

Postharvest Institute for Perishables

WORKSHOP ON COMMERCIAL POSTHARVEST PRACTICES
OF FRUITS AND VEGETABLES

Presented by
The Thailand Institute for Scientific and Technological Research

With technical collaboration from
The Postharvest Institute for Perishables
and
The Tropical Development and Research Institute

by

Dr. Adel Kader
for the
Postharvest Institute for Perishables

GTS Report No.
PIP/Thailand/July 83/No. 22



in cooperation with
**United States Agency for
International Development**

Project Title: Storage and Processing of Fruits and Vegetables
Project No. AID/DSAN-CA-0265
Washington, D.C., U.S.A. 20523

PN-ADU-767

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Workshop on Commercial Postharvest Practices
of Fruits and Vegetables

Report to
The Thailand Institute for Scientific and Technological Research

and

U.S. Agency for International Development
Bangkok

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November, 1983

TABLE OF CONTENTS

| | PAGE |
|---|------|
| I. Executive Summary..... | 1 |
| II. Introduction..... | 2 |
| III. Course on Commercial Postharvest Practices of Fruits and Vegetables..... | 3 |
| IV. Workshop on Handling of Fruits and Vegetables for Export (8/3/83)..... | 4 |
| V. Research and Extension Activities Related to Postharvest Technology of Horticultural Crops in Thailand..... | 4 |
| APPENDICES | |
| Appendix 1 - Schedule of Activities/Dr. Adel Kader..... | 9 |
| Appendix 2 - Organizations Represented at the Training Course..... | 11 |
| Appendix 3 - Postharvest Research of Department of Agriculture..... | 12 |
| Appendix 4 - Interministry Project on Improvement of Producing and Handling of Fresh Fruits, Vegetables, Cut Flowers and Ornamental Plants for Export..... | 16 |
| Appendix A - Statistics of the Export Volume and the Value Exported of Fresh Fruits, Vegetables and Cut Flowers in 1977-1981..... | 36 |
| Appendix B - Researches on Fresh Fruits, Vegetables, Cut Flowers, Ornamental Plants..... | 37 |
| Appendix 5 - Primary Crops Recommended by the Institute of Horticultural Research..... | 41 |
| Appendix 6 - Map: Research station locations..... | 47 |

I. Executive Summary

The Thailand Institute for Scientific and Technological Research (TISTR) requested assistance from the Postharvest Institute for Perishables (PIP) in the presentation of a workshop on "Commercial Postharvest Practices of Fruits and Vegetables." The workshop was presented from July 27 to August 2, 1983.

PIP sponsored the participation of Dr. Adel Kader from the University of California at Davis. He presented workshop sessions on "Factors Which Affect the Postharvest Life of Fruits, Vegetables and Root Crops" and "Methods of Delaying Fruit Ripening." He also participated in panel discussions and made four slide presentations on some tropical fruits.

Dr. Kader collaborated with personnel from the Tropical Development and Research Institute, as well as from TISTR, in presenting the workshop to 44 participants representing numerous governmental and private sector interests in Thailand. In this report he discusses the workshop, postharvest horticultural research and extension activities in Thailand, and possible areas for USAID assistance.

II. Introduction

About 50% of the time in Bangkok involved teaching a training course (July 27 to August 2, 1983) and a workshop (August 3, 1983). The remainder of the time was spent in visits to various institutions and meetings with individuals involved in research and development activities related to postharvest handling of horticultural crops (see Appendix 1 for schedule of activities). This report includes a discussion of the training course, workshop, postharvest horticultural research and extension activities in Thailand, and possible areas for future USAID-PIP assistance.

Appreciation is expressed for the assistance provided by PIP, USAID-Bangkok, and TISTR personnel who made the trip to Thailand very successful.

III. Course on Commercial Postharvest Practices of Fruits and Vegetables

This course was organized by the Thailand Institute of Scientific and Technological Research (TISTR) and sponsored by the British Council (which supported participation of Ms. Felicity Proctor and Dr. John New, TDRI, London, UK) and USAID-PIP (which supported the participation of Dr. Adel Kader and reproduction of the course manual). The 44 participants in this training course came from various Thai universities, the Ministry of Agriculture and Cooperative, TISTR, and other organizations (Appendix 2). The course was very successful in achieving the following:

1. Providing training for 44 participants from various governmental and private organizations in Thailand. Most of these trainees are likely to be involved in future research, extension, and training activities related to postharvest technology of fresh horticultural crops.
2. Bringing together persons interested in postharvest technology from many organizations in Thailand and providing an excellent opportunity for communication among them.
3. Encouraging future cooperation and coordination of efforts on postharvest technology among personnel from various governmental and private organizations.

The lecture materials, which were translated into Thai language and reproduced by PIP (100 copies), will have a long-lasting effect in providing current information about postharvest technology of fruits and vegetables. TISTR personnel asked for an additional 100 copies for distribution to instructors and participants in the workshops and the second training course (Chiang Mai). This request was relayed to PIP, which agreed to provide the additional copies. This effort is very worthwhile.

It would be useful for the research and extension personnel involved in postharvest technology of fruits and vegetables to organize an annual meeting (including presentations of research results, workshops, and/or symposia) to facilitate exchange of ideas, communication, and coordination among them. This proposal was made during the last session of the training course and the majority of those present endorsed the idea. The newly-organized Thailand Society for Horticultural Science should be encouraged to form a Postharvest Working Group which can organize such annual meetings. USAID-PIP can assist by following up on this proposal to ensure its implementation and by sponsoring the 1984 meeting.

IV. Workshop on Handling of Fruits and Vegetables for Export (8/3/83)

This workshop was the first in a series that were attended by 65 participants from various governmental and private organizations. Dr. Kader participated in a panel discussion and made four slide presentations about harvesting and postharvest handling of mango, pineapple, papaya, and banana. The discussions and questions from the participants indicated a high level of interest in and eagerness to learn all available information about postharvest technology of horticultural crops. Dr. Kader also provided individual consultations on specific topics to several exporters who attended this workshop.

V. Research and Extension Activities Related to Postharvest Technology of Horticultural Crops in Thailand

Based on various reports by previous consultants from USAID-PIP, TDRI (formerly TPI), FAO, ASEAN Food Handling Project, and other agencies, and on visits to Kasetsart University, TISTR, and the Department of Agriculture and discussions with their personnel, the following observations and suggestions for consideration are presented:

- A. There is an urgent need for improving communication and cooperation among the various Thai organizations involved in postharvest research and development activities. An attempt for coordination within the Department of Agriculture has been initiated by establishing a committee for coordination of postharvest research (see Appendix 3). It is hoped that this committee will function well and achieve some of its goals in coordinating the Department's postharvest research efforts. Another attempt to provide some coordination among various agencies involves the initiation of an "Inter-ministry Project on Improvement of Producing and Handling of Fresh Fruits, Vegetables, Cut Flowers and Ornamental Plants for Export," which will be coordinated by a committee of 23 members representing the various agencies (Appendix 4, prepared by the Ministry of Agriculture). It was understood that the government will begin funding this project in October, 1983. Also, UNDP-FAO is expected to fund a

two-year (1984-85) project on "Reduction of Postharvest Losses in Horticultural Crops," which is to be carried out by the Department of Agriculture as the coordinating agency. USAID should encourage all postharvest research and extension coordination efforts, using all possible approaches to determine which will work in Thailand. Promotion of professional exchange of information and cooperation through the Postharvest Working Group within the Thailand Society for Horticultural Science (see Section I above) will have a better chance of success in the near future. This type of communication will, in turn, improve the chances for success of other coordination efforts within and among various agencies involved in postharvest technology.

