



**POSTHARVEST INSTITUTE FOR PERISHABLES**

POSTHARVEST LOSS INVESTIGATIONS  
IN  
THAILAND, INDONESIA AND THE PHILIPPINES

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**University of Idaho**

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POSTHARVEST LOSS INVESTIGATIONS  
IN  
THAILAND, INDONESIA AND THE PHILIPPINES

by  
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A condensed report from extensive investigative  
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## I. INTRODUCTION

This report is a condensed version of three observation reports on postharvest losses of perishable crops in Southeast Asia. The countries observed were Thailand, Indonesia and the Philippines. The objective was to observe postharvest handling of horticultural crops in the three countries and, if possible, identify postharvest problems common to all the countries and local facilities or capabilities for addressing those problems. From these problem areas it was hoped that recommendations would surface that would be relevant and beneficial to the three countries. This might include a plan for a postharvest methodology for assessing losses in perishable crops.

Four specialists made trips to Asia to observe postharvest handling of perishable food crops. These people and their specialty areas are given below:

Dr. Samson C.S. Tsou  
Director and Biochemist  
Production Systems Program (PSP)  
Asian Vegetable Research and Development Center

Dr. James R. Jones,  
Agricultural Marketing Specialist, University of Idaho

Dr. James R. Hicks,  
Postharvest Physiologist, Cornell University

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Directorate General of Food Crops/Agriculture  
Ministry of Agriculture, Jakarta, Indonesia

Because of the varied backgrounds of the specialists, it was necessary to condense their detailed observations and bring together in an abbreviated form the important points learned from their postharvest observations in Southeast Asia.

A number of other projects (Appendix i) have been supported by PIP in a continuous program to develop and extend to end-users of the Asian area improved methods for identifying and assessing losses of perishable crops.

II. ORGANIZATIONS INVOLVED IN POSTHARVEST ACTIVITIES  
IN THAILAND, INDONESIA AND THE PHILIPPINES

Thailand

Thailand has a number of involved government agencies to assist the private sector adequately in postharvest handling and marketing of horticultural commodities. These are given below:

- 1) Postharvest Technology Laboratory, Thailand Institute of Scientific and Technological Research (TISTR), Ministry of Science, Technology and Energy
- 2) Domestic Trade Department, Marketing Economic Division, Office of Agricultural Economics
- 3) The Marketing Section, Foreign Trade Division, Marketing Organization for Farmers, Office of Agricultural Economics
- 4) The Sub-division of Vegetable Crop Promotion (or fruit crops), Division of Crop Promotion, Department of Agricultural Extension
- 5) The exportation of horticultural crops also receives support from the Trade Advisory Section, Export Service Center, Department of Commercial Relations, Ministry of Commerce

Although there are several universities that are involved in research and teaching of the plant sciences, Kasetsart and Chiang Mai Universities are the ones that seem to have the most active postharvest programs.

Kasetsart University

Dr. Suraphong Kosiyachinda, Horticulturist and Plant Physiologist, has a well-equipped postharvest laboratory. Major emphasis is on fruit (especially mango). He has published a number of extension-type publications on postharvest handling; some are on vegetables. Dr. Suraphong has done research on containers, fruit ripening, quality, harvesting methods and general

postharvest losses. He also works with the Agriculture Engineering Department on a weight sizer for mangoes. There are also other university personnel involved in some other facets of postharvest work.

#### Chiang Mai University

Dr. Dania is the postharvest specialist who received his graduate training at Oregon State University. He has not had sufficient time to develop a program since he has only recently accepted the position. His main concern is physical damage and the resultant losses. It is thought that Dr. Dania will build his program around vegetable containers and handling. Chiang Mai University does have a postharvest program for grains which seems to be quite active although it is new. The university is starting a graduate program at the M.S. level in general postharvest losses which hopefully will include some aspects of horticultural crops.

Although there is a Department of Agricultural Extension under the Ministry of Agriculture and Cooperatives, the two universities mentioned above are also active in some postharvest extension activities. This situation may have developed out of necessity. At present, personnel at the sub-division of Vegetable Crops Promotion are hoping to initiate a postharvest program in the near future. With already limited resources, they will be faced with an additional task of personnel training.

Within the Department of Agriculture (DOA), the postharvest work is somewhat centered in the Seed and Postharvest Pathology Branch of the Division of Plant Pathology and Microbiology. As the name implies, the major effort is on postharvest diseases. The seed work centers on mycotoxins but there is also emphasis on postharvest diseases of fruits and vegetables.

The pathology orientation is also apparent in the Postharvest Technology Laboratory of the Thailand Institute of Scientific and Technological Research (TISTR). However, in this case research on physiological aspects of postharvest handling is being initiated. The TISTR laboratory is conducting research on ripening, chilling injury and precooling requirements of horticultural crops. The joint effort of the Postharvest Technology and the Packaging Technology Laboratories has resulted in new containers for horticultural produce.

