RECONNAISANCE MISSION

REPORT ON TROPICAL, SUBTROPICAL AND TEMPERATE FRUITS

FOR

THE HANOI REGION

OF

VIETNAM

BY KEITH R. CHAPMAN

TROPICAL FRUITS CONSULTANT
QLD. DEPT. PRIMARY INDUSTRIES
MAROOCHY HORTICULTURAL RESEARCH STATION
NAMBOUR QUEENSLAND AUSTRALIA

AND

GORDON R. EDWARDS

TEMPERATE FRUIT CONSULTANT
4/4 FRICK AVENUE
FIRLE
SOUTH AUSTRALIA
(FORMERLY OF WAITE RESEARCH INSTITUTE
UNIVERSITY OF ADELAIDE
SOUTH AUSTRALIA)

PREPARED FOR - UNDP/FAO
HORTICULTURE PROJECT
VIE/80/005
HANOI. VIETNAM

MISSION VISIT - 9th MAY -
23rd MAY 1986

CONTENTS

		Page No.
SUMMARY OF RECOMMENDATIONS		3
1.	INTRODUCTION	5
	1.1 Terms of Reference	5
	1.2 Program	6
	1.3 Acknowledgements	6
2.	CONCLUSIONS	6
	2.1 Production área and fruit requirements: Hanoi Region	6
	2.2 Constraints to fruit production, Hanoi	8
	2.3 Role of consultants	9
	2.4 Probable fruits for the Hanoi region and surrounding areas	10
	- Tropical/sub-tropical fruits	
	- Temperate tree fruits	
	- Table grapes	
3.	RECOMMENDATIONS	
	3.1 To the People's Committee of Hanoi	17
	3.2 To UNDP/FAO/Government of Vietnam	18
4.	ANNEXURES	
	I - Programme of visit 9-23 May 1986	22
	II - Fruit cultivar lists for introduction to Hanoi region and Vietnam	23
	III - Criteria for determining survival, commercial and best mean minimum July temperatures for various tropical fruits in Australia (S. Hemisphere)	28
	IV - Recommended book list - Horticultural Production Technology	30
	V - Recommended book list - Post Harvest Management of Fruits and Vegetables	35
	VI - Additional Australian references (D. Schoorl and J.E. Holt) on post harvest management of fruits and vegetables	37

SUMMARY OF RECOMMENDATIONS

To the People's Committee of Hanoi

- Encourage an immediate expansion of the area planted to familiar fruits.
- Promote small scale planting for new fruits suggested.
- Arrange a study tour of the raised bank culture of tree fruits in lowland areas of Thailand.
- Recognize the need for 15,000 ha of well drained land to meet the needs of Hanoi for fruit.
- Encourage liaison between the Institute staff and Ministry of Agriculture and other sources of knowledge and experience.
- Assemble, translate and distribute to farmers information on fruit culture.
- Take action to ensure the availability of fertilizers and agricultural chemicals.
- Assemble a list of fruit cultivars presently in Vietnam and note the holding centres.
- Foster the concept of a National Program of fruit research and extension.
- Support the proposal that the Chief Technical Adviser visit Australia to collect fruit cultivars not present in Vietnam.
- Arrange for selected Institute personnel to undertake training in extension methods.
- Recognize that the success of the Hanoi Fruit Project depends upon free exchange of information with the other organisations and travel to other parts of Vietnam.
- Consider an investigation of marketing, transportation, handling and storage of fruits.
- Arrange for future consultancies on propagation techniques, nursery management and fruit tree management.

To UNDP/FAO/Government of Vietnam

- Consider the implications of a proliferation of projects with the geographical and administrative constraints of the People's Committee of Hanoi Horticulture Project before a broader assessment of the needs and possibilities for fruit production in Vietnam has been made.
- Foster the concept of a broader program of Horticulture development aimed at exploiting the wide range of environments available for fruit production in Vietnam.

- Institute a study of available meterological data for Vietnam with the objective of identifying and developing optimum environments for fruit production in Vietnam.

- We urge consideration of a National Fruit Program for Vietnam, embracing research, development, extension, collection, introduction and assessment of fruits throughout Vietnam.

- Adopt a Fruit Development Strategy for Vietnam (see Figure 3).

1. INTRODUCTION

1.1 Terms of reference and scope of project

"Under the supervision of the Chief Technical Adviser and the National Director of the Project, the Consultants will be responsible for:

- suggestions for introduction of the most suitable fruit varieties to be propagated;
- advice on the most appropriate and modern practices related to fruit crops;
- assistance in setting up a tree nursery;
- establishing and executing a training programme for extension agents;
- obtaining and suggesting literature on fruit crops;
- performing other duties within their competence as assigned by the Chief Technical Adviser;
- preparing a detailed report at the end of the mission."

The Government of Vietnam is to be commended for initiating a development programme on horticultural crops, particularly perennial fruits, at a relatively early stage of National Development. Tree fruits by their perennial nature are slow to reach productivity but provide the variety, nutritional value, and enjoyment that societies require when their needs for staple foods have been met. To ensure that such fruit supplies are available when self-sufficiency in staple foods is reached, development must begin well before that stage. Indonesia is a country which illustrates this problem well. Presently self-sufficient in rice production, it is now embarking on a "crash" programme on fruit development. Perennial fruits cannot be developed successfully as crash programmes.

UNDP/FAO is to be commended for supporting this programme in horticulture in Vietnam.

The terms of reference do not suggest, nor did preliminary negotiations with FAO, Rome indicate, any geographical or administrative constraints on the project. It was not until some days after arrival that we came to understand that the present project is confined to the Municipality of Hanoi in conjunction with the Institute of Fruits, Vegetables and Flowers of the People's Committee of Hanoi.

It was thus disappointing that we were not able to visit highland areas to the North, East or South of Hanoi or make contact with Ministry of Agriculture horticulturists.

We believe, our effectiveness, indeed the effectivness of the Chief Technial Adviser, is impaired by these constraints.

1.2 Dates of consultancy - 9th May - 23rd May 1986

1.3 Program - see Annex I

1.4 Acknowledgements

We sincerely acknowledge the assistance of the Vietnamese Government, People's Committee of Hanoi, the Director of Agricultural Services, the Director of the Institute of Fruits, Vegetables and Flowers and their staff for their assistance and hospitality during our mission.

The consultants wish to acknowledge the assistance given by Dr Samu-Negus Haile-Mariam, CTA of the Project, for making all necessary arrangements for our visit and ensuring our stay was a pleasant one.

We also wish to thank various co-operatives, State farms and the Ministry of Industrial Crops for making us welcome and showing us their orchards.

We thank UNDP and FAO staff in Hanoi and FAO staff in Rome and Bangkok for assistance and guidance during and prior to our visit.

K.R. Chapman wishes to sincerely acknlowedge the Queensland Department of Primary Industries for releasing him from regular duties to undertake this mission.

2. CONCLUSIONS

2.1 Production area and fruit requirements: Hanoi Region

2.1.1 We have been advised by the People's Committee of Hanoi of the following facts.

a) The Hanoi region is 1080^{2}km in area.

b) Three (3) million people live in this region.

c) The average consumption of vegetables is 75-80 kg/person/year.

d) The average consumption of fruits in the region is 15-18 kg/person/year.

e) At present 800-900 T of fruit are imported into the region each year.

f) The Hanoi region has available for fruits 5,000 ha of land - 250 ha is contained in co-operatives, while the remainder are peasant gardens.

g) Current average yield of fruits in Hanoi region is 7 T/ha.

h) A firm objective is to increase fruit production in the Hanoi region.

2.1.2 Western countries such as Australia consume around 120 kg/person/year* of vegetables of which about 30 kg are starchy vegetables such as potato (Hanoi - 60-80 kg/person/year).

* A.B.S. (1984) Apparent average annual consumption of vegetables per person. Australian Bureau of Statistics.

2.1.3 Fruit consumption in Australia is between 90-100 kg/person/year.**

2.1.4 In discussion, we have submitted to the People's Committee that 50 kg/person/year of fruit may be a realistic objective for Hanoi and indeed Vietnam - we have received general agreement on this objective.

2.1.5 Now for 3 million people in Hanoi region and a consumption of fruit at 50 kg/person/year you require 150,000 T of fruit.

2.1.6 At a yield of 10 T/ha, 15,000 ha of land will be required to produce this fruit. In fact, more land than this will be needed since roads, headlands, buildings, nurseries, irrigation canals etc. will consume about 20% of the land. Therefore add 3,000 ha to give a total of 18,000 ha required.

2.1.7 10 T/ha is a reasonable yield to expect with low levels of management - the average now is 7 T/ha. Alternatively, with high technology management yields/ha of fruits can easily be doubled or trebled with many fruit from this low level of 10 MT/ha.

Thus: At 20 T/ha - require 9,000 ha of land to give 150,000 T fruit

At 30 T/ha - require only 6,000 ha of land to give 150,000 T.

2.1.8 Such high level technology will not produce such yields in hundreds of garden plots. The management expertise cannot be transmitted and made to work in such tiny holdings. The higher technology could be made to work in large farms, provided that sufficient incentive was present.

2.1.9 Since the Hanoi Region only has 5000 ha of land, mostly in gardens, and the fact that we are dealing with tree fruits, we conclude that there is no way that Hanoi Region can produce enough fruits for its own consumption in the foreseeable future (10-20 years). Dramatic re-direction on land use would have to be made to divert from rice, grain legumes and vegetables to fruit on the lowland areas. We see this as undesirable, unwise and impractical.

2.1.10 A better decision is to go outside the Hanoi region and use the hillsides, which:

a) Are better drained, lighter soils
b) Not suited to rice
c) Less suited to other grains
d) Have a cooler climate, which will possibly allow deciduous fruits to grow along with the sub-tropical/tropical fruits.

2.1.11 We suggest that at least 15,000 ha of land should be sought in the hill country between 0-600 m elevation, for fruit production for Hanoi, both now and in 10 years time when the population may have increased by 15-20%.

2.1.12 If we apply the 50 kg/person/year of fruit for the whole of Vietnam (60 million people) then 3 million tonnes of fruit will be required each year. For a yield of 10 T/ha, 300,000 ha + 20% will be required, i.e. 360,000 ha.

** A.B.S. (1984) Total apparent consumption of fruit and fruit products, Australia. Australian Bureau of Statistics.

2.2 Constraints to fruit production: Hanoi Region

There are many major constraints to fruit production in the Hanoi region and surrounding areas. These are as follows:-

2.2.1 Limited land area in Hanoi region (see above).

2.2.2 If fruit production increases:-

a) Will people want to buy more fruit?
b) Can people afford to buy more fruit?
c) Can fruit be made available to people in a fresh state and good condition?
d) Can fruit be supplied on a regular basis through-out the year at reasonable prices?
e) Can fruit be processed or stored to even out supply?

2.2.3 To decide what fruits can be produced in Hanoi and other areas of Vietnam we have met with constraints in trying to:-

a) Obtain useful climatic data.
b) Obtain useful soils data.
c) Obtain useful contour maps.
d) Obtain information on availability of irrigation - especially in the hills.
e) Find out what fruits are produced where in Vietnam.
f) Find out what cultivars of the different fruits are available in Vietnam and where they can be obtained.
g) Visit other areas outside the Hanoi region to see present status of fruit production and assess pest and disease problems.
h) Visit more Ministry of Agriculture fruit research stations - so far we have seen only one station. We need to see many more.

