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# Postharvest Institute for Perishables

REPORT

TO

Regional Development Office/Caribbean  
USAID, Barbados

PERISHABLE POSTHARVEST LOSSES  
IN SELECTED EASTERN CARIBBEAN COUNTRIES:

CAUSES AND RECOMMENDATIONS

For the Postharvest Institute for Perishables

D. Leeper  
R. Schermerhorn  
D. Jackson

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## I. EXECUTIVE SUMMARY

The AID Regional Development Office/Caribbean (RDO/C), headquartered in Barbados, requested assistance from the Postharvest Institute for Perishables (PIP) with respect to the identification and scope of postharvest loss causes and problems in Eastern Caribbean countries and recommendation of appropriate and economically justifiable interventions to reduce those losses. PIP fielded a 3-man team for a total of 48 man days to provide the requested assistance.

The countries involved in the study were St. Vincent, St. Lucia, Dominica, and Barbados. The focus was on perishable losses in the local country and regional marketing system, not in the extraregional export system.

Relevant prior studies of the production, transport and marketing of perishables were reviewed. Field investigations of marketing systems and losses in the four countries mentioned above, and in the regional trade, were pursued. Farmers, local and regional intermediaries, governmental officials, marketing boards, schooner personnel and others were interviewed. The team had the opportunity to observe the operation of the marketing system from the farm to the consumer.

The subject of postharvest losses can only be analyzed and investigated in the context of the marketing and distribution system as a whole. Speaking broadly, the same system serves all perishable crops although some crops may be more perishable than others and hence require special attention. The purpose of the study was to identify those interventions which would have a broad economic impact in the region, so those recommended are those which are aimed at improving the overall system in significant ways rather than dealing only with particular crops.

The nature of postharvest losses also dictated a systems type of approach for the study. Losses can result from a variety of causes occurring at any stage of the system -- for example, maturity at harvest time, bruising during harvest, lack of careful handling and consequent bruising at any step in the system, or high temperatures. Once damage occurs it is irreversible and cannot be rectified by anything done at a subsequent stage of the system. Damage to products from several causes is cumulative and usually losses do not materialize until later stages of the system.

It was found that a major cause of perishable losses in the Eastern Caribbean was periodic gluts of particular crops arising from overproduction relative to demand. As a result such crops are not even harvested. While technically such losses are not "postharvest," the team felt that the apparent magnitude of these losses is so substantial that they should be addressed in the study.

Perishable losses are high in the Eastern Caribbean, although no reliable data are available to quantify the amount of such losses, either in physical or economic terms. That is the consensus of prior studies and those interviewed. Estimates range from 10% for some durable crops in some countries to 60% and more for other more perishable crops. Analysis has shown that only the most durable crops are regionally traded -- probably because experience has shown that losses of the more perishable crops on schooners make attempts to export unrewarding.

The team's observations tend to support the validity of the foregoing estimates, and perhaps even indicate they are on the low side. In the opinion of the team, order-of-magnitude figures based on best estimates of knowledgeable people in the countries, studies and available U.S. studies on the effect on perishability of such factors as variety, bruising, temperature and humidity will be adequate for this purpose. Precise determination of the magnitude of the losses is neither necessary nor warranted at present. However, it will be needed at a later time in order to establish priorities for future actions.

The basic causes for the current high rate of losses of perishables in the islands investigated--and probably the other Eastern Caribbean countries--and addressed by the recommendations, were found to be:

1. There are few, if any, incentives for farmers or intermediaries to do anything about reducing losses. Premium prices are not paid for better quality products.
2. There is a general lack of knowledge of available, appropriate, and economic technology to reduce on-farm and postharvest losses.
3. No agricultural or market information is available at either the country or regional levels; this is a primary contributor to periodic glut situations, and inefficiency of the marketing system generally, which gives rise to physical and economic losses.
4. There is no effective mechanism for transfer of technology and information.
5. Packaging materials designed to minimize losses are seldom used in the market system.
6. Interisland trade is carried by schooners which are not designed, and are inadequate, for perishables. Irregularity of scheduling also significantly contributes to losses.
7. Little attention is paid to care and proper handling of perishables to minimize losses at any level of the system. Facilities for maintenance of quality or storage are nonexistent, or totally inadequate.
8. Rough and multiple handling, little attention to proper stowage on vehicles or vessels, lack of concern about temperature control and ventilation are characteristics of the system.
9. Commodities not sold for human consumption for any reason are not utilized for any purpose and become a total loss; possible values of such "loss" products are not realized.

Some causes of postharvest losses usually mentioned are not included in the foregoing listing. The lack of farm access roads, and the poor condition of roads, is a significant factor in postharvest losses. However, the team was of the opinion that road improvement was outside the frame of reference of the study.

Lack of storage is another. This was considered, but it was concluded that a recommendation of significant investment in mechanical storage was premature at this time because of lack of maintenance of quality of product prior to entry, and subsequent to exit from, such facilities. Processing is often put forth as a way to convert glut crops into marketable product, but this may be illusory. A commercial processing operation must have a steady, sure supply of its raw material, something it does not have with gluts. Processing should be considered as an element of an agricultural and market development program, not as a loss reduction measure alone.

In development of the recommended interventions, and associated work plans, the following guidelines were used: a) A pragmatic rather than a theoretical approach; b) Use of known, available technology rather than development of new technology; and c) Recommendations are to be tested on a small scale first before embarking on a region-wide program.

#### A. Recommended Interventions

RDO/C requested the identification of five interventions that would appear to have the greatest commercial impact on postharvest loss reduction. Also a scope of work for each intervention was requested, where more detailed analysis would be required before a final investment decision can be made.

The first four interventions that have been identified are categorized under Maintenance of Quality:

- Education and Training
- Temperature Control
- Packaging
- Transport

The fifth is Agricultural and Market Information. An additional and sixth intervention of Utilization of Loss Products arose during the course of the study. The last is not considered to be as significantly important as the first five interventions.

It is recommended that the five interventions be considered collectively, and not in individual isolation, because of the cumulative and irreversible effect of crop damage from various causes as the product moves through the system.

#### I. Maintenance of Quality

A) Education and Training. Farmers require education and training in the stage of maturity when crops should be harvested, harvesting techniques and care and handling of products after harvest to minimize postharvest losses. Incorporated in the program should be introduction of appropriate, low-cost, harvesting equipment, simple farm-to-road vehicles, and appropriate packaging as described below.

Education of intermediaries, and farmers who perform intermediary functions, in the proper care and handling of perishables to minimize losses will be needed. Intermediaries are the principal avenue for introducing new technology, such as packaging, into the system since they serve as the connecting link between the farmer, transporters, and consumers.

The third component of the education and training program involves dockworkers and schooner operators and crews. Proper handling and stowage practices and introduction of new technology to minimize losses should be the content.

The education and training programs should be clearly designed to convey to the participants the "why" of what is being taught as well as how to do it and how it can benefit them. Demonstration should be the principal method of instruction, not just talk.

B) Temperature Control. This is critical to maintenance of quality of perishables as they move through the system. An understanding of this, and appropriate technology, should be an important part of educational programs. Appropriate, simple shade structures to provide protection from sun and rain should be erected as needed at appropriate locations--roadside, collection points, central markets and wharfside.

C) Packaging. Packaging now used offers little, or no protection to perishables from damage. Standardized packaging of appropriate design--useful as containers for a wide range of crops, reusable, rigid, permitting ventilation, stackable, nestable--will go far towards reducing losses from bruising, compression damage, heat buildup and multiple handling at all levels of the local and intraregional system.

D) Transport. The standardized packaging recommended above will significantly reduce damage during vehicle transport. Utilization of foam padding on the floor and sides of the cargo section of buses and trucks would also appear to be worthwhile.

Investigation of the feasibility of establishing a regular interisland shipping service with adequate vessels for the maintenance of quality of perishables is recommended. However, definition of the scope and conduct of such a feasibility study was felt to be outside the study.

With respect to schooners carrying perishables, steps should be taken to assure them priority in wharf space, port and customs formalities, and unloading. The feasibility of utilizing roller raceways and small, moveable dockside cranes for loading and unloading to reduce bruise damage should also be determined. Appropriate modifications to vessels to permit adequate ventilation of perishable cargo, and vent hot air, should be made to reduce heat buildup.

Failure of schooners to arrive for loading when anticipated is reportedly a significant cause of losses due to lack of adequate wharfside facilities to store perishables temporarily to maintain quality. If this is true, it is recommended that self-contained, refrigerated storage units -- new or reconditioned--should be placed on the wharf to reduce losses caused by such delays providing that adequate repair and maintenance services are available or can be established.

## II. Agricultural and Market Information

In the opinion of the team, information is the primary key to reduction of losses from periodic gluts. With reliable data on prospective production and demand, a farmer has a basis for determining what he is going to plant or not plant, which crops are likely to be in oversupply and which will not be.

Current local and regional production market and price data would improve the efficiency of marketing system for all participants--farmer, intermediaries, marketing boards, and others. Sometimes a particular crop is a glut crop in one country while at the same time there is a demand for the same crop in another. With current information provided by the recommended system this type of situation would be alleviated.

### VII. Utilization of "Loss" Products

At the present time perishables not sold for human consumption are not utilized for any purpose. And losses of perishables cannot be eliminated altogether so there will always be some, no matter how successful a loss reduction program may be.

"Loss" products often have a value for purposes other than human consumption which, if realized, can reduce the economic losses of farmers or other participants in the system. For example, they might be used as unprocessed, supplemental animal feeds or serve as the basis for composting--at the same time providing a low-cost substitute for expensive fertilizer. Investigation of these, and other, methods of realizing the value of "loss" products is recommended.

#### B. Work Plans Recommended to Implement Interventions

##### I. Maintenance of Quality

Objective: To develop and establish a program of appropriate and economically justified interventions to assure maintenance of marketable quality of perishables from harvest time through each stage of the country and regional marketing system until they reach the consumer.

##### Methods:

1. Estimate of Postharvest Losses. The value of current postharvest losses and the reduction anticipated from the interventions must be balanced against the size of the investment required. The approach utilized here minimizes the size of the initial investment and hence the criticality of precise determination of the size and value of anticipated reductions. Order-of-magnitude estimates will be adequate for initiation of the recommended program; more reliable data to support larger investments for full implementation of the program will be developed during the first year of the program.

Needed estimates for perishable crops of St. Vincent should be developed in the following way:

- . Confirmation of identification of principal crops and their relative economic importance;
- . With a specific crop-by-crop focus field evaluation to confirm the estimates of the extent, and causes, of losses which are mentioned in this study and the securing of additional estimates from appropriate people or organizations involved in the system if they prove to be inadequate.
- . Conduct of a literature search and analysis to quantify the effect of failure to maintain optimum conditions on maintenance of quality of the crops through the system. For example, the increase in the rate of deterioration, and hence shortened shelf life, resulting from bruising of sweet potatoes during harvest.
- . Adequate estimates to justify the investment in the recommended program can then be derived from the foregoing.

Short term technical assistance will be required to perform the foregoing scope of work, with appropriate in-country cooperation and support of the Department of Agriculture, intermediaries and others.

2. Training and Education. A three-pronged education and training intervention, aimed at farmers, domestic and intraregional intermediaries, and schooner operators and crews, is needed. The programs could be initiated on St. Vincent. The initial substantive content of the programs should include:

a. Farmers

- . Correct harvest time as affected by maturity of the crop.
- . Appropriate harvest techniques.
- . Postharvest care of perishable crops.
- . Introduction of new technology such as low-cost harvesting equipment, packaging, and appropriate, improved farm-to-road transport vehicles.
- . Benefits which the farmers could anticipate.

As a corollary to the farmer education program, an investment in the development of low-cost, appropriate harvesting equipment should be made. A survey of such equipment utilized elsewhere would appear to be adequate. This might well be incorporated as a part of one intervention dealing with all tangible appropriate technology aspects of the program.

b. Intermediaries (including farmers who perform this function)

- . Effect and importance of maturity when harvested, temperature control and protection against bruising and cuts at all levels of the system.
- . Introduction of new technology such as loading and unloading practices and improved packaging.
- . Benefits that intermediaries could anticipate.

c. Schooner Operators and Crews

- . Importance of care and careful handling of perishables, including temperature control.
- . Introduction of new technology such as proper loading, unloading and stowage practices, low-cost schooner modifications and dockside loading equipment.
- . Benefits that schooner operators could anticipate.

The most appropriate country agency for carrying out the farmer education program would appear to be the Extension Service of the Department of Agriculture. And it is also probably the best one to conduct intermediary and schooner education programs as well.

Short term technical assistance will be important in the design of the educational programs and development of their content.

3. Temperature Control. The scope of work of that part of the program aimed at maintaining the temperature of perishables as they move through the system is as follows:

- a. Field investigation and identification of the points in the system--on-farm or subsequently--where heat buildup occurs.
- b. Identification of economic solutions to prevent or reduce such buildup. For example, training with respect to time of day of harvest and use of available shade and the erection of low-cost shade structures at appropriate stages of the marketing system.
- c. Determine the number, appropriate location, and the design, cost and feasibility of needed shade structures. Roadside, central market, loading and unloading wharves are locations to be considered.

Short term technical assistance will be required for performance of the outlined work with the cooperation and support of the Ministry of Agriculture. The Ministry would appear to be the appropriate country agency for implementation of the recommendations to be made in the study.

4. Packaging. Introduction of appropriate packaging to reduce losses due to bruising and heat buildup in products should be an important element of the loss reduction program.

The scope of work for this element of the program is outlined below:

- a. Field investigation, as needed, to confirm what type of packaging is needed for which crops and why; identification of considerations affecting choices such as cost, ease of carrying, or cost of transport on schooners.
- b. Development of detailed criteria for packaging.
- c. A survey of available packaging substantially meeting those criteria, including sources and costs. The team is of the opinion that adequate packing is already developed and available without investment in development of new packaging. Eastern Caribbean Agencies of Kingstown appears to have done some groundwork on this aspect of the work.
- d. The container, or containers, which appear to be the best should then be tested through actual use in the country and regional marketing systems. Arrangements for such testing should be made with one or more interested intermediaries. A sufficient number of containers should be included in the test--say 500--and be conducted for an adequate period of time. The purchase price of the containers should be financed, and not just given to the intermediaries. However, some discount on the price might be justified on the basis of the collection of information with respect to use which will be involved. Advice on ways in which the containers can be kept in the system, once introduced, should be provided to the intermediaries.
- e. Provision should be made for continuing observation of use of the containers in the system and interview of participants in the system as appropriate.
- f. Upon conclusion of the test and evaluation, arrangements will be made to assure availability of the containers and introduction throughout the system.

Package characteristics that should be taken into consideration are:

- a. Sturdy enough to withstand weight of others stacked on top.
- b. Smooth material that will not cut the crop.
- c. Vented or slatted to allow air circulation.
- d. A size that can be easily handled and that will reduce bruising of crops in the container.
- e. The shape should allow containers to be stacked for return trips when empty.
- f. Should allow for multiple handling, i.e. from the field to the ultimate market.
- g. Strong enough to permit repeated uses over a period of time.

The Ministry of Agriculture is probably the appropriate country agency to be involved. Short term consultants should develop the criteria, make the survey of available packaging, and assist in designing and making arrangements for the test. Peace Corps personnel might be considered for the work required during the period of the test. The consultants would then be involved in the evaluation of the test and design of the implementation program.

5. Transport. The establishment of country collection points, at appropriate locations, with adequate supporting services such as routine and timely vehicle pickup, is recommended. The scope of work for this aspect of the program will be:

- a. A survey of the principal crop-producing areas and analysis of how crops currently reach the market.
- b. Determination of the number of collection points which might be justified; where they should be located; of the functions they should serve; and the mode of operation and supporting services required.
- c. Consideration of the design, cost, and feasibility of establishing such collection points.

Short term technical assistance will be required for performance of the work. To avoid duplication, it should be pursued in conjunction with the recommended work proposed in temperature control. Again, the most appropriate country agency involved appears to be the Ministry of Agriculture.

The scope of work for tangible appropriate transport technology at the farmer level is:

- a. Sufficient field investigation of the modes, distances, and other considerations involved in farm-to-road transport to confirm the conclusions of this study.
- b. Development of the design for simple, low-cost equipment to aid in reducing losses and determination of feasibility. The following might be considered: a single-wheeled device for trails with a higher carrying capacity than head carrying; donkey saddle modifications to carry standardized containers.
- c. Recommendations as to sources of supply of such equipment (including farmer or local production) and introduction of the equipment.

At the vehicle transport level, the following should be pursued:

- a. Arrangement of tests with bus and truck operators to determine the effectiveness of using foam padding in cargo spaces to reduce bruising damage.
- b. Analysis of results and determination of feasibility; identification of sources of supply of foam (produced in Barbados.)
- c. Recommendations as to introduction of the use of the foam, if it proves to be justified.

The foregoing two interventions will require short term technical assistance with the Extension Service of the Ministry of Agriculture probably the country agency to be involved.

The other transport intervention recommended is related to the schooner trade. Following is an outline of the scope of work:

- a. The irregularity of schooner arrivals, the causes of such irregularity, and the causes of delays in unloading should be investigated and analyzed. A review of port departure and arrival records, and interview of schooner agents and operators, port and custom authorities, will provide needed data.
- b. Appropriate recommendations with respect to changes in port or customs practices or procedures to minimize delays should be developed.
- c. Losses due to delayed arrivals at the loading port should be assessed and the feasibility of providing short-term storage facilities should be determined. The utilization of self-contained, refrigerated units (reefers) --reconditioned or new--should be considered.
- d. Low-cost, schooner modifications to improve perishable cargo ventilation and reduce hold temperatures should be investigated and feasibility determined. Modifications should be tested on several schooners. After analysis of the tests, recommendations with respect to introduction of the modifications to the schooner fleet should be made.
- e. Simple, dockside handling devices to provide more careful handling of perishables should be investigated and feasibility determined. Use of roller raceways and small, moveable cranes are two possibilities.

Short term technical assistance will be required to carry out the work outlined above. Port authorities will necessarily be involved and it is probable the Ministry of Agriculture should be also. Schooner operators will participate in the vessel modification test.

## II. AGRICULTURAL AND MARKET INFORMATION SYSTEM

Objective: To establish an effective country and regional system for timely collection and dissemination of reliable production, demand and price information.

### Methods:

A two-tier system should be structured, one related to the local country market and the second dealing with the regional market. Information of anticipated future supply and demand should be incorporated in the system as well as current supply, demand and prices.

One country should be selected for initial development, e.g. Dominica where the Ministry of Agriculture and Extension Service appear to be relatively well accepted by farmers, the Ministry has statisticians, and there is a fledgling association of hucksters.

The first two years should be spent establishing and developing the Dominica country system. This prototype, would be established in other Eastern Caribbean countries in the third year and the regional system in the fourth year.

### 1. Development Program, Year One

#### Price Information.

Initially the country price and other sales information gathering and reporting service should be established. Sources of information would be the banana, citrus or other farmer associations, the Marketing Board, representative samples of local and export intermediaries and perhaps farmers. Primary focus will be on the most important perishable crops.

The data will be collected on a routine, current (on a daily or at least weekly) basis. In addition to prices, quantities sold, point of sale and quality information should also be collected.

The information gathered should be disseminated on a daily or weekly basis to anyone, or any organization, interested in receiving it--farmers, intermediaries, market boards or others. Unless the beneficiary receives the data on a timely, current basis it will have little or no value. The most efficient method of dissemination would be through use of the local public radio.

The Extension Service of the Ministry of Agriculture, or perhaps a new statistical reporting service within the Ministry, would appear to be the appropriate agency for gathering as well as disseminating the data.

Production Information. Once the price and sales reporting service becomes operative, production data collection should be established. Representative samples of farmers in the main perishables production areas of the island should be the source. Extension personnel, farmer associations, and intermediaries will all assist in drawing up the samples to ensure that they are representative.

The primary types of production data collected will be: acreage planted, acreage harvested and yields. Cost-of-production data collected at the same time would prove to be useful for a number of purposes.

The appropriate agency for collection and dissemination would appear to be the Extension Service of the Ministry of Agriculture. The data collected could probably be best reported to beneficiaries once a week in association with price and market reports. Production cost data might also be included when appropriate.

Program Implications. Short term technical assistance in regard to the design, content, organization, and establishment of the system will be needed.

In-country personnel required: Extension personnel, one statistician, a technician to organize data. Travel expenses will have to be provided.

Other funding requirements will be:

- . Cost of seminars of intermediaries and farmers.
- . Cost of organization and operation of statistical collection, analysis and summary report system.
- . Cost of radio dissemination of data.