- B. The ability of the Thai colleagues in obtaining funding from various international agencies for postharvest work is impressive. Following are some examples:

| Thai Institutions | International Agencies Providing Some Support for Postharvest Research |
|--|--|
| Kasetsart University, Bangkok | ASEAN Food Handling Project USDA's Highland Project |
| Kasetsart University, Kamphaengsaen | Japanese Government |
| Chiang Mai University | IDRC (Canada) |
| TISTR | ASEAN Food Handling Project IDRC (Canada) |
| Department of Agriculture | IMF, UNDP-FAO, USAID, ASEAN Food Handling Project |

However, the total inputs provided by these agencies and by the Thai Government are still inadequate for an effective program of research, extension, and technology transfer in relation to postharvest handling of horticultural crops (quality maintenance and reduction of losses).

C. The responsibilities of each organization involved can be defined in such a way that would minimize duplication of efforts and maximize utilization of available human and physical resources related to postharvest biology and technology of horticultural crops. Following is a proposed distribution of research and extension responsibilities:

| Organization(s) | Responsibilities |
|---|---|
| I. Universities Kasetsart University, Bangkok and Kamphaengsaen campuses Chiang Mai University Khon Kaen University Other universities | 1. Train students in this field at the B.S. and M.S. levels. 2. Conduct postharvest biology research aimed at providing "basic" information about commodity requirements and postharvest behavior, especially for tropical horticultural crops which have not received much attention in the past. 3. Provide resource people to help in training extension works and other personnel involved in postharvest technology. |
| II. TISTR, Agricultural Products Development Division (sections for Postharvest, Packaging, and Food Technology) | 1. Do contract research aimed at developing appropriate technology for marketing various commodities. 2. Assume a role in improving and standardizing shipping containers for horticultural crops. |
| III. Ministry of Agriculture & Cooperatives A. Department of Agriculture 1. Horticultural Research Institute 7 Regional Research Stations 2. Division of Plant Pathology & Microbiology a. Seed & Postharvest Pathology Unit | 1. Do applied research such as evaluation of new cultivars, pre-harvest factors, and postharvest variables in relation to quality and postharvest life of various horticultural crops which are important in each region. 2. Conduct research on postharvest diseases, host/pathogen interaction, mycotoxins, control methods. |

| Organization(s) | Responsibilities |
|---|--|
| 3. Other Divisions (Agr. engr., Entomology, etc.) | 3. Collaborate on research of the Horticultural Research Institute when needed. |
| B. Department of Agricultural Extension | |
| Should establish a section for Postharvest Horticulture Technology which would cover postharvest handling of fresh fruits, vegetables and ornamentals as well as processing of fruits and vegetables. | 1. Disseminate information about proper harvesting and handling procedures for various commodities to producers, handlers, consumers, etc., using all appropriate extension methods. |
| This section should include Extension Specialists at the national and/or regional levels plus Extension Agents in major production areas. Some of these people can be stationed at the Regional Horticultural Research Stations to facilitate communication with researchers. | 2. Encourage establishment of industry groups (producers, handlers, exporters, etc.) to deal with quality control, market information, research support, promotion, etc. 3. Act as liaison with all government agencies involved in marketing horticultural crops, such as Ministry of Commerce, Export Service Center, Customs Department, Cold Storage Organization, etc. |
| D. Most of the existing problems in handling fresh horticultural crops can be solved by using existing information and applying available technology in Thailand. Thus, emphasis must be placed on extension activities and demonstration research through the major production areas. It is recommended that USAID and PIP give highest priority in assistance to this goal. Examples of possible technical assistance include: | |
| 1. Help the Department of Agriculture Extension to build the infrastructure needed for postharvest activities as soon as possible and initiate educational efforts (through publications, industry meetings, etc.). | |
| 2. Provide funds and technical assistance (if needed) to the preparation, publication and wide distribution of a Thai handbook on postharvest requirements and recommendations for fresh horticultural | |

crops. This project can be done by a small group of postharvest specialists from the universities, Department of Agriculture, TISTR, and/or other agencies. It can be completed in six months provided that adequate support is made available.

- E. Another area where technical assistance from USAID would be very useful is in helping to develop the human and physical resources needed for postharvest research at the various regional stations (Appendix 5). It is understood from the Director of the Horticultural Research Institute that it still has some IMF funds available for physical facilities but does not know what would be required for postharvest research.

APPENDIX 1
Schedule of activities of Dr. Adel A. Kader
Postharvest Horticulture Consultant
Bangkok, Thailand
July 26 - August 4, 1983

| Date | Time | Activity |
|------|---|--|
| 7/26 | 11:00 AM | Arrive Bangkok, meet TISTR and TDRI personnel, preparation for course on Commercial Postharvest Practices of Fruits and Vegetables. |
| 7/27 | 9:00 AM 10:30 - 12:00 AM 3:00 - 4:30 PM | Opening of training course at TISTR Lecture on "Postharvest Biology and Technology - An Overview" Meeting with Mrs. Dara Buangsuwon, Department of Agriculture |
| 7/28 | 9:00 - 10:00 AM 10:45 - 11:30 AM 1:00 - 1:45 PM 2:15 - 5:30 PM | Meeting with Dr. John Conje, USAID/Bangkok Lecture on "Postharvest Handling of Fruits" Lecture on "Methods of Delaying Fruit Ripening" Meeting with Dr. Suraphong Kosiyachinda and his colleagues, Department of Horticulture, Kasetsart University |
| 7/29 | 8:30 - 10:30 AM 10:30 - 12:00 AM 1:00 - 4:30 PM | Visit Department of Agriculture, Horticultural Research Institute, view postharvest research facilities Visit Department of Agriculture, Division of Seed and Postharvest Pathology, view research facilities, discuss mushroom handling with Mrs. Dara and her staff. Discussion of handling bananas, papayas, mangoes and other fruits with Mrs. Dara and her staff. |
| 7/30 | 6:30 AM - 3:30 PM 5:00 - 9:00 PM | Field trip with course participants to three wholesale markets, sea port, and Pisitichai Export Company. Meeting with Dr. Suraphong and other colleagues |
| 7/31 | 8:00 AM - 5:00 PM 7:00 - 10:00 PM | Sightseeing tour Meeting with Dr. Anothai and other colleagues |

