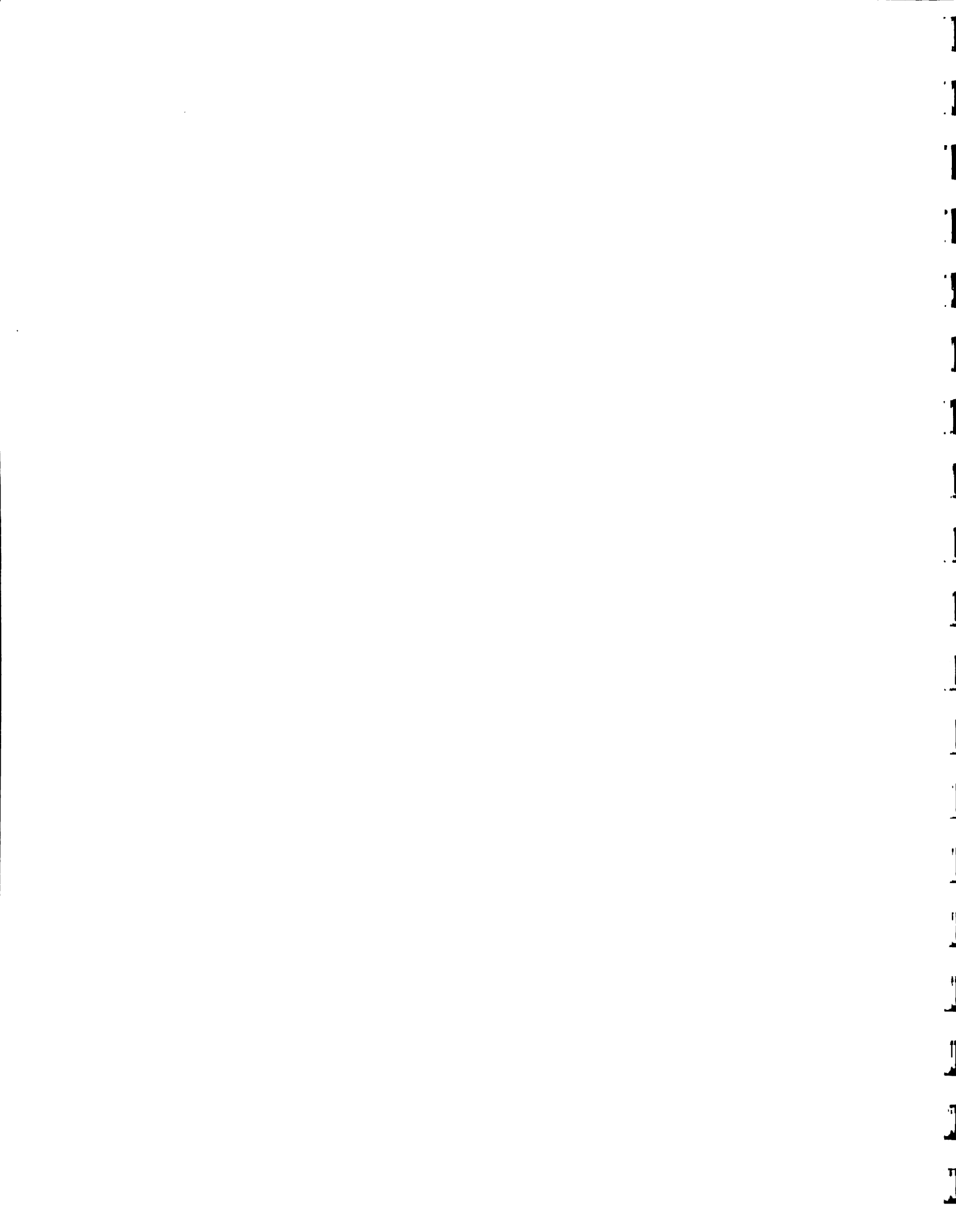
2.1.1 World orange production and processed utilization

Based on data compiled by the Food and Agriculture Organization of the United Nations (FAO) and the US Department of Agriculture (USDA), world orange production was 1149.0 million 90 pound boxes in 1990-91. The largest orange producer was Brazil which accounted for 292.7 million boxes or 25.5% of the world total. The US was the second largest producer, with 177.8 million boxes or 15.5% of the world total. Mexico produced 58.8 million boxes or 5.1 per cent of the world total.

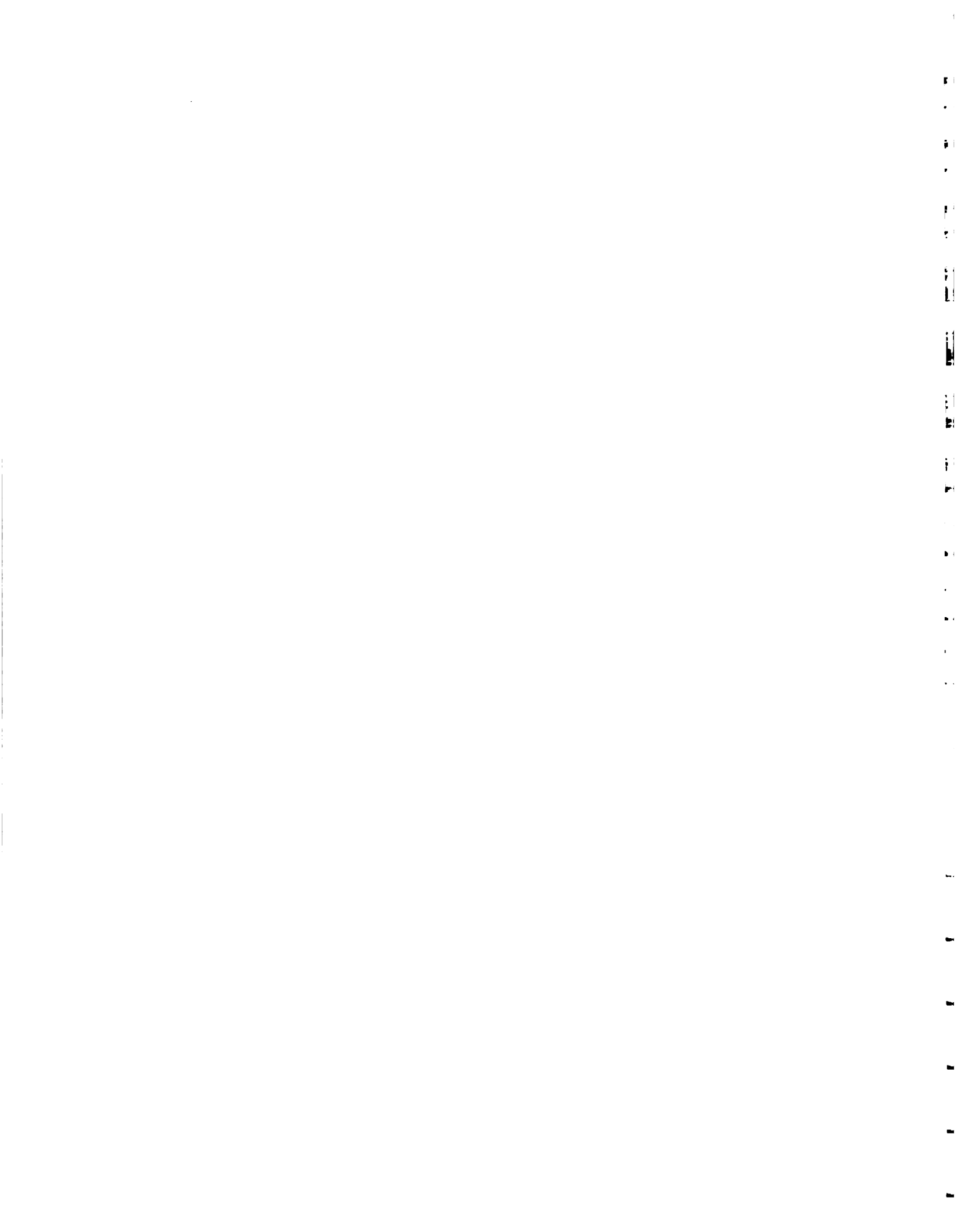


Table 1.1 Logical framework (Citrus industry development project)