2.2.4 Road/transport/distribution systems could be a constraint to the gathering and distribution of fruits, especially from highland areas.

2.2.5 Apparent absence of post harvest storage facilities to even out distribution, preserve fruit quality and extend the supply season.

2.2.6 Chemical fertilizers, pesticides and fungicides appear to be in short supply and the range of products is very limited.

2.2.7 Costs and returns estimates for fruits may well limit fruit production initially when high returns can be made from rotational farming of rice, beans, vegetables, etc. Incentives may have to be given to farmers to induce them to produce fruit.

2.2.8 We believe that the range of fruit cultivars available in Vietnam is limited with many of the fruits - this is a major constraint.

2.2.9 Lack of propagation facilities and technical know how for propagating fruit trees of the best cultivars in large numbers.

2.2.10 A major constraint is the lack of technical expertise and knowledge by farmers, extension officers and researchers on production and post harvest management of fruits in Vietnam.

2.2.11 There is a serious lack of research, and research findings on fruit crops, based on what we have seen so far.

2.2.12 There appears to be a major deficiency of people trained in fruit crop research and production in tropical/sub-tropical environments.

2.2.13 Lack of Government support for research and development of fruit could be a major constraint. Fruit tree establishment seems to have a high priority. Research and development must go hand in hand with such expansion.

2.2.14 There is an apparent lack of co-operation between different regions and organisations. This non-co-operation is not in the best interests of fruit production for Vietnam.

2.2.15 A serious major constraint on our consultancy has been the inability to travel and visit other fruit areas in Vietnam to identify plant performance, cultivars available and management problems likely to be encountered in Hanoi and surrounding areas when production increases.

The C.T.A. experiences the same constraint to the performance of his duties. Our reconnaisance mission has been seriously hampered by this inability to travel and gain information that we need to make decisions.

2.2.16 Climatic constraints will limit the range of fruit crops to be grown in the Hanoi region, with low winter temperatures, providing the major controlling constraint to tropical fruit production (Annex III).

2.2.17 On the Hanoi floodplain of the Red River, high water tables are a major constraint to tree growth, tree health and flowering. Water table control is a key component for problem resolution in this area. For the hill areas, availability of irrigation water and the need for more fertilizer inputs may be constraints which restrict yield.

2.3 The role of consultants

We, as consultants, and the C.T.A. can help in the following ways:

2.3.1 We can assist in deciding how much fruit needs to be grown to satisfy a given consumption of fruit/person/year.

2.3.2 We can decide how much land is required to meet this demand for fruit.

2.3.3 We can assist in selecting the most appropriate fruits for different regions in Vietnam.

2.3.4 We can help select a range of fruits to provide a more regular supply of fruit throughout the year.

2.3.5 We can assist in providing good cultivars of fruits both from within Vietnam and as imports from other countries.

2.3.6 We can assist with the setting up of fruit tree nurseries and teaching people how to propagate and raise trees for distribution to farmers.

2.3.7 We can teach Vietnam how to select the best land and how to prepare it for the planting of fruit trees.

2.3.8 We can provide good information on how to grow fruit trees well and how to develop this information for extension workers and farmers.

2.3.9 We can teach Vietnam how to plant and undertake research in fruit crops.

2.3.10 We can teach Vietnam how to use research information both from Vietnam and overseas and how to transmit this knowledge to farmers.

2.3.11 We can suggest to train personnel in research, extension, production and post-harvest management and arrange for such training to be undertaken by appropriate people.

We cannot as consultants:

2.3.12 Perform miracles!

2.3.13 Provide answers when no information is forthcoming on the things we need to know.

2.3.14 We cannot guarantee that the cultivars of fruit trees we suggest will do well in the Vietnamese environment. Research and testing must be undertaken before large areas of fruits are planted except where good information already exists.

2.3.15 Many of the constraints and considerations presented above are common to other developing countries at the same stage of fruit production. Fruit is rarely given priority until after the production of staple foods meets domestic requirements.

2.4 Probable fruits for production in the Hanoi region and surrounding areas are:

2.4.1 Tropical/sub-tropical fruits for lowland areas 0-100 m altitude.

GROUP 1 - best known and easiest to grow fruits in lowland areas.

Banana	Pummelo	Jambu (Bell fruit)
Papaya	Persimmon	Mulberry
Guava	Sapote (Sapodilla)	Rockmelon
Jujube	Jakfruit	Honeydew melon
Kumquat (plants)		Watermelon

GROUP 2 - more difficult fruits to grow well in the lowland areas.

Longan	*Mandarin
Lychee	*Lime
Victorian pineapple	

GROUP 3 - fruits that should be tested for the lowland areas.

Smooth Cayenne pineapple	Carambola
Mango	Lady finger banana
Avocado	
Yellow passionfruit	

2.4.2 Tropical and sub-tropical fruits for highland areas 100-300 m altitude.

GROUP 1 - fruits already grown in this area.

Guava	Mulberry	Jujube
Longan	Smooth cayenne pineapple	Pummelo
Lychee	Banana	Sapote (Sapodilla)
Jakfruit	Persimmon	Papaya
Banana	Melons	Japanese apricot

GROUP 2 - fruits to be tested in this highland area.

Mango	+Lady finger banana	Lime
	Annona	Loquat
	*Mandarin	Low chill peach
	Carambola	Low chill plum
	*Orange	Avocado
	Grape	Passionfruit

+ = better suited to cooler areas than other cultivars.

2.4.3 Tropical and sub-tropical fruits for highland areas 300-600 m altitude.

To be tested:

Annona	Low chill peach
*Orange	Low chill nectarine
*Mandarin	Low chill plum
Loquat	Carambola
Avocado	Lady finger banana
Guava	Smooth cayenne pineapple
Grape	Persimmon
Lychee	Passionfruit (purple hybrid)
Longan	Japanese apricot

* N.B. Major constraints to expansion of these citrus fruits in Hanoi will be greening disease, and other serious citrus diseases including Phytophthora, Tristezid, Psorosis and insect pests including a serious borer problem. We would prefer to see Pummelo as the more common citrus grown in Hanoi region. Isolated areas in the hills may prove to be more practical for pest and disease management if clean planting materials are used.

Above 600 m we are not certain about climatic conditions in the North of Vietnam as we have no access to reliable temperature and rainfall records at this time. Therefore, it is very difficult to suggest what sub-tropical fruits may be grown above 600 m.

Please also note that many of the above fruits have very specific requirements and unless these are satisfied they may fail and rapid tree death may follow. Thus, an understanding of these requirements is a prerequisite for testing and development. Furthermore, good management is required to ensure that trial plantings and experiments provide a true picture of the ability of the cultivars to perform in a given environment.

Our conclusions about fruits to be grown and tested are based on:-

a) Climatic considerations - especially critical minimum temperatures (Watson & Moncur, 1985)

b) Soil types and drainage.

c) What we have seen growing to date in these areas.

d) The problems likely to be encountered in production and marketing of the fruits.

e) The relative ease with which they may be grown.

f) Consumer preferences - what they would like to eat.

g) Probable yields and thus economic returns.

2.4.4 Tropical fruits of the hot wet tropics.

The Hanoi region and surrounding areas in the hills will generally be unsuitable for the growth and production of tropical fruits of the hot wet tropics, eg. Durian, Mangosteen, Rambutan, Salak, Langsat and Duku, Rambei Chempedak, Marang and Pulasan. However, we are certain that a number of these fruits are grown elsewhere in Vietnam in the hot wet tropical southern region, which has a climate which favours their production. Such fruits may well complement the fruits of the Hanoi region and vice versa through internal trading between North and South.

2.4.5 Temperate (deciduous) tree fruits: apple, pear, peach, etc.

For temperate fruit culture beyond the temperate zone, minimum temperatures are the major determining factor. Both actual minima and the seasonal variation in minima are important. The former is influenced mainly by altitude; the latter by latitude. Two distinct cultural systems are recognized in association with the different temperature regimes:-

1. Sub-tropical: seasonal temperature variation is pronounced; there is a distinct cool season; however minima in the coldest months are not low enough to satisfy the chilling requirement of most deciduous trees. In such areas the normal single growth cycle commencing in spring and ending late summer is all that can be expected. Problems of inadequate winter chilling in the form of delayed, sporadic bud burst occurs in such areas. Successful culture of temperate fruits in such areas is dependent on the use of low-chill cultivars and chemical chilling compensator sprays to promote bud burst. The latitude range of this zone is about 15-25°.

2. Tropical: Seasonal variation is minor; there is no distinct cold period; actual minima vary considerably with altitude. In the lowland, 0-200 m, minima are generally above 20 C and too hot for temperate fruits. In the highland above 2000 m it is too cold year round for good fruit maturation. However, at intermediate altitudes, 500-2000 m, temperatures are favourable for growth and maturation of temperate fruits at any time of the year. Successful culture is dependent on avoiding dormancy, by artificial defoliation, to induce a second growth cycle, resulting in two crops per year. Such areas are found between latitudes 0 - 15 .

There are two areas where such double or continuous cropping has been carried out successfully for many years on a large commercial scale, viz. Batu in East Java for apples and Colonia Tovar, Venezuela for peaches. The success in those areas suggests the technology should be adopted in other low latitude-intermediate elevation areas.

Of these two cultural systems, the sub-tropical one seems applicable to North Vietnam and the tropical system applicable to South Vietnam. Figure 1 compares mean monthly minimum temperatures for several relevant locations.

Curve 1 is for Hanoi, latitude 21 N. Elevation 6 m.
Curve 2 is for Ho Chi Minh City, latitude 10 47'N. Elevation 11 m.
Curve 3 is for Batu, Indonesia, latitude 8 S, elevation 1100 m, the centre of a very large apple industry where double cropping has been practiced since the 1940's.
Curve 4 is for Colonia Tovar, Venezuela, latitude 10 N elevation 1790 m. At lower elevations and therefore warmer temperatures than this, a unique no-chill peach cultivar has been continuously cropped, 2-2 1/2 crops per year, for many years.
Curve 5 is for Spencer Farm near General Santos, Philippines, latitude 6 N, elevation 200 m, at which apples were produced in the third growth cycle within 14 months of planting using the continuous cropping system. Low-chill peaches were unsuccessful at this site, and it is considered temperatures are too high for peach fruit set.
Curve 6 is for Baguio, Philippines, latitude 16 25'N, elevation 2000 m at which apples can be produced by the double cropping system, and low-chill peaches were produced by combining defoliation and chemical bud-break treatments.
Curve 7 is for Nambour, Queensland, Australia latitude 26 37'S, elevation 30 m at which low-chill peaches are cropped very successfully in a single crop cycle per year.

Figure 1 suggests that the temperature regime of Hanoi has a seasonal pattern of the sub-tropical type similar to that of Nambour, Queensland whereas Ho Chi Minh City has a more uniform regime more typically tropical. In either case, the actual mean monthly minima are much higher than respective comparable areas in which temperate fruits are grown. It will be necessary to select sites at higher altitudes (500-1500 m) for the successful culture of temperate tree fruits in both cases. At higher elevation near Hanoi, a single crop cycle is indicated and problems of excessive vegetative growth in the hot-wet summer period and sporadic bud burst in spring must be anticipated. At higher elevation near Ho Chi Minh City, a double cropping system will be essential and possible. If trees are allowed to go dormant it will be very difficult to break dormancy in the absence of any chilling.