## 2. Year 2

Further development and refinement of the country system in Dominica should be pursued. Included may be broadening the scope of the system in terms of the information collected and disseminated. To cover additional crops or producing areas, to advise on projected productions of, and demands for, particular crops; introduction of appropriate technology innovations to farmers, intermediaries or others involved in the system.

Program Implications. Additional in-country personnel requirements: One statistician, two data technicians and additional extension personnel (4?). Added travel and expense support will be required.

Additional funding will also be required for:

- . Cost of seminars for extension agents.
- . Cost of development and distribution of other reporting devices, such as periodic publications.

## 3. Year 3

Country information systems similar to that for Dominica will be established in other Eastern Caribbean countries with program implications similar to those described above.

## 4. Year 4

It is anticipated that all of the country information systems will be functional by the fourth year. At that time the regional system, drawing on the country systems, will be established. The regional information system should be established and operated by some neutral, regional agency not involved in the marketing system or tied to any particular country. The team is not familiar enough with alternatives which may be available to recommend which agency might be most appropriate.

### III. UTILIZATION OF "LOSS" PRODUCTS

#### Objective

To determine the feasibility of utilizing perishable products not used for human consumption for other purposes, thus realizing residual values of such products and reducing economic losses now being incurred.

#### Development Program

A three-year program is recommended. Initially only the feasibility in one country should be studied. Either St. Vincent, St. Lucia, or Dominica could be appropriate choices for the initial study, with the main criteria being which crops are the major "loss" products and known possibilities for utilization of those products.

Subsequently, similar studies in the other countries and dealing with a wider range of products could be pursued.

#### Scope of Initial Study

The following are the principal areas of investigation and consideration which should be involved in the study:

1. Identification of the principal "loss" crops in the country.
2. Determination of the volume, condition and the points in the marketing system where such crops normally collect.
3. Identification of potential, economic uses for such crops, including (but not limited to) use for animal feeds or composting, based upon experience in, or information from, the U.S. or other countries.
4. The existing or potential available market demand for the crop, or resulting product if changed in form, and the requirements for capitalizing on that market.
5. Consideration of any technical or educational aspects involved in the use of the crops in the indicated way.
6. Facility and other requirements.
7. Analysis of the technical and economic feasibility and recommendations with respect to implementation.

Short term technical assistance will be required for the study. Required expertise will be in marketing, the conduct of feasibility studies, and the utilization of agricultural waste. Familiarity with the agriculture and marketing systems of the countries involved, would also contribute to the effectiveness of the program.

## II. INTRODUCTION

The near-term agricultural strategy of the Regional Development Office/Caribbean (RDO/C) in the Eastern Caribbean Region calls for a major focus on improvement of agricultural marketing. Numerous elements of the marketing system are being considered. Reportedly, postharvest losses are high for many perishable commodities and the costs of such losses add substantially to the relatively high marketing costs associated with the commodities.

RDO/C is frequently asked for assistance with respect to construction of storage facilities, financing of container and packaging activities, and establishment of processing plants. While certain of the proposals may have merit, RDO/C required expert assistance to identify with greater specificity the principal postharvest loss causes and problems in the region and to provide guidance on which of those problems can be addressed with technology that is both appropriate to the region and economically justifiable.

The Postharvest Institute for Perishables was established to provide the type of expert assistance required by RDO/C, not only for initial identification and assessment of perishable postharvest loss causes and problems but also the technical expertise needed for the resolution of specific problems that may be identified.

RDO/C requested short-term technical assistance from the Postharvest Institute for Perishables "to provide expert assessment of both the physical and economic losses associated with postharvest handling, transport, storage and distribution of sweet potatoes, avocados and other selected commodities considered to be highly perishable." This report is a presentation of the findings of short-term technical assistance provided by the Institute in response to this request.

### III. SCOPE OF WORK

The basic elements of the work plan for the technical assistance proposed by RDO/C were:

- a) Review relevant documentation and studies available on the Eastern Caribbean Region that describe the marketing system of perishable commodities.
- b) Perform on-site inspections of physical and economic losses associated with the handling, packing, transport, storage and distribution of perishable commodities in Antigua, Dominica, St. Lucia, St. Vincent, and Barbados with special attention to sweet potatoes, cabbage, avocados and ginger.
- c) Identify those perishable commodities in each country visited where economically significant postharvest losses occur and determine on a commodity basis the specific cause(s) for such losses.
- d) Determine on the basis of expert judgment, whether economically and technically feasible alternatives for the reduction of losses identified in (c), above, are available.
- e) Identify five interventions to reduce postharvest losses that appear to have the greatest commercial impact and prepare a scope of work for each intervention where more detailed analysis is required before a final investment decision can be made.

The Institute is to deliver to RDO/C a written report and make an oral presentation of their work to RDO/C staff. A draft report is to be delivered, and the oral presentation made, to RDO/C at the conclusion of the field work. Slides and other visual materials will be incorporated in the presentation as appropriate and feasible.

The final report is to include:

- 1) A general assessment of the amount and value of losses attributable to postharvest losses of perishable commodities in the selected Eastern Caribbean countries.
- 2) For each commodity identified where significant economic losses occur, an analysis of the problem(s), cause(s) and potential solution(s).
- 3) Recommendations as to where AID assistance may be best focused to reduce postharvest losses in perishables, including detailed scopes of work for any further analysis required.

The level of effort proposed by RDO/C was 48 work days. A two-person team, composed of an agribusiness/marketing specialist and an agricultural economist with wide experience in developing countries was suggested.

It was subsequently agreed between RDO/C and the Institute that the request and work plan be clarified or modified as follows:

- .The Institute is to send a three-man team with the additional member to be an agricultural economist with extensive experience in perishable crop marketing systems. Work days are to remain at 48.
- .The relevant documentation and studies to be reviewed are those to be provided by RDO/C, supplemented by any that team members may have available or obtain during the course of the field work. A literature search is not required.
- .Field work is to be limited to St. Vincent, Dominica, St. Lucia, and Barbados. With respect to Barbados, the field work will only be

concerned with the onion storage problem. Interisland aspects of the marketing system to be investigated are to be added to the scope of work as a separate focus.

While the specific crops mentioned in the proposed work plan of RDO/C will be considered, principal emphasis will be on the perishables marketing system and the most important crops supplied to local or regional markets by the countries. Harvesting on the farm will be considered, even though technically not "postharvest," because of the significant contribution that poor harvesting techniques can make to losses at later stages in the system. Crops to be exported to extraregional markets--for example, bananas, sugar and arrowroot--will not be investigated.

The basis for this change from the specific crop-oriented emphasis of the RDO/C proposed work plan is: i) the marketing system for all perishable crops is, in the main, the same; ii) losses in the major crops of a particular island deserve primary attention and principal crops of one will not necessarily be the same as those of the other islands; iii) original research by the Institute team is not possible due to time constraints.

The relative importance of various crops and the quantification of physical and economic losses to be incorporated in the report are based primarily upon the documentary materials and studies provided by RDO/C, unless the field work done by the Institute team tends to conflict with the findings or conclusions of such studies or materials.

#### IV. PROCEDURE

The three members of the Postharvest Institute for Perishables Technical Assistance Team were:

Donald S. Leeper, Team Leader  
Agribusiness/Marketing

Richard W. Schermerhorn  
Agricultural Economist

Donald R. Jackson  
Agricultural Economist

The work was organized and pursued in the following manner:

- 1) Prior to the initial meeting of the Team in Barbados, the Team Leader reviewed three major studies on agricultural production, marketing and marketing systems in the Eastern Caribbean provided by RDO/C. Digests were prepared for the other team members.
- 2) The team met for one day with RDO/C in Barbados to: i) secure full agreement on all aspects of the work plan; ii) secure the advice and input of RDO/C relative to crops to be considered, countries to be studied, organizations and people who might be able to contribute, priorities and scheduling of field work; and iii) make appointments and travel and hotel arrangements for the field work.
- 3) The field work was initiated in St. Vincent where the team spent four days. The governing methodology for the assessment and subsequent independent investigations by individual team members was developed,

and the local and regional export marketing systems of St. Vincent were investigated.

- 4) D. Leeper then returned to Barbados for three days to investigate the importing end of interisland trading and the Barbados onion marketing system. During the same period, D. Jackson pursued the investigation in St. Lucia, and R. Schermerhorn in Dominica, after which they returned to Barbados.
- 5) A preliminary report was prepared and delivered, and an oral presentation made, to RDO/C during the ensuing four days.
- 6) The Team Leader was responsible for editing and preparation of the final report and the photographic exhibit supplementing this report upon his return to the United States.

#### Conduct of the Field Work

To illustrate how the information for the various countries on which the recommendations of this report are based was developed, the investigation pursued in St. Vincent is outlined below in some detail.

The field work was carried out in St. Vincent by the full team over a five-day period, including travel to and from the island.

The first day was spent making appointments and scheduling, interviewing one of the principal export intermediaries who sells a range of perishables to Barbados, Canadian and U.K. markets, and visiting the intermediary's packing shed to view operations.

The next morning the manager of the local flour and feed mill was interviewed in order to assess whether there is, or might be, a market for locally grown perishables as a substitute for imported grains in animal feed. Several members of the Organization for Rural Development (ORD) were interviewed. This is a PVO actively engaged in small farmer agricultural and social development on the island. Subsequently the team met with the chairman of ORD.

Later the intermediary mentioned above drove the team up the windward side of the island as far as Georgetown. It was also a working trip for the intermediary, providing an opportunity for him to contact small farmers from whom he buys and his country buyers who also farm themselves. One of the farmers sells directly to Barbados, performing the intermediary function himself. Observing the intermediary conducting his business, as well as having the chance to interview four of the farmers, was most helpful.

A meeting of the 12-person Executive Committee of the local small farm organization in the Georgetown area--all of them reportedly farmers--had been arranged. The team met with them upon arrival in Georgetown. The principal crop of the Georgetown area is plantain, producing about 80% of St. Vincent production. The association has made several small, trial shipments of boxed plantains to Barbados and is planning to do more.

The following morning the team interviewed the St. Vincent Marketing Corporation's warehouse manager, toured the warehouse and observed activities of the associated supermarket. The team met with the chairman of the corporation the following day. Subsequently there was a meeting with the

Deputy Director of Agriculture.

That afternoon the team drove up the leeward side of the island as far as Chateaubelair with the export intermediary. Again, it could observe the intermediary in action and interview his country buyers and small farmers as on the trip the previous day on the windward side. A greater variety of perishable crops are grown on the leeward side and farming and transport conditions are much more difficult. Several interior valleys, where reportedly the majority of root and tuber crops are grown, were visited as well as a marketing corporation collection point (closed) and a government banana estate (not operating, lengthy strike of workers.) There was also an opportunity to interview a typical woman export intermediary visiting one of the farms who sells to Trinidad and observe how perishables are transported to market.

On Saturday the Kingstown market was in full operation allowing the team to observe arrival of sellers and produce, unloading, facilities, displays and activity, and to interview various sellers in the marketplace.

Two members of the team left the island early the next morning for St. Lucia and Dominica. The other spent the morning observing the loading of a variety of perishables on a typical schooner bound for Barbados from start to finish. There was the opportunity to talk with the boat captain, three intraregional export intermediaries with cargo on the boat, and others. The same team member was able to see the unloading of the same vessel in Barbados. Details and conclusions are reported in the subsequent section of this report on interisland trade.

#### V. METHODOLOGY CONSIDERATIONS

It will be apparent in subsequent sections of this report that postharvest losses in many perishable crops are substantial and can be reduced significantly. Clearly the farmer bears the cost of those losses directly, if he performs the marketing function, or indirectly, if he sells to an intermediary. Private intermediaries, not marketing boards, buy and distribute most of the perishables in Eastern Caribbean markets and the price they are willing to pay the farmer takes into account the losses traditionally incurred in the distribution system.

Will the farmer benefit from reduction in postharvest losses or will just the intermediaries? From personal observations, as well as interviews, the intermediaries' competition for farmers' produce is intense and continuing. The team believes that competitive pressures will, sooner or later, assure the small farmer a share of the benefits of loss reductions which can be achieved.

This assessment deals with a broad range of perishable crops, principally fruits, vegetables, roots and tubers. Losses in the Eastern Caribbean are of two kinds, those arising from physical and/or biological deterioration of the perishable crops and those resulting primarily from over supply in relation to demand, i.e. a glut. Both are important and have been considered in this assessment.

### Losses Due to Physical Deterioration

Some crops are highly perishable, while others are more durable. For each there are optimum conditions for maintenance of quality for the maximum period that inherent characteristics of the crops permit. (See Appendix A.)

It is important to make the distinction between maintenance of quality as the crop moves through the marketing and distribution system, and storage for longer periods to extend the marketing season for the crop. Maintenance of quality is a concern with all perishable crops if postharvest losses are to be minimized. However, only certain crops can be stored, and the period during which such crops can be stored will vary. This distinction is made throughout this report.

The basic factors involved in physical and/or biological deterioration of perishables are:

- .the inherent nature of the crop and the particular variety involved
- .maturity at harvest
- .bruises and skin breaks
- .temperature and humidity, and
- .time from harvest to consumer

Postharvest losses resulting from premature deterioration of a perishable crop are the result of failure to maintain optimum conditions throughout the marketing and distribution period for the crop.

It should be emphasized that damage to perishable crops which hastens deterioration is irreversible. Nothing can be done subsequently to rectify the damage, and damage occurring to the same crops from several of the factors mentioned above or at successive stages of the marketing system is cumulative. For example, a cooling facility at wharfside for an export perishable crop is of little value for reducing losses caused by high temperatures during harvest and transport to the cooling facility. Similarly, wharfside cooling is of little value if the crop is to be transported in the hot, unventilated hold of a schooner after exit from the facility.

Therefore, the methodology employed in this investigation and assessment relating to maintenance of quality focuses on the basic factors affecting crop deterioration at and from harvest through each step of the local and intraregional marketing system. Without minimizing the importance of varietal alternatives in the postharvest loss picture, consideration of this aspect was felt to be beyond the scope of this assessment. Finally, emphasis of the investigation was on those aspects of the care and handling of crops which affect all, or a significant number, of the most important crops rather than on those which are related to only a single crop.

To illustrate the methodology used in this assessment, the following factors were considered:

- . On-farm
  - maturity when harvested
  - time of day when harvested
  - harvest techniques and equipment
  - handling containers
  - crop protection

- . Farm to Road
  - how transported
  - distance transported
  - time of transport in relation to harvest and pickup
  - multiple handling
  - protection at roadside
  - containers
  
- . Road Pickup Point to Market/Collection Point
  - how transported
  - loading techniques
  - protection during transport
  - time in transport
  - multiple handling
  - road condition
  
- . Domestic Market (roadside, central or other)
  - unloading techniques and facilities
  - time of day market operates
  - protection--sun, weather
  - multiple handling
  - grading or sorting--formal, informal
  - pricing
  - consumer packaging
  - containers, multiple use
  - disposition of unsold crops
  
- . Export Market
  - unloading, handling, collection prior to vessel loading
  - containers, multiple use
  - cargo loading and unloading at destination
  - how cargo is stowed
  - cooling devices and ventilation
  - time--arrival to loading, to transport, unloading
  - protection--prior to loading, during transport, after unloading

#### Losses Due to Oversupply

Major losses of certain perishable crops occur in the Eastern Caribbean because production exceeds demand at harvest time. In some cases, glut crops of one island are in short supply on other islands. There is a substantial and direct economic impact on the farmers in a glut situation, either in terms of the low prices received for what is sold or losses occurring from crops not harvested at all. Because such losses are so significant, the team believed it was essential to investigate the causes of such losses and identify possible ways to reduce them.

Storage to extend the marketing period was one alternative which was investigated. It is important to keep in mind that maintenance of quality of perishables before entry into storage is just as essential as when the crops are to be marketed as fresh produce. Only crops in good condition will store.

Processing might also be considered as a way to alleviate a glut situation. It was investigated but did not appear to be a feasible alternative. This opinion, however, may be strongly influenced by the processing capabilities of local industries. This should be investigated further.

Other alternative solutions that were considered for the glut problem were ways to reduce production of potential glut crops, changes in marketing board policies and practices, and establishment or improvement of local and interisland marketing information services.

#### Quantification of Losses

Quantification of the postharvest losses from the causes identified during the course of this investigation was beyond the scope of the work. Such quantifications that appear in this report are estimates of losses as reported in studies available to the team or made during interviews conducted by the team.

A more precise evaluation of the extent of the physical and economic losses being incurred will need to be made before the feasibility of interventions designed to reduce those losses can be assessed. Such an evaluation is incorporated in the recommendations of this report.

With the diversity of perishable crops involved, the multiplicity of potential causes of losses, the cumulative impact of such causes, and lack of basic data, it would be at the very least difficult to quantify definitively the losses. In the opinion of the team an attempt to do so is neither warranted or necessary for the purposes of this report.

Order-of-magnitude estimates of the losses will be adequate for assessment of the feasibility of the recommended interventions. For example, it makes little difference whether postharvest losses of a particular perishable crop are 40, 50, or 60%, it is sufficient to know that they are in the 40-60% range.

At a later date, definitive data concerning quantitative losses will have to be determined. This will be necessary in order to establish priorities in loss prevention programs.

In addition, the amount of the investment in the intervention to reduce the loss is an integral aspect of feasibility. The greater the investment the more critical the need for a precise evaluation of the postharvest losses and the reduction which might be achieved by the intervention. The investment cost of the interventions recommended is minimized by the "try it out first before implementing a broad scale program" approach adopted in this report.

#### VI. STRUCTURE OF THE REPORT

The remainder of this report is divided into four sections: Field Investigation; Summary of Problem Areas; Recommendations; and Related Issues Beyond the Scope of the Study.

A comment on terminology utilized in subsequent sections of the report is necessary at this point. As with any food marketing system, intermediaries are involved between the farmer and the consumer. In the Eastern Caribbean, private intermediaries may be called "hucksters," "higglers," "hawkers," or "traffickers." Which terms are used to describe an intermediary and the function he or she performs, varies from island to island.

To avoid confusion, the term "intermediary," along with words accurately describing his or her function, e.g. local market intermediary or regional export intermediary, will be utilized for the most part, although terms locally used may appear in reports of field investigations of particular countries. A farmer may perform some, or all, of the intermediary functions or an intermediary may perform marketing functions at several levels of the systems. In such cases, the report will indicate the situation.

#### Field Investigation

Country descriptions are provided for St. Vincent, St. Lucia, and Dominica. These are designed to:

- 1) describe the general characteristics of each country--farming areas, type of farming, products produced, products consumed locally or exported, and an overview of the type and amount of postharvest losses which occur;
- 2) describe the marketing system in each country and the participants in it, including a description of the institutions in marketing perishables and the functions they perform; and
- 3) delineate in each country the major constraints or problem areas within the marketing systems which give rise to postharvest losses.

With respect to Barbados, only the production, storage and marketing of dry onions were investigated.

A description of the findings is presented, including a description of the production, storage and marketing system and losses being incurred, identification of participants in the systems, delineation of those aspects of the system significantly contributing to postharvest losses, and a summary of programs or projects which are in progress and that are designed to reduce such losses.

Results of the investigation of the interisland aspects of the marketing system for perishables are reported separately. Aspects covered include a description of the system from arrival on the wharf of the exporting country to unloading at the country of destination and identification of problem areas within the system giving rise to perishable losses.

#### Summary of Problem Areas

This section draws together the postharvest loss problem areas identified in the Field Investigation section and presents major areas common to the region as a whole. The objective of this exercise is to delineate those problem aspects of the perishables marketing system giving rise to losses which, if corrected, will have significant economic impact throughout the East Caribbean.

#### Recommendations

Based upon major problem areas defined in the prior section, this section presents recommendations designed to provide appropriate, practical and economic solutions to those problems. Work plans for the recommended interventions in the marketing system are set forth in the annexes attached to the report.

#### Related Issues Beyond the Scope of Work

During the course of the investigation several major problem areas outside the scope of the study surfaced. The team felt that they were of such importance to agricultural development and marketing in the region that comments on them should be incorporated in this report.

VII. FIELD INVESTIGATION  
A. ST. VINCENT

Characteristics

St. Vincent (Figure 1) has a population of 102,000, with about 29,000 living in Kingstown, the principal and capital city and only port.

The topography is rugged and mountainous and the island has 560 kms of paved roads and 180 kms of secondary roads. All roads are in poor condition with the best being those along the coast.