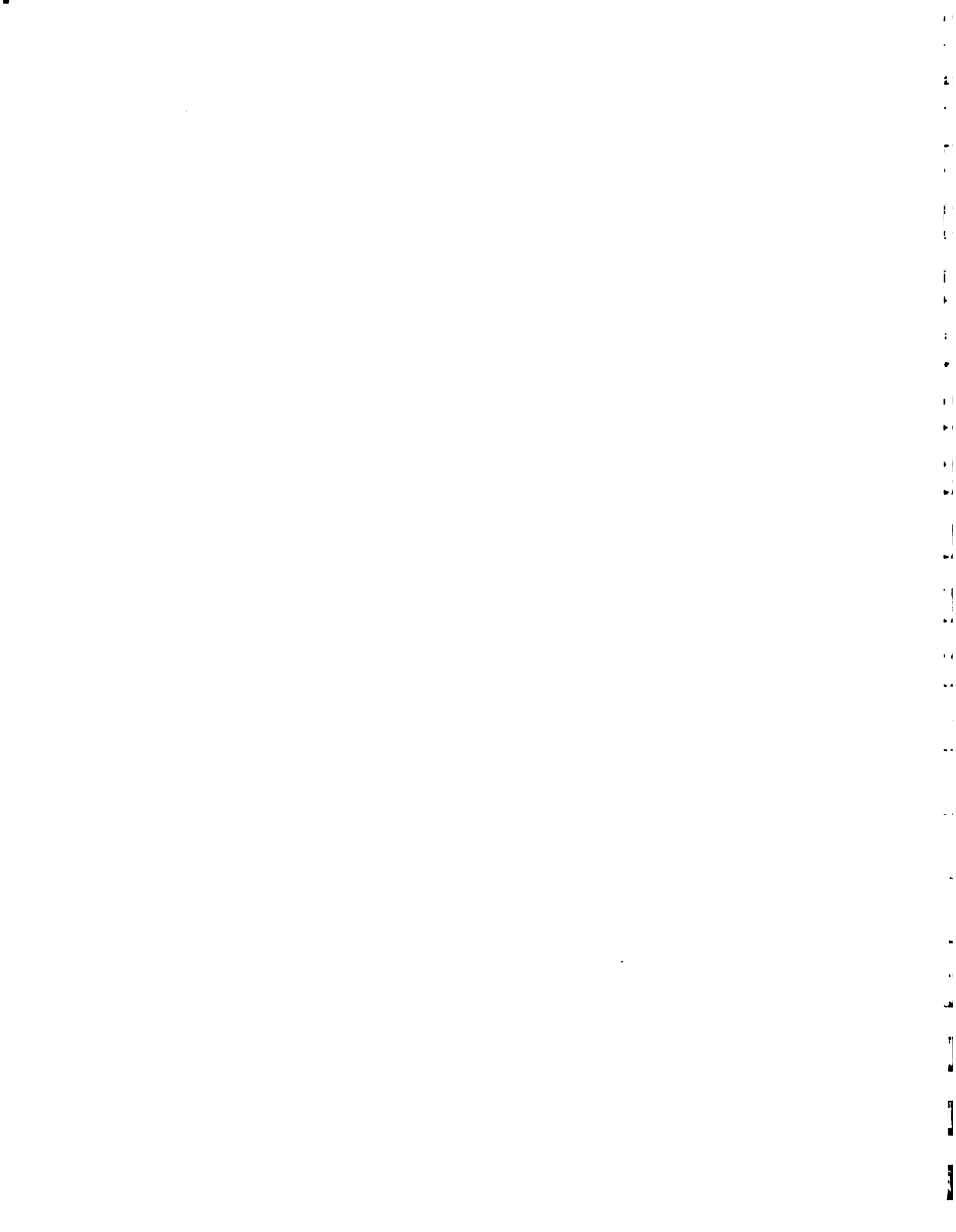
Narrative Summary	Verifiable Indicators	Means of Verification	Assumptions
<p>Overall objective</p> <p>Overall increase in the standard of living; increase of the competitiveness of the citrus sub-sector; increase employment opportunities; increase foreign exchange earning capacity; increased citrus production and productivity.</p>	<p>number of persons employed in the sector; balance of payments; value of citrus products exported; amount of citrus produced.</p>	<p>Balance of and country statistical reports; survey of citrus growers and industry; project monitoring and evaluation reports.</p>	
<p>Project purpose</p> <p>To assess citrus industry and generate baseline information;</p> <p>To strengthen regional and national technology generation and transfer capabilities;</p> <p>To establish sound budwood indexing/certification programme;</p> <p>To strengthen capabilities to manage CTV.</p>	<p>number of training courses/seminars conducted for extension personnel/farmers; preparation and adherence to annual citrus research work plans; relevance of research to addressing citrus production and productivity constraints; level of CTV infestation and damage; number of technological packages generated; amount of certified budwood produced and percentage of total; number of citrus growers adopting new practices</p>	<p>Project implementation reports, citrus industry study report; rapid low-cost studies.</p>	



<p>Intermediate results</p> <ol style="list-style-type: none"> 1. Indepth citrus industry assessment; 2. strengthened capabilities of citrus industry; 3. increased citrus industry productivity; 4. efficient indexing/certification system; 5. trained research extension officers, farmers, and researchers. 	<p>Upgraded budwood indexing/certification system;</p> <p>level of CTV and pest and disease infestation;</p> <p>Equipped research laboratories;</p> <p>number/types of specific technological practices and research reports generated;</p> <p>Percentage of citrus growers adopting technologies;</p> <p>number of demonstration plots established and utilized;</p> <p>yields per acre of citrus;</p> <p>number of acres of citrus surveyed for CTV in each country;</p> <ul style="list-style-type: none"> - Number of persons in the different target groups trained - Number of workshops/seminars conducted; 	<p>Project implementation monitoring and progress reports;</p> <p>rapid low-cost studies; citrus industry assessment study.</p>	<p>Farmers willingness to adopt new technologies;</p> <p>Existence of resources to fund adoption of new technological packages; price for citrus products remain financially attractive.</p>
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<p>Activities</p> <ol style="list-style-type: none"> 1. Citrus industry assessment <ul style="list-style-type: none"> - develop terms of reference; - hire consultant; - conduct study; - prepare report; - disseminate report. 2. CTV eradication survey <ul style="list-style-type: none"> - develop survey instrument; - assemble survey team; - conduct field studies; - analyse data; - eradicate infected trees; - prepare reports. 3. Budwood indexing/certification <ul style="list-style-type: none"> - procure equipment; - train persons concerned; - select high performing trees; - clean selected budwood; - import budwood if required; - multiply cleaned budwood; - implement certification system; - distribute certified budwood. 4. Monitoring Toxoptera citricidus <ul style="list-style-type: none"> - determine areas to be monitored; - place monitoring traps; - monitor traps; - visually observe citrus trees; - prepare reports. 5. Cross protection studies <ul style="list-style-type: none"> - establish links with other institutions; - grow rootstocks; - bud virus-free scions; - inoculate with mild CTV strains; - expose to severe CTV strains; - analyse results; - prepare reports. 6. Crop production/protection trials <ul style="list-style-type: none"> - determine experimental designs; - establish experiments; - monitor experiments; - analyse results; - prepare and disseminate report. 7. Premature fruit drop <ul style="list-style-type: none"> - determine experimental designs; - establish experiments; - monitor experiments; - analyse results; - prepare and disseminate report. 8. Rootstock trials <ul style="list-style-type: none"> - select rootstocks; - determine experimental designs; - establish experiments; - monitor experiments; - analyse results; - prepare and disseminate report. 9. Technology transfer <ul style="list-style-type: none"> - validate technologies; - establish demonstration plots; - organize training activities; - train those concerned 			
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Inputs			
CAPITAL COSTS		TOTAL	
Equipment		550	Project implementation progress reports.
Computers		12	
Vehicles		160	
Total Capital		722	
PERSONNEL			
Project coordinator		120	
Horticulturist		120	
Virologist		120	
Pathologist		120	
Technicians (3)		108	
Graduate students (6)		360	
Total personnel cost		948	
OTHER COSTS			
Training		380	
Travel & per diem		180	
Research costs		270	
Monitoring and Evaluation		110	
Maintenance		95	
Total other costs		1035	
SUB TOTAL		2705	
CONTINGENCIES (10%)		270.5	
TOTAL COST		2975.5	

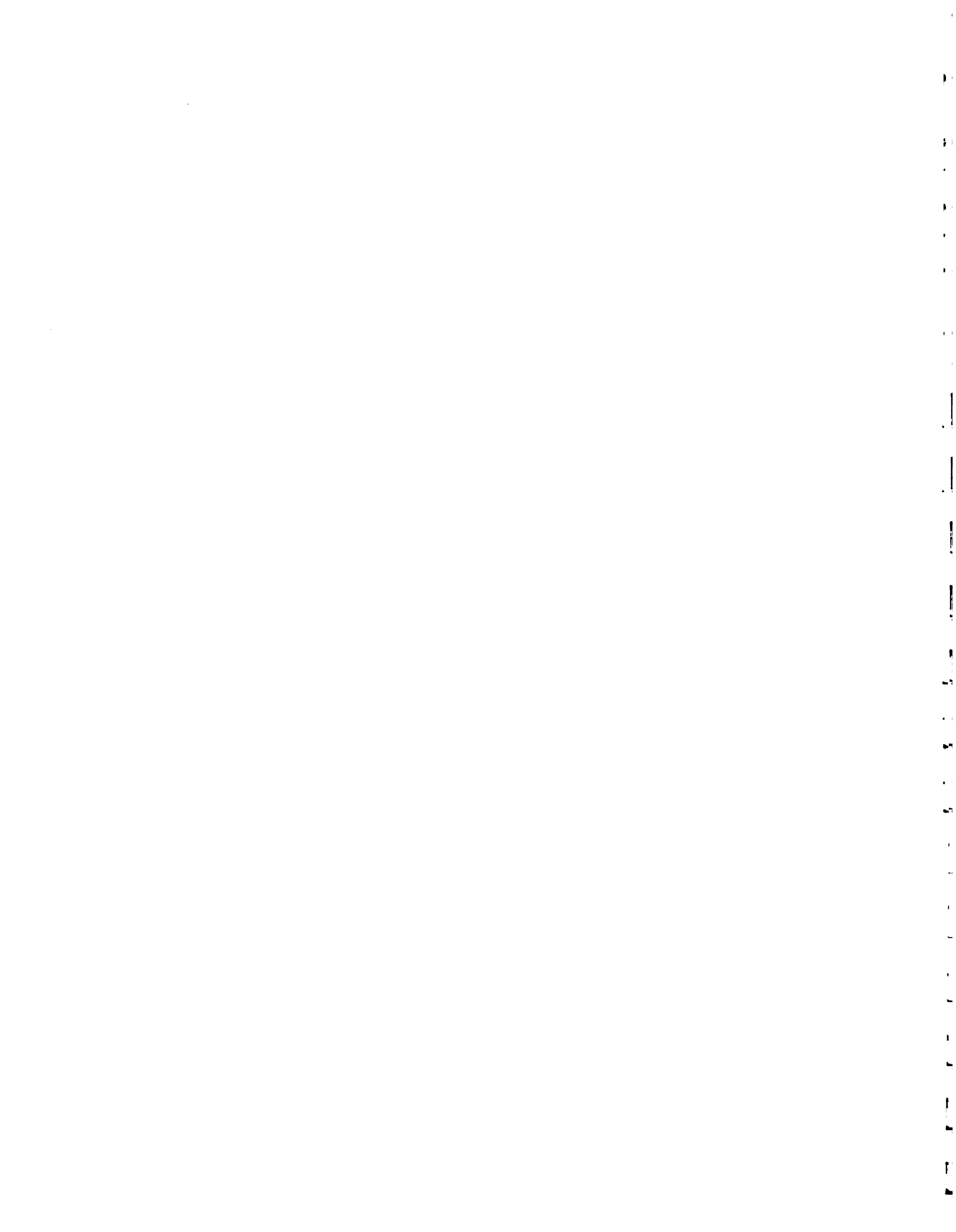
A significant portion of the orange produced is processed. According to FAO estimates, in 1990-91, 38% of the world orange crop, or 434.7 million boxes were processed. The two largest processors were Brazil and the US, which together processed 356.4 million boxes or 82% of the total oranges processed. Brazil processed 207.0 million boxes or 71% of its crop, while the US processed 149.4 million boxes or 84% of its crop that year.