Also operating under the auspices of the DOA is the Pesticide Residue Laboratory. This lab is part of a special project to market vegetables that have "acceptable" residue levels. These products are grown by growers participating in the project and sold in specified retail outlets. The major goal of this project is to demonstrate that vegetables can be grown and marketed without excessive use of pesticides. The DOA is also looking at alternatives for pest control and seems to be making progress.

#### Indonesia

Mr. Jafri Jamaluddin, Secretary General for Food Crops Agriculture,  
Department of Agriculture

On behalf of the Director General, Mr. Jamaluddin discussed the important role of this institution in reducing postharvest losses in relation to improving production and increasing the income of farmers. The government through extension services, workshops, seminars, and training, supports those activities that reduce losses. The government also realizes how difficult perishable crops are to handle compared with grain or other secondary crops. In addition, transportation and handling are still poor.

Dr. Alhambra, Director General, National Agency for Export Development  
(NAFED)

Dr. Alhambra discussed the role of the National Agency for Export Development (NAFED), to improve the quality of commodities being exported, and the role of other institutions involved. The importance of government policy in trade and improvement of marketing efficiency was also mentioned.

Mr. Ginting T., Vegetable and Fruit Market Center

Mr. Ginting T. discussed the role of the Vegetables and Fruits Market Center in improving the quality of the products at the market system in Jakarta and Indonesia as a whole. Introducing cold storage in this central market has apparently not been economically feasible to date.

Mr. Lubis, Chief of the Field, Medan-Belawan Port, Department of Communication

Mr. Lubis discussed and described activities associated with handling vegetable exports in the field and harbor. The kind of losses, transportation systems for vegetables, the role of the storehouses, shipping, trucking, packaging and type of packaging was also discussed. Mr. Lubis concluded that many losses were due to poor handling.

Mr. Ginting S., Director Karye Tani Ltd, Private Exporter

Mr. Ginting S., discussed the closeness of the relationship among middlemen; traders, both domestic and abroad; and the role of handling in determining the losses and the prices of perishable crops. Emphasis was placed on the improvement of storehouses in the field and within the harbor.

Philippines

The Philippine Council For Agriculture Resources Research and Development (PCARRD)

PCARRD is an agency of the National Science and Technology Authority. PCARRD's objective is to develop, strengthen, and coordinate a national research system in agriculture and resource related issues.

Specific Objectives:

- a. Define goals, purposes, and scope of research necessary to support development in agriculture, forestry, fisheries, and mining.
- b. Program the allocation of all government revenues designated for agriculture research to implement a national research program.
- c. Develop a multi-disciplinary, interagency, systems approach in the national research program.
- d. Establish priorities and guidelines for research.
- e. Develop and implement research fund generating strategies.
- f. Program and implement assessment of research progress.
- g. Establish a repository for research information.
- h. Enter into agreements or relationships with other institutions, both national and international, to further the above.

### Activities

PCARRD exercises the power to review all research proposals in agriculture and natural resources and to recommend research proposals for funding. This agency would likely play a coordinating and facilitating role in any future joint efforts between PIP/AVRDC and Philippine entities such as PHTRC or other organizations involved in postharvest and marketing research and training endeavors. PCARRD and the Bureau of Plant Industry (BPI)/Philippine Outreach Program (POP) provided logistical and scheduling assistance to the PIP/AVRDC team on this project.

### The Asian Vegetable Research and Development Center--Philippine Outreach Program (AVRDC/POP)

AVRDC/POP was established in 1975 under a two-year technical assistance agreement between the Ministry of Agriculture and Food (MAF) and the Asian Development Bank (ADB). It was implemented by the Bureau of Plant Industry Economic Garden in Los Banos, Laguna. Upon completion of its two-year assistance agreement with ADB, the Philippine Council for Agriculture Resources Research and Development (PCARRD) approved in 1978 the incorporation of AVRDC/POP in the national research system as PARRS Project 722 entitled "Testing of AVRDC Vegetable Varieties in the Philippines" for a period of 5 years.

In 1983, the AVRDC/POP was integrated in PCARRD's research system with funding jointly provided by the BPI Research Division and the PCARRD.

Doing research on Chinese cabbage, tomato, mung bean, soybean and sweet potato, the main objectives of the project are:

1. To test in the Republic of the Philippines varieties of vegetables and cultural practices developed by AVRDC; and
2. To determine the varieties and cultural practices suited to local conditions and requirements.

Since its establishment, the AVRDC/POP has released through the Philippine Seed Board the following varieties:

- a. Chinese cabbage Hybrid 62 was released in 1983 under the local name "Reyna Elena."

- b. Sweet potato - LO-323 was released in 1983 under the local name "BPI Sp-1."
- c. Mung bean - VC 1163 was released in 1984 under the local name "BPI-Mg-2."