| Date | Time | Activity |
|------|---------------------|--|
| 8/1 | 8:30 - 10:30 AM | Attend training course |
| | 10:30 - 11:30 AM | Lecture on "Sea transportation." |
| | 1:00 - 3:00 PM | Meeting with Mrs. Sing Ching Tongdee and others at TISTR, tour facilities. |
| | 3:30 - 5:00 PM | Participate in panel discussion |
| 8/2 | 8:30 - 9:30 AM | Meeting with some of the course participants to discuss topics related to postharvest technology |
| | 9:30 - 11:00 AM | Attend course |
| | 11:00 AM - 12:15 PM | Participate in panel discussion on handling vegetables |
| | 1:15 - 3:00 PM | Attend course |
| | 3:15 - 4:45 PM | Participate in panel discussion on handling fruits |
| | 7:00 - 10:00 PM | Dinner with TISTR Governor and other staff members |
| 8/3 | 9:00 - 10:00 AM | Meeting with Dr. Conje, USAID/Bangkok |
| | 11:00 AM - 2:00 PM | Attend Workshop No. 1 at TISTR |
| | 2:00 - 4:30 PM | Presentations on mango, banana, papaya, and pineapple handling |
| 8/4 | 8:15 AM | Left Bangkok |

APPENDIX 2

Organizations Represented at the Training Course
July 27 - August 2, 1983

| Organization | Number of Participants |
|--|---------------------------|
| Thailand Institute of Scientific and Technolgal Research | 6 |
| Faculty of Agriculture, Kasetsart University | 3 |
| Faculty of Agriculture, Khon Kaen University | 3 |
| Faculty of Agriculture, King Mongkul's Institute of Technology | 1 |
| Faculty of Natural Resources, Prince of Songkhla University | 2 |
| Institute of Technology and Vocational Education | 1 |
| Faculty of Science, Chulalongkorn University | 1 |
| Ministry of Agriculture and Cooperatives: | |
| Department of Agricultural Extension | 6 |
| Cooperatives Promotions Deparment | 2 |
| Institute of Horticultural Research | 1 |
| Plant Pathology and Microbiology Division | 2 |
| Agricultural Engineering Division | 1 |
| Agricultural Chemistry Division | 2 |
| Agricultural Quarantine Division | 1 |
| Entomology and Zoology Division | 1 |
| Ministry of Commerce: | |
| Department of Foreign Trade | 3 |
| Export and Import Control Division | 1 |
| Department of Internal Trade | 2 |
| Government Cold Storage Organization | 1 |
| Private Import-Export Companies | 4 |
| Total | <u>44</u> |

APPENDIX 3

Postharvest Research of Department of Agriculture

The Department of Agriculture is directly responsible for solving every type of problem related to agricultural production. Postharvest researches are still in the beginning stage and are scattered through many divisions. There is a tremendous need to bring them together so as to be able to identify research priority and weaknesses of the infrastructure and to harmonize the Department's research efforts in this direction.

The Department of Agriculture has appointed a committee called "The Committee for the Coordination of Postharvest Researches and the Pursuance of Postharvest Technology," which consists of postharvest technologists from the following involved Divisions and Institutes:

| | | |
|---------------------------------|---|------------------------------------|
| 1. Dr. Tanongchit Wongsiri | Deputy Director General | Chairman |
| 2. Dr. Prasoot Sittisoung | Institute of Rice | Member |
| 3. Ms. Thaneenart Sombatsiri | Institute of Field Crops | Member |
| 4. Dr. Praphan Nunthachai | Institute of Horticulture | Member |
| 5. Ms. Sriwai Singhagajen | Division of Agricultural Engineering | Member |
| 6. Mr. Chuvit Suprakarn | Division of Entomology | Member |
| 7. Mr. Chamlong Chettanachitara | Agricultural Regulatory Division | Member |
| 8. Mr. Vichien Natvatananon | Division of Pesticide Research | Member |
| 9. Ms. Dara Buangsuwon | Division of Plant Pathology and Microbiology | Member & Secretary |
| 10. Ms. Sunantha Vesaurai | Planning Division | Member & Assistant Secretary |

This committee will serve as the coordinator to cooperate with each Division and Institute to consider the planning of postharvest research in the Department so that there will be no overlapping and the national budget will not be wasted.

Activities

Activities of postharvest teams of the Department of Agriculture include:

1. Coordinating postharvest research within the Department of Agriculture.
2. Formulating standard procedures to assess postharvest losses of grains, fruits, vegetables, cut flowers and other important food crops.
3. Identifying causes and stages of losses of the crops in 2.
4. Developing structure and treatments for long-term storage of grains and other agricultural products.
5. Developing methods to prevent mycotoxin occurrences in storage with special emphasis on aflatoxin.
6. Developing simple methods and guidelines for postharvest handling of grains, fruits, vegetables, cut flowers and other important food crops for the farmers.
7. Developing proper grading, packaging, packing and transportation methods for fruits, vegetables and cut flowers.
8. Developing proper processing, packing and packaging methods for grains.
9. Compiling records on pesticide residue found in agricultural products in storage.
10. Determining residual life and effect of pesticide used in postharvest treatment and developing a more effective treatment with less residual problem.
11. Compiling lists of pests and diseases occurring on grains, fruits, vegetable, cut flowers and other important food crops in storage.
12. Developing and implementing training courses for different levels of trainees.

Institutional Framework

Institutions or branches involved are:

1. Seed and Postharvest Pathology branch, Division of Plant Pathology and Microbiology is responsible for three areas of study: seed pathology, postharvest pathology of perishables and grains, and mycotoxins in agricultural commodities.
2. Field Crops Institute is responsible for research on preharvest, postharvest handling of corn, sorghum, oil crops, etc.
3. Stored Product Insect Branch, Entomology and Zoology Division is responsible for both research and training in the control of insects attacking agricultural products in storage, with emphasis in stored grains.
4. Horticulture Institute is responsible for research on preharvest, postharvest handling and processing of fruits, vegetables, cut flowers and other horticultural crops.
5. Pesticide Residue Analysis Branch, Toxic Substance Division is responsible for research on toxic substances used in agriculture. Its research activities include formulating and synthesizing pesticides, monitoring their occurrence and impact on the environment, and issuing the pesticide residue inspection certificate on agricultural products.
6. Seed Standard and Grain Quality, Rice Institute is responsible for research on seed technology and grain quality of rice and other temperate grain crops. The activities related to postharvest technology extend from the preharvest stage up to utilization of the seed or grain for planting or consumption. In addition, it also involves the breeding program in grain quality improvement.
7. Storage and Processing, Agricultural Engineering Division is responsible for research and development of equipment to be used for food handling and processing at farm and cooperative level, and for conducting training courses on postharvest technology for local agencies. It also serves as the information center in postharvest technology.
8. Statistical Analysis, Planning Division is responsible for conducting research on postharvest loss assessment.