Consumption of orange juice occurs primarily in developed countries, but is largely concentrated in the North American (primarily the US) and Western European markets. In 1990-91, orange juice imports accounted for about 29% of total US orange juice consumption¹. Brazil accounted for 83% of total US orange juice imports. Mexico was the second leading foreign supplier, accounting for 14% of total US imports in 1990-91. The rest of imports, approximately 3% were imported from the Caribbean.

2.1.2 Projected world orange juice outlook

During the next ten years, the market outlook for orange juice will likely be characterized by production growth and relatively low prices. Brazil and Florida are expected to continue being the dominant producers of oranges and orange juice.

¹ Florida Citrus Outlook 1992-93 Season, " Working Paper Series 92-6, Economic Research Department, Florida Department of Citrus, October 27, 1992.



Based on a projected planting rate which maintains the 1992 tree population, Florida's orange production is projected to increase from 179 million boxes in 1993-94 to 257 million boxes in 2002-03, a 43.6% increase. Based on a similar projection, Brazil's orange production is projected to increase from 292 million boxes in 1993-94 to 315 million boxes in 2002-03, a 7.9% increase. A significant increase of the projected output is expected to be processed into orange juice (in recent years, the processed utilization rate in Florida has been about 93% while in Brazil it has been about 83%).

2.1.3 World price and consumption projections

World price and consumption projections are not encouraging for the Caribbean citrus industries. Demand studies of US and Canadian orange juice market have suggested that demand appears to be growing at about 1.5% per year, while demand in Europe and the rest of the world (ROW) appears to be growing faster at roughly 3% and 4% respectively.

On the assumption that demand elasticities and growth rates are consistent with recent historical patterns and that the tariff structure in the major orange juice markets remains unchanged up to 2002-03 (except for an expected phasing out of tariffs on Mexican orange juice imports to the US), Florida FOB and on-tree real prices in 1993 dollars have been projected to average \$1.03 per pound solids and \$3.10 per box respectively, over the ten year projection period.

2.1.4 Main features of the Caribbean citrus sub-sector

Even though citrus production in the Caribbean region dates back to colonial times, it has experienced rapid growth in the last two decades. It is estimated that the region contributes 0.5 % to world citrus output, equivalent to 8.6 million 90 pound boxes in 1990.

Total area planted with citrus in the region in that year was estimated to be approximately 60,000 hectares, the principal producers being Jamaica (8100 hectares), Trinidad and Tobago (6000 hectares), Belize (24,000 hectares), Dominican Republic (11,000 hectares), Suriname (2400 hectares) and Guyana (1600 hectares). At present, in most countries of the region, the citrus industry is viewed as offering a significant scope for expansion and growth. This has motivated a degree of optimism, leading to the expansion of planted areas by existing producers, processing companies, and foreign investors seeking to establish orchards.



2.1.5 Implications for the Caribbean citrus industries

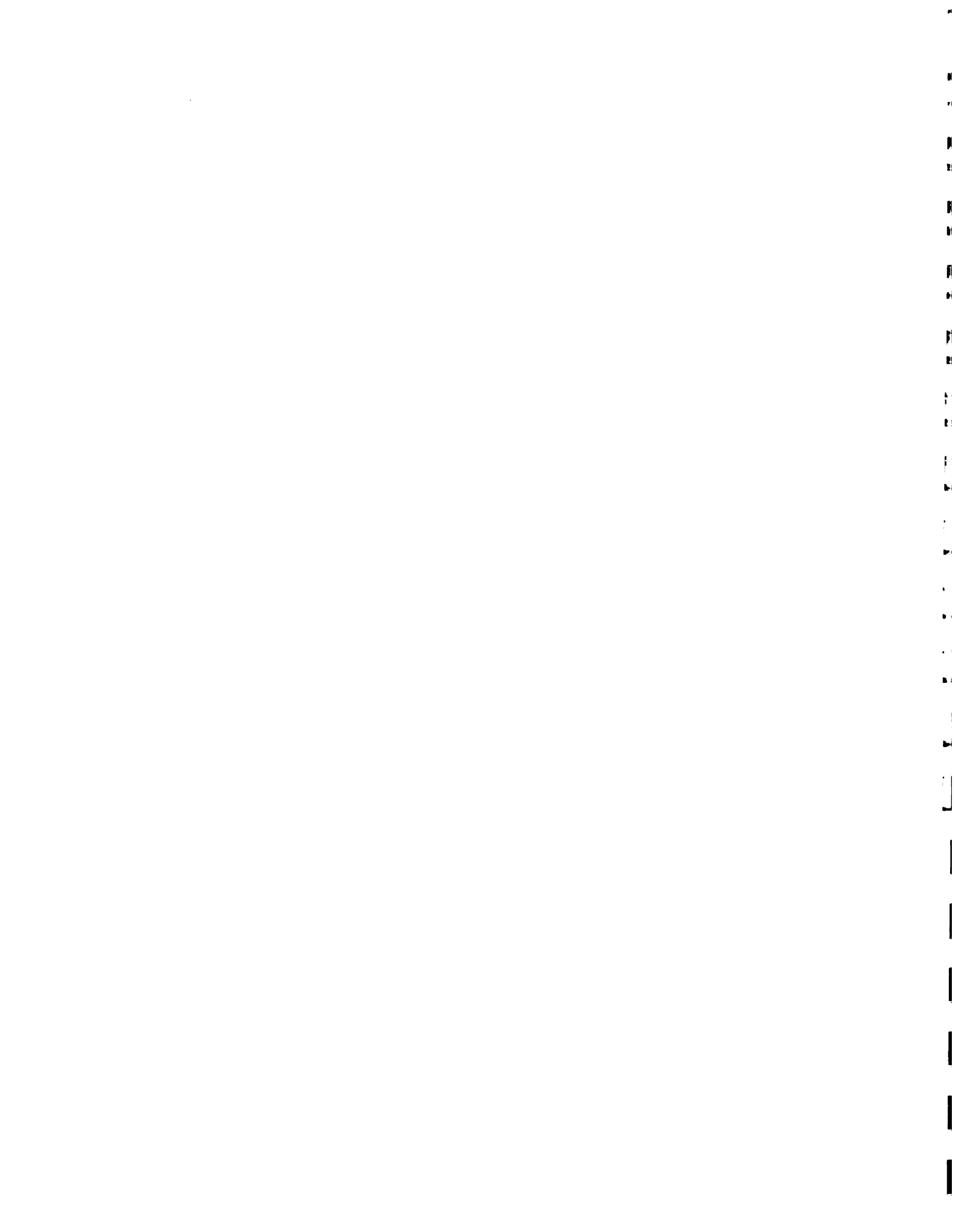
The foregoing discussion has important implications and raises important production and trade issues for the Caribbean citrus industries since a significant proportion of citrus produced in the region is processed for export to the US. Any initiative for development of the citrus industry should take due cognisance of the fact that Caribbean citrus exports must compete with Brazilian, Florida's and Mexico's Frozen Concentrates Orange Juice (FCOJ) in the US. They should be able to produce and supply the product at competitive prices.

2.2 Problems to be addressed

The proposed Project is designed to address the principal problems encountered in the fruit production phase of the industry. In general, these problems are connected to weaknesses in information availability and research and technology transfer services. Such weaknesses inhibit industry development by constraining yields and productivity.

The more relevant problems found in the regional citrus industry which will be addressed, include the fact that:

- (a) the lack of baseline information for planning the development of the citrus industry;
- (b) the rootstock used in the region is generally sour orange and, to a lesser extent, Cleopatra mandarin. Even though sour orange is a good rootstock, it is extremely susceptible to the Citrus Tristeza virus disease (CTV);
- (c) most countries lack a virus free budwood registration and certification programme from where high quality budwood can be obtained and distributed for propagation purposes;
- (d) the quality and quantity of fertilizers applied to orchards are based mainly on tradition, rather than on a technical evaluation of plant and soil nutrient deficiencies;
- (e) farmers in many citrus producing areas lack access to laboratory facilities, to determine soil PH levels, which influence the proper growth and production of citrus trees;
- (f) there is an evident lack of adequate technological packages for different citrus growing regions, providing specific guidelines for the use of herbicides and the adoption of weed control methods, the use of leguminous ground covers, as well as techniques for rehabilitating



old groves and controlling black bees and other insect pests. Cultural practices are usually based on imported technologies often not validated in the region.

The above problem situation is derived from the existence of weaknesses in the technology generation and transfer institutions, the Citrus Grower Associations (CGA's) and Ministries of Agriculture which are directly associated with the citrus industries. In general, these institutions lack adequate staffing, have outdated management systems in place, have not properly prioritized the services needed by growers, and have not been able to establish well-functioning citrus technology generation and transfer systems.

The existing situation has a negative effect upon the development and future prospects of the regional citrus industry. This is especially so, if consideration is given to current world citrus industry forecasts for the next decade. Over the period 1993 to 2002, world orange juice prices are expected to be well below those observed in the latter half of the 1980's, as a result of the expansion of fruit-producing trees in the major exporting countries. This presents a difficult perspective for less efficient growers as well as for those who have expanded or will plant orchards in less productive areas. In the Caribbean region, as expansion of citrus orchards takes place beyond the established areas into fields with poor drainage or lesser fertility, the rates of growth of trees and fruit yields will be lower, affecting the financial viability of new projects and the industry's competitiveness.