Four lines of industrial type of tomatoes have been identified and are widely grown in Pangasinan, Cavite and Laguna to meet the growing demands of the local tomato paste industry. The AVRDC soybean line AGS 73 has ranked consistently among the highest in terms of bean yield in both wet and dry seasons in ten locations. Hundreds of promising AVRDC breeding lines are undergoing different levels of testing both in the experiment station and in the farmers' fields.

At present the AVRDC/POP program lacks a postharvest component.

#### Postharvest Horticultural Training and Research Center (PHTRC)

The ASEAN-supported PHTRC was established by a grant from the Australian Government under the ASEAN-Australian Economic Cooperation Program at the University of the Philippines, at Los Banos (UPLB) in 1977. The Center has served as the ASEAN region postharvest research and training center. As of July, 1985, it has become a national center as the other ASEAN members have developed or are developing their own national programs in postharvest horticultural training and research. The Center is the major institution in the Philippines that conducts postharvest training and research activities.

#### 1. General Objectives

The Center has training, research, and extension activities. Research activities conducted by both the staff and trainees have been focused on the reduction of food losses through the improvement of the handling and distribution of fruits and vegetables at all stages of movement of commodities from harvest to consumption.

#### 2. Specific Objectives

- a. Train and develop a professional staff cadre to address postharvest loss reduction in the nation and region through short and long term training courses ranging from two weeks to one year. The programs are conducted to meet the specific needs of extension agents, researchers and middle level supervisors.

- b. Create an awareness and appreciation of postharvest horticulture in the Philippines (and formerly the southeastern Asian region) through training programs, production of a newsletter, collaborative research, seminars, workshops and in other countries.
- c. Through basic and applied research, develop the knowledge and technology to reduce postharvest losses of fruits and vegetables grown in the Philippines and support the Philippine agribusiness export promotion program.

#### Principal Postharvest Activities

The PHTRC currently conducts the most extensive training programs in postharvest horticulture in Southeast Asia. Training courses are designed to enable graduates to obtain necessary basic information, technology and research skill in postharvest handling of fruits and vegetables. These programs range from two weeks to one year in duration with participants from Thailand and Indonesia as well as other Asian countries. The long-term training courses include lecture-laboratory sessions on principles, technology, instrument familiarization and seminars. Observation tours to various fruit and vegetable growing areas, packinghouses, marketing centers, cold storage plants and canneries are included. Participants also conduct individual short term research projects.

PHTRC postharvest research deals with (1) ASEAN mango and rambutan pre-harvest control, anatomy, packaging, pest and diseases control, storage, ripening, and marketing, (2) survey of potato handling practices, transportation and nonrefrigerated storage, (3) village level onion storage, transportation and packaging, and (4) packinghouse technology. The Center has an experienced and well-trained professional staff which is backed up by relatively modern laboratory and instrument facilities. While this staff is small and has to focus on specific priority activities its most serious constraint at this time appears to be operating funds.

### Food Terminal, Inc.

The Marcos administration has undertaken the development of an ambitious program to improve the agricultural marketing system in the Philippines. To implement this national strategy the Food Terminal Inc. (FTI) was established and formally began operation in 1974. As a subsidiary of the National Food Authority (NFA) and a government owned corporation, FTI engages in direct trading of commodities, storage and food processing, and more recently it has begun to provide transport and retail services in the food industry. FTI is considered the largest food complex in the Philippines covering a 120 hectare area in Manila and consisting of a huge investment in trading, storage, and food research facilities.

#### 1. General Objectives:

FTI's objective is to provide an efficient marketing network for food commodities and to provide facilities and services to farmers, food processors, producers, wholesalers and retailers.

#### 2. Specific Objectives:

- a. Ensure a steady supply of quality foods at reasonable prices
- b. Boost the Philippines' foreign exchange through exports
- c. Provide a center for the latest food technology.

### Principal Postharvest Activities

FTI possesses modern and extensive storage and food facilities. A central refrigerated warehouse with an effective storage capacity of 55,000 cubic meters is considered the largest single refrigerated warehouse in Asia. This is complemented by warehouses, processing facilities, highly trained personnel and modern processing, grading, freezing, packaging and trading equipment. A Food Research Department participates with university and other government agencies in research programs in fruit and vegetable processing, storage, handling, and packaging. The FTI complex includes 77 buildings in the Manila compound and part of these facilities are available for lease by private entrepreneurs. In the decade or so that the complex has been in existence, it has been the brunt of considerable controversy due to the extensive role of the government in marketing activities and the large investments made in the project. While the marketing and transportation network of the countryside is

inadequately developed and overstrained, the modern and extensive Manila FTI complex is underutilized and expensive to maintain. Whether the investment was warranted at the time or not, FTI is important as a component in the postharvest system in the Philippines.