9. Agricultural Regulatory Division. The Technical Plant Quarantine Sub-Division has been responsible for gathering information on plant diseases and pest situations in the world; conducting research on pathogens of commodities to be exported and imported; and developing new techniques for quick inspection and effective treatment measures. These activities have been very helpful in preventing the introduction of exotic diseases and pests of plants and their products. Also export consignments have conformed with the plant quarantine laws and their regulations of destinations.

APPENDIX 4

Interministry Project on Improvement of Producing and Handling of Fresh Fruits, Vegetables, Cut Flowers and Ornamental Plants for Export

A. Background

At present, besides increasing farmers' income directly, the export of fresh fruits, vegetables cut flowers and ornamental plants earns quite a great income for Thailand which helps to solve the problem of unfavorable balance of trade. However, the export business of this produce is not wide implemented as well as it should be eventhough the product volume is immense. This is because farmers and exporters lack enough knowledge in producing, handling and packaging. In addition, there is insufficient cooperation between the government and private enterprises to improve markets, transport system, trade organization as well as to solve any problems of legal procedures which concern export.

The production and the export of fruits, vegetables, cut flowere and ornamental plants still run among small groups of people. This can be summarized as the following.

1. Production Areas

The production areas of fruits such as oranges, bananas, mangoes, mangoesteens and papaya, etc. are not united in a main areas but disperse into small plantations throughout the nation. This leads to the difficulty in gathering the produce. Only few kinds of fruits

are planted in the same areas such as longans which are mainly planted in Cheingmai and Lamphun, pomelos in Nakhonpathom and pineapples in Prachuapkirikan and Chonburi. As for vegetables, cut flowers and ornamental plants, the production areas are scattered around Bangkok. This causes less problem in gathering the produce.

Generally, exporters do not purchase the produce directly from farmers but from middlemen who gather the produce from farmers' orchards. This is because in buying produce especially fruits, the deal is usually made since the fruits start to bloom. Thus, several entrepreneurs are involved in the buying and selling. This, in turn, makes the price higher and the quality lower.

2. The export of fresh fruits, vegetables, cut flowers and ornamental plants

The exporting of this produce is expanding rapidly to foreign markets in Hongkong, Singapore, Malaysia, Europe and the Middle East. The types of fruits exported are bananas, mangoes, pineapples, orange, grapes, water-melons, rambotans, durians, sugar apples, papayas, and longans, etc.

The export is increasing every year. During 1977-1981 the export rate increased 23.66% per year. That is, the value exported in 1977 was 157,208,324 baht and this figure increased to 396,995,746 baht in 1980 (See Appendix A.)

The types of fresh vegetables exported are potato, tomato, mushrooms, bamboo shoots and many other kinds of vegetables including shallot and garlic. This export also increases. During 1977-1981 the export rate increased 22.50% every year and the value of exports of 24, 136,655 baht in 1977 increased to 62,104,809 baht in 1981 (See Appendix A)

The export of cut flowers and ornamental plants during 1977-1981 also increased (32.34% per year). The value exported in 1977 was 133,140,255 baht but in 1980 it increased to 359,721,048 baht (See Appendix A)

3. Problems in Production and Marketing

3.1 Fresh fruits and vegetables

3.1.1 Production

3.1.1.1 Production areas are small scattered plantations which lead the following problems.

3.1.1.1.1 It is difficult to gather the produce at a required volume.

3.1.1.1.2 The control measures of disease and insects cannot be done in a proper way and at the same time

3.1.1.1.3 Plantation management varies in different areas which results in the varying and inconsistent size and quality of the produce.

3.1.1.1.4 The production planning can not be done according to time and volume required by markets.

3.1.1.2 The yearly production volume is inconsistent because the planting largely depends on the nature

3.1.1.3 Producers lack enough knowledge of modern techniques of planting. For example, they cannot control the blooming period of the produce to meet the need of the market

3.1.1.4 Neither the government nor private enterprises have done enough study to find the varieties of produce with transport durability and quality as the market requirement

- 3.1.1.5 The harvest is not properly performed and there is also no indication of ripe stage to harvest of each type of fruit. Besides, the use of pesticide is not properly done which leads to toxic residue in postharvest produce. In addition, there is no formal check of such residue in the produce.
- 3.1.1.6 There is no emphasis on procedure to be taken before and after harvest in order to prevent and control produce deterioration till it reaches consumers.
- 3.1.1.7 The use of insecticide in pre and post harvest produce is not in line with the control measures of some countries where the produce is exported.

3.1.2 Market

- 3.1.2.1 No study has been done on foreign markets and on market searching especially on the nearby markets and those without strict quarantine regulations but with high purchasing power.

- 3.1.2.2 The lack of export standard of the produce results in the problems of price setting. This problem, in turn leads to the conflict between the farmers and middlemen. This is because to produce the vegetables and fruits with the required quality for export demands a greater capital than that spend on such produce for local distribution.
- 3.1.2.3 The relationship between producers and exporters is not reliable; both sides still take advantage of each other.
- 3.1.2.4 Exporters cut price among themselves and compete for customers.
- 3.1.2.5 Packaging and transport.
 - 3.1.2.5.1 Packaging and transport method used for each type of the produce is not suitable and not in line with the system for Phytosanitary certificate and the custom procedures.

- 3.1.2.5.2 There is no packing houses near production areas which makes the produce easily damaged due to long distance transport.
- 3.1.2.5.3 The transport within the country and out of the country is inconvenient and not in line with the harvest. Besides, the type of transport to foreign countries used is mainly air freight which means that the cost of produce is higher.
- 3.1.2.5.4 Suitable store houses for packed produce before being exported is insufficient.
- 3.1.2.6 There is no representative from exporters to take care of the produce at the receiving end which includes transferring the produce from vehicles to deliver to buyers

3.2 Cut flowers and Ornamental Plants

3.2.1 Production

3.2.1.1 Producers lack enough care and caution in cultivating in order to keep the quality required by markets.

3.2.1.2 No emphasis has been put on the steps to be taken before and after the cutting to keep the produce fresh.

3.2.1.3 Apart from orchids, other cut flowers and ornamental plants do not received enough improvement in varietal selection cultivating methods and handling so that they can meet the standard accepted by foreign markets.

3.2.2 Marketing

3.2.2.1 Exporters cut prices among themselves and compete for customers

3.2.2.2 Since the export volume of Thai cut flowers and ornamental plants is vary small, the markets are competed by producess of other countries sending the produce with lower market price.

3.2.2.3 Some legal procedures dealing with export are inconvenient for exporters to serve the orders from foreign countries in time.

3.2.2.4 Transportation is inconvenient due to high tonnage price and insufficient cargo, especially when the market demand is high.

4. Problems of Government Implementation

- 4.1 The research objectives of the responsible division are not in line with the needs of private enterprises in order to solve the problems in production and export
- 4.2 Production volume and export volume do not go along with each other in terms of quality and volume.
- 4.3 The government lacks certain procedural objectives and there is no actual co-operation between organizations. Thus the results received from each organization cannot be combined to solve the problems of export. Besides, there are some repeating researches or missions which lead to the waste of time and other national resources.