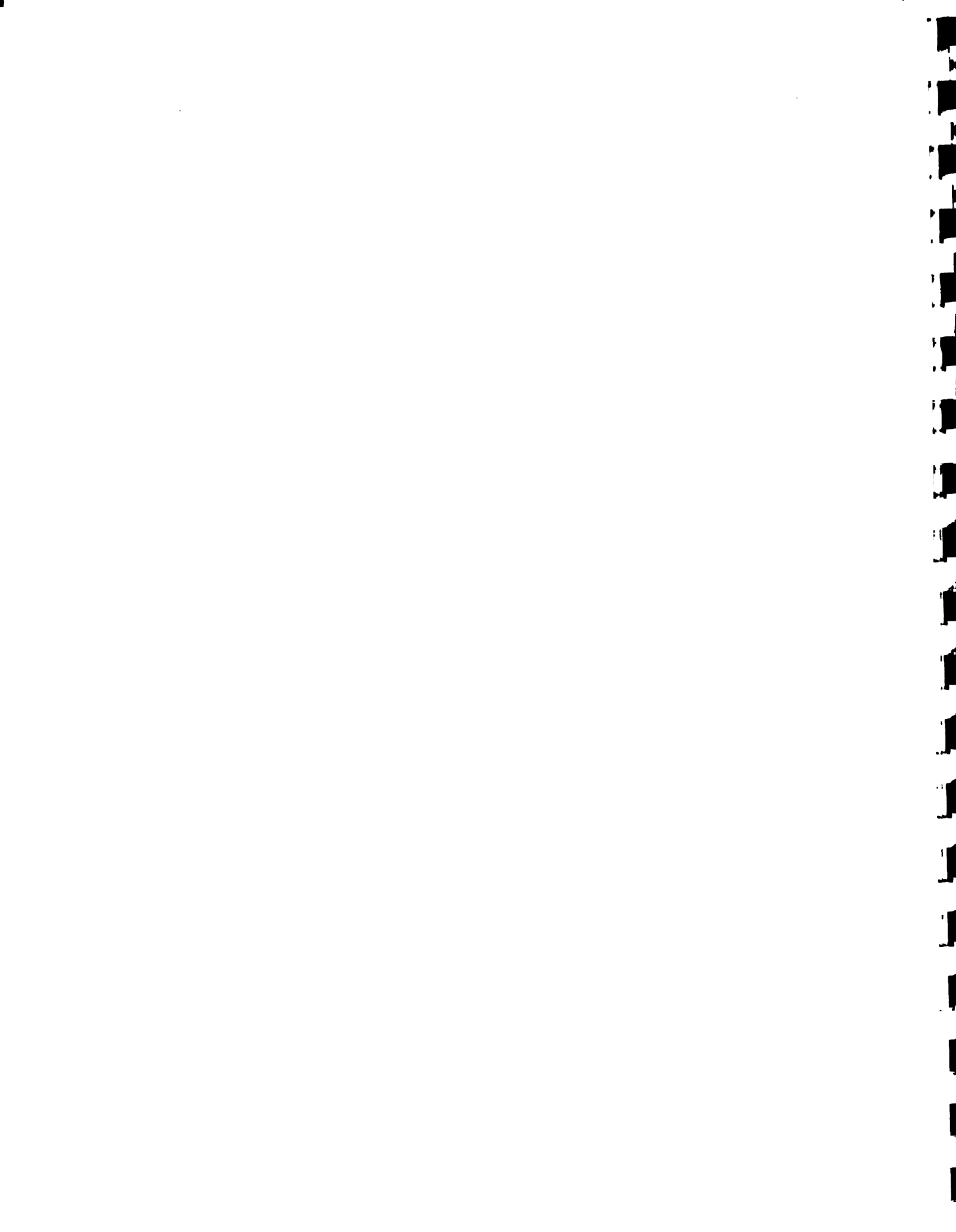
2.3 Documentation Available

There exists in any one place limited documentation concerning the regional citrus industry, due to the institutional dispersion, lack of a central coordinating and support unit for the industry, and the weakness of the service organizations in each CARIFORUM member country. Specifically, there is not a reliable information collection and analysis center for the citrus industry, nor a current assessment on its status, problems, alternative development strategies, nor projections. The absence of this information inhibits sound planning and investment project preparation.

Some of the documentation consulted included:

Agricultural and Management Consultants Limited. Market Study for Citrus Products from Belize. Final Report. Barbados, November 1990.

C.C. Weir. Citrus Growing in Jamaica. Citrus Growers Association, Kingston, Jamaica. 1973.



SIAPA Time Series Statistics on citrus production in the Caribbean Region for the period 1968-1990.

World, U.S. and Mexico citrus production and consumption statistics, for the period 1975-1990.

Costs of production (per acre and per box) for oranges in Florida, California, and Texas in the US and in Mexico.

Projections of orange trees in Florida, Brazil and Mexico for the period 1991-92 to 2010-2011, considering implementation of NAFTA.

CARICOM proposed Terms of Reference for the study of the regional citrus industry.

Citrus Tristeza virus and Toxoptera citricidus in Central America: Development of management strategies and use of biotechnology for control. Proceedings of a workshop in Venezuela: September 14-19, 1992.

Morris, Allen. 1993. The Florida Citrus Industry: Production, Financial and Marketing Issues; Paper presented to Long Range Policy and Planning Advisory Council, Florida Citrus Commission, February 2, 1993.

A Guide to Citrus Growing in Belize, Citrus Growers Association Extension Booklet.

Belize Citrus Growers Association, Annual Report 1991/1992 Crop year.

Florida Citrus Outlook, 1992-93 Season, Economic Research Department, Florida Department of Citrus, October 1992.

3. THE PROJECT, OBJECTIVES AND EXPECTED RESULTS

3.1 Wider indicative programme objectives

The governments of the citrus producing countries have been looking for opportunities to increase the productivity of their citrus industries, increase employment opportunities and increase foreign exchange earnings.

The wider sectoral objectives of the project are to increase citrus productivity, to contribute towards the development of the manufacturing sector, to contribute to the development of the livestock sub-sector, to increase exports and foreign exchange earning capacity, to increase employment opportunities and the overall standard of living in the participating countries.



3.2 Project objectives

The overall objective of the Project is to provide information in the citrus industries, generate, adapt and transfer technologies in support of the development of the citrus industries and enhance their productivity and ability to compete in international markets. In order to achieve these objectives, the proposed citrus development programme has the following specific objectives:

- to assess the citrus industries in the Caribbean and establish baseline information for planning for the development of the industry;
- to strengthen the regional and national capabilities for generation and transfer of citrus production technologies;
- to establish a sound indexing and budwood certification programme for the production and distribution of pathogen-free budwood;
- to strengthen the capabilities of the citrus industries for the control of the spread of **CTV** and **T citricidus** and limit their potential negative effects on the industries.

3.3 Project results

At the completion of the Project, the following results are expected:

- an indepth assessment of the citrus industries of the Caribbean which would serve as a source of information for planning for the development of the citrus industries;
- strengthened capabilities of the citrus industries in the generation, adaption and dissemination of appropriate production technologies to support its development;
- increased productivity of the Caribbean citrus industries;
- the establishment of an efficient system for the indexing and certification of budwood for the prevention of graft transmissible diseases;
- extension officers and farmers trained in crop production techniques through demonstration etc;



- six persons trained at the Post Graduate level in various aspects of citrus production/research.

3.4 Activities

3.4.1 Citrus industry assessment

The lack of information on the citrus industry has constrained efforts for planning its development. This has warranted an indepth study of the citrus industries in each of the participating CARIFORUM countries. The study will establish baseline information and shed light on the major issues constraining the industry's development.

3.4.2 CTV Eradication Survey

Both the severe and mild strains of CTV have been detected in most of the CARIFORUM countries. However, there was a much higher incidence of mild strains. While the efficient aphid vector *Toxoptera citricidus* which can cause the rapid spread of the disease is not present in some of the countries where severe strains of CTV are present, in Belize for example, it is expected to arrive within the next five or so years from Nicaragua where it has been detected. Since up to 90 per cent of citrus orchards in some of the CARIFORUM countries are on the CTV susceptible sour orange rootstock, the spread of CTV is likely to result in losses of a large number of citrus trees (CTV rapidly kills the trees by inducing an irreversible stock/scion incompatibility or causing stem pitting which reduces tree vigor, fruit quality and yield).

The objective of this activity is to eradicate citrus trees infected with the severe strain of CTV.

3.4.3 Budwood indexing and certification

Diseases caused by virus and virus-like organisms can be spread by budwood to new citrus plantings. To avoid the spread of graft transmissible viral diseases, a mandatory certification programme is essential and would ensure that budwood is obtained only from virus-free certified mother trees. Mandatory certification is especially important, since several of the recommended alternate rootstock are severely affected by these organisms.

Because technology is available for the detection of most graft transmissible pathogens, in any citrus development programme, there is no justification for not indexing and eliminating pathogens from propagative budwood.



The overall objective of the indexing/certification programme is to develop pathogen-free budwood and prevent the distribution of citrus trees which are contaminated with pathogens through the propagation of infected budwood.

3.4.4 Monitoring of *Toxoptera citricidus*

Aphid surveys in 1991 and 1992 in some of the CARIFORUM countries revealed that the brown citrus aphid, *Toxoptera citricidus*, the efficient vector of CTV was absent. However, this may not remain so. Although the vector is absent from Belize for example, it has been identified moving northward from South America and is reported in Nicaragua. It is expected that *Toxoptera citricidus* will enter Belize within the next five years. This activity will monitor for *Toxoptera citricidus* in countries which do not presently have it, but are at risk of getting it.

3.4.5 Cross protection studies

Studies have shown that after virus free budwood have been produced and released with and without protection in areas with severe CTV, after a number of years, the fruit weight from unprotected trees may fall by more than 50 per cent as compared to protected trees. There is therefore a need for protecting the trees from CTV.

Some mild strains of citrus tristeza virus are known to protect the citrus tree against the severe strains which are transmitted to the tree by the aphid vector and/or by graft transmission. This technique has been considered as a feasible measure to manage the disease. There is a need to identify the protective strains which are already existing in the CARIFORUM countries, which can be used to protect the trees against the severe strains. Field studies are necessary.

3.4.6 Crop production and protection trials

The following trials would be conducted in citrus growing areas in an effort to improve productivity through efficient practices.

Weed control studies

Weeds are a serious constraint to increased productivity of citrus. At present, effective weed control measures are not implemented because of a shortage of manpower, high labor costs and inappropriate use of chemical and mechanical methods. The weed



control studies would seek to investigate the effectiveness of various methods of weed control.

Studies will be carried out to determine the effectiveness of herbicides in combination with manual and mechanical methods for the control of the different types of weeds in citrus groves. This will include the use of different herbicides, dosage and timing of application, in combination with manual and mechanical measures and number of weed control cycles/year.