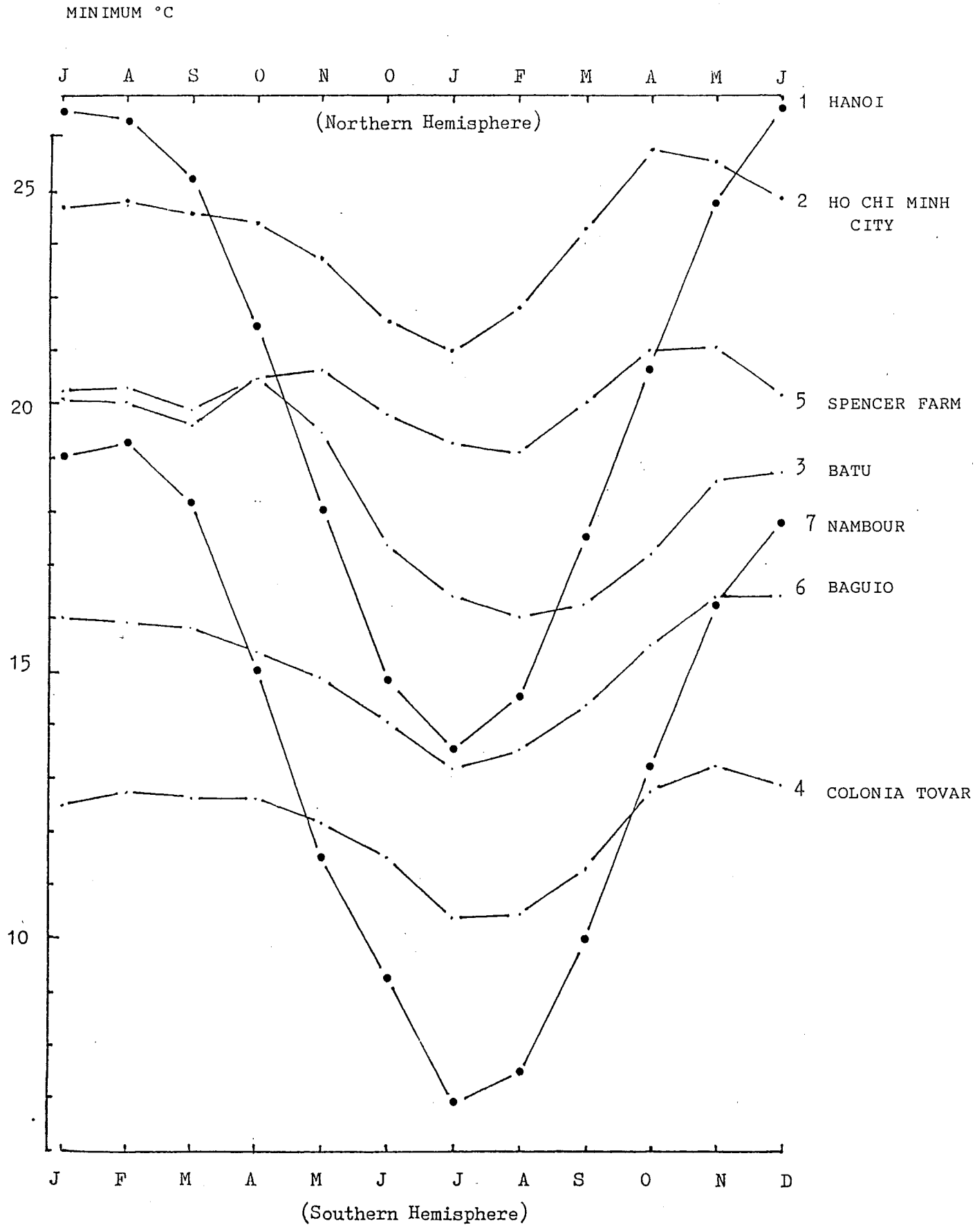


Figure 1 Mean monthly minimum temperatures for several locations around the world.

2.4.6 Table grapes

Table grapes are now widely grown in tropical/sub-tropical environments. Extensive production occurs in Southern India (Bangalore), Venezuela (Maracaibo) and Thailand (Bangkok). In tropical environments, grapes tend to grow continuously, becoming unmanageable and fruiting asynchronously. By pruning to fruitful basal buds, a new growth cycle is induced and at the prevailing high temperatures dormancy is avoided and 2-2 1/2 crops are obtained per year.

In sub-tropical environments, temperatures are too low in the cool months and bud burst is slow and erratic. Chemical treatments are available to improve bud burst but two cycles are more difficult to achieve.

Figure 2 compares mean monthly maximum and mean monthly minimum temperatures for Hanoi, Ho Chi Minh City and Bangkok. Ho Chi Minh City has a practically identical temperature regime to Bangkok, indeed a slightly more uniform minimum temperature and slightly lower annual mean (26.9°vs 28.0°). It should be as suitable for continuous cropping of grapes as Bangkok. However, higher rainfall (2718 mm p.a. vs 1957 mm p.a.) will induce even greater leaf and bunch disease problems than in Bangkok.

Hanoi, in contrast, has more sub-tropical seasonal variation in temperature and a single crop during the dry spring months may be more appropriate.

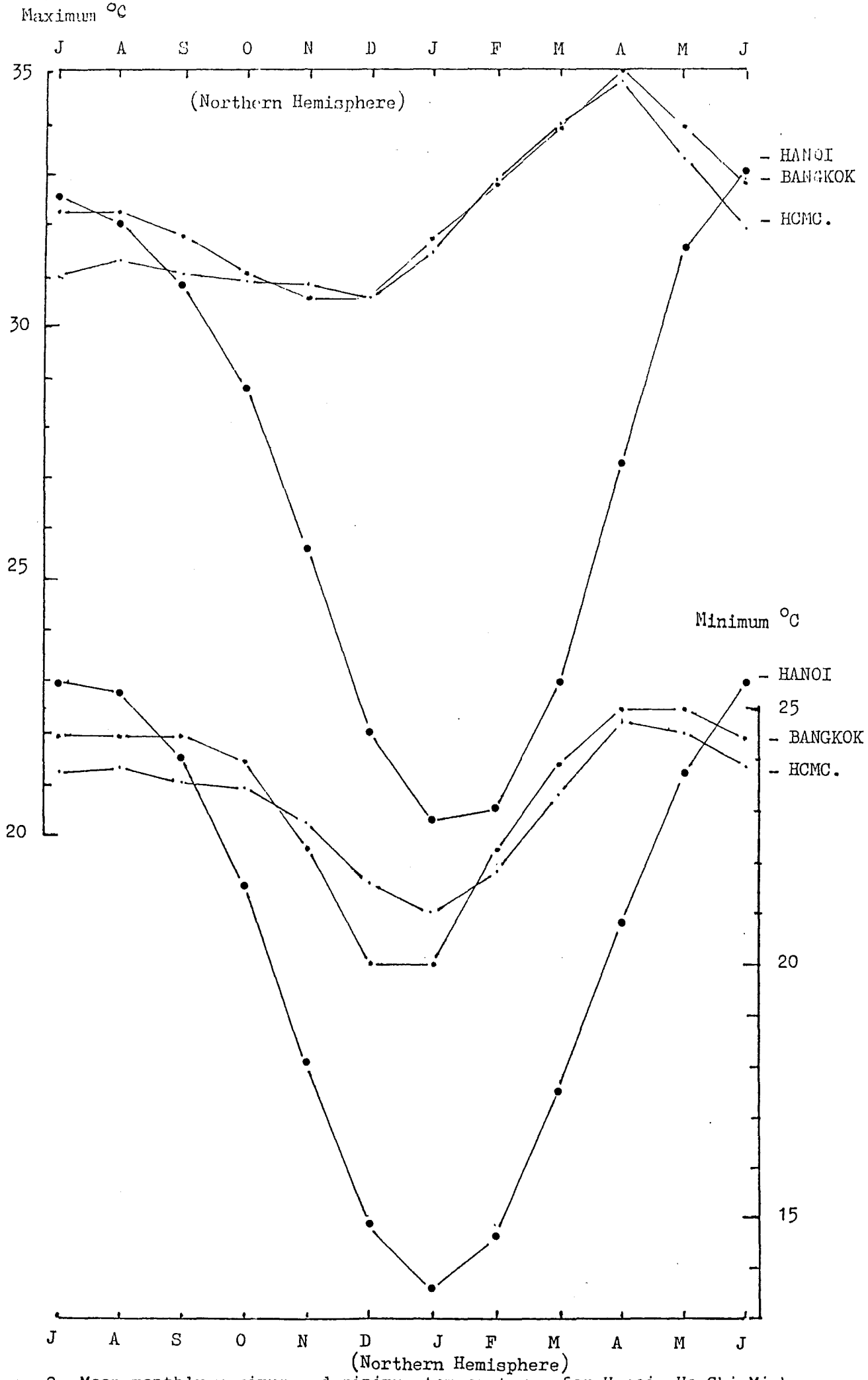


Figure 2 Mean monthly maximum and minimum temperatures for Hanoi, Ho Chi Minh City and Bangkok.

3. RECOMMENDATIONS

3.1 To the People's Committee of Hanoi

3.1.1 Encourage an immediate expansion of the area devoted to fruit crops familiar to the farmers of the region, viz. jujube, sapodilla, guava, papaya, pummelo, banana, etc. It may be possible to stimulate planting of these crops by provision of planting material of the best cultivars available to the farmers at low cost.

Some experiments should be done on extending the production season of these familiar crops to spread the period of availability. e.g. pruning of jujube at different times, and defoliation of guava to alter flowering time.

3.1.2 Promote small scale plantings of the new crops suggested for the area on co-operatives and state farms. It is important to avoid rapid expansion of plantings of unknown fruits until the most suitable varieties have been identified, the farmers have gained experience with them, and clean planting material is available.

3.1.3 The major problem of the lowland areas of the Hanoi region concerning fruit tree production is the lack of control of water table levels. We recommend, as a matter of urgency, that appropriate personnel visit Bangkok and nearby areas to investigate the raised mound (bank) culture of fruit trees. Such technology is highly developed in Thailand and is essential for the culture of trees on the Hanoi flood plain both for disease and cropping control.

3.1.4 Recognise the need for at least 15,000 ha of land in well-drained areas between 0-600 m elevation to produce tropical/sub-tropical fruits sufficient to meet the likely future needs of the Hanoi region. Thought should be given to possible arrangements with neighbouring regions including highland areas above 600 m to the North and West of Hanoi to ensure the future supply of fruit to Hanoi. If highland areas could be included in the fruit development programme, the range of possible crops could be extended to include temperate fruits.

3.1.5 Encourage liaison between the Institute for Fruits, Vegetables and Flowers, and Ministry of Agriculture personnel with expertise in horticultural crops. Co-operative investigations, sharing of knowledge, experimental findings and cultivars available, is essential to ensure the most rapid and successful development. We also believe that a great deal of knowledge and experience is available from the older generation. These people should be encouraged to share their experiences with the project. The best managed orchard that we saw was Da Ton, a co-operative for retired people. This could be used as a model for further development.

3.1.6 Assemble, translate, and distribute to farmers, technical information on the culture of appropriate fruits. We will supply to the CTA such literature from Australia and we recommend that it must be made available to the People's Committee Project and the Ministry of Agriculture.