4.4 There is no close co-operation between the government and private enterprises in improving marketing, trade organization and transport for export as well as in solving any problems of legal procedures dealing directly with export.

It can be seen from the above information that 1) if there is an improvement in handling the produce to keep them fresh with the quality desired by buyers, 2) if there are preventive measures to avoid the mixing of different grades of produce, 3) if there is an improvement in package design to attract buyers attention and lastly if there are considerations to solve problems about production and marketing, not only can we keep the existing markets but we can also expand the markets to more countries. In this way, Japan and the United States which presently reject fresh produce from Thailand due to unqualified disease free produce according to their law will finally import such produce from Thailand.

Thus, in order to upgrade Thai produce in terms of export, quality and volume which will have a good effect on farmers' and exporters' economic as well as the security of the country it is necessary that the improvement in production and export of such produce be undertaken as soon as possible.

B. Policy and Objective

1. Policy

- 1.1 To quicken the improvement of fruits, vegetables, cut flowers and ornamental plants to obtained the quality demanded by foreign markets and the export volume réquire.
- 1.2 To improve packaging techniques so that the packages would be neat and elaborate enough to a attract buyers, would be suitable for each type of produce and transport situation both within and out of the country.
- 1.3 To spread technology in keeping the produced quality as well as packaging according to 1.1 and 1.2 to both farmers and exporters so that they can manipulate properly.
- 1.4 To expand foreign markets of fruits, vegetables, cut flowers and ornamental plants to a wider range through market line in Asia, Europe and the Middle East.
- 1.5 To encourage both government organizations and private enterprises to co-operate more in improving production, marketing, trade, organization, and

transport for export as well as in solving any problems of legal procedures dealing directly with export.

2. Objective

The objectives of the implementation on improving the production and the export of fruits, vegetables, cut flowers and ornamental plants is to implement the research both before and after harvest in terms of quality and volume to meet the requirement of foreign markets. The local demand for such produce will also be considered. The research will be done on each type of produce at a time according to the priority. The test on transport to the receiving end will then be implemented before the results is propergated to farmers and exporters who can follow the suggestion effectively

2.1 Types of produce planned are as followed

2.1.1 Fruits

2.1.1.1 The research on 6 varieties of mango, 3 of longon and 2 of papaya should be finished within the first 2 years of this project (1983)

2.1.1.2 The research on 3 varietics of durian 2 of pamelo, tangerine orange and sweet orange should be finished within the third year of this project (1985)

2.1.1.3 The research on 2 varieties of grape, 1 variety of banana (Musa hybrid sucrier), pineapple and coconut (young) should be finished within the fourth year of this project. (1986)

2.1.2 Vegetables

Group 1 : two-year research (1981-1983)

priority ordering:

1. chili
2. shallot
3. pumpkin and wax gourd
4. ginger
5. garlic
6. onion

Group 2 : three-year research (1982-1985)

priority ordering

1. cabbages
2. cow pea, green pea and garden pea
3. egg plants
4. green roselle
5. water-melon cantaloupe cucumber and bitter cucumber

Group 3 : four-year research (1983-1986)

1. tomato
2. lettuce
3. carrot
4. potato
5. sweet corn

2.1.3 Cut flowers and Ornamental Plants

Orchids, anthurium and other cut flowers as well as ornamental plants are under four year research (1983-1986)

2.2 Marketing is a major factor which help farmers release the produce and increase income. However, foreign markets of such produce re limited to only those in Asia which are Malaysia, Singapore and Hongkong. Thus, it is necessary to expand produce market to other possible markets such as European Economic Community includes France, West Germany and Netherlands, and those in the Middle East such as Bahrain, Saudi Arabia, Gartar and Emerest as well as the markets in the Scandinavian Countries which includes Sweden and Denmark.

C. Planning

1. Organizing

This implementation involves a wide range of both government organizations and private enterproses. Thus, it requires close co-operation between government organizations and private enterpsises and between government organizations themselves. For the implementation to achieve the objectives planned a sub committee of the project on production and export improvement of fruits, vegetables, cut flowers and ornamental plants for export is formed from the Committee on Agriculture and Co-operative Development Policy and Planning. This sub-committee consists of the following

1. The Permanent Under-Secretary of the Ministry of Agriculture Chairman
2. The Director-General of Department of Agriculture or representative member
3. The Director-General of Department of Agricultural Extension or representative member
4. The Director-General of Co-operative Promotion Department or representative member
5. Secretary of Office of Agricultural Economic or representative member
6. Director of Marketing Organization for Farmers or representative member

7. Director of Government Cold Storage Organization
or representative member
8. Director General of Economic Department;
Ministry of Foreign Affairs or representative member
9. Director General of Commercial Relationship
Department or representative member
10. Director General of Customs Department, or
representative member
11. Director General of Aviation Department or
representative member
12. Marketing Vice President of Thai Airways
International Ltd. or representative member
13. Managing Director of Airports Authority of
Thailand or representative member
14. Director of Port Authority of Thailand or
representative member
15. Director of Budget Office or representative member
16. Governor of Thailand Institute of Scientific
and Technological Research or representative member
- 17-19. Representatives from three group of producers-
fruits vegetables, cut flowers and ornamental
plants respectively members
- 20-21. Representatives from three groups of exporters-
fruits, vegetables, cut flowers and ornamental
plants respectively members

22. Dr. Riksh Syamananda member and secretary
23. Mrs. Dara Buangsuwon member and assistant secretary

The sub-committee has complete authority to define methods and procedures to be taken in order to achieve the project objectives and to appoint any temporary working group to carry out particular mission of and the project.

The member and secretary of this sub-committee is the director of the project.

2. Duty and Responsibility of involved government organizations¹⁾

| DUTY | ORGANIZATION |
|--|--|
| 1. Conduct research on technology used before and after harvest of each type of produce specified in the objectives for export | Department of Agriculture and Kasetsart University |
| 2. Provide service in packaging for research | Thailand Institute of Scientific and Technological Research |
| 3. Propagate techniques in handling produce before and after harvest to farmers and exporters according to no. (1) | Department of Agriculture Department of Agricultural Extension and Department of Industrial Promotion |

1) See Appendix B

| DUTY | ORGANIZATION |
|---|--|
| 4. Encourage exporters to form interest group to control produce varieties, planting time as well as harvest to be in line with the market requirement | Co-operative Promotion Department, Department of Agricultural Extension and Department of Agriculture |
| 5. Specify commodity standard to avoid conflict between producers, exporters and foreign customers | Customs Department, Department of Agriculture and Department of Foreign Trade |
| 6. Improve export procedures and methods by making them faster and more appropriate | Customs Department, Department of Agriculture and Department of Foreign Trade |
| 7. Improve transport system and method within and out of the country, consider effectively tonnage negotiation; encourage transport through air freight by using pallet with the standard required by import countries; encourage sea freight using low temperature container and also encourage refrigerated vehicles as a means of transport to the neighbour countries | Aviation Department, Thai International Airways, Port Authority of Thailand, Government Cold Storage Organization, Department of Agriculture and Thailand Institute of Scientific and Technological Research |

| DUTY | ORGANIZATION |
|---|------------------------------------|
| 8. Advertise and propagate fruits, vegetable, cut flowers and ornamental plants with improved quality and ample volume to different countries to expand foreign markets | Commercial Relation Department |
| 9. Follow up and evaluate the project implementation if it is line with the objectives planned | Office of Agricultural Economic |

3. Government organizations should co-operate more closely with private enterprises in propagating research results. This can be done by sending extention officers and experts to train farmers of the plantations of produce for export. In addition, anual seminar and workshop for farmers and exporters should be held to introduce to them the procedures and methods, according to the research results, which are in lin with the local and foreign regulations.