Fertilizer Trials

Fertilizer studies will be conducted in the main citrus growing areas to study the effects of the existing fertilizer regimes and methods, new regimes/methods including foliar applications of micro nutrients and the timing of applications on different soil types. Crop response to the various fertilizer regimes will be evaluated. Factors which will be evaluated would include fruit yield and juice quality.

Premature fruit drop trials

One of the problems identified as constraining increased citrus production in some of the CARIFORUM countries is premature fruit drop. Research activities will be conducted to investigate this problem and determine remedial solutions.

Rootstock trials

A number of different types of rootstock provide some degree of resistance to the citrus Tristeza virus. Among the alternative rootstock are cleopatra mandarin, swingle citrumelo, carizzo citrange, troyer citrange, and c35 citrange. However, those rootstocks differ in terms of their ability to withstand other diseases, the quality of fruits produced (size, colour, flavour, tree vigor etc) and the performance the scions under different soil conditions. It is important therefore that rootstock trials using a designated set of rootstocks for each country are conducted to evaluate the performance of various CTV tolerant rootstocks.

3.4.7 Technology transfer

Observation of the existing citrus grove management practices has shown a general failure of citrus growers to follow recommended production practices. This suggests the importance of ensuring that the transfer of technologies forms an integral part of the overall programme, linking the research programme to citrus production at the farm level. In order that the research findings



are finally accepted and used by citrus producers, they should be adjusted to the farm conditions in each of the participating countries, both in terms of their technical and economic feasibility.

Within the technology transfer sub-programme, there are to be two components: one is on-farm validation of the research findings and the other is the actual dissemination of the technologies. These two components are complementary and will allow participation of citrus producers in the development process and thus facilitate adoption.

The specific objectives of this component are:

- to adjust and validate the technologies so that they are suited to farm conditions in the participating countries;
- to familiarize extension professionals with the technical and methodological aspects of the practices so they will understand the requirements and be able to effectively transfer them to citrus producers;
- to establish an efficient flow of information between researchers and citrus producers so that the research can be geared to alleviate the problems limiting increased citrus productivity;
- to strengthen the capacity of and increase the activities of the citrus extension service to ensure that the recommended technologies are transferred to all citrus producers in the participating countries.

Validation of Technology

In the research component, the researchers will play the principal role. In the validation stage however, extension personnel and farmers are also to be involved. This participation of researchers, extension agents and farmers will allow necessary adjustments to facilitate adoption of the technologies. At this stage also, the technical and economic feasibility of the technologies in the farm environment will be assessed. In addition, extension agents will be trained in the various aspects of the technologies to facilitate dissemination of the results to farmers.

Dissemination of Technology

An important sub-component of the transfer of the technologies after they have been validated is the demonstration of the results through the utilization of demonstration plots where the present



practices used by citrus producers would be compared with the recommended production packages. Here plots on farmers fields would be utilized. The farmers will be assisted by extension agents in the establishment and maintenance of those plots. Field days will then be organized so that other citrus producers would be able to view the results and see the difference between the practices presently in use and the new technologies.

To further reinforce the field demonstration effects, simple fact-sheets outlining the new technologies would be produced for distribution to citrus producers. In addition, audio visual materials would be produced and used for the training of farmers.

4. PROJECT IMPLEMENTATION

4.1 Physical and non-physical means

The estimated physical and non-physical resources required for the implementation of the project are presented in Table 4.1.

Table 4.1: Physical and non physical resources '000 US\$

RESOURCE CATEGORY	YR1	YR2	YR3	TOTAL
CAPITAL COSTS				
Equipment	550			550
Computers	12			12
Vehicles	160			160
Total Capital	722	0	0	722
PERSONNEL				
Project coordinator	40	40	40	120
Horticulturist	40	40	40	120
Virologist	40	40	40	120
Pathologist	40	40	40	120
Technicians (3)	36	36	36	108
Graduate students (6)	120	120	120	360
Total personnel cost	316	316	316	948
OTHER COSTS				
Training	60	160	160	380
Travel & per diem	60	60	60	180
Research costs	90	90	90	270
Monitoring and Evaluation	30	30	50	110
Maintenance	25	35	35	95
Total other costs	210	310	310	1035
SUB TOTAL	1248	626	626	2705
CONTINGENCIES (10%)	124.8	62.6	62.6	270.5
TOTAL COST	1372.8	688.6	688.6	2975.5



4.2 Implementation procedures

Establishment of the project implementation unit

To coordinate and monitor the overall implementation of the Project in the region, a Project Coordinating Unit (PCU) would be established comprising of personnel from the citrus growers associations in the participating countries, the University of the West Indies and the Ministries of Agriculture. Specifically, the Project would fund the resources to contract a Regional Project Coordinator and research personnel, plus the necessary equipment and operating resources.

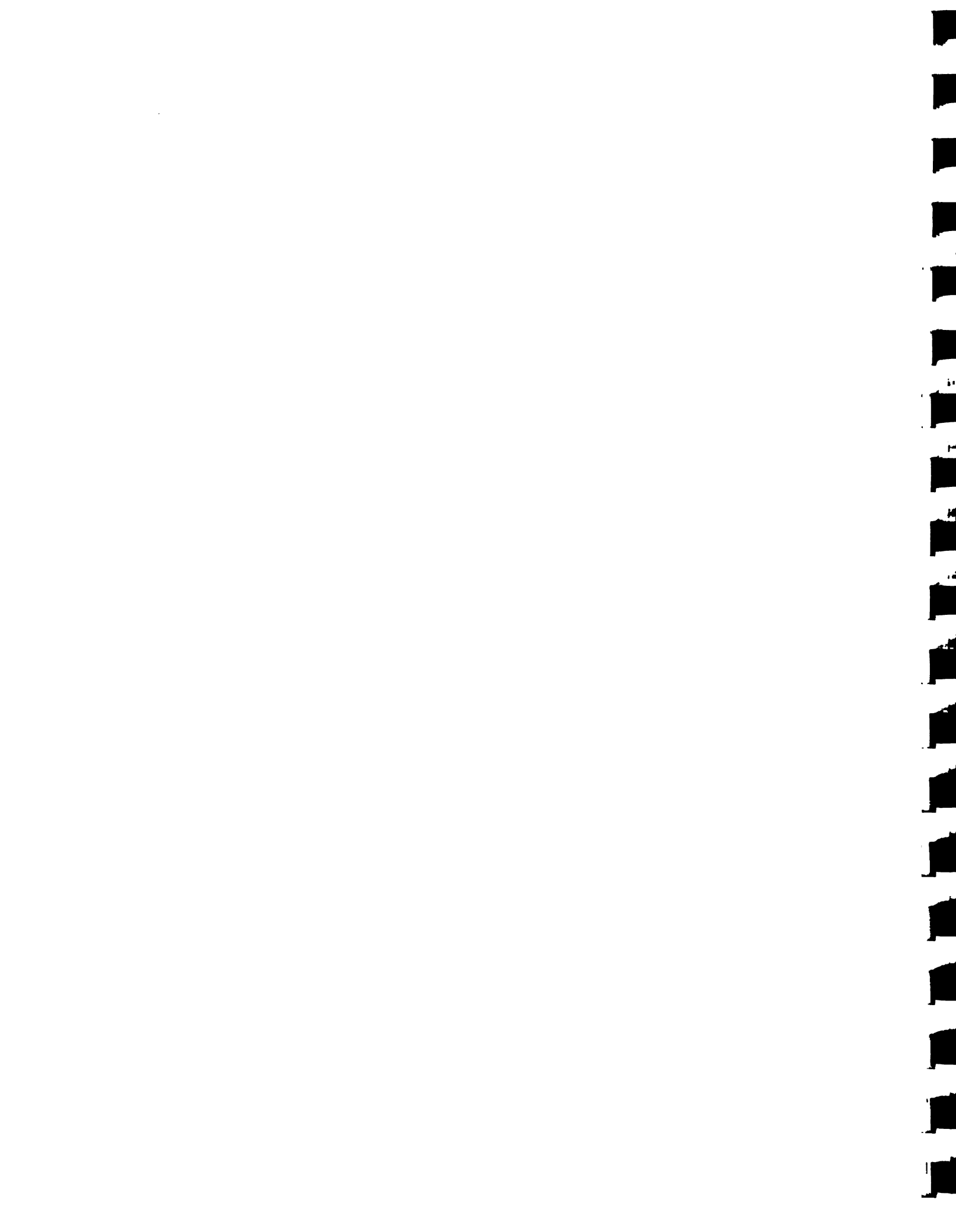
The technology generation and transfer components would be delivered through the University of the West Indies, the existing national CGA's, CARDI and Ministries of Agriculture. As much as possible, research activities will be conducted by the University of the West Indies through the graduate research programme and utilizing graduate students, who would earn Post Graduate Degrees in the process. The bud certification component would be carried out by the pest management unit of the Ministry of Agriculture in collaboration with the University of the West Indies and IICA.

Citrus industry survey

This activity will be conducted by a consultant. The study will be required to establish baseline information on issues including cultivated areas, cultivation practices, yields per acre and production and processing costs, production and marketing losses, marketing channels and margins, processing, transport and storage functions, financing and insurance and organizations serving the industry. This assessment would also review world consumption, production and trade statistics in citrus and citrus-based products. It would also seek to ascertain the validity of the production problems emphasized in the present profile, evaluate needs felt by producers, as well as by officials of CGA's and Ministries of Agriculture.

CTV Eradication Survey

At least 20 per cent of the citrus acreages in each of the participating countries will be surveyed each year. Within 5 years the entire citrus industry will be covered. The survey will be carried out in 3 phases. In the first phase, budwood source trees will be tested. Hot spot areas identified with severe CTV strains will be covered in the second phase. In the third phase, all other trees will be tested. The survey will be carried out by the research personnel under the guidance of a citrus virologist. Infected trees will be eradicated.