#### Agro-Processing and Marketing Project (APM)

The Philippine government in its thrust towards food self-sufficiency and agribusiness export development has requested through the National Food Authority (NFA) a loan from the Asian Development Bank (ADB) for loan assistance to provide funds for an Agro-Processing and Marketing project (APM). According to the information received in 1982, ADB extended to the Philippine Government a loan amounting to \$36 million to support the foreign exchange cost of the project and the local cost component to be provided by the government is to be another \$16 million. (Feasibility study conducted by the Postharvest Institute for Perishables)

Objectives and Scope. The Agro-Processing and Marketing project aims to support government efforts to augment and modernize postharvest and marketing facilities in the food crop sector (rice, fruit and vegetables are included). The project states as one of its aims the improvement of the efficiency of postharvest handling and correction of distortions in the marketing system. Included in the Agro-Processing and Marketing proposal is the establishment of six farmers' markets in the major vegetable growing areas of Luzon. Two trading centers will be improved to link these markets and in addition, plans call for opening a new wholesale market in Metro Manila. Plans also call for establishing a Food Technology Research and Development Center (FTRDC) to undertake studies on how to reduce postharvest losses and improve marketing techniques and ways to preserve the quality of fruits and vegetables. Original plans called for the AMP to be in place by 1986.

#### The Food and Nutrition Research Institute (FNRI)

FNRI is the Philippine's lead agency for food and nutrition research.

##### Objective

Improve and develop processes enhancing the nutritional value of food.

Other international agencies involved in postharvest activities in the Philippines are:

World Bank (WB)

United States Agency for International Development (USAID)

ASEAN-Australian Economic Cooperation Program

Asian Development Bank (ADB)

III. PROBLEMS OBSERVED IN POSTHARVEST ACTIVITIES IN THAILAND, INDONESIA AND THE PHILIPPINES

The three countries where observations were made have a number of common characteristics. They are in hot, tropical areas with relatively large land areas spread out over considerable distances. Roads other than main arterials are generally poor. All three of the countries can or do produce somewhat the same vegetable or fruit crops. All are suspected of having large postharvest losses in perishable crops with limited personnel and financial commitments to reduce these losses.

Because of the commonality between the three countries, the problem areas studied by the three specialists have been grouped together. A difference that could probably be shown is the degree or severity of the problem areas mentioned in the three countries. Establishing that a particular, serious postharvest problem exists within the countries examined was judged sufficient to include it as a common problem. Whether it was less or more severe in a particular country was immaterial as far as the objective of this report of listing the major problem areas common to the three countries.

Problem areas briefly described below are given in more detail in some of the PIP reports listed in Appendix 1 that were the result of investigative work in Asia.

Vegetable Handling Technology

The handling of vegetables and most fruit has not advanced significantly in the past several decades in any of the three countries according to many of those interviewed. This is especially true in rural areas that are far from the large urban centers. There is still no premium price paid for grading produce and standards have not been established in vegetables and most fruit species.

In the Philippines, the Food Terminal Inc. has a program to train people who in turn train growers to grade their fruit. As observed, this program is limited to either fruit purchased by the FTI or that which is exported. There is very little, if any, emphasis on vegetables.

The private sector does grade fruit according to its standards which are more applied to exports. The main reasons for lower prices in vegetables exported from Indonesia have been reported to be low quality, lack of standards and poor shipping<sup>1/</sup>.

One importing company in Hong Kong reported that it avoids purchasing fruits or vegetables from Thailand because of lack of quality standards or grades. Company personnel reported that they believe that orders are filled with whatever quality produce that is available at the time of the purchase order.

In Southeast Asia, it is standard practice to sell perishable produce on the basis of an expected average quality throughout the container. That is, a standard basket container will be comprised of good, average and poor quality produce. Depending on the end user of the product (domestic, processing or export) the produce may be sorted and/or graded according to individual preference. Since there are few, if any, incentives offered for marketing a high quality product, the result is average quality for any particular lot of produce.

#### Inadequate Packaging and Shipping Containers

The standard shipping container for transporting fruits and vegetables within the three countries of this report is a flexible basket made from split bamboo. These containers are inexpensive, readily available and can be packed tighter than rigid containers. Observations show that they are frequently over-packed in transporting vehicles. These baskets, packed tightly in vehicles, and coupled with long transportation routes in hot, humid weather on poor roads, almost guarantee sub-quality produce at arrival points.

There is a question of whether domestic demand, which utilizes most of the fruits and vegetables grown in the three countries, will pay for higher quality with increased prices. There is also the question of whether other more expensive manufactured packing methods are economically feasible as substitutes for using actual produce as a transport cushion in bamboo baskets.

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<sup>1/</sup> Postharvest Losses of Vegetables from Indonesia to Singapore, M.S. Thesis, Nasrun Hasibuan, University of Idaho, 1985.