4. The whole implementation should be undertaken co-operatively. Any stage coming to a stop would result in the failure of the whole project. To implement the project which involves a longe number of representatives from both government organizations and private enterprises would require a large sum of budget and man power. Past experience indicates that assigning a mission to any organization without specifying pasticular person to be responsible for it and a lack of budget usually result in the failure

of such mission. Thus, in order to facilitate the implementing procedures within the organizations and to enforce the responsibility assigned to each organization certain budget and specific man power should be used to carry out such implementation.

E. The Results from the Project

1. The project will result in increased export because there is more co-operation between government organizations themselves and between such organizations and private enterprises.

2. Farmers' income will increase due to the increased production volume and improved quality.

3. Technology will be improved thus, farmers will be able to use such technology to improve the quality of their produce because they realize that better quality means higher income.

4. As a result of 3, the cost of production per unit will decrease. This will make it possible to compete with foreign markets which in turn, will increase export volume according to the Fifth National Economic and Social Development Plan.

5. Private enterprises will be encouraged to have more confidence and to invest more money in the produce business and thus the investment rate will be increased.

6. More foreign currency will be flown into the country which will improve national economics.

Appendix A

Statistics of the export volume (kilogram) and the value exported of (baht) of fresh fruits, vegetables and cut flowers in 1977-1981.

| YEAR | FRESH FRUITS ¹⁾ | | VEGETABLES ²⁾ | | CUT FLOWERS AND ORNAMENTAL PLANTS ³⁾ | | | TOTAL | |
|--------------------|----------------------------|-------------|--------------------------|------------|---|-------------|---------------|-------------|--|
| | EXPORT VOLUME | VALUE | EXPORT VOLUME | VALUE | EXPORT VOLUME | VALUE | EXPORT VOLUME | VALUE | |
| 1977 | 37,061,615 | 157,208,324 | 9,460,513 | 24,136,655 | 3,235,520 | 133,140,254 | 49,760,048 | 314,435,234 | |
| 1978 | 53,392,324 | 178,965,491 | 18,533,770 | 45,710,076 | 4,512,119 | 192,600,971 | 66,433,213 | 417,276,538 | |
| 1979 | 42,610,396 | 212,913,731 | 12,612,897 | 53,802,793 | 4,279,931 | 383,777,866 | 59,503,223 | 650,524,390 | |
| 1980 | 39,422,450 | 234,723,453 | 10,751,454 | 52,562,769 | 5,227,206 | 435,036,932 | 55,401,110 | 722,323,159 | |
| 1981 ⁴⁾ | 44,013,375 | 396,995,716 | 11,629,005 | 52,104,809 | 9,894,225 | 359,721,048 | 60,542,605 | 818,821,603 | |

N.B. 1) Bananas, mangoes, pineapples, oranges, grapes, watermelons, rambutans, durians, sugar apples, papaya, etc.

2) potato, tomato, mushroom, bamboo shoots, shallot, garlic etc.

3) Orchids, cut flowers, foliate branch and other part of trees and plants and other leaves plant including tree, shrub, bushes, roots, cuttings, slits.

4) statistics in January-November 1981.

From Division of Marketing and Commodity Research, Department of Business Economics, Ministry of Commerce.

1-261

Appendix B.

According to this project, researches on fresh fruits, vegetables, cut flowers and ornamental plants are as followed.

1. Research on Preharvest

- 1.1 To hasten the varietal improvement of the produce in order to get varieties which will give higher yield and quality resistance to diseases and insects to meet the export market requirement.
- 1.2 To hasten the conduct of research to increase yield of the produce in order to reach the export market demand.
- 1.3 To hasten the conduct of research to improve the quality of produce in order to reach the market standard level.
- 1.4 To hasten the conduct of research on cultivating efficiency in order to minimize losses after harvest as well as to introduce preventive measures to control diseases and insects in order to keep the produce in good quality by carefully use of chemicals as less as possible which will lessen hazardous to consumers.
- 1.5 Harvesting index. Indications of ripe stage for each produce are used to indicate the exact maturity for harvest. However, due to the lack of such information our produce is inconsistent and inappropriate for export. Thus, proper maturity to harvest results in good quality produce which has longer storage life.

1.6 Harvesting methods. Crude method of harvesting can injure the produce and can provide entrance for microorganisms which cause rotting. Proper methods of harvesting each produce is therefore needed to lessen losses since the first stage of harvest.

2. Research on Post-harvest.

2.1 Maintaining of freshness and controlling losses. The research aims at cheap, simple and practical methods which are close to actual situation and which can keep the produce in good quality, fresh and free from diseases and insects which will lead to higher the price. Those methods used include packaging with modified atmosphere, hot water treatment and chemicals coating as well as the use of some chemicals to absorb carbondioxide and ethylene gas which will longer storage life of the produce. All these chemicals should be used with great care and only when necessary. If inavoidable, minimum doses of such chemicals is recommended and safety level should be carefully studied for use. In addition, research in using gamma irradiation should be included to maintain storage life and control losses from diseases and insects because there is a trend that irradiation will substitute the use of chemicals in future.

2.2 Packages should be improved to suit each produce and to keep the produce in good quality to the final consumers. The cost of packages should be decrease by using local materials. However, package design should be improve to attrqct buyers attention.

2.3 Standard size of packages. Package size should be standardised base dimensions in order to give good pallet utilization and suitable pallet patterns of the important export markets of our produce. As many foreign countries usually use pallet in air transportation and there are some differences in pallet patterns, standard pallets should be introduced in air transportation. This is because it will make the transportation faster and more effective.

2.4 Packaging. Commodity should be suitably standardised in terms of types and sizes to facilitate packaging process and to distribute at reasonable price.

2.5 Export Characteristics of Thai produce.

Improvement in packaging for export should be done both for retailing and wholesaling. Good package design will dramatically improve the produce and attract consumers. Thus, details in marketing needs should be emphasized in order to design proper packages so that we can sell both produce and packages.

2.6 Train and encourage exporters. to improve packages and packaging procedures for example packages should be tested before use.

2.7 Packing houses should be introduced and constructed in production areas.

3. Encourage the use of air transportation by using low temperature containers to near by countries such as Hongkong, the Middle East etc. and improve the use of refrigerated vehicles to transport produce to neighbour countries.