Budwood indexing and certification

The procedures for implementing this activity include:

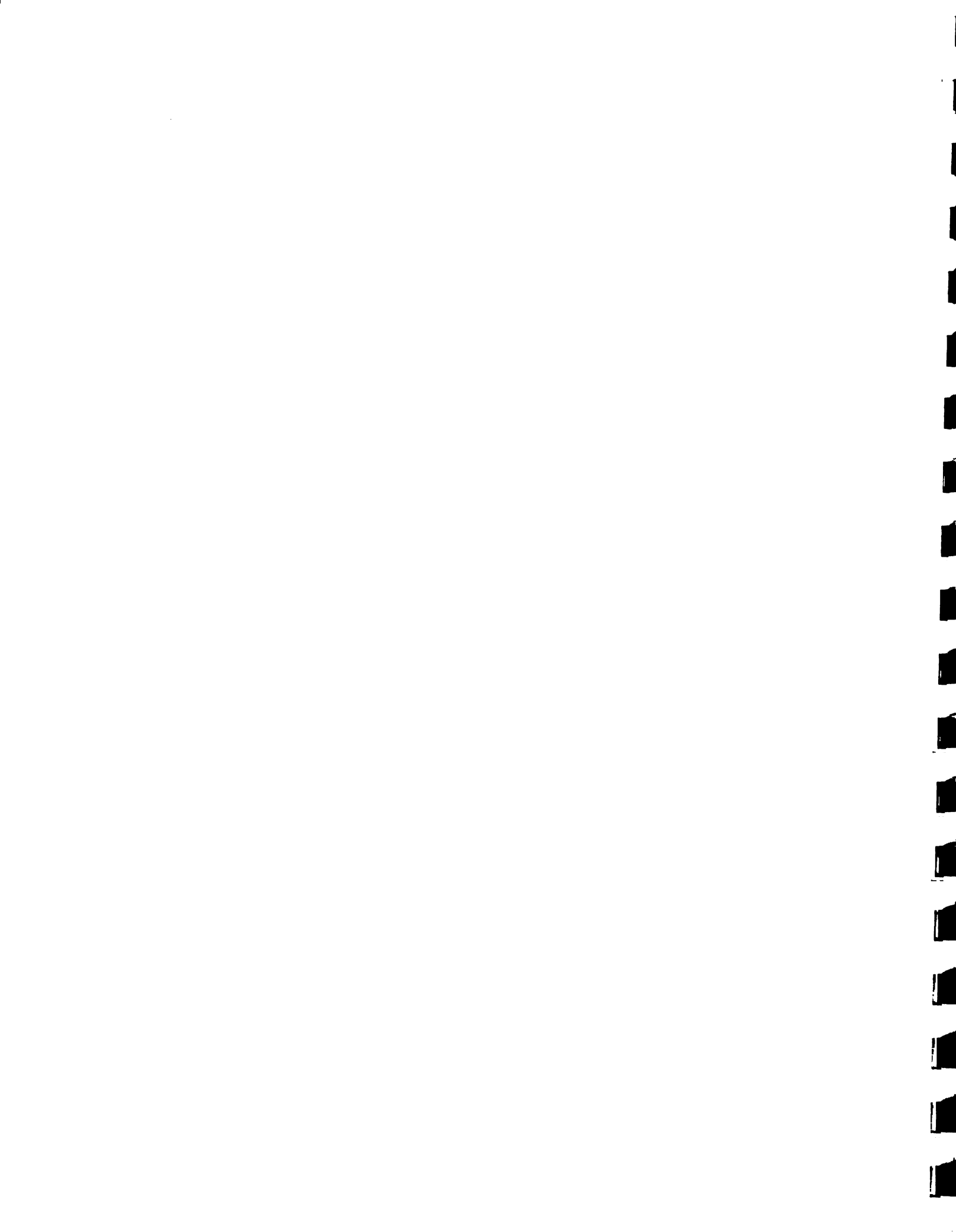
- the selection of consistently high-performing citrus varieties of (sweet orange grapefruit etc.) trees in each country of to be cleaned of all graft transmissible diseases. This material will be used for meristem culture;
- the importation of cleaned budwood from California if necessary;
- the multiplication of virus-free citrus budwood and seedlings from mother trees under greenhouse;
- the distribution of certified plants to citrus growers;
- training of laboratory staff.

Training of laboratory's staff in the following areas is essential for the indexing and budwood certification programme:

- the conducting of CTV ELISA tests and Exocortis PAGE tests etc;
- the location and isolation of fungal and bacterial organisms of citrus diseases;
- budwood registration and certification duties;
- the techniques of disease indexing;
- quarantine procedures;
- the techniques of shoot tip grafting and thermotherapy for the clean stock programme.

Monitoring of Toxoptera citricidus

Systematic and periodic surveys will be conducted in citrus orchards in the countries. Citrus orchards will be examined for the presence of the aphid through trap monitoring and/or direct visual surveys. This activity will be implemented in collaboration with the resident entomologist in the countries.



Cross protection studies

This activity will be implemented by the University of the West Indies in collaboration with the citrus growers associations in the respective countries. To implement the cross protection studies, rootstocks will be grown under insect-free conditions. Virus free scion materials will be budded to the rootstocks. The plants will be inoculated with protective strains of CTV isolates taken from different citrus growing areas in the CARIFORUM countries.

Linkages will be established with research institutions conducting similar activities for exchange of information so that unnecessary duplication of efforts would be avoided.

Crop production and protection trials

The various crop production and protection research activities will be implemented by the University of the West Indies, CARDI, the Citrus Growers Associations and the Ministries of Agriculture in the respective countries. As much as possible, the University of the West Indies will play a leading role through the graduate research programme and utilizing graduate students who will earn Post Graduate Degrees in the process. Provisions will be made for adequate supervision when research is to be conducted in the various countries.

Technology transfer

The technology transfer activity will be implemented by the Citrus growers in collaboration with the University of the West Indies (through its CEPAT programme) and IICA.

4.3 Timetable

The timetable for the project implementation is presented in Table 4.2.



Table 4.2: Citrus production improvement project timetable

	YEAR 1	YEAR 2	YEAR 3
Industry Assessment	=====		
CTV Eradication Survey	=====	=====	=====
Establishment coordination unit	=====		
Monitoring of Toxoptera	=====	=====	=====
Research on Citrus Production			
Training of Personnel			
of CGAs and M. of Agriculture.	=====	=====	
Research experiments	=====	=====	=====
Regional seminars		■	■
Development of Technological Packages			
Publication of material and dissemination to farmers		=====	=====
Training of CGAs and M. of Agricultural personnel			
- plant propagation	■		
- soil analysis and fertilization		■	■
- grove management	■	■	■
Bud Certification system staffing and training.			
Staffing and Training		■	
Provision of services to farmers.	=====	=====	=====

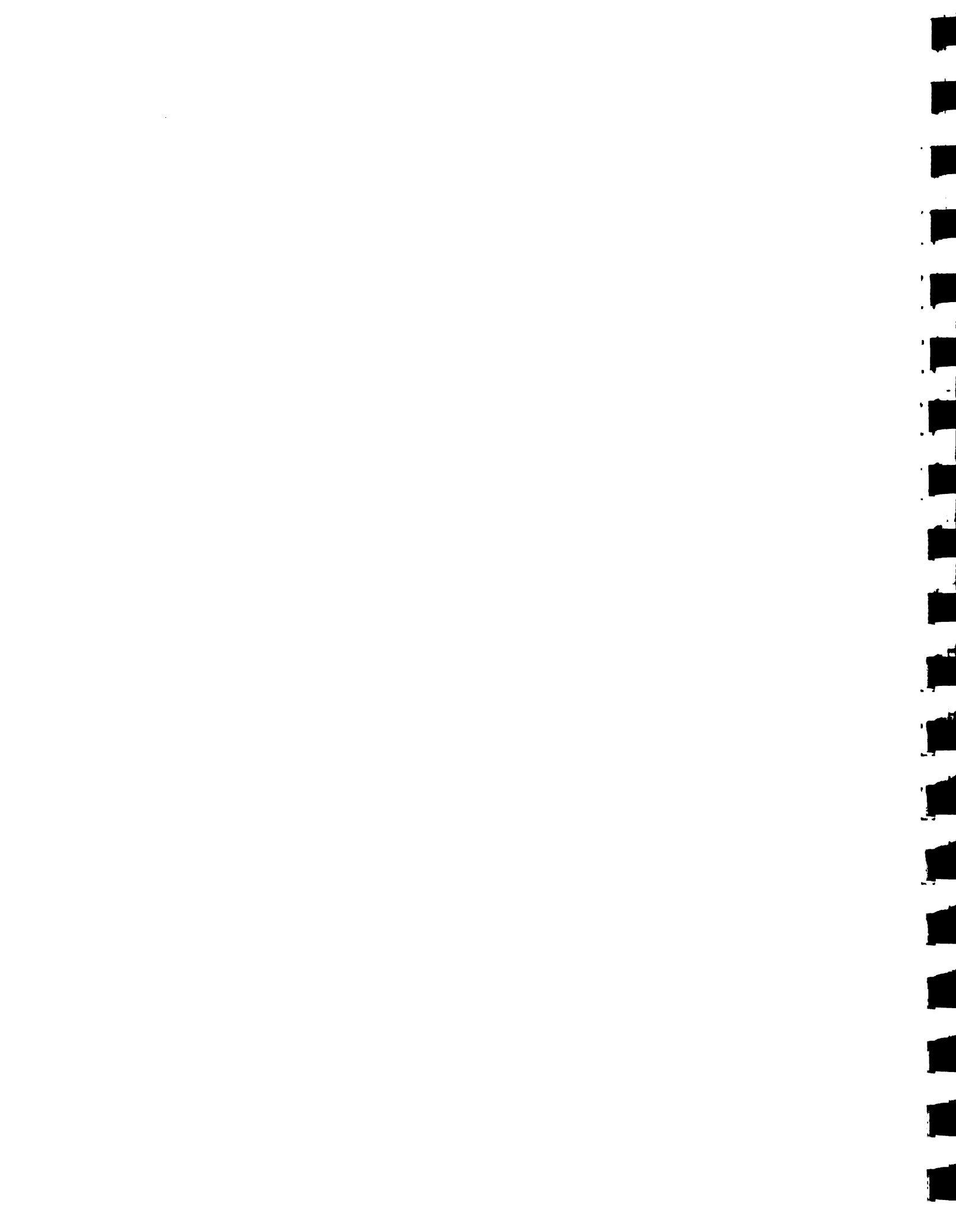
4.4 Cost Estimate and Financing Plan

The cost of the Project is estimated at US\$ 2.98 million, including a 10% contingency cost. The Project is to be financed by a grant from the EEC.