Agriculture currently provides about 25% of the country's Gross Domestic Product (GDP), employs 29% of the work force, and accounts for 75% of all exports from the island. The only industries are a corrugated box factory, a flour and feed mill, a lime processing plant and a clothing fabrication operation.

As with other Eastern Caribbean countries, small farmers dominate the rural scene and produce most of the perishables. While farms with less than 2 ha represent 77.9% of the holdings, they only represent 22.3% of the acreage. Most farming is mixed, with three or four different crops being grown. Farms on the leeward side are primarily located in steep hillsides, up to 3 or 4 miles from the nearest road. Those on the windward side are generally located in valleys or hillsides with better road access.

Principal crops currently produced are bananas, plantains, oranges, grapefruit, limes, mangoes, breadfruit, sweet potatoes, yams, eddoes, tannias, dasheen, cabbage, carrots and tomatoes.

Bananas are the major crop, the main source of income for farmers and the principal export, primarily to the U.K. Estimates of 1978 exports, as a percent of total exports, were:

	%	
Bananas	59.1	primarily to extraregional markets
Arrowroot	5.2	
Coconut Oil	2.6	
Sweet Potatoes	2.6	to regional markets
Carrots	1.7	
Eddoes & Dasheen	3.5	
	<u>74.7%</u>	

Reliable data on the size and value of perishable losses is nonexistent. However, the consensus of reports and those interviewed was that on-farm losses of certain crops due to glut situations is "high." Postharvest losses incurred for selected commodities were estimated by intermediaries in the domestic marketing system for St. Vincent in a 1981 FAO Study to be:

Bananas	10%+
Mangoes	up to 35%
Tomatoes	10 - 35%
Cabbage	10 - 20%
Dasheen	10%
Carrots	10%

Observations of the team and the opinions of those interviewed would tend to support these estimates, and they may even be low. Losses incurred with other crops appear to be of the same order of magnitude.

#### Marketing System

The structure of the perishables marketing system for the local, St. Vincent, and regional markets is outlined in Figure 2. The system, insofar as it relates to extraregional exports--namely, bananas, arrowroot and coconut oil, is not shown.

It will be noted from Figure 2 that a majority of the farmers perform the intermediary function themselves. And 50% of the farmers or intermediaries sell to consumers at their home, an unusually high percentage in comparison with other Eastern Caribbean countries. Most of the other sales occur at the central market in Kingstown. There are several private supermarkets in Kingstown but they do not handle locally-grown perishables. Farmers do not normally export, such sales being handled by specialized export intermediaries called "traffickers" in St. Vincent. The marketing corporation is not a major factor in local or regional marketing except with respect to the three commodities to which it has exclusive export rights.

Associations. With the exception of the Banana Growers Association and the Arrowroot Association, which market to extraregional markets, there are no farmer associations other than the Georgetown Area Farmers Association. That is a young organization which has not proved its effectiveness as yet. The Organization for Rural Development is a PVO dedicated to assisting small farmers in agricultural production and social development on a one-to-one basis, rather than promoting cooperative efforts of the farmers to help themselves.

There are no cooperative associations of domestic or export intermediaries nor are there any indications of interest in establishment of such associations.

Care and Handling of Perishables. From interviews, all harvesting of crops is done by hand. At what stage of maturity a crop is harvested depends on the practices of the particular farmer rather than being governed by what might be best for maintenance of quality as the produce moves through the marketing system. Not a great deal of emphasis is placed on careful harvesting and handling to prevent bruising or skin breaks. For example breadfruit, a highly perishable crop, is harvested by cutting the stem and letting it fall as much as 20 feet to the ground.

Containers for harvest, on-farm collection and transport to roadside are whatever the farmer has available. Plastic or jute sacks, some holding as much as 200 lbs, are normally used for root and tuber crops, as well as other crops. Used cardboard cartons are common, sometimes banana boxes and homemade wooden crates made with unfinished lumber are used. For the most part, containers are not used by small farmers for bananas and plantains, rather they move through the system on the stem.

Reportedly, harvest usually occurs the day before the crop is to be sold and it is collected either where harvested or at the farm home. There may, or may not, be protection from the sun and weather. While there is probably some informal sorting on the farm, it is only minimal. There was no indication of any utilization of crops culled for animal and poultry feed or other purposes on the farm. There is no farm storage or cooling.

Early on pickup day, the farmer transports the crop to the roadside. Two modes of transport are used, carrying on the top of the head and donkeys.

Crops are usually left by the roadside until picked up for truck or bus transportation to a collection point or to Kingston. An intermediary may pick up the crop after having made prior arrangements with the farmer, or the farmer may accompany his crop on the vehicle. There may or may not be shade for the crop at the roadside. Apparently perishable crops are not marketed by farmers to the marketing corporation in any quantities. The farmer must deliver to the corporation at a collection point or the main warehouse in Kingstown while intermediaries pick up at roadside.

How long the produce remains by the roadside depends on the pickup schedule of the intermediary. At least on the leeward side, the buses are scheduled to leave the north end of the road about 6 a.m. of the marketing days, picking up as they go along, arriving at the Kingstown market about 7:30 or 8:00 a.m.

Buses have some sun and wind protection for cargo, intermediary trucks usually not. Loading is by hand with little attention to careful handling. Buses are loaded with no attention to the relative susceptibility of the various crops to bruising and other damage. Passengers ride on benches, not on top of cargo.

The roads are in very poor condition - narrow and full of unavoidable potholes. They are, particularly on the leeward side, extremely tortuous.

At the Kingstown market, there are numerous vendors selling a wide variety of fresh produce. Inside market stalls are provided with sun and weather protection but many stalls were not utilized. Reportedly there is a small daily fee for these. Most vendors were located outside with little or no protection from sun or weather. Most spread a plastic or paper on the ground and arranged their displays on it. Produce is subject to multiple handling during the market process. Much produce was immature and small.

Fruits were in all stages of maturity. There was evidence of informal sorting, but little indication of specific price differentials based on quality. Prices are negotiable between sellers and buyers, so it is probably the quality of the particular produce being bought that is a factor. In response to the question, "What do you do with the produce left at the end of the day?", the answer was, "I throw it away or take it home."

There are two market days: Friday and Saturday. The team is not sure whether the same vendors stay overnight and sell the second day or a new group comes in. In any event, there is not storage of any type at the marketplace for the vendors.

Marketing Corporation. The St. Vincent Marketing Corporation has what appears to be a clean, efficiently managed warehousing operation. It does not deal or otherwise become involved in the marketing of perishables for the local market other than supplying governmental institutions, operating a supermarket where some perishables and imported grocery store items are sold, and selling imported rice and white potatoes of which they are exclusive importers. They also are exclusive exporters of sweet potatoes, carrots and peanuts and those are all the crops they export.

Prices they pay farmers are set and reviewed every six months. Farmers must deliver to a collection point or central warehouse. According to the manager of the Corporation, the Corporation is not required to buy from farmers, and buys only marketable quality produce.

There is no impression of any active, affirmative, effective marketing program. It is unlikely that it does anything but lose money on its locally-produced perishable crop activities, although some of its other activities may be profitable.

#### Postharvest Loss Problem Areas

The principal problem areas giving rise to the significant on-farm and postharvest losses in perisables in St. Vincent are summarized below.

1. Technology. On-farm there is a lack of information, and application of, known technology with respect to proper stage of maturity to harvest, harvesting techniques and handling to prevent losses at subsequent stages in the marketing system. Likewise, intermediaries do not know or apply known technology to maintain quality and reduce losses during the marketing process. There is little appreciation of the importance of careful handling and protection of the produce and there is little or no incentive for farmers or intermediaries to do anything about reducing losses. With the exception of the Georgetown Farmers Association there are no farmer or intermediary associations to provide avenues for introduction of technology.

2. Packaging. Packaging utilized on the farm or at subsequent stages of marketing offers little protection from bruising, skin breaks or other causes of premature deterioration and losses. Introduction of appropriate packaging in the system would do much to reduce those losses, not only in domestic marketing but also in export.

3. Transport. Many small farms are some distance from the nearest road. Produce must be head-carried or donkey transported, thus limiting the volume of perishable crops which can be delivered to a vehicle pickup point and increasing the number of times the crop is handled. Perishables are carried in trucks or on buses to the marketplace. Frequency of bus schedules appears to be more or less adequate. Roads are extremely tortuous and poorly maintained, with numerous, unavoidable potholes. Substantial bruising and skin-bred damage to produce occurs during the journey which, coupled with compression damage from improper loading practices, result in significant losses.

4. Care and Handling of Perishables. Substantial losses occur as a result of the lack of care and rough handling on-farm and at every stage of the marketing process. Introduction of improved harvest techniques, reduction of multiple handling, proper vehicle loading and unloading practices and stowage, protection from the hot sun, and careful handling in general would go far in reducing these losses. However, before such steps will be accepted, farmers and others involved will have to understand and accept why such practices are important to them.

5. Cooling and Storage. There are no cooling or long-term storage facilities available on the island. High temperatures are a significant cause of premature deterioration in highly perishable commodities. The longer the time from harvest to the consumer, the more critical cooling becomes. It appears that perishables destined for the domestic market reach the consumer in a day or less, so investment in mechanical cooling facilities probably is not economically justified. However, provision for shade at all stages would be economical and worthwhile. Mechanical cooling facilities wharfside for regional exports may be justified at this time and are discussed in the section on interisland trading. Investment in mechanical facilities for long-term storage would be premature at this time. Necessary steps to maintain the optimum quality of the perishable crops entering and exiting such storage must be instituted before such facilities will be feasible.

6. Market Information. Neither farmers, intermediaries or the Marketing Corporation have any source of current or prospective supply and demand or price information for local or regional markets. Glut situations could be alleviated if farmers and intermediaries had some basis for assessing prospective production and local and regional demand.

7. Financing. Farmers and intermediaries have few financial resources or ability to finance new technology or practices designed to reduce losses, even if they were to be convinced that they should adopt them. Financial support will have to be provided.

8. Marketing Corporation. The Corporation is not a major factor in perishables marketing, either locally or regionally. And it is unlikely to become one with its present purchasing and pricing policies and marketing ineffectiveness.

9. Utilization of "Loss" Crops. Crops which are not harvested at all or which are not sold for human consumption for any reason, are not utilized for any purpose. Principal points in the system where "loss" crops accumulate are on the farm and at the central market in Kingstown. "Loss" crops could have an economic value for such things as animal and bird feed or compost production.

## B. ST. LUCIA

### Characteristics

St. Lucia (Figure 3), one of the Windward Islands is located between Martinique to the north and St. Vincent to the south. It has an area of 238 square miles or 150,000 acres of which 41,700 (28%) are under some form of cultivation. Approximately 10,200 acres are planted to bananas, the principal export and foreign exchange earner of the country. Farms with less than 10 acres produce about 56 percent of all crops produced, including bananas.

Agriculture contributed 16 percent to the GDP of the country in 1980, down from 34 percent in 1962. Of the total economic contribution from domestic and export food production (EC \$61,200,000 in 1980) 53 percent came from banana exports. Other crops included in agriculture's contribution to the GDP in 1980 were: coconuts (9%), plantain (6%), dasheen/tannia (8%), and general fruits and vegetables for export (2%).

The population of the country in 1980 was estimated to be 140,000 with 40,000 living in Castries, the capital. Over 43 percent of the work force is employed in agriculture and related industries.

In 1978 it was reported that there were 305 miles of paved roads and an additional 170 miles of unpaved roads. Road maintenance is, however, generally poor. Port facilities have undergone substantial upgrading and expansion in recent years.

### St. Lucia's Marketing System

The Extraregional Export Market. There are essentially four channels for export of agricultural products:

- 1) Bananas are marketed through the Banana Growers Association which is responsible for purchasing, grading and selecting and preparation for shipping. The Association also provides support services to farmers such as technical assistance and input supply. The bananas are shipped in Geest Industries' hulls to the U.K.

Even in this relatively modern and efficient marketing channel, postharvest losses are high. The size of the losses varies from month to month, from a high of 46% in January to a low of 29% in June. Losses are primarily due to rejection of fruit upon delivery by the farmer because of small size and rust thrip damage. Little, if any, of the rejected fruit is utilized for animal feed, supply of the domestic market or other purposes, so it represents a complete loss to the producer.

- 2) Coconut exports are handled by St. Lucia processors. The copra is delivered to processing plants by the farmers (or "gatherers") where it is processed into various forms and then exported to extraregional markets.
- 3) The St. Lucia Produce Marketing Board (SLPMB) purchases, transports, grades and exports a broad selection of the country's non-banana produce. Originally established to encourage and find markets for non-traditional agricultural exports, the Board has become a "protector" of the farmer. This in practice means that it "serves as a residual buyer, purchasing at glut periods and selling at depressed prices," as one observer has stated.

The Board purchases produce from farmers who either sell at the farm gate or bring their crops to the Board's offices in Castries. If the produce is purchased at the farm gate it is done on dates and time previously specified by the Board through the use of Board employees and Board trucks. The price paid by the Board is the same at the farm gate as at the offices. The Board follows this practice because it feels that it can better control the quality of the produce during transport. There also appears to be a preference on the part of the Board to reject produce at the farm gate instead of at the offices in order to save the farmer two-way transportation costs on the rejected produce.

Interestingly enough the Board's prices offered to farmers lag those of private traders in times of scarcity--with the Board constantly having to raise its prices to compete with the traders--and leads the traders' prices in times of glut. Evidently the Board's pricing policy bears no relationship to production costs.

All of the Board's marketing of export crops is to the U.K. on aircraft through Barbados. It attempts no intraregional trade due to the lack of reliability of the schooner transport system.

In an attempt to reduce its usual operating deficit, the Board also engages in retail sales of selected import produce. It currently is the sole importer and retailer of eggs, carrots and cabbage and the sole exporter of ginger. However, not much of the deficit is made up through this activity.

- 4) In addition to the Board there are presently two private traders who deal in the export of non-banana perishables to the U.K. market. Both of these deal principally in breadfruit and mangoes. All of their produce is exported by means of Tropic Air charter to Barbados and then jumbo jet to London. Both have their own fleets of trucks which pick up produce from farmers who have previously been advised of their arrival by the commercial radio stations. Grading and selection is done at the farm gate. The produce is then packed for export, usually in corrugated banana boxes at the trader's office in Castries.

Intraregional Export. Other intermediaries deal in produce for export to Barbados and other islands. These are called hucksters in St. Lucia and rely on schooners for transport. They buy from farmers at the farm gate, at the central market in Castries, or at the dock.

There is no standard procedure for payment, packaging or grading. It appears that buying takes place every day of the week except Sunday. Some farmers perform the intermediary function themselves. It does seem, however, that huckstering is primarily an itinerant profession with many people entering and leaving at will. Indeed it appears that the principal reason for handling export produce at all is to get enough money to be able to bring back a shipment of non-food consumer goods for resale in St. Lucia.

The Domestic Market. The domestic marketing of produce, principally that grown on the island, is performed by either the SLPMB or by private traders, also called hucksters. However, it appears that the Board has little, or no, involvement in or impact on the domestic trade in perishables except in times of glut when it purchases at floor prices.

Many of the hucksters are farmers themselves, selling their own produce, that of their neighbors, or a combination of both. It also appears that they buy produce during the early days of the week and then bring it into town on Fridays and Saturdays, although there is market activity every day but Sunday. It appears that no premium is paid for selected or graded produce either at the farm gate or in the marketplace.

Although there is an adequate indoor marketplace in Castries with stalls, water and electricity (built in 1893), the majority of the stalls are dedicated to the straw and clay pot trade with most produce being sold outside in the sun and rain. It is thought that this is due to the itinerant nature of the huckster trade.

The structure of the St. Lucia system for domestic and intraregional marketing is summarized in Figure 4.

Postharvest Losses. There is little specific or reliable data on the extent of postharvest losses incurred in the domestic and intraregional marketing system. However, they are thought to be "high." Estimates made: 30%-40% of mangoes are lost due to late harvesting; 15%-20% of citrus crop is not harvested because of glut situations; breadfruit, soursop, guava, papaya and pineapple losses are as high as 50%; ground provision losses are 20-25% and other vegetables are 10%-20%.

#### Problem Areas and Constraints to the System

The constraints to the effective functioning of St. Lucia's marketing system appear at several levels: government policy, technological gaps, and infrastructural deficiencies. At the first level, that of government policies, the issue of the Produce Marketing Board is the most significant. Even if one agrees with the underlining philosophy of the Board--as a protector of the small farmer and as a mechanism of income transfer--it can be seen that it is completely ineffective. Outdated equipment and installations, underfinanced activities, and the lack of a dynamic administration serve only to provide jobs to a few government employees. Indeed, the provision of imported eggs to consumers is the only real service the Board provides, albeit an artificially induced one.

Additionally, the unpredictable Board policies to control and restrict the export of certain crops (coconut, for example) impede private traders from establishing efficient marketing channels in these areas. If a trader or huckster cannot be assured that he, or she, will be able to deal in a commodity, or if the Board can take away the right without notice, he will not be willing to commit the necessary resources to seek markets for it.

Another area of government policy which severely impedes the marketing system is the lack of financial resource commitment to the agricultural sector. It was estimated that for the 1978/79 fiscal year, 97.4 percent of the Ministry of Agriculture's entire budget was supplied out of grants from international donors (mainly the BDD) for specific projects. Indeed, only 0.6% of donor funding was directed to recurrent expenditure for that year. This has severely hampered the Ministry's developmental activities, especially in the areas of marketing research and information and extension.

At the level of technological gaps, there exist, in some cases, information voids, and in others a lack of effective mechanisms for the transfer of the technological information. In either case, the marketing system suffers. On St. Lucia examples of technology gaps are: varietal differences in terms of storability, planting and harvesting dates, harvesting techniques, and handling, storage and transportation practices.

Lastly, marketing constraints at the infrastructural level abound. Roads between the farm gate and markets range from nonexistent (farmers having to head-carry produce for 3 hours to the nearest road over extremely rough terrain) to paved roads deplorably maintained. Systems of vehicular transport which are totally inadequate for the requirements of perishable crops also add to the problem.

Once the produce finally reaches a marketing area another series of infrastructural constraints take over. Inadequate storage and processing facilities, be they cold storage, simple shade or grading, and selection facilities are rudimentary at best. Furthermore, facilities for retail selling are not conducive to stimulation of adequate consumer demand.

On the export side, the problems of schooner transport, docking, and loading and unloading facilities are endemic to St. Lucia as they are to the rest of the islands.

The infrastructural issue which impacts on most of the other constraints is the lack of organizations of the various participants in the marketing chain. Aside from the Banana and Coconut Growers Associations, no other farmer organizations exist. Likewise, hucksters or other trading intermediaries are not organized. Lack of such organizations means that participants in the system have no effective means for expressing their needs for system improvement, and the government or other agencies have no effectively organized structure to work with in the alleviation of the marketing constraints. In essence, avenues for a two-way flow of needs and their corresponding solutions are not available.

### C. DOMINICA

#### Characteristics

Dominica (Figure 5) has a population of approximately 75,000. Dominica's topography can be described as generally rugged with about 52 percent of its land area classified as farmland and 38 percent as forest--the remaining 10 percent is made up of villages, roads, homesites, etc.

Agricultural production dominates the economy of Dominica, accounting for about 43 percent of the country's GDP (government services account for another 32 percent). Employment in agriculture accounts for 36 percent of the total work force and agricultural exports (food and live animals) account for almost 80 percent of all exports from the country. The major export commodities are, in order of significance, bananas, grapefruit and coconut oil. Also significant quantities of root crops, other citrus and non-citrus based oils are exported.

Although data are very sparse concerning exports, some estimates have been made regarding the percent of production of certain commodities that are exported:

<u>Commodity</u>	<u>% of Commodity Exported</u>
Dasheen	3.0%
Tannias	2.5
Yams	2.0
Sweet Potatoes	2.0
Cassava	25.0
Bananas	75.0
Plantains	13.0

In terms of land area utilized for the production of various crops, bananas utilize 59 percent of the farmland, coconuts 25 percent, citrus 10 percent, cocoa 3 percent, and the remainder is in vegetables, fruits and ground provisions. The areas most suited for agricultural production are the Layou, Roseau, Rosalie and Blenheim valleys.

Land tenure characteristics in Dominica are typical of most other Eastern Caribbean islands--69 percent of the land holdings are farms of less than two hectares accounting for 11 percent of the land area; 1 percent of the land holdings are farms with over 40 hectares accounting for 56 percent of the land area. Generally, the large land holders have the most productive land located near the all-season roads. The smaller land holders have the steep hillside, relatively infertile land, that is located some distance from markets which must be reached over very rough roads. Further, most small farmers have fragmented holdings, i.e. they farm several small parcels of land, often over one-half mile apart.