3.1.7 Appropriate action will be necessary to ensure the availability of a wider range of fertilizers, pesticides and insecticides than is presently available, if expanded production of fruit is to succeed.

3.1.8 There is an urgent need to assemble a list of cultivars of all fruit species which presently exist in Vietnam. This should precede introduction of new cultivars. The risk of introducing diseases new to the country with introduced cultivars means that any cultivar already present should not be re-introduced. Previous experience with existing cultivars is a valuable guide to the types that should be introduced.

3.1.9 In the light of this knowledge, a programme of introduction and assessment of new cultivars should be established. We strongly believe this should be done as part of a National Co-ordinated Fruit Programme, to avoid unnecessary duplication and to ensure that introductions are tested in several regions to fully assess their suitability. We will recommend an appropriate list of cultivars for introduction from Australia to Vietnam. We will assist with the procurement of material for introduction on the firm understanding that such material will be made available for distribution throughout Vietnam.

3.1.10 To expediate such introductions, we recommend that the CTA, Hanoi Project, make a two-week visit to Australia at an appropriate time to collect the selected planting materials and bring them back to Vietnam in person. Experience has shown this to be the only reliable method of introduction of perishable plant material.

3.1.11 We recommend that selected personnel from the Institute for Fruits, Vegetables and Flowers participate in the current UNDP sponsored Extension Methods Training Programme.

3.1.12 Our impression is that the People's Committee of Hanoi Fruit Project is seriously handicapped by restrictions on availability of information from other organisations, restrictions on travel to other regions, and lack of information on cultivars, production methods and problems in other parts of Vietnam. We consider this a serious obstacle to the success of the project. We strongly recommend that greater co-operation and assistance for the CTA and future consultants is essential.

3.1.13 Based on our experience in Australia, we recommend that a concerted study should be made to assess marketability, transportation, storage and handling facilities and consumer acceptability of fruit species and cultivars before large scale expansion of plantings is commenced.

3.1.14 For future consultant visits we recommend that specific advice be requested on fruit nursery operations, propagation techniques and tree management operations.

3.2 To UNDP/FAO/Government of Vietnam

3.2.1 We are deeply concerned by the limited scope and severe geogaphical and administrative constraints of the People's Committee of Hanoi Horticulture Project - VIE/80/005. We understand that the original concept envisaged a programme of broader dimensions directed towards the development of horticulture in Vietnam as a whole. We understand that funding limitations precluded this approach. We concede that in the face of such limitations, the Hanoi region by virtue of its greater need, was an appropriate choice for a programme on a smaller scale. We do not wish, in any way, to denigrate the existing programme, its objectives or its execution within the given frame of reference.

However, we recommend strongly against a proliferation of such geographically and administratively constrained projects (suggestions of which we have encountered), at least until a broader assessment of the needs and possibilities of fruit production in Vietnam has been made.

3.2.2 To support this recommendation, we offer three considerations, as examples:-

- The Hanoi programme envisages the introduction and testing of new cultivars and species of fruit trees. It would be unwise to introduce to Vietnam a comprehensive range of cultivars and confine their assessment to the Hanoi region alone. It is highly probable that some would be unsuited to the Hanoi region but may excel in another region. At the present time it is not possible to know what cultivars are already in the country.

- It seems foolish to embark on a programme of "training extension agents" that is confined predominantly to personnel of the Hanoi region to the exclusion of personnel from other regions and organisations.

- We as consultants, and we understand the Chief Technical Adviser also, have not been able to travel to other regions, visit research stations, variety collections, or gain access to available information in other parts of the country or from other organisations.

- We recommend that such regional endeavours as the Hanoi project be co-ordinated and integrated within a broader programme aimed at exploiting the wide range of environments available for fruit production in Vietnam.

3.2.3 There are insignificant differences in the temperature regimes of the sites that we visited, for which data was vailable, viz. Hanoi, Suoi Hai, Phu Ho and Ba Vi - all lowland sites. The minimum temperature of the warmest months is ca. 25°C and of the coldest months ca. 13°C. Of the full range of tropical/sub-tropical and temperate fruits, only certain species and cultivars will succeed in this environment. Vietnam, as a whole, ranges in latitude from 9-21° N, and in altitude from 0-3000 m. A wide variety of climatic conditions is represented. Environments, other than the Red River Delta flood plain, must be brought into the present project to extend the range of possible fruit crops and, indeed, to provide the area of land needed to supply Hanoi with fruit. We recommend that all available meterological data for Vietnam should be assembled and assessed with the objective of identifying and delineating optimum environments for the whole range of fruit crops from hot-tropical to cold-temperate.

3.2.4 As a matter of urgency, we recommend the establishment of a National Fruit Program for the conduct and co-ordination of research, extension, collection, importation and assessment of fruits throughout Vietnam.

We recommend this program for UNDP support and development. Such a program may best be developed in an autonomous National Institute of Fruit Crops responsible directly to the Ministry of Agriculture. The Institute would make use of existing research station facilities belonging to the Ministry of Agriculture, but would have its own budget for operation and acquiring new facilities, buildings, etc. in the future. To a large extent, this should allow the Institute to function more efficiently and effectively.

The National Fruit Program would clearly identify major fruit crop regions in Vietnam for the establishment of regional research and extension programs. The selection of such regions should be decided on the potential for fruit crop production and not based on People's Committee Regions.

Such an Institute and Program would provide the necessary back-up of research and extension to support the regional People's Committee's and allow them to concentrate on fruit crop propagation, establishment and development appropriate for the various People's Committee Regions.

The Institute would retain nucleus collections of fruit cultivars for distribution to People's Committees in small quantities. The Institute will clearly need trained personnel for research and extension. In turn, the extension section would have a major role in training selected personnel from People's Committees in propagation and production and post-harvest management technology.

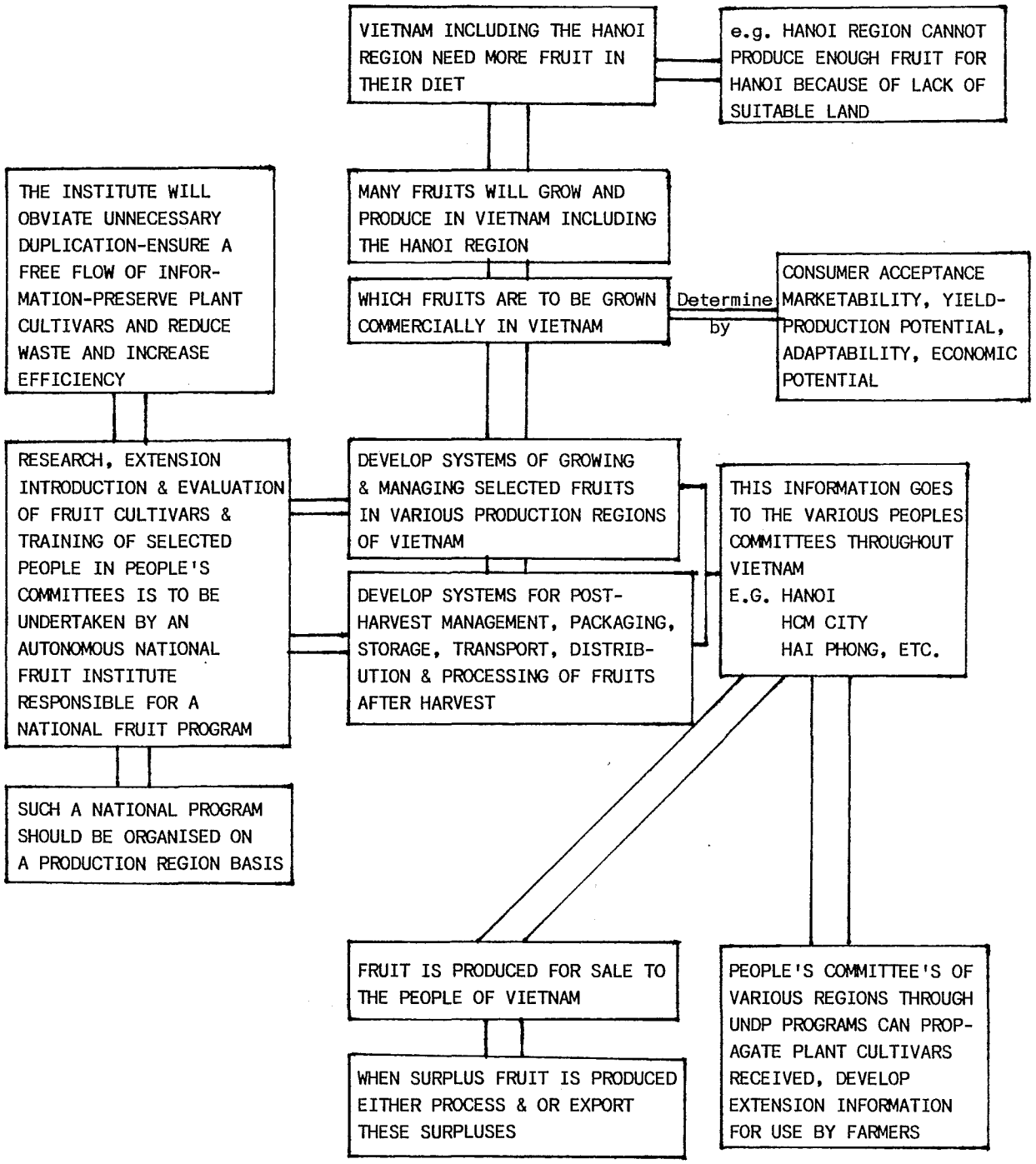
We see such a National Fruit Programme as a very high priority for Vietnam. It will allow for the free exchange of information and planting materials and allow scientists and consultants to move around Vietnam. The Institute and Programme will overcome unnecessary duplication and waste of precious resources in research and extension that surely will eventuate if the Hanoi Region Programme is repeated many times.

We suggest that UNDP pursue the above thoughts and concepts of a National Fruit Programme and National Fruit Crops Institute with the Government of Vietnam. Furthermore, we suggest that UNDP actively discourage the distribution of planting materials throughout Vietnam, without the back-up of research and extension at a regional level.

3.2.5 A strategy for fruit development in Vietnam is attached as Figure 3.

FIGURE 3.

A STRATEGY FOR FRUIT DEVELOPMENT IN VIETNAM



ANNEX I - PROGRAMME OF VISIT 9-23RD MAY 1986

Friday 9/5 -	Arrive Hanoi
Saturday 10/5 -	Meeting with Chief Technical Adviser, Dr Sahu-Negus Haile Mariam
Sunday 11/5 -	" " " " " " " "
Monday 12/5 -	Meeting with National Project Director Mr Tao, and staff of Institute for Fruits, Vegetables and Flowers of the People's Committee of Hanoi. Briefing from UNDP and FAO officers in Hanoi.
Tuesday 13/5 -	Visit Suoi Hai State Farm, district and pineapple State Farm, Suoi Hai
Wednesday 14/5 -	Visit Thach That district, Lychee State Farm, and Phu Minh Co-operative
Thursday 15/5 -	Visit Da Ton Co-operative, Thach Ban Cooperative, Gia Thuy Co-operative, Gia Lam district
Friday 16/5 -	Visit Phu Ho Research Station of Ministry of Industrial Crops
Saturday 17/5 -	In-service training programme - Introductory Sessions
Sunday 18/5 -	Report writing in lieu of travel to Ho Chi Minh City
Monday 19/5 -	Report writing and preliminary briefing with UNDP on findings
Tuesday 20/5 -	Repeat visit to Suoi Hai to collect meteorological data and visit forest station at 400 m - the latter did not eventuate. Visit to Australian Embassy.
Wednesday 21/5 -	Visit to Me Linh district, Kim Hoa Co-operative
Thursday 22/5 -	De-briefing with People's Committee of Hanoi/Staff of Institute for Fruits, Vegetables and Flowers. De-briefing with UNDP, FAO, People's Committee of Hanoi and Government representatives.
Friday 23/5 -	Depart Hanoi - end of mission

ANNEX II - FRUIT CULTIVAR LISTS FOR INTRODUCTION TO HANOI REGION AND VIETNAM

APPLE (Malus pumila Mill.)