5. NON-ECONOMIC FACTORS ENSURING SUSTAINABILITY

5.1 Policy support measures

The Caribbean governments have identified agricultural diversification and increased trade as two strategies for accelerating growth of their agricultural sectors. One of the crops which have been targeted is citrus. The governments are fully aware that for the citrus industry to develop, policy support measures are required. Included in the support given is the provision of duty-free privileges for the import of equipment for use in the citrus industry and the services of the Ministry of Agriculture personnel.



5.2 Appropriate technology

Technological packages to be developed with Project support, as well as actions to certify bud quality would improve productivity. With more efficient use of fertilizers and inputs for pest and disease control, there will be a reduced sectoral dependence on imported inputs. Efforts will be made to ensure that the technological packages are first validated under farm conditions in the particular agro-ecological zones before dissemination to citrus producers, thereby ensuring their appropriateness.

5.3 Environmental protection measures

Through a strong emphasis on the efficient use of chemical inputs, the promotion of Integrated Pest Management (IPM) practices, the combined use of mechanical and chemical weed control, the use of leguminous ground cover in citrus groves to provide nitrogen and ground cover, the possible detrimental effects of citrus production on the environment will be reduced.

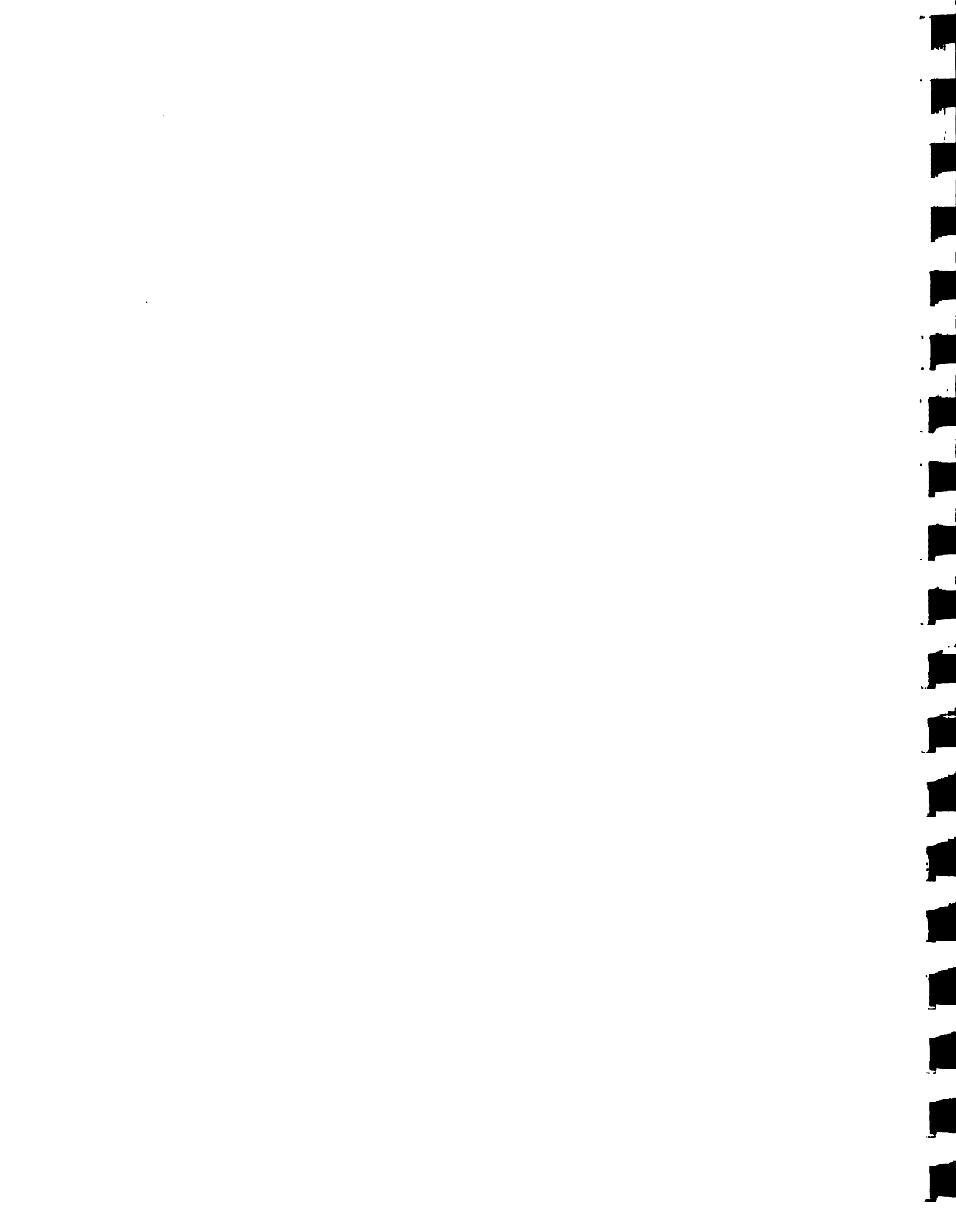
This proposed citrus development Project also stands to benefit from another project for upgrading plant and animal quarantine facilities in the Caribbean which will increase capabilities for more efficient pest and disease management. These measures would definitely be beneficial to the environment and are expected to produce beneficial effects long after the project is completed.

5.4 Sociocultural and legal aspects/community participation

The Project would be implemented in close collaboration with, and by personnel from the University of the West Indies, the national Ministries of Agriculture and the Citrus Growers Associations. The involvement of the national citrus growers associations would ensure that the growers' interests are well represented. The Project is gender-neutral and would benefit all citrus growers and processors of the participating countries.

5.5 Institutional and management capacity building

Project activities necessitate strengthening the capacity of the University of the West Indies, the Citrus Growers Associations and the Ministries of Agriculture in the countries to provide effective service through the provision of incremental staff, training, technical assistance, equipment and vehicles, and operating resources. This will help ensure sustainability of the citrus industry after project completion.



6. ECONOMIC AND FINANCIAL SUSTAINABILITY

One of the indirect benefits of establishing a comprehensive budwood certification programme is that it provides the possibility for early discovery of induced pathogens which could be highly destructive once they become disseminated by vector or budwood.

Another advantage of budwood certification is that it allows the production of pathogen-free trees derived by shoot-tip grafting for example. Trees produced by this method are generally more healthy, more uniform, higher yielding with better coloured fruit and thus results in more economical groves.

As is shown in the analysis presented in Table 6.1, the Project would be financially viable. The indicators of financial feasibility are:

IRR: 43%
NPV (12%): US\$ 4.61 million

7. ASSUMPTIONS, RISKS AND FLEXIBILITY

It is assumed that regional governments will continue to view favorably the development of the citrus industry. It is also assumed that in the coming years, even though world prices of citrus are expected to experience a downward trend, they will not fall such that current financial attractiveness of citrus production in the region becomes questionable.

The principal risk of the Project is associated with the nature of future price trends for citrus products in the world market, which are expected to follow a downward pattern as increased output from the major producers particularly Brazil and the USA enters the market.

The fact that the Project is designed to promote productivity increases in citrus cultivation represents an adequate and necessary development strategy in the current circumstances. Precisely because of current market projections, it is essential that regional citrus productivity increase to retain competitiveness in the export markets.



Table 6.1: Financial analysis of the project

	YEARS									
	1	2	3	4	5	6	7	8	9	10
Situation Without The Project										
Cultivated Area (Acres)	60000	60600	61206	61818.06	62436.2406	63060.60301	63691.20904	64328.12113	64971.40234	65621.11636
Yield (90 lb box /acre)*	150	150	150	150	150	150	150	150	150	150
TOTAL OUTPUT	9000000	9090000	9180900	9272709	9365436.09	9459090.451	9553681.355	9649218.169	9745710.351	9843167.454
PRICE (US\$/90lb box)	5	5	5	5	5	5	5	5	5	5
VALUE OF PRODUCTION	4500000	4545000	4590450	4636354.5	46827180.45	47295452.25	47768406.78	48246090.84	48728551.75	49215837.27
COSTS OF PRODUCTION/ *	27900000	28179000	28460790	28745397.9	29032851.879	29323180.4	29616412.2	29912576.32	30211702.09	30513819.11
GROSS MARGIN	17100000	17271000	17443710	17618147.1	17794328.571	17972271.86	18151994.58	18333514.52	18516849.67	18702018.16
Situation With The Project										
Cultivated Area (Acres)	60000	60600	61206	61818.06	62436.2406	63060.60301	63691.20904	64328.12113	64971.40234	65621.11636
Yield (boxes)	150	150	154	154	154	154	156	158	160	160
TOTAL OUTPUT	9000000	9090000	9425724	9519981.24	9615181.0524	9711332.863	9935828.61	10163843.14	10395424.37	10499378.62
PRICE	5	5	5	5	5	5	5	5	5	5
VALUE OF PRODUCTION	4500000	4545000	47128620	47599906.2	48075905.262	48556664.31	49679143.05	50819215.69	51977121.87	52496893.09
COSTS OF PRODUCTION	27900000	28179000	28460790	28745397.9	29032851.879	29323180.4	29616412.2	29912576.32	30211702.09	30513819.11
GROSS MARGIN	17100000	17271000	18667830	18854508.3	19043053.383	19233483.92	20062730.85	20906639.37	21765419.78	21983073.98
INCREMENTAL BENEFIT	0	0	1224120	1236361.2	1248724.812	1261212.06	1910736.271	2573124.845	3248570.117	3281055.818
Minus: Incremental Costs										
Investments †	722000	0	0	0	0	361000	0	0	0	0
Recurrent Costs	650800	688600	688600	0	0	160000	0	0	0	0
NET BENEFITS	-1372800	-688600	535520	1236361.2	1248724.812	740212.0601	1910736.271	2573124.845	3248570.117	3281055.818
Financial Indicators		0.43								
		4607256								

(a) Yields are assumed to increase from 150 boxes/acre to 160 boxes/acre in the 10 year project horizon.
 (b) Costs of production are estimated to decrease 5% over 10 year period as a result of improved fertilization and use of certified budwood.
 (c) Investments in Year 6, are estimated at 50% of Year 1 investments all vehicles are replaced in year 7.