Dominica in the past was largely a plantation economy, mainly involved in the production of extraregional export crops--namely limes, vanilla, cocoa, coffee, coconuts, grapefruit, and bananas. Most of the technical assistance provided to farmers was centered on these crops and consequently, well-known techniques of production and processing have been adopted for these crops.

However, very little attention has been paid to the small peasant farmers producing nonexport crops. Hence, although postharvest losses are still experienced in the principal export crops and there is room for improvement, the major postharvest loss problems in Dominica concern the domestic crops. Principal domestic crops involved are avocados, dasheen, sweet potatoes, breadfruit, tannias, yams, pawpaw, oranges, soursop, guavas, sweetsop, cucumbers, christophene, cabbages, lettuce, carrots, tomatoes, peppers and pumpkin.

The following is an estimate of the production and percent of production lost after harvest in 1980:

<u>Crop</u>	<u>Percent Loss</u>
Bananas	45%
Plantain	50
Root Crops	60
Yams	40
Sweet Potatoes	50
Vegetables	60
Peas and Beans	30
Coconuts	20
Grapefruit	30
Mangoes	30
Cocoa	30
Avocado	40
Oranges	40
Limes	20

(Source: Dominica Ministry of Agriculture)

As can be seen from the above, estimated postharvest losses range from 20 percent (limes and coconuts) to 60 percent (root crops and vegetables). This is a considerable loss and the value of the loss during 1980 is estimated to be in excess of EC \$2,000,000.

#### Marketing System.

Figure 6 illustrates the institutional aspects of the local and regional marketing system in Dominica--it is a flow diagram of perishable commodities from producers to consumers. It is estimated that about 50 percent of all fruits, vegetables, and root crops produced in Dominica are consumed locally. The remaining 50 percent is exported. Bananas, the major commodity exported, plus citrus are primarily exported to the United Kingdom. The remainder of the bananas and citrus exported plus the other fruits, vegetables and root crops exported are marketed primarily within the East Caribbean Region. Crops such as corn, lettuce, cucumbers, carrots, pineapple, cabbage, watermelon, breadfruit and other leafy vegetables are almost exclusively consumed within the country.

As shown in Figure 6, Dominica producers have four different channels for local and regional marketing of their produce. Some producers market exclusively to one type of market while others will market to two or more types of markets. Hence, producers may sell their produce direct to consumers at the marketplace; they may sell to intermediaries called hucksters who, in turn, may sell directly to consumers in the marketplace, export the produce, or sell to local retail stores; they may sell to the Marketing Board which

will either export the produce or sell it in its local retail store; and/or the producer may sell directly to retail stores. It is estimated that about 20 percent of the total production of commodities in Dominica is handled by hucksters for intraregional export; 30 percent by the two farmer associations and the Marketing Board, mostly for extraregional export; and 50 percent of the total production is handled by farmers or hucksters, and a small amount by the Marketing Board, for direct sale at the marketplace or to retail outlets for domestic consumption.

Marketplace. There are two organized major marketplaces on Dominica. One located in Roseau, the capital city, and one in Portsmouth. There are small, unorganized markets in the smaller villages. Market days are largely confined to two days each week--Wednesday and Saturday--sales are negligible on other days except Friday. This causes a significant problem for producers since the number of market days limits the number of days that crops may be harvested--crops become overripe and many times cannot be sold in the marketplace.

Basically, if a farmer sells his produce in the marketplace, he harvests the produce a day or two before the market day, stores the produce at his farm until time to take it to the market and then transports it to the marketplace. If the farmers are unsuccessful in selling the product, it generally becomes a postharvest loss. There is no organized collection and redistribution of produce on a village or marketplace basis. All commodities are brought to town on market day and if not sold, they perish.

Farmer Associations. There are two farmer associations in Dominica handling fresh produce--the Citrus Growers Association and the Dominica Banana Growers Association. Farmers selling to these Associations harvest and transport the produce to the Associations' packing plants. Both Associations export only, i.e. they do not market domestically.

The Banana Association exports its bananas to the United Kingdom. Overall, the Association experiences about 40 percent postharvest loss of bananas. About 60 percent of this loss occurs during the harvesting process when the farmer is transporting the bananas from the field to the packing plant. Bananas are carried to the edge of the field on the worker's head and then placed in banana boxes for transport to the plant. During this process bananas are scarred and scratched (some preharvest damage occurs from insects). Another 25 percent of the total damage occurs from poor handling in the boxing plant. The final 15 percent of the damage occurs during the transport to the wharf and to the United Kingdom.

The Citrus Association exports its citrus primarily to the United Kingdom. They feel that the United Kingdom is a relatively secure and sound place to trade. The market season to the U.K. is from late July to the end of September, a period when the U.K. cannot get citrus from other production areas and consequently the price received by the Association is relatively high. However, the citrus production period is from July to April. Thus, citrus remains on the trees and essentially is lost after the U.K. market ceases. However, some of the crop is handled by hucksters serving the local and regional markets. In fact, it is estimated that the Association markets only 15-20 percent of the total citrus production. The Association has made very minor attempts to develop a regional market for citrus during the rest of the production period. They claim that regional markets in the Caribbean resist graded, clean fruit and prices received are not as high as those

received from the United Kingdom. Also, they claim to have experienced a 35-40 percent loss of their product when shipped to Barbados.

This year the costs of production, packing and transportation to the U.K. were greater than the price paid by the U.K. The Association nevertheless guaranteed prices to producers that would cover all costs and borrowed from the Caribbean Development Bank to cover the guarantee. They expect to pay the loan back from next year's proceeds.

Hucksters. Hucksters are an extremely important institution in the marketing system. There are approximately 200 hucksters operating regularly in Dominica (there are over 500 who obtain export licenses from time to time.) Some sell only in the domestic market, while others concentrate on the export market. If the export market to the United Kingdom is excluded, hucksters handle about 70 percent of all marketing.

Domestic hucksters typically buy produce from a number of farmers, primarily at the marketplace, although a few purchase at the farm. About one-third of these hucksters market only their own produce while the rest market their own plus produce bought from others. Over half of these hucksters store the produce prior to sale mostly at their homes. Over three-fourths of these hucksters transport produce to the point of sale and all types of packaging is used in transport, but primarily sacks and baskets. About one-third of these hucksters sell their produce at roadside or in their homes, while the remainder is sold at the marketplace. The usual practice is for these hucksters to sort, wash and clean their produce before sale. The most widely sold fruits are bananas, grapefruit, limes, sorrel and mangoes, and for vegetables, the most widely sold by these hucksters are yams, tomatoes, cabbages, cucumbers, sweet potatoes, pumpkins, carrots, christophene, eddoes, and peppers. In addition to domestic produce, a few hucksters also sell dry goods, spices, flowers, imported root crops (white potatoes), dried produce such as onions and lentils, and alcohol.

Export hucksters almost exclusively sell produce which is purchased wholesale, i.e. they do not produce their own commodities. The most frequent practice of export hucksters is to buy produce from the farmer at the farm, with the produce normally being picked by the farmer and packed by the huckster. Those hucksters living in town, however, usually have the farmer deliver their produce to them in town. The general tendency is for these hucksters to store their produce at their homes, after purchase and prior to shipping it off the island. Produce is packed primarily in cardboard or wooden boxes, although a number use sacks. The produce is trucked to the wharf, loaded on vessels and shipped to destination. The normal shipping days are Friday, Tuesday and Wednesday and the most common destination is Guadeloupe. Other destinations include St. Maarten, Antigua, Barbados, Montserrat, St. Thomas, St. Croix, St. Barts and Martinique. Typically, it will take eight hours to transport produce to Guadeloupe and for most of the other markets it will take two days. Most of these hucksters accompany their shipment on the boat to the destination and then fly back to Dominica. It is also normal practice for these hucksters to buy goods (primarily food commodities, dry goods and clothes) with the proceeds of their produce sale for resale back in Dominica. In fact, it is this part of their business that creates the greatest profit. The primary commodities exported by these hucksters are grapefruit, oranges, mangoes, plantains, limes and dasheen. At times, up to 50 percent of some of these products are lost by the time it reaches the destination.

The hucksters in Dominica have formed the "Dominica Hucksters Association" in an attempt to help themselves by finding solutions to some of their problems. Some of the specific objectives of the Association are:

- . to encourage methods of good handling, packing and grading of fruits and vegetables;
- . to encourage members to maintain high standards in quality of produce bought and sold;
- . to encourage members to use proper packaging material suitable for each type of produce;
- . to encourage members to use standard size boxes that are easy to handle, and to ensure good keeping quality of produce;
- . to provide marketing information for its members as to what fruits and vegetables are needed and the selling prices, and
- . to encourage members to use proper sheds with facilities for washing, grading and selecting fruits and vegetables and at the same time, offering protection from wind, rain and sun.

Although this Association is just beginning to function, it is anticipated that it could have a significant impact on the marketing system in Dominica.

Marketing Board. The Marketing Board is a governmental agency charged with the responsibility of marketing farmers' produce.

The Marketing Board operates two collection points in Dominica, one in Portsmouth and one in Roseau. Farmers bring their produce to these collection points for sale to the Board. The general procedure for selling to the Board is for the farmer to come to the collection point and tell the Board what he has to sell. The board then decides if it will purchase the produce and gives the farmer written instructions as to when he should harvest, what condition the produce should be, when he should transport it and what time he should deliver it to the Board. When the farmer delivers the produce, it is graded and only the good produce is kept by the Board, the remainder being returned to the producer. Quite often, the farmer will then take the off-grade produce to the marketplace and sell it there.

The Marketing Board usually accepts nonperishable produce regularly, but can only accept highly perishable produce when boat space is assured since most of this produce is exported. The Board has a standing weekly order for produce for the United Kingdom but occasionally there is no ship available, or there is no room on the ship for transporting the produce. Thus, the Board must always get space confirmation, then tell the farmers they can bring in the produce. Supposedly this problem will be eliminated soon as the transport company is getting new ships. At the present time, all exports from the Board go to the United Kingdom--they tried interisland trade in the past, but ran into too many problems, such as nonpayment.

The Board pays farmers for their produce at the time of delivery to the Board. Since payment from the U.K. takes considerable time, and since the government subsidy to the Board ceased last June, the Board currently has a serious cash flow problem.

However, it is to receive a working capital loan in the near future from IFAD. At present, the Board does not have functioning cooler space. They do have about 1,200 cubic feet of cooler space but it was damaged by the 1979 hurricane and has never been repaired. This causes additional problems because the Board has no space to store products until shipment.

Retail Outlets. Retail outlets are comprised of supermarkets and small retail grocery stores. Farmers or hucksters marketing to these outlets harvest and transport their produce to the outlet. The outlet then sorts the produce and pays the farmer for what it keeps. Most of the sales to retail outlets are on a continuing basis and a result of a long-standing relationship between the buyer and seller.

#### Problem Areas and Constraints in the System

The following is a listing of the problem areas within the marketing system giving rise to postharvest losses in Dominica.

1. Market Information. There is literally no information available to any of the various segments of the market system with respect to: i) the demand at local, regional or export markets (including size of demand and which produce items are in demand); ii) the supply at local, regional or export markets (including production acreage in local areas and supply at any given market or point in time); and iii) market prices. Without information of this type, producers and hucksters, as well as the Associations and the Marketing Board are unable to produce crops or supply the markets in an orderly fashion. The result is market gluts at times and market deficits at other times. Further, without information relative to what produce is demanded, farmers continue to produce what they have always produced and, consequently, are many times producing for a market that doesn't exist and are not able to take advantage of markets that do exist.

Further, in many cases the marketing season is not fully exploited. An example is the case where citrus is marketed to the U.K. over an eight-week period while the production season lasts for about nine months. Products are marketed during only a portion of the production period, leaving unharvested produce to spoil on the tree or the ground. Information about available markets could reduce this type of loss considerably.

2. Technological Information. There is a lack of information on techniques of picking, ripening indices, handling and packing at all levels of the marketing system and storage, i.e., at the farmer level in terms of knowing what to do about loss problems or how to prevent loss problems and at the huckster level in terms of knowing how to handle a perishable product properly. Adding to this situation is the lack of incentive to take steps to reduce or eliminate losses. There is much evidence of the lack of technological information and the lack of incentive to use known technology. This is shown by the extensive bruising of produce due to poor harvesting, packaging or transport methods and spoiled produce due to the lack of proper temperature and humidity control or storage facilities.

3. Transportation. Adequate transportation is lacking at all levels of the marketing system. Local transportation from the farm to collection points or to the marketplace, or to the wharf for export is very poor. In some areas there are no roads between the farm plots and the main road where produce is picked up. This encourages a high percentage of loss since significant quantities of produce may not even be carried out to the road because of the difficulty, or it may take so long for the produce to reach the main road

that it gets overripe and cannot stand the trip to market. Roads are extremely rough and produce bounces around in the transport vehicle and becomes bruised and hence unmarketable or, at the very least, there is premature deterioration.

On the regional level, most produce is shipped in schooners which are not suitable for transporting perishables, and little care is exercised in the handling of produce. Another serious problem relates to the situation that regularly scheduled transportation in and out of Dominica seldom exists. Ships at times are full and do not stop at Dominica. Schooners are not dependable since they transport cargo around all of the islands and go where they can secure a cargo. They may or may not come to Dominica at a particular time.

4. Maintenance of Quality of Produce. In most places there is a lack of facilities for maintaining condition of produce while it moves through the market system. Where facilities do exist, this poor condition gives rise to substantial losses. Deterioration of produce occurs at a very rapid rate when produce is unsheltered and exposed to the elements - sun, rain and overripening due to poor aeration. This is especially critical when produce does not get to market within a day or two after harvest. These losses occur at all levels of the marketing system. At the farm level while produce is waiting for transport to market; at the marketplace level while waiting for market day; or at the wharf while waiting for ocean transport. The latter may be especially critical since occasionally ships do not arrive or do not have room for produce. There are no cold storage facilities at the wharf in Dominica to handle these situations.

5. Packaging Materials. Packaging materials are not readily available, or are not available at a price producers and hucksters are willing to pay. Locally, bags and baskets are used to pack all kinds of commodities. These are loaded on transport vehicles and considerable damage occurs due to squeezing and bruising. On the regional level the hucksters use bags, cartons and large wooden crates. Bags are semiplastic or jute and are not suitable for carrying perishable commodities because there is no air circulation and no protection from bruising during the handling process. The wooden crates are often too large and consequently too much produce is placed in the crate creating a situation where all the produce at the bottom of the crate is squashed. In addition, they are often constructed from unfinished lumber, rather than smooth boards, increasing the bruising and skin break damage to the produce during the transport process.

6. Financing. Means of financing new technology or new marketing techniques is generally unavailable to the small farmer producing domestic produce. Hence, even though a technique is available for reducing postharvest loss, farmers would be unable to obtain financing to cover the cost of adopting the new method.

#### D. BARBADOS - ONIONS

The investigation in Barbados was limited to postharvest losses in onions. Time available was not adequate to conduct a broader investigation similar to that pursued in other islands.

This commodity was selected for attention because of the substantial year-round demand in Barbados, satisfied with local production only during

local harvest season, and the good export potential to Trinidad and other Eastern Caribbean Islands. Serious storage and marketing problems have been encountered with Barbados-grown onions and significant losses have been incurred.

Production and Demand. Onions have been grown in Barbados since 1969. In 1972, the highest production year, 1133.8 metric tons (mt) were produced and 734 mt were exported, primarily to Trinidad. Yet, in the same year 1292.8 mt were imported into Barbados from the U.S. or Europe to satisfy local demand during months other than local harvest months. From that peak year, production declined to 539.7 mt in 1979, with only 70.6 mt being exported. Imports increased to 1510.5 mt. Annual per capita consumption in Barbados has remained relatively constant over the 10 years, varying from 6.4 kg to 8.9 kg.

Estimated acreage of onions harvested has declined from a high of 278 in 1972 to 182 in 1978. The waning farmer enthusiasm for onions is attributed to highly variable yields, pest and disease problems, high postharvest losses, and storage and marketing problems.

Marketing of Onions. The Barbados Marketing Corporation (BMC) handles all export marketing of onions. Under the AMP Agreement Barbados has a quota for onions, which it has been unable to fulfill. BMC also supplies the local market, selling 69% of the onion crop in 1979 but only 39% in 1980. The balance was marketed by local intermediaries.

BMC has facilities for the drying and storage of onions at Fairy Valley, Christ Church but they are inadequate. These are the only such facilities available on the island. The facilities can only maintain the quality of onions which have been properly cured and dried in the field by windrowing, the usual practice, for two or three weeks. No provision has been made for curing and drying of onions which have not been properly field-dried, or which could not be field-dried because of rain, nor are there any facilities for long-term cold storage. Recommendations for upgrading the facility to provide such capabilities have been made from time to time but none has been implemented to date.

Losses. Both on-farm and postharvest losses are substantial. Inspection of some farms in 1981 showed losses as high as 50% due to neck rot. Such rots develop from failure to harvest at the proper time. In 1980 BMC made two export shipments to Trinidad. Estimator losses on the first were 30%, and 70% on the second.

The onions grown in Barbados are of the soft varieties which inherently are highly perishable and do not store for long periods of time. With optimum conditions, 32° F. at 65-70% humidity, these varieties can only be stored for 1 to 2 months. The harder varieties can be held for 6 to 8 months. While improper cultural practices, harvesting at incorrect times, and failure to cure and dry onions adequately all contribute to the high rates of loss experienced, it is apparent that the onion industry in Barbados will not revive unless and until hard varieties are introduced.

Recommendations. Over the past 10 years, Barbados has emphasized and supported onion production and marketing. The varietal problem, appropriate cultural and harvesting practices, and proper handling and storage requirements are well known in Barbados.

Reportedly the Department of Agriculture is conducting varietal trials but there was insufficient time for the team to investigate fully the scope and status of such trials. Technical assistance and support has been, and is now, available from organizations such as IICA and the Tropical Products Institute.

While the Department of Agriculture might benefit from overseas technical assistance in connection with varietal trials, they claim that none is required. It appears that adequate expertise with respect to cultural practices, harvesting, and postharvest handling and storage is already being provided at this time.

In the opinion of the new Chairman of BMC, with which the team concurs, "the onion problem is not one of lack of technical knowledge in Barbados, rather it is lack of will on the part of the government and others to do what everyone knows ought to be done." The team has no recommendation to make with respect to technical assistance.

The team does have one recommendation, however. BMC has the exclusive right to export onions, and from all reports its ineffectiveness is a major contributor to declining onion production and lack of progress in the resolution of problems. If private traders were permitted to export onions freely it is probable that the export potential would be realized and, in the process, the current technical and other problems alluded to above would be resolved. The new Chairman of BMC indicated that his thinking was similar and he hoped that BMC, under his leadership, would go in that direction. If it were to materialize it would be a definite departure from past policies of BMC and other Boards in the Eastern Caribbean.

#### E. INTERISLAND TRADE

St. Vincent exports perishables principally to Trinidad and Barbados, St. Lucia to nearby small islands and Barbados, and Dominica to Guadeloupe and islands such as St. Maarten, Antigua, Montserrat, St. Thomas, St. Croix, St. Barts and Martinique. Barbados exports few perishables to the other islands.

Interisland marketing is done by private export intermediaries of the exporting country. The St. Vincent Marketing Board does a limited amount of trading in sweet potatoes, carrots and peanuts (items to which it has exclusive export rights), St. Lucia's and Dominica's do none.

Perishables destined for the regional market are almost always carried on small schooners. Sometimes they are transported from Dominica or St. Lucia on larger, general cargo vessels. Air transport is not used. Export licenses, routinely issued, are normally required. The intermediaries deliver the perishables at the wharf of the exporting country. Usually no repacking for export is done wharfside. The packaging utilized for export is the same as that used for domestic marketing which has been described previously.

A Typical Example of Schooner Transport. The schooner, Simone II, sailing from St. Vincent and destined for Barbados was loaded on Sunday, an unusual situation the team was informed, and one team member was able to observe the complete loading process as well as the subsequent unloading in Barbados.

The vessel captain, extraregional and regional export intermediaries, port authorities and others were interviewed or questioned during the lengthy periods involved. From those, and other interviews, it appeared that this particular schooner and voyage were typical.