Low chill cultivars: Dorset Golden
Anna
Rome Beauty

AVOCADO (Persea americana Mill.)

Scion cultivars: Hass, Reed, Sharwil, Hazzard, Wurtz, Edranol

Rootstocks: G1033, G755A), G755B), G755C) — P. schiedana

BANANA (Musa spp.)

Mons Mari)
Williams Hybrid) introduce as rooted tissue cultured plants
Lady Finger) in bottles

CARAMBOLA (Averrhoa carambola L.)

Fwang Tung
B6
B4

CITRUS ROOTSTOCKS

Troyer Citrange
Trifoliata
Cleopatra Mandarin
Swingle Citrumelo

CUSTARD APPLE (Annona atemoyer)

Cultivars: African pride
Palethorpe
Hilary white

GRAPE (Vitis spp.)

Early White Muscat)
White Malaga)
Flame Seedless) V. vinifera
Cardinal)
Perlette)

Schuyler) V. labrusca
Improved Isabella)

Rootstocks for V. vinifera

Dog Ridge
3306
Rupestris Du Lot

Muscat Bayley A) French hybrids
Carolina Blackrose)

GUAVA (Psidium guajava L.)

Indian Pink
Seedless Thai Guava
Klom Toon Khao
GA11-56 Selection for processing
Common Pink selections

JAK (Artocarpus heterophyllus Lam.)

Large seed
Small seed
Hew No. 1
Jampa

JAMBU (Syzgium aqueum (Burm. f.) Alston)

Bogor
Chompoo Pa

JUJUBE (Zizphus mauritiana Lam.)

Rien Tong	Guay Thong
Bombay	Dok Phiset
Calcutta	

KUMQUAT (Fortunella japonica (Thumb.) S.W.)

Som Jeed

LONGAN (Euphoria longan (Lour.) Steud.)

Kohala	Daw	Skek Yip
Haew	Biew Kiew	
Dang	Chompoo	

LOQUAT (Eriobotrya japonica (Thunb.) Lindl.)

Try for Japanese and Taiwanese sweet cultivars
Plus: Cartagena, Bessel Brown and Champagne

LIME (Citrus aurantifolia (Christm.) Swingle.) - West Indian Lime

Manao Khai	Manao Panne
Manao Nung	

LIME (Citrus latifolia Tan. CI.) - Tahiti Lime

Tahiti Lime (Persian Lime)

LYCHEE (Litchi chinensis Sonn.)

Sum Yee Hong
Hong Huey
Kwai May (Pink)
Salathiel
Tai So
Souey Tong
Fay Zee Siu

MANGO (Mangifera indica L.)

Sweet cultivars:	Nam Doc Mai	Early Gold
	Okrong	Florigon
	Thong Dum	
	Ngar Charng	
	Carabao	
Starchy cultivars:	Pimsen Mun	
	Khiew Savoey	

MANDARIN (Citrus reticulata Blanco)

Imperial	Ellendale
Emperor	Murcott
Hickson	Khiew Wan

MULBERRY (Morus nigra L.)

Everbearing
Peradeniya
Local (Australia)

NECTARINE (Prunus persica (L) Batsch)

Fla 6-3
Fla 3-4
Fla 5-4
Fla 9-8

PAPAYA (Carica papaya L.)

Dioecious lines - Australia
Hermaphrodite lines - Australia
Large Thai Red Hermaphrodite lines - Thailand
Small Thai Red Hermaphrodite lines - Thailand
Sunrise Solo line - Hawaii

PASSIONFRUIT (Passiflora spp.)

Hybrids: (Purple) - Highland

Lacey
Days Special
E-23

Flavicarpa: (Yellow) - Lowland

Selections from Seychelles and Australia

PEACH (Prunus persica (L) Batsch)

Low chilling cultivars:	Rootstock:
Flordaprince	Okinawa
Flordaking	
Flordagold	
Flordabelle	
Flordared	

PERSIMMON (Diospyros kaki L.f.)

Izu
Fuyu Hana — Pollinator: Gailey
Ichikikei Jiro
Suruga
Fuyu

PINEAPPLE (Ananas comosus (L) Merrill)

Smooth Cayenne: (Processing)

Qld. Cayenne Clone 8	Champaka F-180
Qld. Cayenne Clone 10	
Qld. Cayenne Clone 13	
Qld. Cayenne Clone 30	

Hybrid: (Processing/Fresh fruit)

53-116

Fresh fruit: Selection of rough/smooth crosses from Australia

PLUM (Prunus spp.)

Satsuma
Santa Rosa
Others being screened in Australia

PUMMELO (Citrus grandis Osbeck.) (Citrus maxima Burm. Merrill.)

* Khao Phuang	Sang Khunnon
** Khao Pan	***Morakot
*** Khao Thongdee	+Daeng Tubtim
* Khao Jeep	***Khao Pom
* Khao Yai	Kroon
*** Khao Nampheung	Taeng Gua
Khao Hom	Namtarn Sai
Pattayia	
* Bang Khunnon	(all Thai cultivars)

* = light creamy flesh
**= dark creamy flesh
*** = light pink flesh
\+ = dark pink flesh

SAPODILLA (SAPOTE) (Manilkara zapota (L) Van Royen)

Thailand cultivars:

Makok Lek	Kra Suay
Makok Yai	Far Chee
Khai Harn	Ma For

Many others available in Australia.

N.B. Require seed of Mimusops hexandra Roxb. S for rootstock of Sapodilla. Common names are Khirni, Rayan, Palu, Palai. Mee - Bassia longifolia from Sri Lanka is also a good rootstock for Sapodilla.

STRAWBERRY (Fragaria x ananassa Duchesne)

Earlisweet
Redlands Crimson

SWEET ORANGE (Citrus sinensis (L.) Osbeck)

Washington navel
Joppa
Pineapple
Valencia

ANNEX III

WATSON, B.J. AND MONCUR, M. (1985) - CRITERIA FOR DETERMING SURVIVAL, COMMERCIAL AND BEST MEAN MINIMUM JULY TEMPERATURES FOR VARIOUS TROPICAL FRUITS IN AUSTRALIA (S. HEMISPHERE), - WET TROPICS REGIONAL PUBLICATION, QLD PP. 3.

		C Minimum temp. for July		
COMMON NAME	BOTANICAL NAME	SURVIVAL	COMMERCIAL	BEST
Abiu	Pouteria caimito	8-10	10 plus	12-18
Acerola	Malpighia glabra	6-8	8 plus	14 plus
Akee	Blighia sapida	10-12	12 plus	16 plus
Ambarella	Spondias cytherea	10-12	12 plus	14 plus
Babaco	Carica hybrid	?	6-12?	6-10?
Banana	Musa spp.	6-8	8 plus	16 plus
Bell fruit	Syzygium aqueum	8-10	10 plus	16 plus
Black persimmon	Diospyros digyna	6-8	8-18	8-14
Blueberry (L.Chill)(L.C.)	Vaccinium spp.	0-2?	1-12?	6?-10?
Bread fruit/Bread nut	Artocarpus altilis	14-16	16 plus	16 plus
Caimito	Chrysophyllum cainito	8-12	12 plus	16 plus
Canistel	Pouteria campechiana	6-8	8 plus	14 plus
Carambola	Averrhoa carambola	6-8	8 plus	14 plus
Casimiroa	Casimiroa edulis	2-4?	4-14?	4-12?
Chempedak	Artocarpus polyphema	12-14	14 plus	16 plus
Cherimoya	Annona cherimola	4-6?	6-12?	6-10?
Cocoa	Theobroma cacao	12-16	16 plus	18 plus
Coconut	Cocos nucifera	8-10	10 plus	18 plus
Custard apple +	Annona hybrid	4-6?	6 plus?	10-14?
Durian	Duno zibenthus	14-16	16 plus	18 plus
Duku	Lansium domesticum	12-14	14 plus	18 plus
Guava	Psidium guajava	4-8	8 plus	14 plus
Jaboticaba	Myrciaria cauliflora	6-8?	8-18	10-16
Jack fruit	Artocarpus heterophyllus	6-10	10 plus	14 plus
Kiwifruit	Actinidia chinensis	?	?	?
Langsat	Lansium domesticum	12-14	14 plus	18 plus
Longan +	Euphoria longan	4-8	8-18	8-14
Loquat	Eriobotrya japonica	2-4	4-14	6-?
Lychee +	Litchi chinensis	4-8	8-18	8-14
Mabolo	Diospyros discolor	8-14	14 plus	16 plus
Malay Apple	Syzygium malaccense	8-14	14 plus	16 plus
Mamey Sapote	Pouteria sapota	6-8	8 plus	14 plus
Mammea	Mammea americana	10-12	12 plus	16 plus
Mamoncillo	Melicoccus bijugatus	10-16	16 plus	18 plus
Mango	Mangifera indica	6-8	8 plus	12 plus
Mangosteen	Garcinia mangostana	10-14	14 plus	16 plus
Marang	Artocarpus odoratissimus	12-16	16 plus	18 plus
Matisia	Matisia cordata	12-16	16 plus	18 plus
Miracle fruit	Synsepalum dulcificum	8-12	12 plus	14 plus
Mulberry	Morus nigra	2-4?	2-18?	4 to 12?
Nectarine (L.C.)+	Prunus persica	2-4?	4-12?	4-10?
Nutmeg	Myristica fragrans	10-14	14 plus	16 plus
Papaw	Carica papaya	6-8	8 plus	14 plus
Peach (L.C.)+	Prunus persica	2-4?	4-12?	4-10?
Pepper	Piper nigrum	12-14	14 plus	16 plus
Persimmon	Diospyros kaki	0-2?	6-12?	8-12?
Pitaya	Hylocereus guatemalensis	12-14	14 plus	16 plus
Pineapple	Ananas comosus	6-8	8 plus	10 plus

TABLE 5 (CONTINUED)

COMMON NAME	BOTANICAL NAME	SURVIVAL	COMMERCIAL	BEST
Pulasan	Nephelium mutabile	14-18	18 plus	18 plus
Pummelo*	Citrus grandis	4-8	8 plus	14 plus
Rambutan	Nephelium lappaceum	8-12	14 plus	18 plus
Rollinia	Rollinia deliciosa	8-10	12 plus	14 plus
Rose apple	Syzygium jambos	8-12	12 plus	16 plus
Salak	Salacca edulis	12-14	14 plus	18 plus
Santol	Sandoricum koetjape	10-14	14 plus	16 plus
Sapodilla (Chico)	Manilkara zapota	6-10	10 plus	14 plus
Soursop	Annona muricata	6-10	10 plus	16 plus
Tamarind	Tamarindus indica	6-10	12 plus	14 plus
Taun (Dawa)	Pometia pinnata	8-12	14 plus	16 plus
Uvilla	Pourouma cecropiaefolia	8-12	14 plus	16 plus
Vanilla	Vanilla planifolia	8-12	14 plus	16 plus
Wampi	Clausena lansium	2-6	6-14	8-10
Wax jambu	Syzygium samarangense	8-10	10 plus	14 plus
Woolmi	Antidesma dallachyanum	8-10	12 plus	14 plus
Macadamia +	Macadamia spp.	4-6?	6-12?	8-10?
Palm oil	Elaeis guineensis	10-16?	16 plus	18 plus
Aloe Vera	Aloe barbadensis	?	8 plus	14 plus?
Cashew	Anacardium occidentale	8-10	12 plus	16 plus
Lime (W.I.)	Citrus aurantifolia	8-10	12 plus	16 plus

NB + Varietal reaction to 'chill' temperature variable
* Quality downgraded if grown in cool conditions.