### Lack of Refrigeration and Storage Facilities

Refrigerated vehicles and cold storage are acutely inadequate in the three countries. All three have some refrigeration facilities, most notably in the large urban areas such as capital cities. The public sectors in the Philippines (Food Terminal Inc.) and Thailand (Cold Storage Organization-CSO) own cold storage and refrigerated vehicles. The CSO in Thailand owns a number of refrigerated vehicles which are contracted to ship longans and grapes to Singapore.

There is an unknown quantity of cold storage facilities owned by the private sector although that which is known to be available is grossly inadequate. It is known that very few cold storage facilities are available in any of the three countries to transport perishable produce grown some distance from the large urban centers.

It has also been observed that growers do not have facilities to remove field heat from fruits and vegetables prior to shipping. It can be said with almost certainty that the loss of quality in perishable crops usually begins with the handling of produce during and immediately after harvest.

### Improper Handling of Onions, Garlic and Potatoes

Onions, garlic and potatoes are a part of the diets of the three countries with onions and garlic being utilized more extensively. Because of lack of proper storage facilities, Thailand is reportedly losing 40-50 percent of its potatoes. It has been observed that onions in Thailand are harvested, topped, and bagged in the same day without curing. Onions are stored, usually under ambient temperatures and humidity.

Garlic may be exported during the harvest period and imported during the other times of the year because of a lack of storage facilities.

### Inadequate Extension of Relevant Economic Postharvest Technology to Potential Users

There is no lack of awareness, knowledge or concern by specialists associated with postharvest activities in the three countries on the need to

improve postharvest technology. For various reasons, the postharvest technology within each country and the region, is not reaching those who might benefit from the information. Extension of practical postharvest technology has been slow to take effect in Southeast Asia. Some of the reasons observed for this immobility are: inadequate funding commitments, too few specialists in postharvest activities, lack of incentives to the private sector to improve food quality, substantial investments required, insufficient information at a practical level received by the majority of potential end users, difficulties in breaking down traditional barriers, and insufficient economic data to show that improvements in postharvest technology are economically viable.

The three countries examined in this report have a total estimated population of 250 million. As mentioned earlier in the text, there are long distances between urban centers and rural production areas. Roads are generally poor and communications inadequate. With this background, it is not surprising that postharvest technology has not been extended to producing areas in the remote sections of the country.

#### A Shortage of Postharvest Loss Data

Postharvest losses of perishable crops in the three countries are largely based on estimates, not accurate data. There have been few studies to determine where major perishable food crop losses occur and the percentage of losses based on scientifically collected data.

There has been relatively little research on the economics of postharvest losses to establish what percent of losses is economically acceptable.

Because of the above unknowns - and others - and the lack of a relevant postharvest assessment methodology that is affordable and practical, this field is still in its infancy in Thailand, Indonesia and the Philippines.

#### IV. RECOMMENDATIONS

Two of the consultants who visited the three countries in this report spent a considerable amount of time in Taiwan during their Asian trip. In Taiwan, they cooperated with the Asian Vegetable Research and Development Center (AVRDC), and particularly with Dr. Samson Tsou. Since the AVRDC is involved with vegetable research in the Asian area and with the three countries in this report, its personnel are also concerned with postharvest losses of perishable crops. Therefore, some of the recommendations have included the involvement of the AVRDC.

Two of the PIP consultants attended the Workshop on Postharvest Loss Assessment in Manila in February, 1985 (Appendix 2). Some of the recommendations in this report are spin-offs of more detailed recommendations made at the workshop.

##### 1. Information Exchange Between PIP and the AVRDC

AVRDC is involved with vegetable research in the Asia area. In regard to postharvest information exchange, the AVRDC has requested that this research center collaborate with the Postharvest Institute for Perishables. The AVRDC would act as the Asian repository for postharvest research information collected and stored by PIP. This research data would be distributed to other Asian countries through requests and workshops by the AVRDC.

##### 2. Development of a Combined Postharvest Training Course and Field Manual for Mid-Level Personnel on Assessment of Perishable Food Losses

There is a need for a practical set of training guidelines offering an intensive short course for mid-level agricultural personnel and private sector intermediaries in initial efforts at identification and assessment of postharvest losses. This course would emphasize what to look for and how to use the information after it has been collected. Sector loss assessment would be the objective rather than on a country wide basis. (See pp. 28-30 of Appendix 2.)

A publication or guideline manual would be developed to be utilized as a field manual that would be widely distributed to Third World agricultural organizations for initiating the process of identifying postharvest losses. PIP, AVRDC and ASEAN and other relevant organizations should collaborate on the development of the proposed manual.

3. Support of Postharvest Organizations in Thailand, Indonesia and the Philippines - Immediate

There was until June, 1985 a regional postharvest center, the ASEAN Postharvest Horticulture Training Research Center (APHTRC) in the Philippines. It has since reverted to a national center for postharvest activities.