The vessel carried 50 metric tons of cargo. It carried a sail and had an engine; both are used together during the voyage. There was a captain and crew of three. The vessel had two holds, one forward with a hatch opening about 10' x 10' and one aft entered through a 3' x 3' opening in the floor of the wheelhouse. The engine room separated the two. The engine room cover was open during both the loading and unloading process, and presumably during the voyage to exhaust the engine heat. The forward hold, the larger one, was approximately 16' x 20' with solid bulkheads fore and aft and no space for air circulation under the floor. The floor was approximately 8' from the top of the hatch coaming. The floor and walls of the hold were not squared off but rather followed the frame of the ship. There was an air scoop mounted on the forward bow but it appeared that the solid forward bulkhead of the hold blocked any entry of air into the cargo area. There was no exhaust for hot air from the hold.

The cargo carried was a range of perishables, including breadfruit (in new corrugated boxes destined for Barbados and transshipment to air transport to Canada), grapefruit and oranges (in plastic, onion net or jute bags, and boxes), golden apples (in plastic banana field boxes; solid with no bottom or side vents), eddoes and tannias (in 200 lb jute bags), coconuts in sacks and plantains on the stem. Approximately 12 intermediaries had cargo on the vessel.

Each intermediary brought his cargo alongside the vessel in trucks or other vehicles, which stood in the sun without shade throughout the loading period. Most of the produce appeared to be in reasonably good condition at that time. For the most part the cargo was loaded as it arrived although some items were set aside for later loading.

Loading commenced at 9 a.m. and finished about 1 p.m. The intermediary with the corrugated box shipment (about 10% of the total tonnage), had made special arrangements with the owner of the vessel and had a say in the manner of stowage and location of his produce in the forward section of the hold. In addition some breadfruit was placed on the deck aft of the wheelhouse and covered with a tarp. One other intermediary, who regularly uses this schooner, also requested that his produce be located in the forward part of the hold, his experience being that little damage occurred if located there. The other intermediaries appeared to have little interest or perhaps little ability to influence, where and how their cargo was stowed. The captain is the final authority on stowage.

Loading was done by crew members, intermediaries and others. Only plantains were loaded in the aft hatch. Three or four people handled each container of produce or stem of plantains; one took it off the truck and passed it to another on the deck or set it on the rail of the vessel. In loading the aft hatch it was passed to a second person who handed it to another in the hold.

When loading the front hold, the boxes, bags or stems were set on the hatch coaming and then passed down to one of several people in the hold who stowed it.

Heavy bags of eddoes were normally dropped into the hold, hitting the floor or cargo previously loaded. Initially loaders handled other produce in a reasonably careful manner. As they tired, they became less careful.

The cargo was stowed as tightly as possible, and up to the ceiling and hatch cover. No air circulation was possible. Early in the loading process, the hold area under the hatch was carpeted with cargo-- principally bags of eddoes--to make it easier for the loaders in the hold and they continually walked on them while they were working.

When the hold was full, the top was covered with boards and a tarpaulin. The vessel left St. Vincent at 3:00 or 4:00 p.m.

The schooner was scheduled to arrive in Barbados at 8:00 a.m. Monday morning, in sufficient time to meet scheduled transshipment of the boxed perishables to a plane for Canada. However, it arrived at approximately 10:30 a.m. By then no space was available at wharfside and it had to tie up on the off side of a larger ship.

That day only the ill-fated transshipment cargo was unloaded, commencing at about 1:30 p.m. According to the captain, the delay was primarily due to customs formalities, with perhaps late arrival of the intermediaries' trucks contributing somewhat.

A line of nine people, crew and dockworkers, unloaded the boxes over the deck of the larger ship to the truck by passing from one person to another. At five points along the line each box was set down, carefully at first and later dropped as the workers tired. Those in the hold stood on the cargo directly below the hatch during the entire unloading process.

Condition of the boxes appeared to be generally good, with only a few torn or ripped. However, those stowed at the bottom in the hold had been compressed, probably with significant damage to their contents.

About 4:00 p.m. work stopped and the hatch was closed. The next morning (Tuesday) the schooner was moved to another location alongside the wharf. About 12:00 noon, unloading of the plantains and other intermediary cargo commenced in the manner described above. Cargo directly under the hatch was not unloaded, being used as a platform by unloaders. Again at 4:00 p.m., with an estimated 20% of the cargo still in the vessel, unloading stopped and the hatch was sealed. All cargo was not off the vessel until late afternoon on Wednesday, some 78 hours after loading commenced in St. Vincent. All the reasons for the long delays were not apparent, but Customs, docking and unloading procedures were major contributors.

There was no shade for the cargo after it was unloaded on the wharf. The plantains were stacked in large piles. It was noted that several intermediaries partially covered them with pieces of cardboard. All perishables were picked up the day they were unloaded, but some remained on the wharf for up to 6 hours.

The condition of the cargo as it was unloaded varied considerably. Perishables packed in new cartons, plastic banana boxes and bags, and stowed in the front of the hold appeared to be in reasonably good condition. Plantains on the stem showed visible bruising damage and ripening.

Extensive bruising damage was apparent on other cargo, particularly that stowed directly under the hatch of the main hold. There were numerous loose plantain fingers and citrus in the hold, from bags whose tops had come open. The breadfruit on the deck was still on board Wednesday morning and examination showed that at least the top layers were unmarketable. No quantification of the total amount of losses could be made, but it was clear that it was substantial.

In addition to the foregoing, the unloading of a much larger, general cargo vessel with a substantial, unprotected deck cargo of perishables was observed over the same three-day period. The vessel had come from Dominica and St. Lucia.

The ship had arrived Sunday afternoon. Unloading did not commence until after noon on Monday. According to a Customs official, the delay was due to port and Customs' procedures. It was done in much the same manner as described above. About a dozen dock workers walked all over cargo, picking up the packages of cargo for the intermediaries alongside the vessel who happened to get their attention.

Bananas and plantains had been carried on the stem with no protection from the elements. Most of the rest of the cargo was packaged in used corrugated boxes of all sizes, tied with string. A few homemade wooden crates were seen. Substantial damage to the perishables was evident, the impression being that it was significantly greater than that to the schooner cargo. The majority of the cartons had come apart. Sea water washing over the deck may, or may not, have been a contributing cause to the damage.

Problem Areas. From reports and interviews with intermediaries, significant postharvest losses of perishables are incurred in the schooner trade. Principal causes normally identified are:

- . irregularity of service; uncertainty of arrival at the exporting country and time of arrival and unloading at the importing country;
- . lack of care and facilities for loading and unloading; and
- . lack of ventilation and high temperature in the holds.

The schooner trip observations described above tend to confirm these conclusions. On the other hand, statements were made that there are three schooners which regularly travel between St. Vincent and Barbados once a week, loading on Monday or Tuesday. When reference is made to regularity and availability of service, it sometimes appears to be referring to the uncertainties as to time--and even day--of arrival at the exporting port and the unloading port rather than whether any shipping service is or will be available at all. If a perishable cargo is delivered to the loading wharf in

anticipation of a schooner's arrival, significant delays in that arrival will give rise to losses since no method of maintaining the condition of the perishables is available at wharf side.

### VIII. SUMMARY OF POSTHARVEST LOSS PROBLEM AREAS

A number of contributing causes for the apparently substantial perishable losses occurring in Eastern Caribbean countries have been identified and discussed in some detail in Section VII, FIELD INVESTIGATION. This summarizes the conclusions of the team with respect to the principal problem areas and will set the stage for the recommended interventions presented in the next section of this report.

1) SIZE OF LOSSES. There is little, if any, reliable data as to the size of on-farm or postharvest losses being incurred. However, the consensus is that they are large with estimates ranging from 10% for some commodities to 50% or more for others. In order to assess the feasibility of interventions an order-of-magnitude assessment of the magnitude of the losses will be required.

2) LACK OF INCENTIVES TO REDUCE LOSSES. No price or other incentives to do anything about reducing losses exist at the farmer or other levels of the market system. There is no grading and payment of a premium price to the farmer or intermediary for better quality.

The only incentive which does exist is the sale of a higher percentage of production, produce which enters the market channels, if demand exists. If it doesn't, the farmer is in a position to produce alternative commodities for which there is a demand.

3) MARKETING BOARDS. Boards are not a significant factor in the local and regional marketing of perishables, except insofar as they may serve as market of last resort with regard to commodities in a glut situation or have an exclusive right to export or import particular commodities.

Marketing boards are generally ineffective in developing new markets or performing the marketing function. Purchase and market pricing policies have failed to promote orderly marketing. Board policies have impeded the effective development of markets by private traders.

4) TECHNOLOGY. There is a general lack of knowledge of existing technology to reduce harvest losses on the farm and postharvest losses at subsequent levels of the marketing system.

5) MARKET INFORMATION. No local or regional information on current or prospective commodity supply, demand or prices is available to farmers or other participants in the perishable marketing system.

6) TRANSFER OF TECHNOLOGY AND INFORMATION. There is no effective mechanism for the transfer of technology and information. Farmers, intermediaries, and schooner operators are not effectively organized for cooperative activities, a prerequisite for any effective public sector intervention.

7) TEMPERATURE CONTROL. There is little appreciation of the importance of keeping perishables cool as they move through the system. Available shade at roadside, the market and elsewhere may, or may not, be used.

8) PACKAGING. Packaging materials designed to minimize loss are seldom used at any stage of the marketing system. Appropriate materials are not available in some areas, and, if available, farmers and other participants do not often use them because of the cost in relation to perceived benefits.

9) TRANSPORT OF PRODUCE. Many small farms are located some distance away from roads so produce must be carried by the farmer, or sometimes by donkey, to the roadside for vehicle pickup. The amount of produce which can be delivered to the roadside is, therefore, limited.

In general, roads are poorly maintained and rough. Much bruising during transport occurs, significantly contributing to losses.

Interisland transport of produce is by schooners. They are not designed, or adequate, for the transport of perishable products. Furthermore, irregularity of scheduling of the schooners is a major cause of losses.

10) CARE AND HANDLING OF PERISHABLES. Little attention is paid to proper care and handling of perishables at the farm level or any stage of the system. Loading and unloading is by hand. The available product handling equipment is outdated or nonoperative. Multiple handling of produce is a characteristic of the system. Those involved are not educated in the proper handling of produce, or the importance of doing so.

11) FACILITIES FOR MAINTENANCE OF QUALITY OR STORAGE. Facilities for these purposes are nonexistent or inadequate throughout the system.

12) FINANCING. Means of financing new technology or marketing techniques is generally unavailable to participants in the production and marketing system.

13) UTILIZATION OF "LOSS" PRODUCE. Commodities which are not sold, either because of deterioration or lack of market demand, are not utilized for any purpose and are a total loss.

## IX. RECOMMENDATIONS

The recommendations made in this section represent an attempt by the PIP investigation team to define appropriate and economic ways to reduce the postharvest losses identified in the study.

The areas addressed are those which appear to be those of major economic significance to all the countries of the region. While the interventions recommended are regional in scope, the team believes that they should be tested on a limited scale prior to embarking on region-wide implementation--a "try it out first" philosophy.

The suggested interventions are designed to improve various elements of the existing perishables marketing and distribution system in ways which reduce the postharvest losses currently being incurred. They cannot be initiated, generally, in isolation and achieve a reduction in losses.

In other words, the solution of a loss problem at a specific point in the market system won't be successful unless the product is in good condition when it arrives at that point, and unless the quality of the product is maintained after that point. Marketing of perishables is a system of institutions, processes and functions interdependently woven together to move the product successfully from the producer to the ultimate consumer. Improvement of the system involves a step-by-step building process through appropriate interventions at various stages at appropriate times during the process.

Several significant causes of postharvest losses have been identified which are not addressed in the recommendations made. The lack of small farm access roads, and the poor condition of the roads which do exist, is well known. Obviously, construction of appropriate access roads, and improvement of existing roads, would aid in reduction of postharvest losses as well as serving other objectives. However, such a recommendation is not included here since the team felt that reduction of losses was only one of a number of justifications for investment in such basic infrastructure as roads and hence consideration was beyond the scope of the study. Nor have significant investments in mechanical cooling and cold storage been included as suggested interventions, the team being of the opinion that such investments at this time would be premature because of lack of maintenance of product quality prior to entry into, and after exit from, such facilities. It is probable that consideration of such investments will be appropriate after the recommendations made in this report are implemented.

In general, the team observed that participants involved in the marketing chain--farmers, intermediaries, land and ocean transporters--are not organized or, in several instances, are only in the initial stages of self organization. The lack of associations of participants causes inefficiencies in the marketing chain and imposes difficulties in making improvements in three areas: i) there is no effective way for participants to express their needs or problems to people or agencies in a position to resolve them; ii) there is no effective means for them to take advantage of economies of scale in the marketing chain; and, iii) there is no efficient means by which governments or other agencies can deal with participants on an individual basis.

The team realized that organizations of these types of groups would have to serve many needs not connected with postharvest losses and establishment solely for the purpose of addressing losses would not be warranted. For this reason promotion of, and assistance for, organization or groups for cooperative action is not included in the recommended interventions.

The team also sees training or related educational programs directed towards the various groups involved in the marketing chain as an important process. Such programs are an integral part of a number of the recommendations which follow. In the opinion of the team, demonstration in the field will be the most effective mode of conducting such programs and securing acceptance on the part of farmers and other participants in the system. Detailed delineation of such programs was felt to be beyond the scope of this report but the general structure and content is covered.

Recommended interventions are presented in the remainder of this section, grouped into three substantive categories: i) Maintenance of Quality in the Marketing System; ii) Information System; and iii) Utilization of "Loss" Products. Work plans for implementation of the recommendations are also outlined.

#### A. MAINTENANCE OF QUALITY

Quality maintenance of perishable products is a function that must be carried out at every level of the marketing system--beginning at harvest and ending with the ultimate consumer. Therefore, attention must be given to adopting known technology designed to maintain quality throughout the entire system.

#### EDUCATION AND TRAINING

Farmers. Generally, harvesting of perishable products is done by hand without the aid of any harvesting equipment. The stage of maturity at which products are harvested generally depends upon traditional practices of individual farmers, not necessarily influenced by what might be best for maintaining quality during the marketing process. Further, very little concern is shown for harvesting techniques or practices that prevent bruising or skin breaks in the product--a prime cause of premature deterioration.

For example, the sweet potato root is covered by a thin, delicate skin that is very easily broken. Striking the roots with harvesting tools or throwing them from row to row or into containers injures this skin. If the sweet potato is cut or bruised during harvest or handling, a heavy, milky juice exudes from the injured cells. This juice dries in a few hours and may appear to have closed the wound but actually several days are required for the growth of new cells that protect the interior cells from infection. The dried juice on the surface of the wound is in itself no appreciable protection against rotting. Thus, whatever else is done to the injured sweet potato during the remainder of the marketing process will not prevent the rotting process from taking place.

Another example would involve the harvesting of immature mangoes. By selling immature mangoes, farmers are virtually guaranteeing that those who buy them will not buy anymore since immature mangoes have an unpleasant taste. The problem is that farmers generally pick all fruit off a given tree at one time but the fruit of an individual tree does not all mature at the same time. Each tree needs to be picked a number of times, with the removal only of fruit which has begun to change in ground color.

In addition to harvesting considerations and techniques, the education of farmers in the proper care and handling of perishables after harvest will be important. The need to maintain cool temperatures and for careful handling at and after harvest will be included. These aspects are discussed below.

It is recommended that a farmer training program be initiated to educate farmers in: i) the correct harvest time according to maturity of the product; ii) proper harvesting techniques; iii) postharvest care and handling; and iv) new technology with respect to low-cost harvesting equipment and packaging designed to maintain product quality.

Intermediaries. Education of intermediaries on the requirements for maintenance of quality of the produce must be an integral part of the postharvest loss reduction program. Since numerous farmers also perform the intermediary function, selling their own produce to consumers at central markets, such education should also be incorporated as a part of farmer education programs.

As the team sees it, intermediaries are the focal point for postharvest loss reduction efforts because they are the connecting links between the farm and consumer. They are responsible for the care and handling of produce and hence an educational program aimed at them is an essential intervention. In addition, they will serve as a principal conduit of farmer education, insistence on proper care and handling by transporters during the marketing process, and introduction of new, appropriate packaging discussed below.

Therefore, intermediate education and training with respect to maintenance of quality of produce, the factors involved and new technology available is a recommended intervention.

Handling During Transport. The third component of the recommended education and training involves the care and handling of produce during transport.

Essentially three modes of transport are utilized, by head or donkey from the farm to the road, by truck or bus to the central marketplace or place where it is sold, e.g. collection point or warehouse, and by schooner to intraregional markets. Proper care and handling during the first should be a part of the farmer education program. Intermediaries (including farmers) will usually be directly involved in, or at least will be able to supervise and influence, loading, unloading, and protection from the elements in vehicles, so proper care should be included in the intermediary education program. Due to the number and diversity of transport personnel involved in vehicle transport, the team does not feel that a separate program aimed at education of such personnel would be justified.

However, the same is not true of dockside workers and schooner captains and crews involved in interregional exports. They are relatively small in number and locations where they work are limited in number. The team therefore recommends that the third element of the training and education program should involve schooner operations and encompass the care and handling of perishables from arrival at the loading wharf through the pickup time at the unloading wharf and introduction of the improvements and new technology mentioned below.

It is critical to keep in mind that potential users of the recommendations made in this report must be adequately informed about the objectives that the recommendations are designed to achieve, why and how they do it, and the benefits which users can anticipate from such use.

A small scale test of recommendations before region-wide programs are implemented can provide the economic benefits and costs needed to sell the recommendation effectively to the users in the education and training programs. Such an approach is more likely to result in more widespread adoption and a more successful loss reduction program.

Temperature Control. Temperature control is critical to the maintenance of quality of perishable products. For example, if mangoes are picked before they are ripe, the ripening process is retarded at temperatures above 90° F., also the higher the temperature during ripening, the greater the weight loss of the fruit. Another example would be that in warm weather grapefruit can be ventilated during transit to preserve quality, but if shipments are in transit longer than 8 to 10 hours, the grapefruit should be refrigerated. The desired transit temperature would be 50° to 60° F. with a relative humidity 85% to 90%. Grapefruit is subject to pitting and physiological breakdown when held at temperatures below 50° F. Hence, proper maintenance of temperature level is critical to maintaining quality in the fruit.

Mechanical cooling capacity has been recommended by numerous entities for the Caribbean Region. Cooling ability has been recommended for use at collection points for temporary storage, on wharfs (for both loading and unloading operations where fruit and vegetables might have to be temporarily stored due to transport problems) and aboard ocean vessels transporting commodities between islands. These would provide optimum temperature control conditions and would greatly assist in the maintenance of quality assuming, of course, that the quality of the produce entering the cooler facilities at collection points had been adequately maintained through harvest and transport to collection points. Currently the quality is not adequately maintained and a principal thrust of the recommendations made in this report is to improve the system in this regard.

Cooling capacity is a relatively expensive venture and one for which the economic feasibility has not been analyzed (at least as far as this team could determine). Generally, other studies correctly concluded that cooling capacity would reduce postharvest loss. However, these studies did not determine a cost/benefit ratio from providing such cooling capacity. The team is of the opinion that consideration of mechanical cooling facilities (except for refrigerated temporary storage wharfside; see discussion and recommendations on Transport) at this time is premature and it is unlikely that economic viability could be demonstrated. Subsequently, after implementation of the recommendations made in this report, investment in cooling and long-term storage facilities may be warranted.

However, there are simple, low cost practices with respect to the postharvest care of produce which will lessen quality loss which the team recommends:

Collection Points and Wharfside Temporary Storage. At both of these locations, shelters should be constructed to provide shade from the sun and protection from the rain. These will provide adequate protection from the elements during the temporary storage required until transport to the market or wharf (in the case of collection points) and until loading on ships or schooners or pickup at the destination (in the case of wharfside). They would also provide protection during the sorting and grading process.

A second consideration regarding collection points is their strategic location. Collection points have considerable merit and can facilitate considerable reduction in postharvest loss. They can, and are being used for sorting, grading, and packing produce. Possible economies can be gained by performing these functions in a facility with capacity for handling a relatively large volume of produce. Further, with larger volume, it may be possible to provide transport specifically designed for and limited to transporting produce. Further, these collection points can be used as a center for educating farmers on what quality is desired, as well as how quality can be maintained. However, if collection points are too far apart, the produce loss due to longer transport by farmers could be very high. On the other hand, the cost of providing collection points near all farmers would be unfeasible. Thus, these aspects must be analyzed in order to locate optimally the collection points.