ANNEX IV - RECOMMENDED BOOK LIST - HORTICULTURAL PRODUCTION TECHNOLOGY

Adams, C. and Bamford, K. (1984). "Principles of Horticulture". W. Heinemann Press. pp. 264.

Alexander, D. McE. (1978). "Some Avocado Varieties for Australia". C.S.I.R.O. Australia. pp. 36.

Alexander, D. McE., Scholefield, P.B. and Frodsham, A. (1982). "Some Tree Fruits for Tropical Australia". C.S.I.R.O. Australia. pp. 56.

Allen, B.M. (1975). "Common Malaysian Fruits". Longman Malaysia Sdn. Bhd. Kuala Lumpur. pp. 64.

Anon. (1970). "Physiology of Tree Crops". Academic Press, London, N. York. Ed. by L.C. Luckwill and C.V. Cutting. pp. 382.

Anon. (1976). "Underexploited Tropical Plants with Promising Economic Value". National Academy of Sciences, Washington D.C. pp. 189.

Anon. (1982). "A Handbook of Plant Diseases in Colour, Vol 1 Fruit and Vegetables". 2nd ed. Qld D.P.I. pp. 300.

Antcliff, A.J. (1976). "Some Wine Grape Varieties for Australia". C.S.I.R.O. Australia. pp. 50.

Antcliff, A.J. (1979). "Major Wine Grape Varieties of Australia". C.S.I.R.O. Australia. pp. 61.

Australian Hort. Res. Newsletter - published once or twice per year. State editor Qld D.P.I. Hort. Branch.

Baxter, P. (1981). "Growing Fruit in Australia". Thomas Nelson Australia, Melbourne, pp. 200.

Bender, F.E., Douglass, L.W. and Kramer, A. (1982). "Statistical Methods for Food and Agriculture". AVI Publishing Co. Inc. Westport. Connecticut. pp. 345.

Bose, T.K. (1985). "Fruits of India: Tropical and Sub Tropical". Naya Prokash, Calcutta, India. pp. 658.

Bose, T.K. and Mitra, S.K. (1985A). "Propagation of Tropical and Sub-Tropical Horticultural Crops". Naya Prokash, Calcutta, India. pp. 580.

Bose, T.K. and Mitra, S.K. (1985). "Mineral Nutrition of Fruit Crops". Naya Prokash, Calcutta, India. pp. 550.

Bull, P.B., Jackson, D.I. and Smith, S.M. "Edible Tree Nuts in New Zealand". Parts I and II. Lincoln College, Dept. of Horticulture Bulletin 19. New Zealand. pp. 105.

Childers, N.F. (1975). "Modern Fruit Science". Somerset Press Inc. New Jersey U.S.A. pp. 976.

Childers, N.F. and Zutter, H. (1975). "Modern Fruit Science Lab Manual". Horticultural Publications. pp. 250.

Childers, N.F. et al. (1966). "Fruit Nutrition : Temperate to Tropical". 2nd Edition. Horticultural Publications. pp. 888.

Chin, H.F. and Yong, H.S. (1980). "Malaysian Fruits in Colour". Tropical Press Sdn. Bhd. Kuala Lumpur, pp. 126.

Cobley, L.S. and Steele, W.M. (1976). "An Introduction to the Botany of Tropical Crops". 2nd ed. Longmans, London. pp. 371.

Cook, A.A. (1975). "Diseases of Tropical and Sub-Tropical Crops". Hafner Press (MacMillan) New York.

Coronel, R.E. (1983). "Promising Fruits of the Philippines". College of Agriculture, University of Philippines at Los Banos College, Laguna, Philippines. pp. 507.

C.S.I.R.O. Division of Horticultural Research, Annual Reports.

Debney, H.G., Blacker, K.J., Redding, B.J. and Watkins, J.B. (1980). "Handling and Storage for Fresh Fruit and Vegetables". Aust. United Fresh Fruit and Vegetable Association. C.O.D. Rocklea, Qld.

Edmond, J.B., Senn, T.L., Andrews, F.S. and Halfacre, R.G. (1975). "Fundamentals of Horticulture". McGraw-Hill Book Co. pp. 560.

"Fifth Int. Symposium on Tropical Root and Tuber Crops". ed by E.H. Belen and M. Villanueva. Philippine Council for Agriculture and Resources Research and Development, 1979. pp. 716.

"Fruits". English version, Ed. by C.H. Lamoureux. IBPGR Secretariat, Rome, 1980. pp. 127.

Garner, R.J. and Saeed Ahmed Chaudhri (1976). "The Propagation of Tropical Fruit Trees". Hort. Review No. 4. Commonwealth Bureau of Horticultural and Plantation Crops.

Hackett, C. and Carolane, Julie. (1982). "Edible Horticultural Crops". A compendium of Information on Fruit, Vegetable, Spice and Nut Species. Parts I-IV. Academic Press Sydney, New York, London. pp. 671.

Hartman, H.T. and Kester, D.E. (1975). "Plant Propagation Principles and Practices" 3rd Edition. Prentice Hall Inc. Englewood Cliffs, New Jersey. pp. 662.

Hely, P.C., Pasfield, G., Gellatley, J.G. (1982). "Insect Pests of Fruit and Vegetables in N.S.W.". Inkata Press, Melbourne, Sydney and London. pp. 312.

Hesse, B.J. (1980). Rep. on Visit to Florida and California (Plant nursery systems and electricity supply Co. Advisory Services). S.E.Q.E.B. Brisbane.

Hillel, D. (1982). Introduction to Soil Physics. Academic Press, London. pp. 364.

Horticulture Technical Annual Reports. Qld D.P.I. Hort. Branch.

Jackson, D. (1984). "Temperate and Sub-Tropical Fruit Production". Butterworths, New Zealand.

Janick, J. Ed of Hort. Reviews Vol 1-6. (1979-1984). AVI Publishing Co., Westport, Connecticut.

Johns, L. and Stevenson, V. (1979). "The Complete Book of Fruit". Angus and Robertson, Australia. pp. 309.

Kilpatrick, D.T. (1968). "Pruning for the Australian Gardener" (Rigby Ltd, Adelaide).

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. Academic Press. New York, San Francisco, London. pp. 811.

Lindsay, P. and Cull, B.W. (1982). "Fruit Growing in Warm Climates, A.H. and A.W. Reed Pty Ltd. N.S.W. PP. 80.

Macmillan, H.F. (1949). "Tropical Planting and Gardening". Macmillan & Co. Ltd. London. pp. 560.

Maroochy Hort. Res. Station Research Reports I, II & III. ed. by K.R. Chapman 1977-78, 1979-80, 1981-83. N. Moreton Regional Publications.

McGregor, S.E. (1976). Insect Pollination of Cultivated Crop Plants. Agriculture Handbook No. 496. Agricultural Research Service USDA Washington D.C. pp. 411.

Martin, F.W. et al. (1980). "Cultivation of Neglected Tropical Fruits with Promise". (Studies in Tropical Agriculture) Gordon Press.

Martin, F.W. and Ruberte, R.M. (1975). "Edible Leaves of the Tropics". Agency for Int. Development and Agric. Res. Service, U.S.D.A. pp. 235.

Mastalerz, J.W. (1977). The Greenhouse Environment. John Whiley and Sons, N. York - Chichester-Brisbane-Toronto. pp. 629.

Milburn, J.A. (1979). Water Flow in Plants, Longman.

Moore, J.N. and Janick, J. (1983). "Methods in Fruit Breeding". Purdue Univ. Press. West Lafayette, Indiana, U.S.A. PP. 464.

Nagy, S. and Shaw, P.E. (1980). "Tropical and Subtropical Fruits Composition, Properties and Uses". AVI Publishing Inc. Westport, Connecticut. p. 570.

Nijjar, G.S. (1977). "Fruit Breeding in India". Oxford and IBH Publishing Co. New Delhi, Bombay, Calcutta. pp. 219.

Norman, M.J.T., Pearson, C.J. and Searle, P.G.E. (1984). "The Ecology of Tropical Food Crops". Cambridge University Press. Cambridge. London, N.Y., New Rochelle, Melbourne, Sydney. pp. 369.

"Outlines of Perennial Crop Breeding in the Tropics". ed by F.P. Ferwerda and F. Wit. H. Veenman & Zonen N.V. Wageningen, 1969. pp. 511.

Pearce, S.C. (1976). "Experiments with Fruit Tree and other Perennial Plants". Cab, Buckinghamshire, England. pp. 182.

"Pesticide Application Manual". ed. by G. Behncken, Qld D.P.I. (1983). pp. 232.

Popenoe, W. (1974). "Manual of Tropical and Sub-Tropical Fruits". A Facsimile of the 1920 edition. Hafner Press N.Y., London. pp. 474.

"Principles of Crop Protection". ed. by I.K. Hughes, Qld D.P.I. (1982). pp. 144.

Proceedings of the First Australian Macadamia Research Workshop. ed. by R.A. Stephenson and E.C. Gallagher, Qld D.P.I. Publication, 1983.

Purseglove, J.W. (1974). "Tropical Crops Dicotyledons". Longmans, London. pp. 719.

Purseglove, J.W. (1975). "Tropical Crops Monocotyledons" Parts I and II. Longmans, London. pp. 607.

"Root and Tuber Crops". English version, Ed. by C.H. Lamoureux and M.A. Rifai. IBPGR Secretariat, Rome 1981. pp. 107.

Ruck, H.C. (1975). Deciduous Fruit Cultivars for Tropical and Sub-Tropical Regions. C.A.B., Buckinghamshire, England. pp. 91.

Salisbury, F.B. and Ross (1978). Plant Physiology, Wadsworth Publishing Co., Belmont, California 1978. (2nd edition).

Samson, J.A. (1980). "Tropical Fruits". Longmans, London. pp. 250.

Sturrock (1980). "Fruits for Southern Florida". A handbook for the home owner. Hort. Books, Stuart, Florida.

"Tabular Descriptions of Crops Grown in the Tropics". A series, published by C.S.I.R.O. Institute of Biological Resources, Division of Water and Land Resources, Canberra. Series has recently commenced on various crops. (various authors)

Tropical Fruit Research Station, Alstonville, Res. Report 1980-81. ed. by D.W. Turner, N.S.W. Dept. of Agric. pp. 61 (plus later issues).

"Tropical Tree Fruits for Australia". Compiled by P.E. Page, Qld D.P.I. (1984) pp. 226.