4. Encourage producers to form interest groups to control produce varieties, planting time as well as harvest to be in line with the market requirement.
5. Government organizations should co-operate more closely with private enterprises in propagating research results as well as procedures and regulations for export which can lead them to the right implementation.

Government organizations, therefore, should co-operate with each other to consider together the planning of the project so that the mission will not be overlapping and the national budget will not be wasted. Moreover, procedural system should be improved by defining strict administration and by specifying and organizing man power and budget in order to facilitate the implementation and to avoid abstracting other routine duties so that the project can be achieved as soon as possible.

APPENDIX 5

Primary Crops Recommended by The Institute of Horticultural Research¹

Tropical and Sub-tropical Crops:

| | | | | | |
|------------|--------|--------|--------|----------------------|----------|
| Mango | Durian | Longan | Grape | Tangerine & Mandarin | Rambutan |
| Mangosteen | Banana | Papaya | Litchi | Macadamia Nut | Avocado |

Vegetable Crops:

| | | | |
|--------|----------------------------|-----------------|------------------------|
| Tomato | Asparagus (Yard long bean) | Cucumber | Water spinach |
| Garlic | Shallot | Chinese mustard | Tabasco pepper (chili) |

Ornamental Horticulture Crops:

| | | | | | |
|-----------|---------------|-----------|-------------------|------------------------|--------|
| Jasmine | Chrysanthemum | Anthurium | Rose | Gerbera | Orchid |
| Gladiolus | Carnation | Aster | Local Ornamentals | Foliage & Potted Plant | |

Highland Crops:

| | | | | |
|-------|---------|-----------|-------|------|
| Apple | Apricot | Persimmon | Peach | Pear |
|-------|---------|-----------|-------|------|

Herbs and Spices:

| | | | |
|--------|----------|-------|-----------------|
| Pepper | Cardamom | Clove | Long pepper (?) |
|--------|----------|-------|-----------------|

Industrial Spices:

| | | | | | |
|---------|------------|-----|--------|-------|----------|
| Coconut | Cashew nut | Tea | Coffee | Cacao | Oil Palm |
|---------|------------|-----|--------|-------|----------|

¹Translated by Mr. Jingtair Siriphanich, Ph.D. student, Department of Pomology, University of California/Davis, who also drew the map/Appendix 6 showing locations of these research stations.

APPENDIX 5, continued

| Stations | Vegetables | Fruit Crops | Ornamentals | Coconut | Beverage Tea, Coffee, Cacao | Oil Palm | Cashew Nut | Herbs & Spices |
|---|---|---|--|---------|-----------------------------------|-------------|---------------|-----------------------------|
| 1. CHIANG RAI Center | Chinese Mustard Kale Garlic Tomato Potato Shallot Sugar pea Chinese radish Kale | Litchi* Longan* Mango Tangerine Grape Straw- berry Banana Macadamia Avocado Pineapple | Orchid Gladiolus Carnation Rose Chrysanthemum Gerbera Aster Anthurium <u>Local ornamentals</u> Statice Snapdragon Strawflower Other Potential Crop For Growing Commercially Bird of Paradise | - | Tea, Coffee | - | - | Cardamom Clove Pepper |
| 2. Hort. Exp. Station HAANG- CHARD | Tomato Chinese radish Kale Chili Yardlong bean Eggplant (round) | Mango* Tamarind Longan Grape Tangerine Pineapple | Rose, Aster Local ornamentals: Strawflower Other potential crops | - | - | - | - | - |
| 3. Hort. Exp. Station NAN | Pak-choi Asparagus Tomato | Tangerine Mango Longan Litchi | Rose, Local ornamentals Other potential crops | - | Tea | - | - | - |

- 42 -

Continued:

| Stations | Vegetables | Fruit Crops | Ornamentals | Coconut | Beverage Tea, Coffee, Cacao | Oil Palm | Cashew Nut | Herbs & Spices |
|--|---|---|---|---------|-----------------------------------|-------------|---------------|-------------------|
| 4. Hort. Exp. Station FANG | Potato Chinese radish Kale Chinese cabbage Sweet potato Cabbage Chinese mustard | Macadamia* Litchi Longan Avocado | Anthurium Orchid, Mum Snapdragon Local ornamentals Other potential crops | - | Tea | - | X | Cardamom Clove |
| 5. Hort. Exp. Station DOI-MU-SER | Sugar pea Tomato Crucifer | Avocado Macadamia Strawberry | Gladiolus Rose Local ornamentals Carnation Gerbera Bird of Paradise Other potential crops | - | Tea,* coffee* | | | Cardamom Clove |
| 6. Exp. Sta. Highland Agriculture (KASET-TE-SOONG) | Crucifers | Persimmon Peach Apricot Pear Apple | Flower crops for seed and bulb production, Temperate crops | | Tea,* coffee* | | | Spices |
| 7. PHI-CHIT Center | Water spinach Cucumber Tomato Chinese radish | Pomelo Banana Papaya Mango Tangerine Grape Tamarind Guava Jackfruit | Jasmine, Mum Rose, Aster Local ornamentals Other potential crops | X | - | - | - | - |

- 43 -

Continued:

| Stations | Vegetables | Fruit Crops | Ornamentals | Coconut | Beverage Tea, Coffee, Cacao | Oil Palm | Cashew Nut | Herbs & Spices |
|---|--|--|---|---------|-----------------------------------|-------------|---------------|---------------------------------|
| 8. Hort. Exp. Station THA-CHAI | <u>Chili</u> <u>Eggplant</u> Water spinach | <u>Banana</u> <u>Grape</u> <u>Mango</u> Papaya Tamarind Sapodilla | <u>Local ornamentals</u> Jasmine, Rose X (Champee, Champa) | | - | - | - | Cardamom Spices |
| 9. SRI-SA-KET Center | <u>Chili</u> <u>Shallot</u> <u>Tomato</u> Cucurbit | <u>Mango</u> <u>Papaya</u> | <u>Local ornamentals</u> Aster Jasmine Gladiolus Mum Gerbera Other potential crops | | - | - | X | |
| 10. Hort Exp. Station NA-KHON PANOM | <u>Chili</u> <u>Eggplant</u> Chinese radish Kale | <u>Mango*</u> <u>Tamarind</u> Durian Litchi Longan Rambutan Jackfruit Sweetsop | <u>Local ornamentals</u> Rose | | - | - | | - - |
| 11. RATCH- BURI Center | <u>Yardlong bean</u> <u>Tomato</u> Sweet potato Chili Eggplant | <u>Papaya*</u> <u>Tangerine*</u> <u>Mango*</u> Durian Rambutan Mangosteen Banana Grape Jackfruit Sapodilla Tamarind Guava | <u>Rose, Orchid</u> X Mum, Jasmine Gerbera, Aster Anthurium <u>Local ornamentals</u> Foliage plants Other potential crops | | | - | | Pepper Spices Long pepper |