Marketplace. Protection from the elements must also be provided and utilized at the marketplace during the time sellers are displaying their produce. At the present time, most marketplaces provide inside market stalls with adequate protection. However, during market days many stalls are unoccupied while sellers are located outside the building with no protection from the sun or rain. A small fee is usually charged for the use of inside stalls which appears to discourage use of these stalls. Sellers should be educated, by demonstration, in the difference between the quality of produce that is displayed for a period of time outside the building versus that displayed inside. If this doesn't work, thought should be given to eliminating the fee charged for use of the inside stalls or perhaps consideration should be given to initiating a fee for the use of the ground outside the building.

The team recommends that, in addition to education on the importance of keeping produce cool, simple shade structures be constructed on-farm, at the roadside, collection points, wharfside or at marketplaces as needed for quality maintenance.

Packaging. Considerable damage occurs to perishables due to the types of containers now used by farmers and intermediaries. They use whatever is available--no containers at all, plastic or jute sacks, plastic banana field boxes (which are not ventilated), used cardboard cartons and unfinished lumber crates.

Most offer little or no protection to the produce during the transport process. Multiple handling from one container to another is common. Bruises and cuts hastening deterioration are the result. Lack of ventilation in banana field boxes and plastic sacks (often used for citrus) permits high heat buildup in the produce.

As much as 200 pounds of produce may be placed in a bag, e.g. eddoes, (a common root crop related to taro,) resulting in substantial bruise damage from squashing and dragging or dropping of the sack because handlers cannot lift or carry the sack. This was particularly apparent from observations of schooner loading and unloading.

Introduction of a standard container into the system, i.e. one which could be utilized from harvest time through subsequent stages of the system, could, in the opinion of the team, significantly reduce losses from bruise and cut damage and multiple handling during the marketing process.

Eastern Caribbean Agencies Limited (primarily an export intermediary) in Kingstown, St. Vincent, has located a container which appears to be appropriate. It is supplied from Jamaica and reportedly priced at EC \$12. Containers meeting the criteria are available from other sources.

The most appropriate avenue for introduction of standardized containers is through the intermediaries. They are in a position to provide the containers to the farmers from whom they buy and insist on their use and to deal with vehicle and schooner transporters with respect to fees and charges made for carrying the produce. They will, of course, have to be convinced before they will adopt them.

Transport. As alluded to previously, the lack of farm access roads and the generally poor condition of those in existence, are major causes of postharvest losses. However, a recommendation for improvement of the road system was felt to be beyond the terms of reference of the study.

Education on proper vehicle loading, unloading and stowage, mentioned previously, would reduce perishable losses caused by the poor roads to some degree.

Farm to Roadside Transport. Head transport is the most common way of transporting produce from the farm to a roadside pickup point, followed by donkey transport. If the use of the standardized, rigid containers recommended above is initiated, it is likely that they would not be used widely for these modes of transport. Bags and other types of packaging currently used are more easily handled.

In areas where produce is carried from the field on heads, a simple, single wheel cart might be utilized. The single wheel structure would allow ease of turning and following narrow mountain trails. The cart would be designed to carry at least two containers thus reducing the number of trips required and consequently providing an incentive for the use of carts. The containers would be strapped to the cart to reduce shifting that can result in bruising.

In areas where donkeys are used, a simple saddle harness device can be designed to hold containers, one on either side. Again, the incentive for adopting this technique would be the reduction in the number of trips required to move produce from the field to the roadside.

Roadside to Collection Point, Market or Wharf. Buses, which also carry people, and pickups or larger trucks of intermediaries, grower associations and marketing boards are the usual modes of transportation from the roadside to collection points, markets and wharves for export. Buses are loaded with perishable cargo as they go along their route with no attention being paid to how the cargo is stowed. Highly perishable commodities are as likely to be on the bottom as the top. Cargo is not usually tied down. Bruise and compression damage is often severe. More care is likely to be used in loading trucks, and tying down is more common, so damage during transport by truck will normally be less.

Damage being incurred during loading, unloading, and transport could be materially reduced by education on proper practices, adoption of the standardized packaging recommended above, and tying down cargos to reduce bouncing and shifting. Utilization of foam padding on the bed and sides of the cargo area of a bus or truck would also reduce losses due to bruising during transport.

The establishment of the suggested collection points at appropriate locations would aid in reducing losses. Full truckloads could be accumulated, permitting proper loading of larger trucks with tiedowns.

Export. Schooners currently transport most of the interregional perishable trade and postharvest losses are high. This is true even though only a few relatively durable crops, such as roots and tubers, are transported in any significant quantities. More perishable crops are not shipped on schooners. It would appear that significant new marketing opportunities in intraregional trade of such crops would develop if more adequate transport services were available.

Major reasons for the inadequacy of schooner transport is that vessels are not built for, and are inadequate for, the transport of perishables and the irregularity of their schedules.

The establishment of a reliable, scheduled, interisland sea transport service with appropriate vessels and facilities for handling and maintenance of quality of perishables would appear to be a promising way to reduce current losses. No such service currently exists although it has been tried, and abandoned, in the past. The feasibility of establishing such a service should be analyzed. The team understands that this is already being investigated, but if this is incorrect it would recommend such an investigation. Outlining a work plan for such a feasibility study was beyond the scope of this study.

However, whether or not such a new service is established, it is probable that schooners will continue to carry a significant amount of the interisland perishable trade because of lower cost. So it is worthwhile to consider appropriate and economic steps which might be taken to reduce losses in the schooner trade.

Uncertainty of time of arrival for loading is reported to be a major cause of losses. Some questions might be raised on the validity of such reports, at least in the case of St. Vincent where 3 schooners reportedly make a weekly run from St. Vincent to Barbados. One obvious solution is to encourage more reliable scheduling. However, the way the schooner trade operates it is unlikely that this could be achieved to any degree.

The length of the sea journey and the time for unloading are two other factors to be considered. It appears that little could be done about the length of the trip. The primary causes of unloading delays, three days after arrival in Barbados in the case which the team observed, are lack of schooner docking space at the wharf and port entry and customs procedures. Unloading delays could be minimized if schooners transporting perishables were given priority at the destination with assigned wharf space and expedited port and customs clearances. Barbados does have designated wharf space for schooners in its new port but it is not operative because of a long-standing controversy with dock workers. The team recommends that an investigation be made of what changes in port procedures might be made to assure priority for schooners carrying perishable cargos. If significant delays in unloading can be avoided it is probable that more reliable scheduling of the time of arrival at loading ports might be possible.

Schooners can be delayed for days in arrival for loading. Perishables delivered at the wharf in anticipation of loading on a particular day are often complete losses when the schooners arrive. If provision were made for cooling facilities on or near the wharves such losses would be minimized. Self-contained, refrigerated units might economically provide what is required and investigation of their feasibility is recommended. Used, reconditioned reefers are available at a cost of approximately \$10,000 (1980 West Coast prices).

Rough and multiple handling, and consequent bruising, during the loading, stowing and unloading appear to be significant causes of losses. Education and training as well as standardized containers would protect the perishables and materially reduce losses. Availability of several types of equipment on the exporting and importing wharves would also help to reduce the losses associated with handling. The feasibility of using roller raceways and/or small moveable cranes on the wharves should be investigated. Possible attitudes of unions to the introduction of such equipment will have to be considered.

From studies, interviews, and observation, a major cause of damage to perishable cargos is the lack of ventilation in the holds of schooners and the high temperatures generated because of lack of ventilation. While a small self-contained refrigeration unit might be designed to fit in a schooner hold to alleviate the foregoing, the team doubts the practicality or economic feasibility of such a solution.

However, there are several things that might be done to improve ventilation in the holds and reduce temperatures. Most schooners have air scoops on the bow, designed to channel fresh air into the hold area. Nevertheless, they serve no purpose if there is no way for the air to reach the cargo because it is blocked by a bulkhead or by hot air building up in the hold.

If a vessel does not have an exhaust, a simple, appropriately-designed non-mechanical exhaust device installed at the aft end of the hold would appear to be adequate to permit escape of the hot air.

To maintain the perishables at the coolest temperature possible, the cool air entering the hold should flow around, and through, the perishable cargo in the hold. If the cargo is tightly packed, it cannot.

Hence, it is necessary to stow the cargo in such a way that the air can move through it. Introduction and utilization of standard packaging would permit adequate ventilation in schooner holds, if the containers were properly designed so that they could only be stowed and stacked in a manner which allows for proper ventilation. Whether or not schooner captains and owners would be receptive to doing that without compensating payment for open space is perhaps questionable.

#### B. AGRICULTURAL AND MARKET INFORMATION SYSTEM

One of the principal deficiencies of the marketing systems of the countries visited was the lack of reliable and timely agricultural information. This was a common complaint among respondents from all sectors. Indeed, farmers, intermediaries, marketing boards and government planners are all forced to operate in an information vacuum. Data concerning prices of agricultural commodities, actual and estimated production, simply does not exist. Nor is there any information on technological innovations available.

As a result, periodic glut situations occur with respect to particular commodities and substantial losses are incurred by producers. An effective information system would go far to alleviate the problem by providing reliable information to farmers with respect to prospective production and demand for particular crops, both in their home country and within the region, providing a basis for selection of which crops they will plant and which they will not. Current market information will identify demand, supply and prices in each country, and regionally, for farmers and intermediaries thus improving the efficiency of the marketing system. Also, reliable agricultural and marketing information will substantially aid government policy makers and planners in performance of their functions.

The team recommends the establishment of a two-tiered agricultural and marketing information system, which would operate at a national or island level, as well as at a Caribbean or interisland level. A key component to such a system, and an essential element for increasing marketing efficiency, is that the system be two-way and open to all potential beneficiaries--farmers and farmer organizations, intermediaries and intermediary organizations, marketing boards, and government planners and policy makers. This will not only be important insofar as maximizing system impact, but also in assuring accurate and timely use of the system by those it is designed to benefit. In essence, if a potential beneficiary sees no direct benefits to being part of the system, he will not participate in it.

#### C. UTILIZATION OF "LOSS" PRODUCE

Currently, significant postharvest losses of perishables are incurred on the farms and at later stages of the marketing system. And unharvested crops represent substantial losses as well. "Losses" in the sense utilized in this report means that crops are not sold for human consumption, the primary reason for their production, either because of lack of demand or because of deterioration.

But that does not mean that "loss" crops may not have an economic value for other purposes which, if realized, would reduce the economic losses of producers or others involved in the system. At the present time "loss" crops are not utilized for any purpose at any stage of the system and, hence have no economic value of such crops is not realized. One area to be explored might be utilization as a supplemental feed for animals. However, note the comments with respect to processing in the subsequent section of this report. A second, promising area would be use of such products for composting, either on the farm, at the central market or other stage of the marketing system where an adequate volume of "losses" occur to justify such an operation. If composting proves to be feasible, it could also benefit farmers by providing a low-cost substitute for expensive fertilizer.

Another possibility for extracting value from "loss" produce to be explored, might be the institution of an auction system for such produce at central markets--and perhaps at other locations. At the end of the market day unsold produce would be auctioned for whatever price is bid. Some might be sold for human consumption to those who could not otherwise afford to pay normal market prices but it is anticipated that most would be bought for feed, composting, or other uses.

#### X. RELATED ISSUES BEYOND THE SCOPE OF THE STUDY

During the course of investigation the team identified several important issues related to postharvest losses which were beyond the scope of the study. The team felt that the following comments should be made.

Competition and Prices. Eastern Caribbean suppliers of perishables to the U.K., Canada or other extraregional markets are competing with suppliers from other countries. Prices and quality of Caribbean suppliers must be competitive with other potential suppliers if they are to maintain those markets. If costs of production, marketing and transport make the price of a Caribbean product noncompetitive with that offered by other countries, Caribbean countries will not only fail to develop new markets, but also will lose traditional ones. And in a free market system such as that of the Eastern Caribbean, the same type of competition exists with respect to interisland trade in perishables. Further, it is important to recognize that any individual Eastern Caribbean country must be able to produce and market a commodity in its own country at a cost and price competitive with that of other potential supplying countries if it is to supply its home market. For example, Barbados onion growers must be able to produce and sell at a price competitive with that of U.S. produced onions delivered to Barbados markets. If they don't, or can't, the onions will be supplied by the U.S.

Alternative Crops. If attempts to reduce postharvest losses are successful two things may occur: i) If markets are available, the produce saved through reduction of losses can be sold, increasing farmers income; or ii) if markets are not available for the produce saved, the farmer can reduce his production of the crop to the amount which can be marketed and use the land and resources for the production of alternative crops with a market demand, thus increasing his income in that manner.

As a corollary to the postharvest loss reduction program the team would recommend institution of a program to identify and introduce alternative crops, with a high market potential being the main criterion for selection and emphasis.

Processing as Means of Reducing Postharvest Losses. Processing is often recommended as a solution to glut situations--for example, processing of perishables into formula animal feed, jellies and jams, dried banana chips or exotic liqueurs. Thus, the thinking goes, the perishable that cannot be sold is converted into a product which can be marketed.

In the view of the team, processing should not be considered as a way of reducing losses, rather it should be considered as a part of an overall program to increase agricultural production and market development, i.e. a new agribusiness. A profit-oriented processing business usually must have a sure, steady supply of the raw materials it uses and cannot operate on erratic supply situations dependent on whether a glut exists or not.

Marketing Boards. Boards are not a principal factor in the local and regional perishables marketing system, and in the team's opinion are not likely to become one until new, more commercial pricing and other policies and practices are adopted and effective marketing is pursued. For these reasons, involvement of marketing boards was given little attention in the recommended postharvest loss reduction program.

## XI. WORK PLANS RECOMMENDED TO IMPLEMENT INTERVENTIONS

### A. MAINTENANCE OF QUALITY OF PRODUCT IN THE SYSTEM

Objective. To develop and establish a program of appropriate and economically justified interventions to assure maintenance of marketable quality of perishables from harvest time through each stage of the country and regional marketing system until they reach the consumer, hence reducing postharvest losses insofar as it is feasible.

Structure of the Program. Losses of perishables may be due to either lack of market demand or premature deterioration due to lack of proper care and handling as the crop moves through the system--physical losses resulting in economic losses. This program is concerned with the latter.

In order for such a program to be effective, it is essential to incorporate a series of interventions designed to address the principal causes of physical losses occurring at the various stages of the marketing system into one program. Provision has to be made for overall coordination of the specific interventions.

Initially, the order-of-magnitude size of losses being incurred must be determined in order to furnish a basis for assessment of the economic impact of the specific loss reduction interventions recommended. The scope of work of the specific interventions will be outlined in following sections. Program implications will then be summarized.

Program Development. The program should be initiated in one country during the first year of the program. St. Vincent would be a good selection. Farmers and other participants in the system appear to be interested in improvement of perishable production and marketing and to have some appreciation of the importance of maintenance of quality in the system.

There is current, routine participation of both intermediaries and the Marketing Corporation in the regional export market--primarily Barbados and Trinidad--which is not the case in other countries investigated.

During the second and subsequent years similar country programs should be initiated in other Eastern Caribbean countries and improvements in the regional system as a whole should be pursued. After establishment of the basic program outlined here, continuing improvements of the St. Vincent, other country, and regional systems should be pursued as an on-going loss reduction program. They might include consideration of the feasibility of long-term storage facilities, development of improved packaging for specific crops, and feasibility of establishment of a packaging production enterprise to fabricate packaging.

## Program Interventions

1. Estimate of Postharvest Losses. In order to justify investment in any recommended interventions for the reduction of postharvest losses, it is first necessary to determine the cost : benefit ratios for the interventions individually. Order-of-magnitude estimates will be adequate for initiation of the recommended programs. Nevertheless, more reliable data to support larger investments for full implementation of the program should be developed during the first year of the program.

Needed estimates for perishable crops of St. Vincent should be developed in the following way:

- . Confirmation of identification of principal crops and their relative economic importance;
- . With a specific crop-by-crop focus field evaluation to confirm the estimates of the extent, and causes, of losses which are mentioned in this study and the securing of additional estimates from appropriate people or organizations involved in the system if they prove to be inadequate.
- . Conduct of a literature search and analysis to quantify the effects of failures to maintain optimum conditions on maintenance of quality of the crops through the system. For example, the increase in the rate of deterioration, and hence shortened shelf life, resulting from bruising of sweet potatoes during harvest.
- . Adequate estimates to justify the investment in the recommended program can then be derived from the foregoing.

Short term technical assistance will be required to perform the foregoing scope of work, with appropriate in-country cooperation and support of the Department of Agriculture, intermediaries and others.

2. Training and Education. Lack of care and careful handling of perishables is characteristic of the marketing systems and is a significant cause of postharvest losses being incurred. A three-pronged education and training intervention, aimed at farmers, domestic and intraregional intermediaries, and schooner operators and crews, is needed.

The initial substantive content of the programs should include:

- a. Farmers
- . Correct harvest time as affected by maturity of the crop.
  - . Appropriate harvest techniques.
  - . Postharvest care of perishable crops.
  - . Introduction of new technology such as low-cost harvesting equipment, packaging, and appropriate, improved farm-to-road transport vehicles.
  - . Benefits which the farmers could anticipate.

- b. Intermediaries (including farmers who perform this function)
  - . Effect and importance of maturity when harvested, temperature control and protection against bruising and cuts at all levels of the system.
  - . Introduction of new technology such as loading and unloading practices and improved packaging.
  - . Benefits that intermediaries could anticipate.
- c. Schooner Operators and Crews
  - . Importance of care and careful handling of perishables, including temperature control.
  - . Introduction of new technology such as proper loading, unloading and stowage practices, low-cost schooner modifications and dockside loading equipment.
  - . Benefits that schooner operators could anticipate.

"Showing" rather than paperwork or talk should be the primary mode of education and training.

As a corollary to the farmer education program, an investment in the development of low-cost, appropriate harvesting equipment should be made. A survey of such equipment utilized elsewhere would appear to be adequate. This might well be incorporated as a part of one intervention dealing with all tangible appropriate technology aspects of the program.

The most appropriate country agency for carrying out the farmer education program would appear to be the Extension Service of the Department of Agriculture. And it is also probably the best one to conduct intermediary and schooner education programs as well.

Short term technical assistance will be important in the design of the educational programs and development of their content.

3. Temperature Control. The scope of work of that part of the program aimed at maintaining the temperature of perishables as they move through the system is as follows:

- a. Field investigation and identification of the points in the system--on-farm or subsequently--where heat buildup occurs.
- b. Identification of economic solutions to prevent or reduce such buildup. For example, training with respect to time of day of harvest and use of available shade and the erection of low-cost shade structures at appropriate stages of the marketing system.
- c. Determine the number, appropriate location, and the design, cost and feasibility of needed shade structures. Roadside, central market, loading and unloading wharves are locations to be considered.

Short term technical assistance will be required for performance of the outlined work with the cooperation and support of the Ministry of Agriculture. The Ministry would appear to be the appropriate country agency for implementation of the recommendations to be made in the study.

4. Collection Points. The establishment of country collection points, at appropriate locations, with adequate supporting services such as routine and timely vehicle pickup, is recommended. The scope of work for this aspect of the program should be:

- . A survey of the principal crop-producing areas and analysis of how crops currently reach the market.
- . Determination of the number of collection points which might be justified; where they should be located; of the functions they should serve; and the mode of operation and supporting services required.
- . Consideration of the design, cost, and feasibility of establishing such collection points.

Short term technical assistance will be required for performance of the work. To avoid duplication, it should be pursued in conjunction with the recommended work proposed in the previous section, temperature control. Again, the most appropriate country agency involved appears to be the Ministry of Agriculture.

5. Packaging. Introduction of appropriate packaging to reduce losses due to bruising and heat buildup in products should be an important element of the loss reduction program.

- a. The type of container construction should result in a sturdy container able to withstand weight of other containers stacked on top. It should be of smooth material to eliminate cuts and bruises, and should allow ventilation throughout the produce packed inside.
- b. The size of the container should limit the amount of its contents so that squashing is reduced and should facilitate easy handling by persons responsible for loading and unloading the containers.
- c. The container should be designed so it is appropriate for stacking during transport. It should be designed so other containers do not rest on produce inside the container, and it should allow for air space between containers. They should be of uniform size and allow for economical return trips for the empty containers.
- d. The container should allow for multiple use, i.e. it should be designed to allow its use from the field to the ultimate market. This would eliminate the now typical practice of multiple handling of produce when it is transferred from one type of a container to another.

The scope of work for this element of the program is outlined below:

- a. Field investigation, to confirm what type of packaging is needed for which crops and why; identification of considerations affecting choices such as cost, ease of carrying, or cost of transport on schooners.
- b. Development of detailed criteria for packaging.
- c. A survey of available packaging substantially meeting those criteria, including sources and costs. The team is of the opinion that adequate packing is already developed and available without investment in development of new packaging. Eastern Caribbean Agencies of Kingstown appears to have done some groundwork on this aspect of the work.