The immediate need is support for in-country postharvest organizations within the three countries concerned with this report. Collaboration with the other international or regional organizations operating in the area, which are concerned with postharvest losses, would be more effective. This might include PIP, the AVRDC, ASEAN, the Asian Development Bank and SEARCA.

The respective countries should be responsible for preparing proposals to funding organizations to assist in postharvest loss programs.

Postharvest areas that need to be strengthened are more effective extension programs to reach the potential end users of postharvest information, including the private sector. The research results that have been obtained are not getting out effectively to where the losses are occurring and to the food handlers that might benefit from training and information.

4. Development of a Regional or International Postharvest Loss Center in Asia for Vegetables - Long Term

There is a need for a regional or even international postharvest loss center in Asia for vegetables to provide technical assistance, training and transfer applied research to the extension process in postharvest loss areas. Most of the emphasis by in-country organizations is currently on

fruit losses. The large populations in Asia, combined with inadequate infrastructures and the lack of emphasis on vegetables, dictate that the long term solution to reduce food losses requires at a minimum the establishment of a regional center. One or two experts to be utilized at the center might be academicians with postharvest expertise taking sabbatical leaves. This would greatly reduce the costs involved, especially in the initial stages of development.

5. Research on Traditional Bamboo Containers Used in Transporting Perishable Food Crops

Traditional bamboo and sometimes thatch baskets are utilized to transport many perishable crops in Asia. It is expected that these containers will continue to be utilized for the foreseeable future.

Research should include estimating losses attributed to the use of these baskets in transporting major crops and strengthening the frames if losses are found to be substantial. Research work has been initiated in Thailand on better stacking methods and strengthening the frames of these traditional baskets.

6. Research to Develop Improved Storage Facilities for Onions, Garlic and Potatoes in Thailand, Indonesia and the Philippines

All three of the countries produce onions, garlic and potatoes and consequently have storage problems due to the hot and humid climates. Cost effective and technologically sound storage facilities for these crops are needed to extend storage time over longer periods of time.

APPENDIX 1.

PIP-Supported Studies and Workshops  
on Postharvest Activities in Southeast Asia

1. Postharvest Losses Associated with Exports of Vegetables from Indonesia to Singapore, M.S. degree Thesis, Nasrun Hasibuan, University of Idaho. PIP/Indonesia/June 85/No. 1R.
2. An Integrated Approach to the Study of Postharvest Problems in Tropical Countries: A Case Study in Taiwan, Jerry LaGra, James R. Jones and Samson C.S. Tsou, PIP GTS Report No. 26, Sept. 1983.
3. Workshop on Postharvest Handling of Tropical Crops, presented by various Indonesian government organizations with participation by PIP consultant, Dr. Gary Beaver, PIP GTS Report No. 27, September 1983.
4. Workshop on Commercial Postharvest Practices of Fruits and Vegetables, presented by the Thailand Institute for Scientific and Technological Research, with participation by PIP consultant, Dr. Adel Kader, PIP GTS Report No. 22, July 1983.
5. Workshop on Commercial Postharvest Practices of Fruits and Vegetables, presented by the Thailand Institute for Scientific and Technological Research, with participation by PIP consultant, Dr. Peggy Pletcher, PIP GTS Report No. 23, August 1983.
6. Workshop on Transportation and Handling Techniques for Horticultural Produce, Report to ASEAN Food Handling Bureau, Bangkok and Manila, Dr. Miguel A. Jimenez, PIP GTS Report No. 27, June 1983.
7. Marketing Survey of Tnai Processed Fruits and Vegetables, Harvey Neese and Don Leeper, PIP GTS Report No. 13, November 1982.
8. Project identification at the Thailand Institute for Scientific and Technological Research, Harvey C. Neese, PIP GTS Report No. 6, November 1982.
9. Feasibility Report on Agro-Processing and Marketing Project for the National Food Authority in the Philippines, PIP Team for the Asian Development Bank, 1982.
10. Handling and Packaging Fresh Tropical Fruit for Export, Dr. Julian June-Ling Lee. PIP GTS Report No. 17.
11. Solar Dryer Construction and Food Preservation Workshop. Workshop presented by the Postharvest Institute for Perishables in collaboration with Visayas State College of Agriculture and USAID/Manila. PIP consultants Kenneth D. Hoyt and Marilyn A. Swanson. PIP GTS Report No. 24.
12. Food Preservation-Solar Drying with Supplemental Heat. Workshop presented by the Postharvest Institute for Perishables in collaboration with Sam Ratulangi University, Washington State University and USAID/Jakarta. PIP GTS Report No. 33.