Tukey, H.B. (1964). "Dwarfed Fruit Trees" (MacMillan, New York).

"Vegetables". English version, ed. by C.H. Lamoureux and M.A. Rifai. IBPGR Secretariat, Rome 1981. pp. 117.

Wareing, P.F. and Phillips', I.D.J. (1981). The Control of Growth and Differentiation in Plants. Pergamon Press. (3rd ed.). pp. 343.

Watson, B.J. (1978). An appreciation of five exotic tropical fruit tree species and their potential in Queensland. Kamerunga Hort. Res. Station. Occasional publication. pp. 163.

Watson, B.J., Lewis, W.J., Maggs, D.H. and Page, P.E. (1984). "Austrofruit I". Checklist of Tropical and Sub-tropical Horticultural Crops. Botanical and Common Names (Standard Nomenclature for Australia). Qld D.P.I. Bulletin QB84005 pp. 79.

Westwood, M.N. (1978). "Temperate Zone Pomology". W.H. Freeman. pp. 428.

Will, A.A., Golby, E.V., Maxwell, L.S. (1980). "Florida Fruit". Lewis S. Maxwell, Tampa, Florida. 33610.

Winkler, A.J. (1965). "General Viticulture (University of California Press, Barkley and Los Angelos, California, U.S.A. and Cambridge Press, London).

ANNEX V - RECOMMENDED BOOK LIST - POST HARVEST HANDLING MANAGEMENT OF FRUIT AND VEGETABLES

Apple, J.M. (1977). "Plant Layout and Materials Handling." John Wiley and Sons, Inc., New York.

Bacharach, S.B. and Lawler, E.J. (1981). "Power and Politics in Organizations." Jossey-Bass Publ., San Francisco.

Bates, D.L. and Eldredge, D.L. (1984). "Strategy and Policy", 2nd Edition. Wm. C. Brown Publ., Dubuque, Lowa.

Ballou, R.N. (1973). "Business Logistics Management." Prentice-Hall Inc., London.

Bell, D. (1976). "Five Dimensions of Post-Industrial Society." Ed. by Bereano, P.L. Technology as a Social and Political Phenomenon, John Wiley and Sons, New York, 99-109.

Benson, D. and Whitehead, G. (1975). "Transport and Distribution Made Simple." W.H. Allen, London.

Boulding, K.E. and Senesh, L. (1983). "The Optimum Utilization of Knowledge." Westview Press.

Burrell, G. and Morgan, G. (1979). "Sociological Paradigms and Organizational Analysis." Heinmann, London, 21, 37.

Checkland, P.B. (1981). "Systems Thinking Systems Practice." John Wiley and Sons, New York. 1 330.

de Bono, E. (1971). "Technology Today." Routledge and Kegan Paul Ltd, London, 2.

Dunphy, C.D. (1981). "Organizational Change by Choice." McGraw-Hill, Sydney.

Gilmour, P. (1974). "Physical Distribution Management in Australia." Cheshire, Melbourne.

Gordon, J.E. (1979). "The New Science of Strong Materials." Penguin Books Ltd. Harmondsworth, Middlesex, England.

Gordon, J.E. (1978). "Structures." Penguin Books Ltd. Harmondsworth, Middlesex, England.

Huizinga, G. (1970). "Maslow's Need Hierarchy in the Work Situation." Wolters-Noordhoff Publishing, Groningen, 1-52.

Hulme, A.C. (1970). "The Biochemistry of Fruit and Their Products." Academic Press, London.

Kotler, P. (1974). "Marketing Decision Making. A model building approach." Holt, Rinehart and Winston, London; 1-720.

Lutz, J.M. and Hardenburg, R.E. (1968). "The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks." Agriculture Handbook No. 66. USDA, Washington; 26-27.

Marriott, J. (1980). "Bananas - Physiology and Biochemistry of Storage and Ripening for Optimum Quality." Crit. Rev. in Food Sci. and Nut. 1; 41-88.

Maslow, A.H.(1970). "Motivation and Personality." 2nd edition, Harper and Row, New York, 35-58.

Mitchell, F.G., Guillou, R. and Parsons, R.A. (1972). "Commercial Cooling of Fruit and Vegetables." University of California. Manual 43.

Mohsenin, N.N. (1980). "Thermal Properties of Foods and Agricultural Materials." Gordon and Breach Science publishers., New York.

Mohsenin, N.N. (1970). "Physical Properties of Plant and Animal Materials." Vol. I. Gordon and Breach, New York.

Rambo, A.T. and Sajise, P.E. (1984). "An Introduction to Human Ecology Research on Agricultural Systems in South East Asia." University of the Philippines, Los Banos, 25-38.

Rhodes, V.J. (1978). "The Agricultural Marketing System." Grid Publishing, Inc. Ohio; 9, 117-141.

Rogers, E.M. and Shoemaker, F.F. (1971). "Communication of Innovations." 2nd ed. Collier Macmillan Publ., London, 1-465.

Ruttan, V.W. (1982). "Agricultural Research Policy." University of Minnesota Press, Mineapolis, 17-44.

Ryall, A.L. and Lipton, W.J. (1979). "Handling Transportation and Storage of Fruit and Vegetables." AVI Publishing Company Inc. Westport. Connecticut.

Schon, D.A. (1971). "Beyond the Stable State." Temple Smith, London, 31-60.

Silvermann, D. (1971). "The Theory of Organizations." Heinemann, London, 1-125.

Smykay, E.W. (1973). "Physical Distribution Management." Macmillan Publishing Co. Inc., New York.

Spedding, C.R.W. (1979). "An Introduction to Agricultural Systems." Applied Science Publishers, London. 15-32.

Vincent, J.F.V. and Curry, J.D. (1980). Symposium of the Society for Experimental Biology. Cambridge University Press.

Vincent, J.F.V. (1982). "Structural Biomaterials." The Macmillan Press Ltd, London.

Wills, R.H.H., Lee, T.H., Graham, D., McGlasson, W.B. and Hall, E.G. (1981). "An Introduction to the Physiology and Handling of Fruit and Vegetables." New South Wales University Press.

ANNEX VI - ADDITIONAL AUSTRALIAN REFERENCES (D. SCHOORL & J.E. HOLT) ON POST HARVEST MANAGEMENT OF FRUITS & VEGETABLES

1. Schoorl, D. (1984). A methodology for the management of quality in horticultural distribution. Doctor of Agricultural Science Thesis, University of Queensland.

2. Schoorl, D. (1974). Packaging and mechanical damage to fruit. Master of Agricultural Science Thesis, University of Queensland 1-108.

Properties of horticultural produce

3. Holt, J.E., Schoorl, D. (1984). Mechanical properties and texture of stored apples. J. Text. Stud. 15, 377-394.

4. Holt, J.E., Schoorl, D. (1983). Cracking and energy dissipation in cabbages. J. Text. Stud. 14(2) 99-111.

5. Schoorl, D., Holt, J.E. (1983). A practical method of tensile testing of apple tissue. J. Text. Stud. 14(2) 155-164.

6. Holt, J.E., Schoorl, D. (1983). Fracture in potatoes and apples. J. Mat. Sc. 18, 2017-2028.

7. Schoorl, D., Holt, J.E. (1983). Cracking in potatoes. J. Text. Stud. 14(1) 61-70.

8. Holt, J.E., Schoorl, D. (1982). Strawberry bruising and energy dissipation. J. Text. Stud. 13(3) 349-357.

9. Holt, J.E., Schoorl, D. (1982). Mechanics of failure in fruit and vegetables. J. Text. Stud 13(1) 83-96.

10. Schoorl, D., Holt, J.E. (1980). Bruise resistance measurements in apples. J. Text. Stud. 11(4) 389-394.

11. Schoorl, D., Holt, J.E. (1977). The effects of storage time and temperature on the bruising of Jonathan, Delicious and Granny Smith apples. J. Text. Stud. 8(4) 409-416.

12. Holt, J.E., Schoorl, D. (1977). Bruising and energy dissipation in apples. J. Text. Stud. 7(4) 421-432.

13. Holt, J.E., Schoorl, D. (1984). Slip and cleavage failure in potatoes. Proc. Conf. on Agric. Eng., I.E. Aust. Bundaberg, August 75-77.

14. Holt, J.E., Schoorl, D. (1983). Physical damage in fruit and vegetables. Proc. Workshop on Fruit Handling and Distribution, DSIR, Auckland, November.

15. Schoorl, D., Holt, J.E. (1982). The application of the mechanics of failure in fruit and vegetables. Abstract 1424, XXIst Inter. Hort. Congr., Hamburg, August-September.

16. Holt, J.E., Schoorl, D. (1982). Apple bruising. Qld Fruit and Veg. News, 3 June, 407-408.

17. Holt, J.E., Schoorl, D. (1981). Strawberry bruising. S.E. Moreton Hort. Dig., 18.

Packaging

18. Holt, J.E., Schoorl, D. (1984). Package protection and energy dissipation in apple packs. Sci. Hort. 24, 165-176.

19. Holt, J.E., Schoorl, D. (1983). The robustness of a model predicting bruising in impacted multilayered apple packs. J. Agric. Engng Res. 28, 97-105.

20. Schoorl, D., Holt, J.E. (1982). Impact bruising in 3 apple pack arrangements. J. Agric. Engng Res. 27, 507-512.

21. Holt, J.E., Schoorl, D., Lucas, C. (1981). Prediction of bruising in impacted multilayered apple packs. Trans ASAE 24(1) 242-247.

22. Holt, J.E., Schoorl, D. (1981). Packaging and handling - where to in the 80's? Agric. Eng. Aust. 19(1) 29-32.

23. Schoorl, D., Holt, J.E. (1974). Bruising and acceleration measurements in apple packs. Qld J. Agric. and Anim.

24. Holt, J.E., Schoorl, D. (1973). A new drop tester. Qld J. Agric. and Anim. Sci. 39(2) 145-149.

25. Schoorl, D., Williams, W.T. (1973). The robustness of a model predicting drop testing performance of fruit packs. Qld J. Agric. and Animal Sci. 30, 247-253.

26. Schoorl, D. (1973). Tight-fill tomato packaging. Qld J. Agric. and Animal Sci., 30, 137-143.

27. Schoorl, D., Williams, W.T. (1972). Prediction of drop testing performance of apple packs. Qld J. Agric. and Anim. Sci. 29, 187-197.

28. Schoorl, D., Williams, W.T. (1972). Prediction of drop test performance of strawberry punnets. Masters of Agric. Sci. Thesis, University of Queensland. 29-43.

29. Schoorl, D., Holt, J.E. (1984). Quantifying package protection for horticultural produce. Proc. 38th Ann. Gen. Conf., The Techn. Assoc. of the Aust. and N.Z. Pulp and Paper Industries (Appita), Surfers Paradise. May.

30. Schoorl, D. (1972). Package performance evaluation. Proc. 6th Aust. Fruit and Veg. Stor. Res. Conf., Cowes, October, 64-73.

31. Schoorl, D. (1968). Evaluation of package performance. Proc. 5th Aust. Fruit and Veg. Stor. Res. Conf., Hobart, August, 63-70.

32. Schoorl, D., Holt, J.E. (1982). Package design - taking cracks and bruises out of fruit and vegetables. Packaging News, 7 August.