- 44 -

Continued:

| Stations | Vegetables Crops | Fruit | Ornamentals | Coconut | Beverage Tea, Coffee, Cacao | Oil Palm | Cashew Nut | Herbs & Spices |
|---------------------------------------|--|---|--|---------|-----------------------------------|-------------|---------------|--|
| 12. Hort. Exp. Station PLEW | Tomato Yardlong bean Water spinach | Rambutan* Durian* Mangosteen* Tangerine Longgong Sala Carambola Jackfruit Avocado | Local Ornamentals - Aster Foliage plants Mum Jasmine Gerbera Anthurium Rose Other potential crops | | Cacao, coffee | - | - | Pepper* Long pepper Clove |
| 13. Hort. Exp. Station BANGKOK NOI | Yardlong bean | Mango Tamarind Litchi Guava Jackfruit | Anthurium Jasmine Gerbera Aster Other potential crops | - | - | - | - | Pepper Spices |
| 14. SURAT- THANEE Center | Sweet potato Local vege- tables | Durian* Rambutan* Mangosteen* Longgong* Laneet Banana Jackfruit Tangerine | Anthurium Local Orna- mentals Foliage plants Orchid. Rose Aster, Mum Gerbera Jasmine Other potential crops | - | Coffee*, cacao | X | X | Cardamom Clove Pepper Long Pepper (Chan-tes) |
| 15. Hort. Exp. Station TRUNG | (Sa-tao) Local vege- tables | Durian Rambutan Mangosteen Banana Pineapple Tangerine (Longgong) | Local Orna- mentals Foliage plants Anthurium Rose, Aster Mum, Gerbera | X* | Cacao, coffee | X | X* | Pepper (Chan-tes) Cardamom Long Pepper Clove |

15.

Continued:

| Stations | Vegetables | Fruit Crops | Ornamentals | Coconut | Beverage Tea, Coffee, Cacao | Oil Palm | Cashew Nut | Herbs & Spices |
|----------------------|------------|-------------|-------------|------------|--------------------------------|-------------|---------------|--|
| 16. SWAWEE Center | - | Durian | - | <u>X</u> * | <u>Cacao</u> *, coffee | - | - | Pepper Cardamom Long Pepper (Chant-tes) |

17/2/83

- * Indicates MAIN CROPS: commercial crop and suitable for local social and climatic conditions
- ___ Indicates URGENT CROP: recommended for each station
- X The crop in that column is also indicated

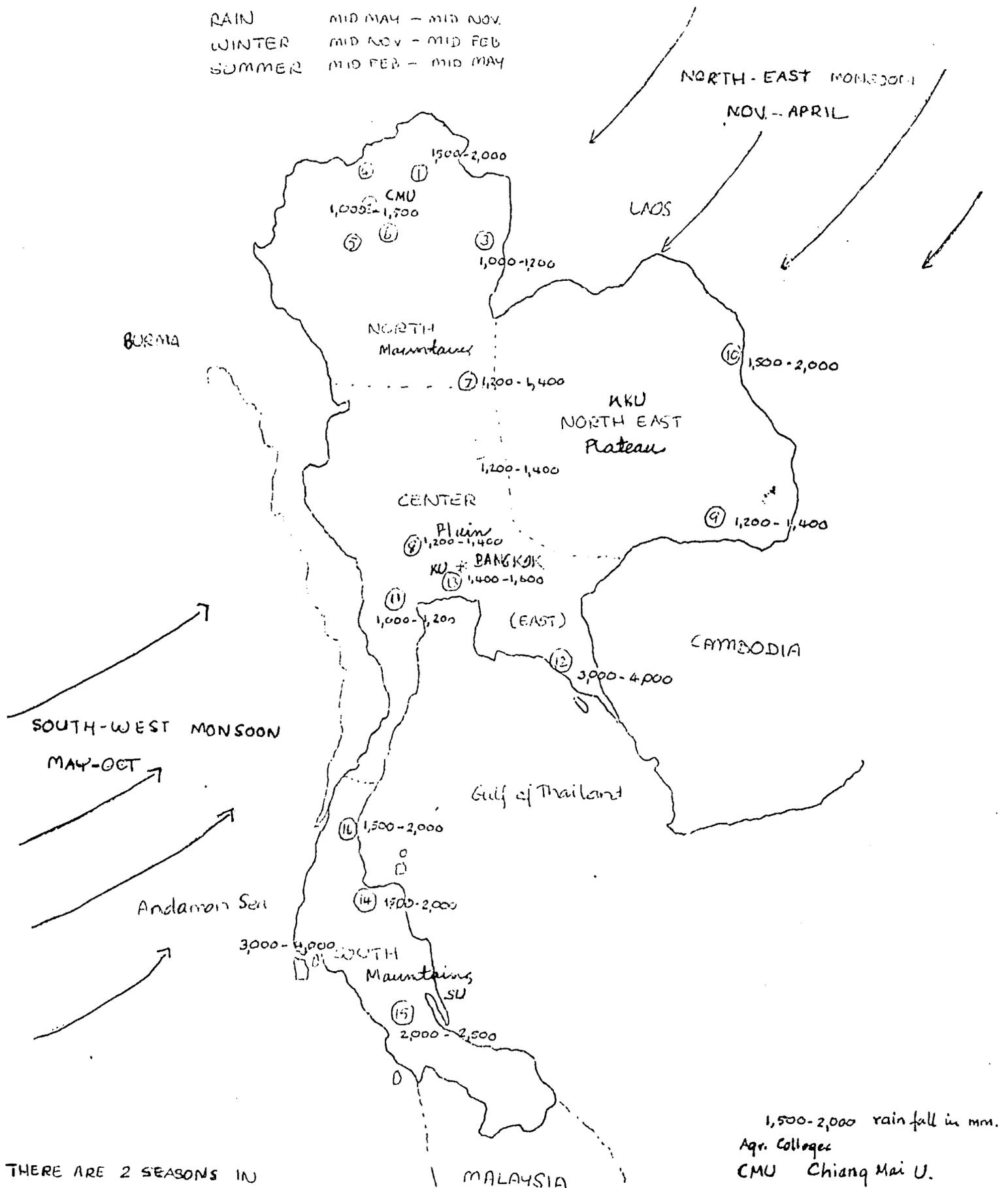
Characteristics of Urgent Crops:

1. Follow the national Social and Economic Development Plan
2. Are economically important
3. Are useful in terms of natural resource conservation
4. Have high potential

46

THERE ARE 3 SEASONS IN
NORTH, NORTH-EAST & CENTER REGIONS

RAIN MID MAY - MID NOV.
WINTER MID NOV - MID FEB
SUMMER MID FEB - MID MAY



THERE ARE 2 SEASONS IN
SOUTH & EAST REGIONS

WET JUNE - FEB
DRY MAR - MAY

APPENDIX 6

1,500-2,000 rain fall in mm.
Agr. Colleges
CMU Chiang Mai U.
KKU Khon Kaen U.
KU Kasetsart U.
SU Songkhla Nakarin U.