APPENDIX 2

REPORT ON THE WORKSHOP ON POSTHARVEST LOSS  
ASSESSMENT OF HORTICULTURAL PRODUCE  
MANILA, PHILIPPINES  
11-13 FEBRUARY 1985

The workshop on Postharvest Loss Assessment of Horticultural Produce was held in Manila, Philippines on 11-13 February 1985 to consider and recommend activities to the ASEAN Horticulture Working Group (HWG). Participants to the Workshop were from Negara Brunei Darussalam, Indonesia, Malaysia, Singapore and Thailand as well as the Philippines. Participants from Australia and the Dominican Republic (Dr. Jerry Lagras) were also in attendance, as well as Drs. James R. Hicks and James R. Jones from the Postharvest Institute for Perishables. The workshop consisted of presentation of papers, work group sessions and an observation trip to fruit and vegetable markets.

WORK GROUP SESSION A

The objectives of Work Group Session A were as follows:

1. Identify problems and bottlenecks affecting losses in perishables being experienced at various steps in the postharvest system (system approach).
2. Indicate solutions/measures to these problems. Classify solutions into three categories (for immediate action, for mid-term action, for long-term action).

For Work Group Session A, the Workshop participants were divided into three groups (Group Alpha, Group Beta and Group Gamma). The following are the outputs from the three groups:

Group Alpha

The 4 priority commodities i.e., mango, citrus, cabbage, and tomatoes were used as a basis for discussion. However, mango was chosen as a model.

The following postharvest operations have been identified and discussed:

- A. Harvesting
- B. Presorting and grading
- C. Packing
- D. Transportation
- E. Storage
- F. Ripening
- G. Retailing

A. HARVESTING

Problems identified

- i) Determination of suitable maturity indices as a correct and precise method is not available
- ii) Method of harvesting (time, method, apparatus)

Possible solutions

- i) There is a need to find/study a practical method for maturity determination
- ii) Introduction of the appropriate harvesting procedures

B. PRESORTING AND GRADING

Problems identified

- i) Lack of standards guidelines
- ii) Lack of incentives

Solutions

- i) To develop suitable standards for both local and export markets
- ii) Setting up standards with collaboration from the farmers and traders

C. PACKING

Problems identified

- i) Overfilling of containers
- ii) Suitability of containers with regard to size, physical property
- iii) Lining materials as some of them are not suitable for certain commodities
- iv) Cost benefit

Solutions

- i) The use of suitable containers especially the returnable plastic containers should be encouraged
- ii) To gather and compile data available for distribution
- iii) To conduct further research in order to fill-in gaps in information
- iv) To look into the suitability and acceptability of the containers currently available

D. TRANSPORTATION

Problems identified

- i) Lack of proper management which always results in over-stacking, over-loading, and no proper loading and unloading operations.

Solutions

- i) To compile some data/information that is already available for dissemination. Further research is also necessary to fill-in gaps.

E. STORAGE

Problems identified

- i) For local market the members felt that storage may not be needed. However, the cost benefit and infection by disease and infestation by insects is the major problem.

Solutions

- i) Studies on the cost benefit of storage should be carried out.
- ii) To promote the use of hot water treatment for both disease and insect controls.

F. RIPENING

Problems identified

- i) There is no proper method and materials for ripening being used by farmers and distributors.

Solutions

- i) Should determine/study the right ripening methods and procedures by conducting research in this aspect.

G. RETAILING

Problems identified

- i) Ill practice by consumers and retailers always lead to losses.

Solution

- i) There is a need to educate both consumers and retailers in the aspect of better produce handling.

Group Gamma

Commodity Grouping

- A. Leafy types
- B. Immature fruit type
- C. Mature fruit type
- D. Root, tuber and bulbs

A. LEAFY

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PROBLEMS	CAUSAL FACTORS
Yellowing	Time-extended period of handling Temperature - high temperature will result in yellowing
Dehydration	Time - temperature, r.h. of the surrounding and wind velocity
Mechanical	Poor handling, packaging and transport condition - roads, during transportation (stacking)
Insect damage	Pre-harvest conditions
Disease damage	Pre-harvest condition, mechanical condition, mechanical damage Temperature, r.h.

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Solutions

- i) Better roads and transport facilities
- ii) Availability of low temperature facilities
- iii) Improvement of the handling practices
- iv) Information campaign or education

Bottlenecks

- i) Unavailability of transport facilities and poor road condition
- ii) Lack of storage facilities
- iii) Lack of economic incentive
- iv) Lack of sufficient information/awareness

B. IMMATURE FRUIT (CUCUMBER, EGGPLANT, etc.)

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GENERAL PROBLEMS	CAUSAL FACTORS
1. Incorrect maturity	Poor harvesting practices, demand/supply
2. Yellowing	Time, temperature, over-maturity
3. Mechanical damage	Packaging, handling, transport
4. Shrivelling	Time, temperature, mechanical damage
5. Disease	Pre-harvest factors, damage, temperature, r.h.