- d. The container, or containers, which appear to be the best should then be tested through actual use in the country and regional marketing systems. Arrangements for such testing should be made with one or more interested intermediaries. A sufficient number of containers should be included in the test, e.g. 500, and be conducted for an adequate period of time. The purchase price of the containers should be financed, and not just given to the intermediaries. However, some discount on the price might be justified on the basis of the collection of information with respect to use which will be involved. Advice on ways in which the containers can be kept in the system, once introduced, should be provided to the intermediaries.
- e. Provision should be made for continuing observation of use of the containers in the system and interview of participants in the system as appropriate.
- f. Upon conclusion of the test and evaluation, arrangements will be made to assure availability of the containers and introduction throughout the system.

The Ministry of Agriculture is probably the appropriate country agency to be involved. Short term consultants should develop the criteria, make the survey of available packaging, and assist in designing and making arrangements for the test. Peace Corps personnel might be considered for the work required during the period of the test. The consultants would then be involved in the evaluation of the test and design of the implementation program.

6. Transport. Proper loading, unloading and stowage practices on vehicles and schooners are included in the education and training sections above.

The scope of work for tangible appropriate technology at the farmer level is:

- a. Sufficient field investigation of the modes, distances, and other considerations involved in farm-to-road transport to confirm the conclusions of this study.
- b. Development of the design for simple, low-cost equipment to aid in reducing losses and determination of feasibility. The following might be considered: a single-wheeled device for trails with a higher carrying capacity than head carrying; donkey saddle modifications to carry standardized containers.
- c. Recommendations as to sources of supply of such equipment (including farmer or local production) and introduction of the equipment.

At the vehicle transport level, the following should be pursued:

- a. Arrangement of tests with bus and truck operators to determine the effectiveness of using foam padding in cargo spaces to reduce bruising damage.
- b. Analysis of results and determination of feasibility; identification of sources of supply of foam (produced in Barbados.)
- c. Recommendations as to introduction of the use of the foam, if it proves to be justified.

The foregoing two interventions will require short term technical assistance with the Extension Service of the Ministry of Agriculture probably the country agency to be involved.

The other transport intervention recommended is related to the schooner trade. Following is an outline of the scope of work:

- a. The irregularity of schooner arrivals, the causes of such irregularity, and the causes of delays in unloading should be investigated and analyzed. A review of port departure and arrival records, and interview of schooner agents and operators, port and custom authorities, should provide needed data.
- b. Appropriate recommendations with respect to changes in port or customs practices or procedures to minimize delays should be developed.
- c. Losses due to delayed arrivals at the loading port should be assessed and the feasibility of providing short-term storage facilities should be determined. The utilization of self-contained, refrigerated units (reefers)--reconditioned or new--should be considered.
- d. Low-cost, schooner modifications to improve perishable cargo ventilation and reduce hold temperatures should be investigated and feasibility determined. Modifications should be tested on several schooners. After analysis of the tests, recommendations with respect to introduction of the modifications to the schooner fleet should be made.
- e. Simple, dockside handling devices to provide more careful handling of perishables should be investigated and feasibility determined. Use of roller raceways and small, moveable cranes are two possibilities.

Short term technical assistance will be required to carry out the work outlined above. Port authorities will necessarily be involved and it is probable the Ministry of Agriculture should be also. Schooner operators will participate in the vessel modification test.

#### Summary of First-Year Program Implications

Appropriate technical assistance for the design, coordination of short term assistance and evaluation of the overall maintenance of quality program will be required. Short term consulting assistance will be necessary for:

- . Development of order-of-magnitude estimates of size and value of postharvest losses and anticipated reductions.
- . Design and content of farmer, intermediary and schooner education and training programs.
- . Development of tangible appropriate technology -- harvesting, farm-to-road equipment, temperature control structures, foam padding in vehicles.
- . Establishment of collection points.
- . Packaging.
- . Schooner--port and customs practices, self-contained refrigerated reefers, schooner modifications, dockside loading/unloading equipment.

The Ministry of Agriculture appears to be the most appropriate country agency to be involved in the overall establishment and implementation of the program. With respect to interisland aspects, port authorities would appear to be the appropriate principal. Peace Corps personnel could be utilized in the conduct of recommended tests. Private intermediaries and schooner operators will necessarily participate in the conduct of tests. And organizations of farmers, intermediaries and schooner agents and operators will be principal conduits for implementations of recommendations made in this report, or those flowing from tests to be conducted.

## AGRICULTURAL AND MARKET INFORMATION SYSTEM

### Objective

To establish an effective country and regional system for timely collection and dissemination of reliable production, demand and price information.

### Structure of System

It should be a two-tier system, one related to the local country market and the second dealing with the regional market. Information of anticipated future supply and demand should be incorporated in the system as well as current supply, demand and prices.

### System Development

One country should be selected for initial development. It is suggested that it might be Dominica where the Ministry of Agriculture and Extension Service appear to be relatively well accepted by farmers, the Ministry has statisticians, and there is a fledgling association of hucksters--the only one found in the countries investigated - all of whom would be important participants in the system.

The first two years should be spent establishing and developing the Dominica country system. This prototype, would be established in other Eastern Caribbean countries in the third year and the regional system in the fourth year.

#### 1. Development Program, Year One

##### Price Information.

Initially the country price and other sales information gathering and reporting service should be established. Sources of information would be the banana, citrus or other farmer associations, the Marketing Board, representative samples of local and export intermediaries and perhaps farmers. Primary focus should be on the most important perishable crops.

The data should be collected on a routine, current (daily or weekly) basis. In addition to prices, quantities sold, point of sale and quality information should also be collected.

The Extension Service of the Ministry of Agriculture, or perhaps a new statistical reporting service within the Ministry, would appear to be the appropriate agency for gathering as well as disseminating the data.

The information gathered should be disseminated on a daily or weekly basis to anyone, or any organization, interested in receiving it--farmers, intermediaries, market boards or others. Unless the beneficiary receives the data on a timely, current basis it will have little or no value. The most efficient method of dissemination would be through use of the local public radio stations in much the same manner as the "Agricultural Hour" or similar programs that are used.

Production Information. Once the price and sales reporting service becomes operative, production data collection should be established. Representative samples of farmers in the main perishables production areas of the island should be the source. Extension personnel, farmer associations, and intermediaries should all assist in drawing up the samples to ensure that they are representative.

The primary types of production data collected should be: acreage planted, acreage harvested and yields. Cost-of-production data collected at the same time would be useful for a number of purposes.

The appropriate agency for collection and dissemination would appear to be the Extension Service of the Ministry of Agriculture. The data collected could probably be best reported to beneficiaries once a week in association with price and market reports. Production cost data might also be included when appropriate.

Program Implications. Short term technical assistance in regard to the design, content, organization, and establishment of the system will be needed.

In-country personnel required: Extension personnel, one statistician, a technician to organize data. Travel expenses will have to be provided.

Other funding requirements will be:

- . Cost of seminars of intermediaries and farmers.
- . Cost of organization and operation of statistical collection, analysis and summary report system.
- . Cost of radio dissemination of data.

## 2. Year 2

Further development and refinement of the country system in Dominica would be pursued. Included may be broadening the scope of the system in terms of the information collected and disseminated; for example, to cover additional crops or producing areas, to advise on projected productions of, and demands for, particular crops; or introduction of appropriate technology innovations to farmers, intermediaries or others involved in the system.

Program Implications. Additional in-country personnel requirements: One statistician, two data technicians and additional extension personnel (4?). Added travel and expense support will be required.

Additional funding will also be required for:

- . Cost of seminars for extension agents.
- . Cost of development and distribution of other reporting devices, such as periodic publications.

### 3. Year 3

Country information systems similar to that for Dominica would be established in other Eastern Caribbean countries with program implications similar to those described above.

### 4. Year 4

It is anticipated that all of the country information systems would be functional by the fourth year. At that time the regional information system, drawing on the country systems, should be established and operated by some neutral, regional agency not involved in the marketing system or tied to any particular country. The team is not familiar enough with alternatives which may be available to recommend which agency might be most appropriate.

## C. UTILIZATION OF "LOSS" PRODUCTS

### Objective

To determine the feasibility of utilizing perishable products not used for human consumption for other purposes, thus realizing residual values of such products and reducing economic losses now being incurred.

### Focus and Development Program

A three-year program is envisioned. Initially only the feasibility in one country should be studied, although conclusion of the study may well have application in other countries. Either St. Vincent, St. Lucia, or Dominica could be appropriate choices for the initial study, with the main criteria being which crops are the major "loss" products and known possibilities for utilization of those products.

During subsequent years, similar studies in the other countries and dealing with a wider range of products could be pursued. This program is not intended to cover implementation of any recommendations which may be made in such studies, that will be the subject of separate, additional projects.

### Scope of Work - Initial Study

The following are the principal areas of investigation and consideration which should be involved in the study:

1. Identification of the principal "loss" crops in the country.
2. Determination of the volume, condition and the points in the marketing system where such crops normally collect.
3. Identification of potential, economic uses for such crops, including (but not limited to) use for animal feeds or composting, based upon experience in, or information from, the U.S. or other countries.
4. The existing or potential available market demand for the crop, or resulting product if changed in form, and the requirements for capitalizing on that market.
5. Consideration of any technical or educational aspects involved in the use of the crops in the indicated way.
6. Facility and other requirements.
7. Analysis of the technical and economic feasibility and recommendations with respect to implementation.

Short term technical assistance will be required for the study. Required expertise will be in marketing, the conduct of feasibility studies, and the utilization of agricultural waste. Familiarity with the agriculture and marketing systems of the countries involved, would also contribute to the effectiveness of the program.

### Program Implications

It might be possible to find a single expert with the necessary technical and other expertise, but it is probable that a two-man team will be necessary. One would provide the marketing and feasibility study expertise and the other the technical expertise. Either, or both, should have area or country knowledge. Necessary travel and other support will have to be provided.

NOTES:

- <sup>1</sup> Principal Sources: Fruit and Vegetable Facts and Pointers (a series), United Fresh Fruit and Vegetable Assn.; The Commercial Storage of Fruits, Vegetables, Florist and Nursery Stocks, Ag. Handbook 66, U.S. Department of Agriculture (1968).
- <sup>2</sup> These periods are those normally experienced with the varieties commonly grown and marketed in the U.S. Storeability of other varieties, and periods during which quality can be maintained, may vary.
- <sup>3</sup> Mangoes and ripe bananas not stored.
- <sup>4</sup> Ripe tomatoes and melons not stored.

APPENDIX A

OPTIMUM CONDITIONS FOR MAINTENANCE  
OF QUALITY AND STORAGE OF SELECTED  
FRUITS AND VEGETABLES

<u>Fruit</u> <sup>3</sup>	<u>Transit &amp; Storage Temp. (°F.)</u>	<u>Storage Humidity %</u>	<u>Period of Maintenance of Marketable Quality</u> <sup>2</sup>
Avocados (West Indian Varieties)	55°	N.A.	Max. 2 weeks
Grapefruit	50°-60°	85-90%	4-6 weeks
Oranges	40°-50°	N.A.	8 weeks or less
Limes	48°-50°	85-90%	Some varieties, 3-4 weeks
 <u>Vegetables</u> <sup>4</sup>			
Cabbage	32°	90-95%	3-4 months
Carrots	32°	90-95%	Topped: 4-6 weeks (if hydrocooled at harvest)
Cucumbers	45°-50°	90-95%	10-14 days
Egg Plant	50°	90%	7 days
Okra	45°	N.A.	7-10 days
Onions, dry	32°	65-70%	Curing required, Soft varieties - 1-2 months, Hard varieties - 6-8 months
Sweet Potatoes	55 -60	85-90%	Curing required, about 4 months

APPENDIX B  
PARTIAL LISTING OF  
PEOPLE AND ORGANIZATIONS CONSULTED

In addition to those people identified below, numerous others were contacted on a casual basis during the course of the study. Among them were farmers, country buyers for intermediaries, domestic and export intermediaries, marketplace sellers, port and customs officials, schooner crews and dock workers.

DOMINICA

Collin Bully - Chief Agricultural Officer, Ministry of Agriculture  
Allen Guy - Director of Extension, Ministry of Agriculture  
H. Clarendon - Crop Protection Unit, Division of Agriculture  
M. Laurence, Produce Chemist Laboratory, Division of Agriculture  
Mrs. Fingal, Dominica Industrial Development Corp.  
Herman Adams - Caribbean Agricultural Research and Development  
Institute  
R. Shukla, N. Charles - Manager and Assistant Manager, Marketing  
Board  
J. C. Bruney - Manager, Citrus Growers Association  
Mr. James - Manager, Dominica Banana Growers Association  
T. McCoy - Coconut Rehabilitation Program  
Dore O'Garro - President, Dominica Huckster's Association  
Albert Astafea - Farmer (Huckster)  
Refred Andrew - Farmer  
Goddard Williams - Farmer

## Appendix B (Cont'd)

### ST. LUCIA

- David DeMarque - Chief Agricultural Officer, Ministry of Agriculture
- Robert Rickman - British Advisor to the Chief Agricultural Officer
- Maurice G. Carter - Regional Marketing Advisor, British Development Division
- David Jackson - Tree Crops Expert, British Development Division
- Michael P. Toussaint - General Manager, St. Lucia Marketing Board (SLMB)
- Mr. Ambrose - Purchasing Manager, SLMB
- Mr. Pemberton - Warehouse Manager, SLMB
- A. F. Rodriguez - Director, Geest Line Caribbean Representative
- Jean Baptiste - Private trader

### BARBADOS

- Basil G. F. Springer - Chairman, Barbados Marketing Corporation
- James S. Lohar - Marketing Advisor, ITCA, Barbados Office
- F. J. Proctor - Tropical Products Institute (London)
- David Hughes - Export Consultant, Haskins & Sells (Canada), working with the Systems Group, a Barbados consulting organization.

### ST. VINCENT

- Mr. Van Loo - Deputy Minister of Agriculture
- Jethro T. Green (and other members of organization) - Chairman, Organization for Rural Development
- A. C. Antrobus - Manager, St. Vincent Marketing Corp. (SVMC)
- Mr. Henderson - Warehouse Manager, SVMC
- Marcus DeFreitas - Managing Director, Eastern Caribbean Agency, an exporter to Canada, UK and Barbados
- Executive Committee - Georgetown Farmers Association
- Mr. McLean - Intra-Regional Intermediary
- Mr. Skaggs - Schooner Captain

## APPENDIX C

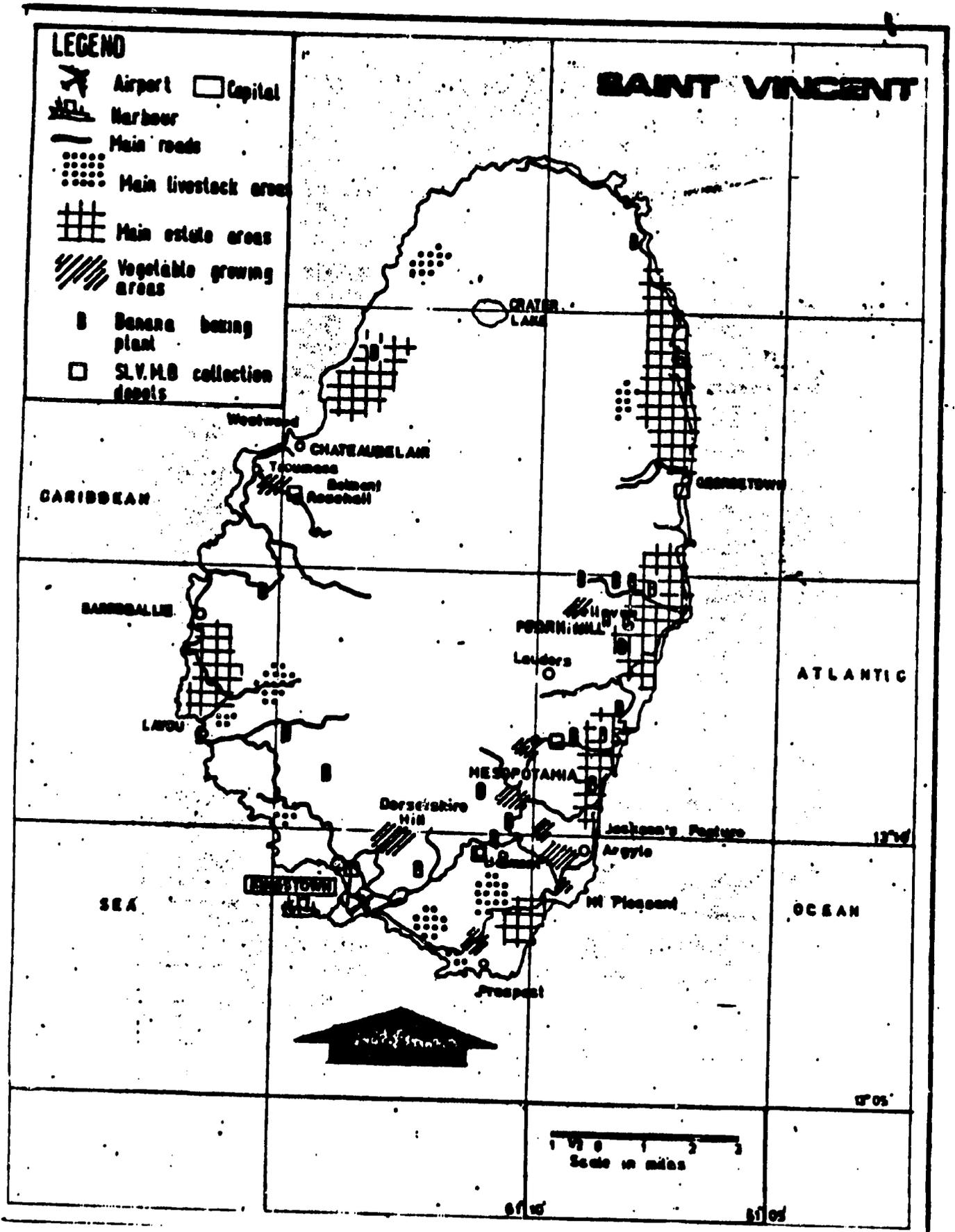
### PRINCIPAL SOURCES CONSULTED

- (1) Small Farmer Production and Marketing Systems Study - Phase I and II Reports, Louis Berger International, Inc. in joint venture with Systems (for Caribbean Development Bank (1978 )
- (2) A Survey of Small Scale Agricultural Marketing Enterprises in the Eastern Caribbean - Volumes 1 and 2, Systems group of companies (for the FAO) (1980)
- (3) Small Farming in the Less Developed Countries of the Commonwealth Caribbean, Weir's Agricultural Consulting Services Ltd. (for Caribbean Development Bank) (1980).
- (4) "An Overview of Postharvest Losses in the Caribbean", Jerry LaGra (Agricultural Marketing Specialist, ITCA). Paper presented at the first consulting meeting on postharvest losses in the Caribbean, University of West Indies, Trinidad, July, 1981).
- (5) "Postharvest Losses in Perishable Crops", Michael F. Jamieson (Regional Agricultural Services Officer, FAO Regional Office for Latin America).
- (6) "Evaluation of Problems of the Food Crop Marketing System with Special Reference to the More Developed Countries of Caricom", Winston C. Smith (Caricom Staff). Paper presented at aforementioned Trinidad meeting.
- (7) "Postharvest Losses in St. Lucia", Julius Polius (Agronomist, Ministry of Agriculture, St. Lucia). Paper presented at aforementioned Trinidad meeting.
- (8) "Postharvest Losses in Dominica", H. Clarendon (Crop Protection Unit, Ministry of Agriculture, Dominica). Paper presented at aforementioned Trinidad conference.
- (9) "Postharvest Losses in Barbados", Jeffrey E. Jones (Ministry of Agriculture, Barbados). Paper presented at aforementioned Trinidad meeting.

Appendix C (Cont'd)

- (10) An Analysis of Food Self-Sufficiency in Barbados,  
J. S. Lahoar (ITCA) (1981)
- (11) An Assessment of the Production and Marketing of  
Onions in Barbados, ITCA (1981)
- (12) Onion Harvesting, Drying and Storage in Barbados,  
F. J. Proctor (of Tropical Products Institute for  
ITCA) (1980)
- (13) Fruit & Vegetable Facts & Pointers, United Fresh  
Fruit & Vegetable Association (USA). A series,  
technical and marketing information with respect  
to fruits and vegetables commonly traded.
- (14) "St. Vincent Marketing Corporation Act, 1975",  
Assembly of St. Vincent, June 6, 1975.