8. MONITORING AND EVALUATION OF THE PROJECT

8.1 Definition of indicators

8.1.1 Project purpose

Purpose level questions

Purpose level questions which will help determine whether the project purpose is being achieved would include:

- To what extent has the regional capabilities for organizing and carrying out production oriented research and technology transfer increased?
- To what extent has information for planning for the development of the citrus industries been generated and made available?
- To what extent are certified budwood available for use in the citrus industries?

Purpose level indicators

Indicators which will be considered could include:

- citrus research output;
- number of professional staff and support staff involved in citrus development activities;
- preparation of an adherence to an annual research plan for citrus;
- relevance of research to addressing citrus production and productivity constraints;
- increased technical knowledge of extension agents after training;
- increased technical knowledge of the farmers as indicated by technology usages;
- staff training successfully completed at appropriate levels;
- number of farmers adopting the new practices;
- percentage of plants produced from certified budwood.



Purpose level data collection methodologies

Examination of the Project's administrative records and interviews with staff members will provide some of the required data. Data on farm performance and extension contacts will be submitted by the extension agents. New procedures will be developed for collecting and maintaining the additional information.

8.1.2 Intermediate results

Result level questions

Some of the questions which will help determine whether the project results are being achieved are:

- To what extent are the capabilities of the citrus industries for research and dissemination of technology strengthening?
- To what extent is per acre yield of citrus increasing?
- To what extent is pest damage decreasing?
- To what extent is certified budwood used?
- To what extent is the unit cost of production decreasing?
- What specific agronomic practices suitable for increased productivity have been developed by the project?
- To what extent have these practices been adopted by farmers?
- To what extent have training courses been successfully conducted for extension personnel and citrus producers?
- To what extent have demonstration plots been established and utilized?
- What factors facilitate or hinder adoption of the disseminated agronomic practices?
- Are research reports being completed accurately and on time?



Result level indicators

Some indicators to be used for measuring project achievement of the stated results could include:

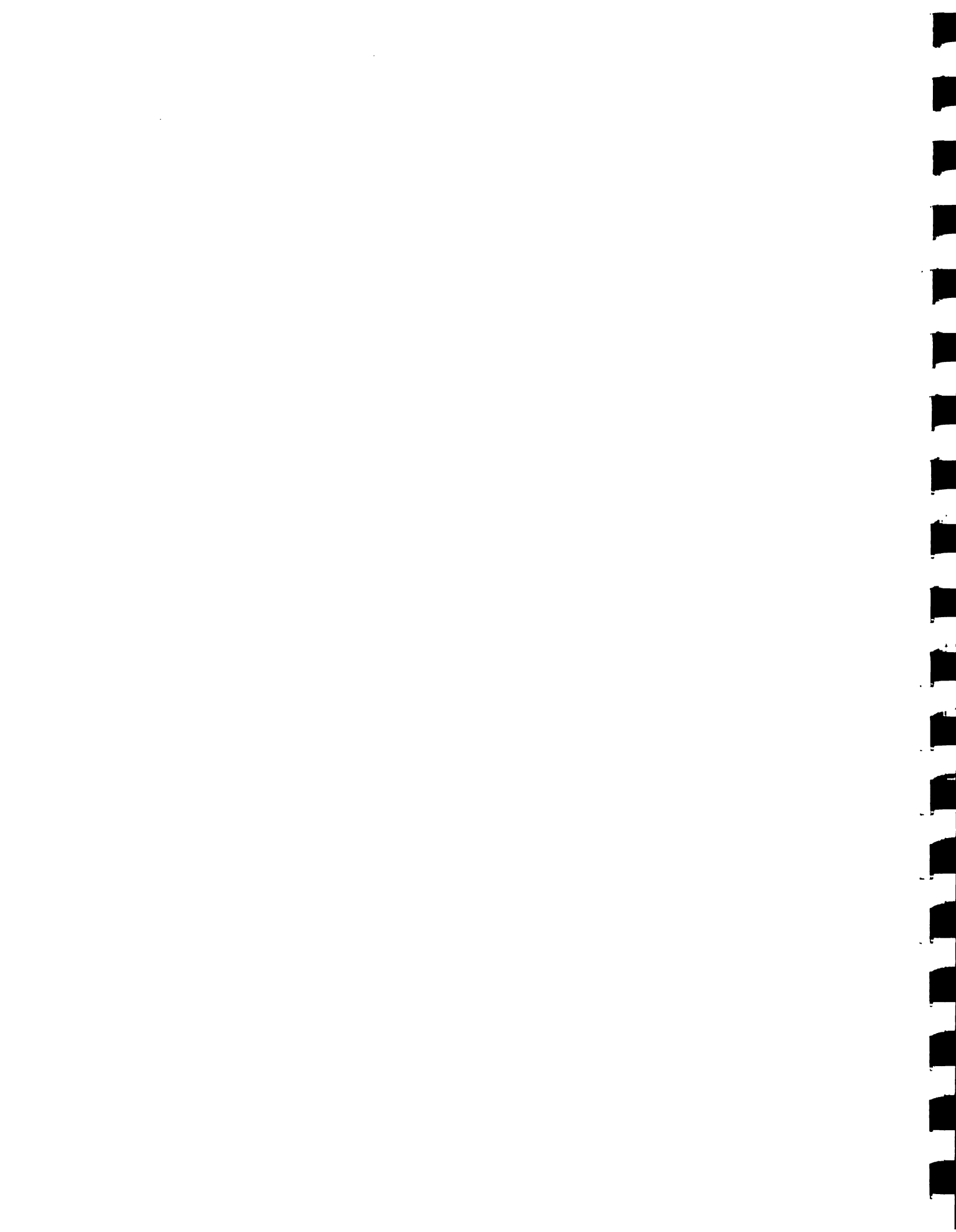
- number/type of specific agronomic practices developed;
- percentage of citrus growers adopting the disseminated technologies annually;
- expanded extension staff and farmer capabilities and competency as demonstrated by increases in skills of those trained;
- number of extension staff and farmers trained;
- number of demonstration plots established and number of times utilized;
- per acre yields of citrus;
- per acre cost of production;
- number of acres of citrus surveyed in each country for CTV;
- level of CTV and other pest and disease infestation and damage to citrus groves;
- amount of pathogen-free citrus plants produced and planted by growers;

Result level data collection methodologies

To obtain information on the types of agronomic practices and technical packages developed, the adoption rate by farmers and factors facilitating or hindering adoption, project records will be supplemented by rapid low-cost studies in each participating country. Extension agents will be required to provide data every quarter on the number of farmers contacted and using the technologies. Rapid low-cost techniques using interviews and observation techniques will be used for collecting data on farmers' adoption of practices to complement and spot check the accuracy of the information provided.

8.1.3 Special Studies

Rapid low-cost studies will be conducted to examine variations in results achieved among the participating countries and farms within the countries and to identify factors that may have



facilitated or hindered adoption of disseminated technologies. Individual and group interview techniques will be used. In addition, special case studies will be undertaken annually to examine the impact of the project and the benefits produced.

8.1.4 Feedback

As the monitoring information system becomes operational and begins to produce data, project management will ensure that the reports are completed in a timely and understandable manner and distributed so that timely modifications and improvements of projects can be made for more effective implementation. Information will be disseminated to all the information users: farmers, CGA, The University of the West Indies, CARDI, IICA, etc.

8.1.5 Input requirement and budget

To carry out the data collection and analysis for monitoring and evaluation, temporary personnel will be hired for filling out the forms to be used for data collection. Approximately 1 per cent of the amount designated for the Project has been set aside for data collection, analysis and reporting. This amount is also for two scheduled evaluations.

8.2 Evaluation schedule

The data gathered and analyzed in relation to project purpose and intermediate results, will provide basis for empirical evaluations. Midway through the Project, there will be an evaluation. The purpose of this evaluation will be to determine the extent of progress achieved and whether the activities are on target.

Just before its termination, there will be a full evaluation to determine whether the Project has achieved the expected impact on citrus production. In addition, this evaluation will provide guidelines as to future activities which should be considered for the continued development of the citrus industry.

9. CONCLUSIONS AND PROPOSALS

The analysis in this profile has indicated that the proposed Project would be technically, institutionally, financially and economically viable and, therefore, warrants preparation of the feasibility study.

WHAT IS IICA?

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

IICA was founded as an institution for agricultural research and graduate training in tropical agriculture. In response to changing needs in the hemisphere, the Institute gradually evolved into an agency for technical cooperation and institutional strengthening in the field of agriculture. These changes were officially recognized through the ratification of a new Convention on December 8, 1980. The Institute's purposes under the new Convention are to encourage, facilitate and support cooperation among the 32 Member States, so as to better promote agricultural development and rural well-being.

With its broader and more flexible mandate and a new structure to facilitate direct participation by the Member States in activities of the Inter-American Board of Agriculture and the Executive Committee, the Institute now has a geographic reach that allows it to respond to needs for technical cooperation in all of its Member States.

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

The 1987-1991 Medium Term Plan, the policy document that sets IICA's priorities, stresses the reactivation of the agricultural sector as the key to economic growth. In support of this policy, the Institute is placing special emphasis on the support and promotion of actions to modernize agricultural technology and strengthen the processes of regional and subregional integration.

In order to attain these goals, the Institute is concentrating its actions on the following five programs: Agricultural Policy Analysis and Planning; Technology Generation and Transfer; Organization and Management for Rural Development; Marketing and Agroindustry; and Animal Health and Plant Protection.

These fields of action reflect the needs and priorities established by the Member States and delimit the areas in which IICA concentrates its efforts and technical capacity. They are the focus of IICA's human and financial resource allocations and shape its relationship with other international organizations.

The Member States of IICA are: Antigua and Barbuda, Argentina, Barbados, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the United States of America, Uruguay and Venezuela.

The Permanent Observer Countries of IICA are: Arab Republic of Egypt, Austria, Belgium, Federal Republic of Germany, France, Israel, Italy, Japan, Netherlands, Portugal, Republic of Korea and Spain.

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