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Solutions

- i) Proper handling
- ii) Proper packaging
- iii) Availability of low temperature facilities

Bottlenecks

- i) Lack of economic incentive
- ii) Lack of information/awareness
- iii) Lack of storage facilities

C. MATURE FRUITS (MANGO, CITRUS, BANANA)

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PROBLEMS	CAUSAL FACTORS
1. Incorrect ripening	Over maturity, time, temperature
2. Mechanical damage	Packaging, handling, transportation conditions
3. Disease damage	Pre-harvest factors, mechanical damage
4. Immaturity	Poor harvesting practices
5. Insect injury	Pre-harvest factors

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Solutions

- i) Better harvesting practices
- ii) Proper handling
- iii) Proper packaging
- iv) Low temperature facility
- v) Proper ripening techniques
- vi) New methods of insect control
- vii) Better pre-harvest control of diseases

Bottlenecks

- i) Substitute to the present insect control methods
- ii) Unavailability of ripening facilities
- iii) Lack of economic incentive
- iv) Lack of awareness/knowledge

D. ROOTS, BULBS AND TUBERS

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PROBLEMS	CAUSAL FACTORS
1. Sprouting	Time, temperature, r.h.
2. Mechanical damage	Packaging, handling, transport condition
3. Disease	Pre-harvest factor, mechanical damage, r.h.
4. Insect injury	Pre-harvest factor

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Solutions

- i) Better pre-harvest control measures
- ii) Proper handling
- iii) Low temperature facilities
- iv) Proper packaging

Tomatoes

- A. Soft rot disease due to high temperature, high relative humidity and rough handling system
- B. Poor color development due to existing high ambient temperatures
- C. Mechanical damage incident to rough handling, poor containerization and
- D. Maturity indices for commercial cultivars

Cabbage

- A. Soft rot associated with mechanical damage, high temperature and humid conditions during distribution and retail.
- B. Mechanical damage due to over trimming at the farm level, poor containerization and rough handling.
- C. Weight loss due to prolonged retail displays.
- D. Trimming losses should be appropriately separated from physiological loss in weight

Suggested Solutions

Solutions to the above problems are expressed in general terms upon training, research and extension programs involving agencies with capability to undertake and willingness to share their resources to others on an integrated industry approach.

WORK GROUP SESSION B

Work Group Session B had the following objectives:

1. Plan for a loss assessment program focusing on the four priorities identified by the HWG (mango, citrus, tomato, cabbage).

### Bottlenecks

- i) Lack of economic incentive
- ii) Lack of information/awareness
- iii) Lack of sprouting control measure

### Group Beta

#### Problems

#### Mango

In this commodity the problems that were identified are:

- A. Immaturity which is related to harvesting and ripening aspects
- B. Diseases specifically anthracnose and Diplodia which reflects lack of appropriate pre-harvest cultural and retail treatment
- C. Mechanical injuries inadvertent to handling and containers
- D. Physiological disorders
- E. Lack of acceptable quality mangoes for export
- F. Shrivelling which is a consequence of loss due to the physiological process of transpiration

#### Citrus

- A. Physiological disorders specifically oil cell rind injury, dryness of vesicles chilling injury incident to harvesting and pre-harvest cultural attention.
- B. Pathological damage particularly penicillium rots brought about by conditions of transport, temporary storage, ripening and retail activities.
- C. Mechanical injuries due to poor handling, container and transport facilities.

2. List down information needed for inclusion in a loss assessment program.

The workshop participants were again divided into three groups and then met in plenary and recommended the following to the HWG:

RECOMMENDATION

That the HWG conduct loss assessment studies on the four priority fruits and vegetables identified by the HWG (mango, citrus, tomato, cabbage).

The following were identified as the information needed for the loss assessment studies:

- a. Relevant production information (primary and secondary data)
- b. Commodity flow
- c. Identified nature, extent and causal factors of physical losses
- d. Ramification of loss in socio-economic, cultural, nutritional terms

It was recommended:

RECOMMENDATION

That the activities be carried out in loss assessment studies:

- a. Surveys -- preliminary or background (ocular survey)  
-- detailed survey (interview scheduled or unstructured questionnaires)
- b. Experimental estimates

WORK GROUP SESSION C

The Workshop Group Session C was conducted in plenary. The following were the items identified for consideration:

1. Organizations/bodies to co-ordinate the activities on loss assessment.
2. Methods or guidelines for the assessment of postharvest losses.

It was recommended:

RECOMMENDATION

That the activities on loss assessment be carried out by national implementing agencies of the H/WG.

It was agreed that guidelines are important for program on assessment of postharvest losses. The following items were identified as important matters to consider in preparing guidelines for assessment of postharvest losses:

- a. Collect information and do research on different commodities (physical loss studies)
- b. Consider information on costs
- c. Consider effect of improved harvesting methods on marketability/ returns
- d. Consider the marketing system (modern, traditional state)
- e. Should be multi-disciplinary