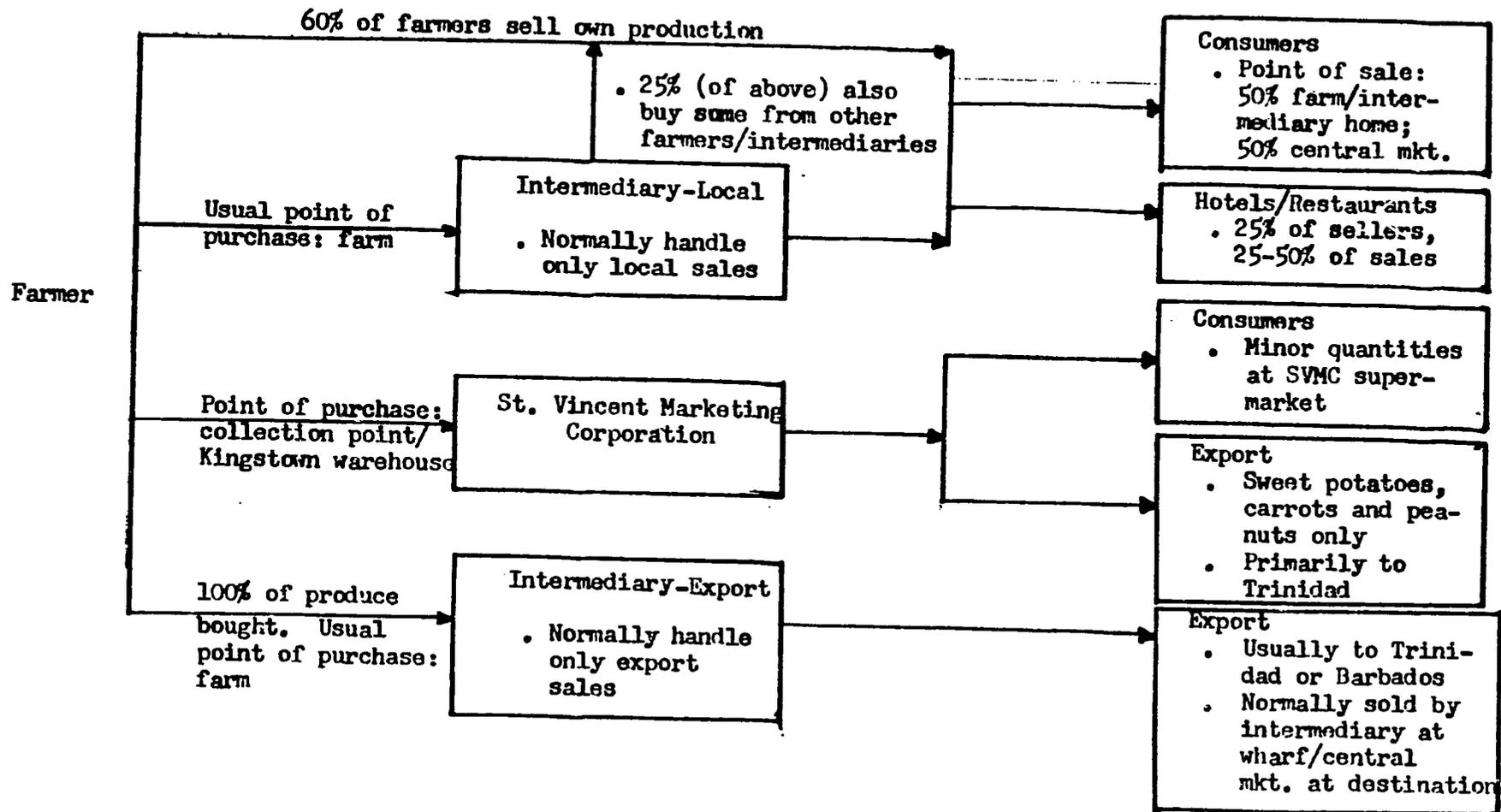
FIG. 1



SOURCE: Small Farmer Production and Marketing Systems Study (Phase I Report), Louis Berger International, Inc. (1978).

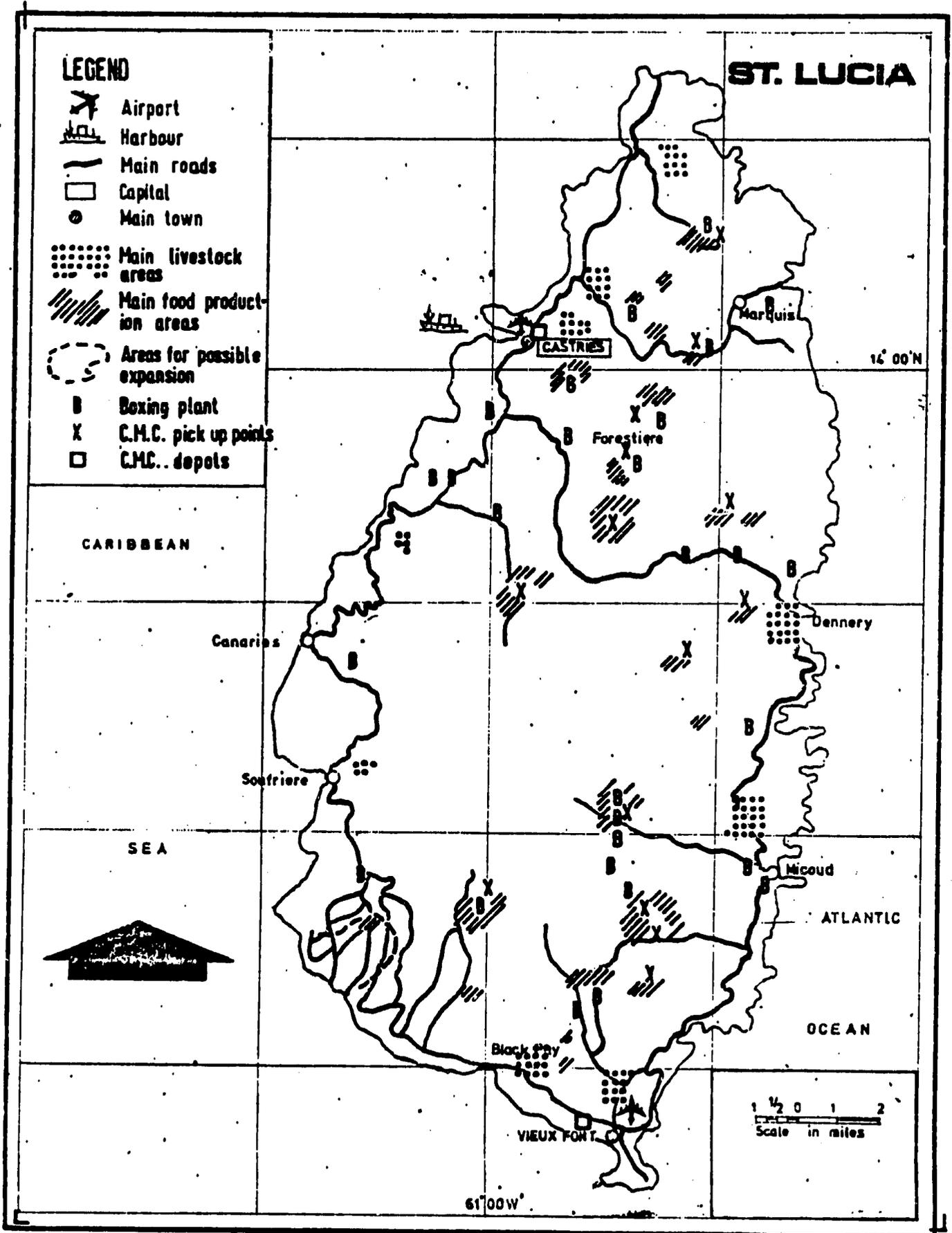
FIG. 2

ST. VINCENT - LOCAL AND REGIONAL PERISHABLES MARKETING SYSTEM<sup>1</sup>



1. Primarily derived from A Survey of Small Scale Agricultural Marketing Enterprises in the Eastern Caribbean (Vol. 1), Systems Group (for the FAO) (1978). Percentages refer numbers of sellers, not sales.

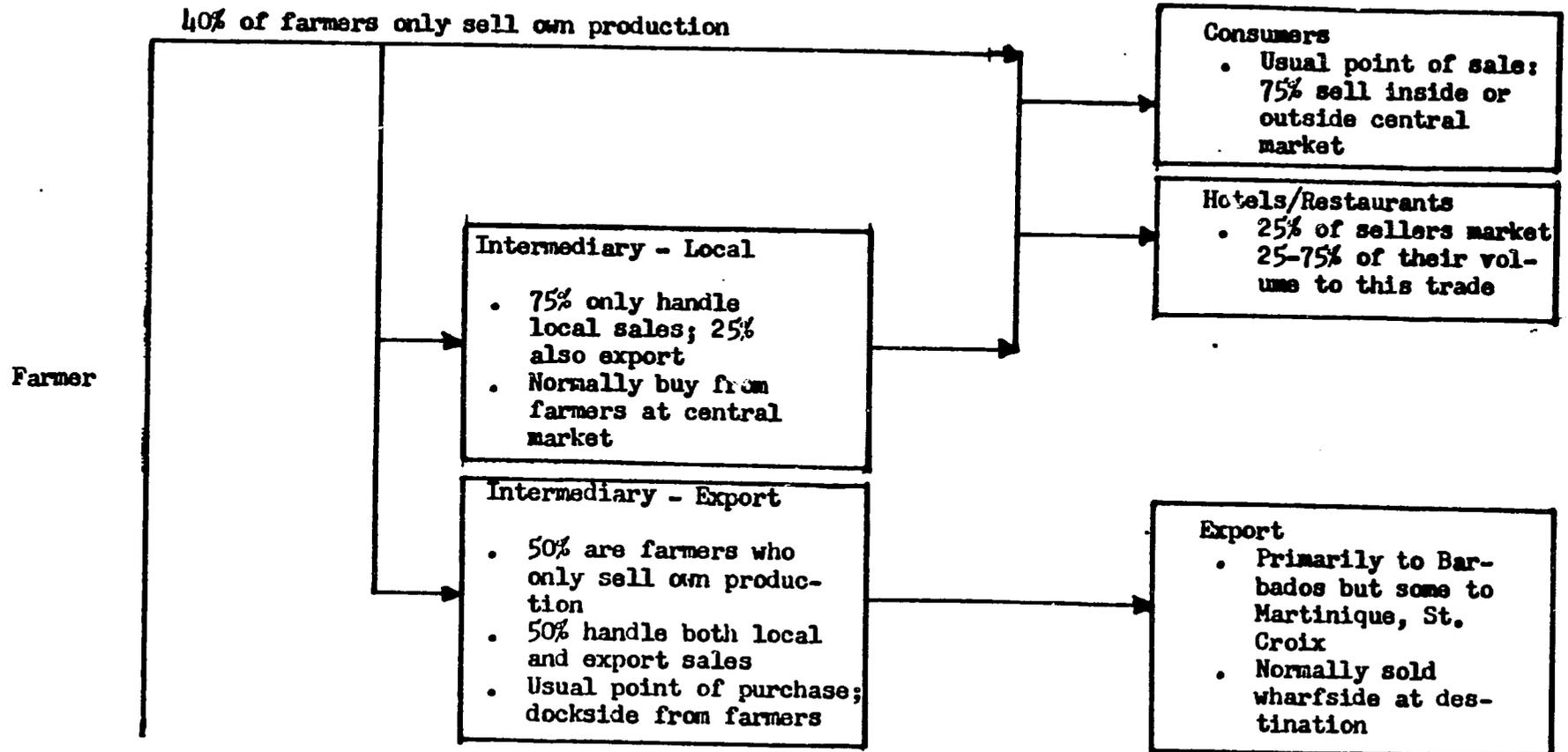
FIG. 3



SOURCE: Small Farmer Production and Marketing Systems Study (Phase I Report), Louis Berger International, Inc. (1978)

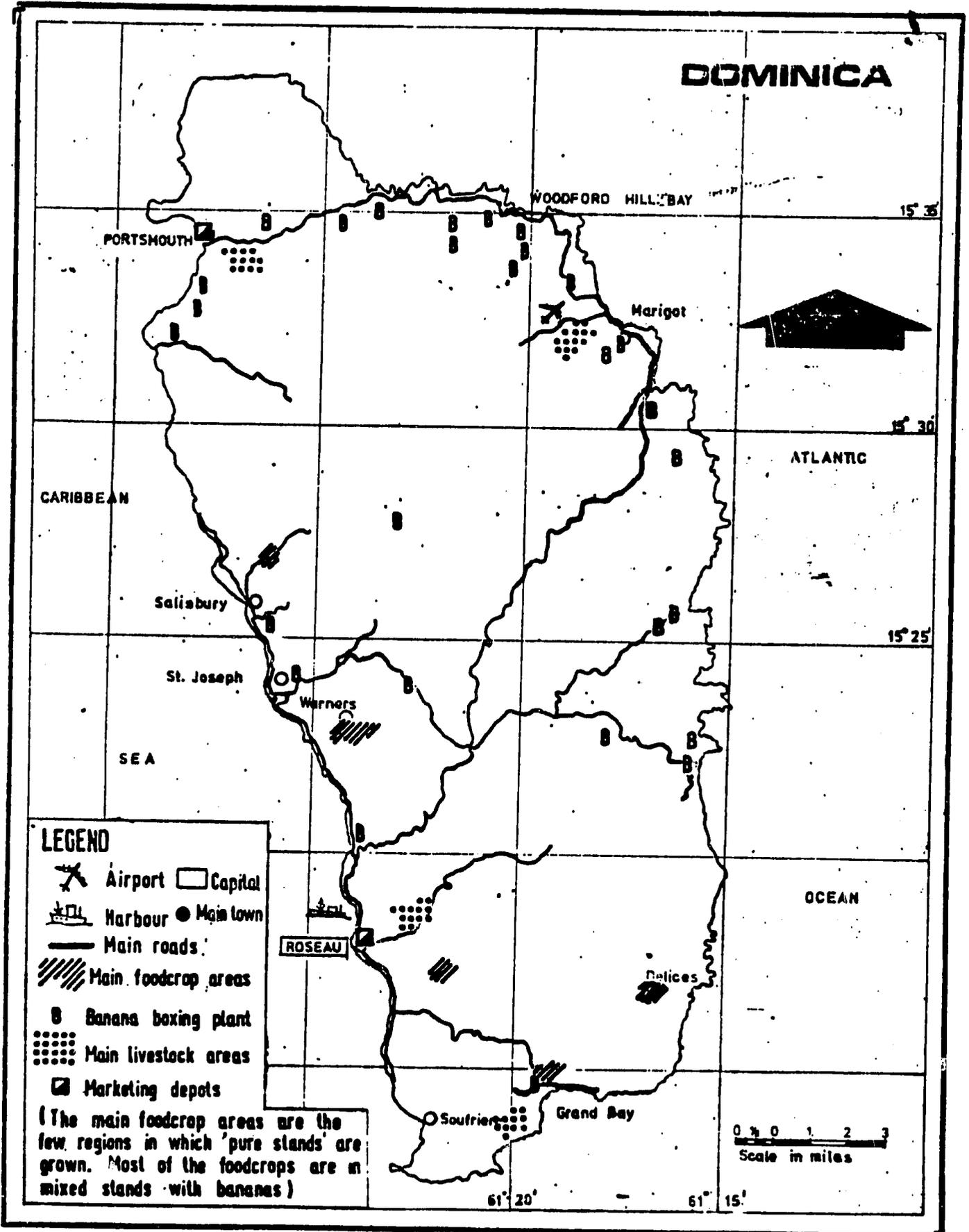
FIG. 4

ST. LUCIA - LOCAL AND REGIONAL  
PERISHABLES MARKETING SYSTEM<sup>1</sup>



1. Primarily derived from A Survey of Small Scale Agricultural Marketing Enterprises in the Eastern Caribbean (Vol. 1), Systems Group (for the FAO) (1978). The Marketing Board is not a significant participant in the system so is not shown. Percentages refer to number of farmers, not sales volumes.

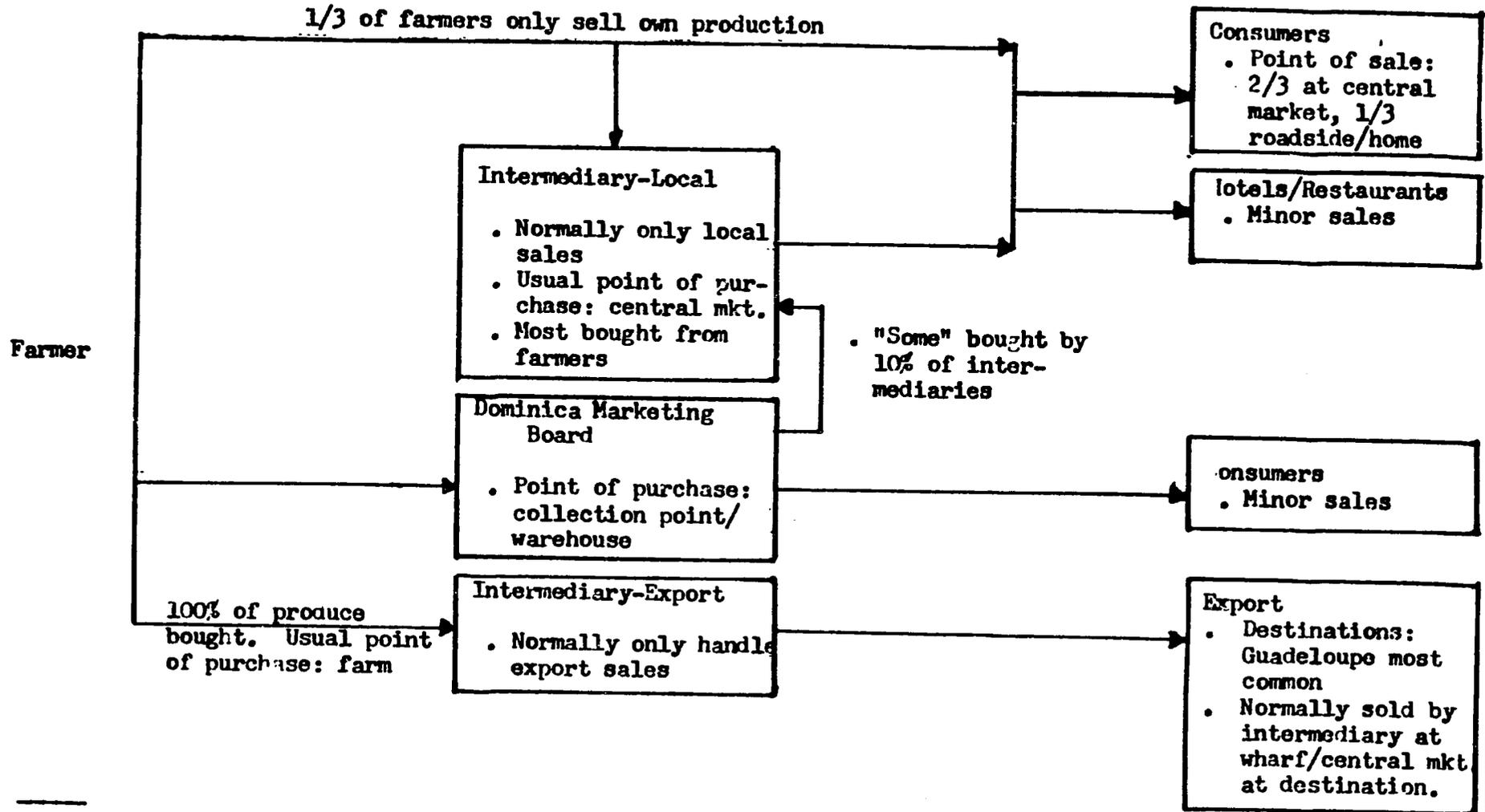
FIG. 5



SOURCE: Small Farmer Production and Marketing Systems Study (Phase 1 Report), Louis Berger International, Inc. (1978)

FIG. 6

DOMINICA - LOCAL AND REGIONAL PERISHABLES MARKETING SYSTEM<sup>1</sup>



1. Primarily derived from A Survey of Small Scale Agricultural Marketing Enterprises in the Eastern Caribbean (Vol. 1), Systems Group (for the FAO) 1978. Percentages refer to numbers of sellers, not sales volumes.