33. Schoorl, D. (1981). Buying packages. Qld Fruit and Veg News.

34. Schoorl, D., Holt, J.E., Debney, H. (1977). Design criteria for a new bulk bin. Qld Fruit and Veg. News, 20 May, 223-224.

35. Schoorl, D. (1976). Re-usable containers for fruit and vegetables. Aust. Pack., April 51-55.

36. Schoorl, D. (1973). The new mandarin pack and its development. Qld Fruit and Veg News, 6 Dec., 505-507.

37. Schoorl, D. (1971). Progress in banana packing research. Qld Fruit and Veg. News, April, 319 and 331.

Transport and handling

38. Schoorl, D., Holt, J.E. (1984). Verification and application of a model for predicting damage to horticultural produce during tansport. Agric. Syst. 16, 67-83.

39. Holt, J.E., Schoorl, D. (1983). A theoretical and experimental analysis of the effects of suspension and road profile on bruising in multilayered apple packs. J. Agric. Engng Res. 31, 297.

40. Schoorl, D., Holt, J.E. (1982). Road-vehicle-load interactions for transport of fruit and vegetables. Agric. Syst. 8(2) 143-155.

41. Schoorl, D., Holt, J.E. (1984). A basis for selecting vehicles for the transport of horticultural produce. Proc. Conf. on Agric. Eng. I.E. Aust., Bundaberg, August 205-207.

42. Walker, R.J., Schoorl, D., Holt, J.E. (1978). The vibration bruising of apples. Proc. Conf. on Agric. Eng., I.E. Aust., Toowoomba, August, 51-83.

43. Schoorl, D., Holt, J.E. (1983). Transport costs form a major part of wholesale price of produce. Qld Fruit and Veg News, 19 May, 328-329.

44. Schoorl, D., Holt, J.E. (1978). Advances in packing and handling. Qld Fruit and Veg. News, 12 July, 415-417.

45. Schoorl, D. (1975). The handling and transport of produce. Power Farming Jan., Feb., March.

Quality prediction

46. Schoorl, D., Holt, J.E. (1984). Post harvest energy transformations in horticultural produce. Agric. Syst. (in press).

47. Schoorl, D., Holt, J.E. (1984). The evaluation of post harvest disease control measures using a temperature-time framework. Agric. Syst. 13(2) 97-111.

48. Schoorl, D., Holt, J.E. (1983). Mechanical damage in agricultural products : a basis for management. Agric. Syst. 11(3) 143-157.

49. Holt, J.E., Schoorl, D., Muirhead, I.F. (1983). Post harvest quality control strategies for fruit and vegetables. Agric. Syst. 19(1) 21-37.

50. Holt, J.E., Schoorl, D. (1981). Fruit, packaging and handling distribution systems : an evaluation method. Agric. Syst. 7(3) 209-218.

51. Schoorl, D., Holt, J.E. (1982). Predicting the performance of a product distribution system. J. Tech. Assoc. of Aust. and N.Z. Pulp Paper Ind., 35(4) 330-331.

52. Schoorl, D., Holt, J.E. (1981). Management of fruit and vegetable quality. Proc. Post Harvest Hort. Workshop, Brisbane, September, 201-210.

53. Holt, J.E., Schoorl, D. (1978). The prediction of fruit, packaging and handling studies. XXth Inter. Hort. Congr., Sydney, poster paper No. 1156.

54. Holt, J.E., Schoorl, D. (1978). The prediction of fruit bruising from fruit, packaging and handling studies. Proc. Conf. on Agric. Eng., I.E. Aust., Toowoomba, August, 54-57.

55. Schoorl, D., Holt, J.E. (1982). Damage prediction in potato handling. Refnote Agdex 262/54, DPI, Queensland.

Quality/price relationships

56. Schoorl, D., Holt, J.E. (1983). Quality and reputation in the market place. Agric. Syst. 13, 191-203.

57. Schoorl, D., Holt, J.E. (1983). An analysis of the effect of quality on prices of horticultural produce. Agric. Systs. 12(2) 75-99.

58. Holt, J.E., Schoorl, D. (1984). Marketing technology and price of horticultural produce. Proc. Conf. on Agricultural Eng., I.E. Aust., Bundaberg, August, 208-209.

59. Holt, J.E., Schoorl, D. (1983). Quality produce - worth a little extra effort. S.E. Moreton Dig. 20.

Technological management

60. Schoorl, D., Holt, J.E. (1985). A methodology for the management of quality in Horticultural Distribution. Agric. System 16, 199-216.

Planning

61. Holt, J.E., Schoorl, D. (1983). A hard systems approach to the management of quality horticultural distribution. Agric. Syst. 13.

62. Schoorl, D., Holt, J.E. (1982). Fresh fruit and vegetable distribution - management of quality. Sci. Hort. 17, 1-8.

63. Holt, J.E., Schoorl, D. (1982). Perspective for planning in agriculture. Agric. Syst. 8(3) 219-224.

64. Schoorl, D., Holt, J.E. (1984). Implementing technology change in agriculture. Proc. Conf. on Ag. Eng., I.E. Aust., Bundaberg, August, 13-14.

65. Holt, J.E., Schoorl, D. (1984). Some thoughts on exploiting technology in horticultural packaging. Proc. 38th Ann. Gen. Conf., Appita, Surfers Paradise, May.

66. Holt, J.E., Schoorl, D. (1983). Horticultural business planning. Proc. Workshop on Fruit Handling and Distribution, DSIR, Auckland, November.

67. Schoorl, D., Holt. J.E. (1983). Profit, price and performance in horticultural distribution. Proc. Workshop on Fruit Handling and Distribution, DSIR, Auckland, November.

68. Holt, J.E., Schoorl, D. (1983). The nature and management of distribution systems for fruit and vegetables. Acta Horticulturae, 135.

69. Holt, J.E., Schoorl, D. (1981). Planning for change in horticulture - technology in its place. Proc. Post harvest Hort. Workshop, Brisbane, September, 233-243.

70. Schoorl, D., Holt, J.E. (1978). A national distribution system for fruit and vegetables. Proc. Conf. on Agric. Eng., I.E. Aust., Toowoomba, August, 347-348.

71. Schoorl, D., Holt, J.E. (1978). A national distribution system for fruit and vegetables. XXth Inter. Hort. Congress, Sydney, August, Abstract No. 1221 (Keynote address).

72. Schoorl, D., Holt, J.E. (1977). An integrated distribution system for fruit and vegetables on a national scale. Proc. 7th Aust., Fruit and Vegetable Stor. Res. Conf., Adelaide, September, 111-123.

73. Holt, J.E., Schoorl, D. (1981). Northern Territory fruit and vegetable distribution. Special Report, commissioned by Agric. Dev. Mark. Authority, Darwin, 1-5.

74. Schoorl, D., Holt, J.E., Mayer, D.G. (1984). Opportunities for decision making in farming using personal computers. S.E. Moreton Dig., 21.

75. Holt, J.E., Schoorl, D. (1981). From kerosine tin to electronics - future developments for the Bowen District. Commerc. Hort. 2(3) 43-51.

76. Schoorl, D., Holt, J.E. (1977). The distribution of fruit and vegetables and the 1 165 mm pallet. Aust. Pack. J., October, 77-79.

Facilities design

77. Holt, J.E., Schoorl, D. (1983). Design criteria for a distribution terminal for cut flowers. Agric. Syst. 12(4) 213-230.

78. Schoorl, D., Holt, J.E. (1982). Planning for change in horticulture - case study in packing shed design. Agric. Syst. 8(2) 77-86.

79. Schoorl, D. (1981). Packing shed design. Brochure, Dept Primary Ind., Queensland.

80. Schoorl, D. (1978). The design of a total distribution system. MATPAK 78, Seminar 1 - Distribution and freight movements, November, 121-129.

81. Holt, J.E., Schoorl, D. (1980). Flower Packaging and distribution. S.E. Moreton Dig., 16, 9-11.

82. Holt, J.E., Schoorl, D. (1980). Guidelines for the design of a packing shed. Gatton Expo 80, brochure.

83. Schoorl, D. (1979). Tomato demonstration, electronic colour sorting. DPI brochure.

84. Schoorl, D., Davey, J. (1979). Electronic colour sorting demonstration. Qld Fruit and Vegetable News, October, 610.

85. Schoorl, D. (1979). Electronic colour sorting of tomatoes. Qld Fruit and Veg. News 417.

Distribution models

86. Schoorl, D., Holt, J.E. (1983). Green-life and market options in banana distribution. Agric. Syst. 12(1) 1-16.

87. Holt, J.E., Schoorl, D., Mayer, D.G. (1983). A BASIC program to simulate green-life and market options in banana distribution. Commer. Hort. 3(3) 11 and 3(4) 56.

88. Schoorl, D., Mayer, D.G., Holt, J.E. (1983). A BASIC program to calculate bruising in apples during handling. Commer. Hort. 3(4) 30-31.

89. Mayer, D.G., Holt, J.E., Schoorl, D. (1984). A BASIC program to simulate post harvest colour development and profitability in tomato marketing. Commer. Hort. 4(1) 12-13.

90. Holt, J.E., Schoorl, D., Mayer, D.G. (1984). A BASIC program to simulate post harvest water loss in horticultural products. Commer. Hort 4(2).

91. Schoorl, D., Mayer, D.G., Holt, J.E. (1984). A BASIC program to calculate post harvest shelf-life in horticultural produce. Commer. Hort. 4(3), (in preparation).

92. Mayer, D.G., Holt, J.E., Schoorl, D. (1984). A BASIC program to simulate post harvest ripening and pathogen growth in horticultural produce. Commerc. Hort 4(4), 51-52.

93. Mayer, D.G., Watkins, J.B., Schoorl, D. and Holt, J.E. (1985). A BASIC program to calculate - How much ice in ice packs. Commercial Horticulture 5(2) 36.

94. Schoorl, D., Holt, J.E., Mayer, D.G.. A BASIC program to forecast mango production and market demand (Intern. DPI paper restricted circulation).

Technology and Adoption of Change in Agriculture

95. Holt, J.E., Radcliffe, D.F., Schoorl, D. (1984). Design or problem solving - a critical choice for the engineering profession. Design Studies 6(2) 107-110.

96. Holt, J.E., Schoorl, D. (1984). Technological change in agriculture - the systems movement and power. Agric. Syst. (in press).

97. Holt, J.E., Schoorl, D. (1985). The role of innovation, servicing and obsolescence in agriculture extension. Agric. Syst. (in press).

98. Holt, J.E., Schoorl, D. (1985). Change and conservatism in Agricultural Organizations. Agric. Syst. (submitted).

Overseas Reports

99. Schoorl, D. (1978). Report on the distribution of fruit and vegetables in Papua New Guinea. Dept Primary Indust. Report, Queensland.

100. Schoorl, D. (1976). Report on Food Marketing Corporation's role in distribution in Papua New Guinea. Dept Primary Ind. Report, Queensland.

101. Schoorl, D. (1971). An overseas investigation of fruit and vegetable preparation, packaging and transport research. Dept Primary Ind., Report, Queensland.

Recent Publications

102. Schoorl, D. (1985). A mango industry overview. A special report commissioned by the Director General, Department of Primary Industries. 1-69. (Restricted circulation)

103. Schoorl, D. (1985). An analysis of mango production and marketing in Australia. Agric. Syst. (submitted).

104. Schoorl, D., Mayer, D.G. (1985). Bruising and Quality of apples. Stanthorpe Apple Seminar 81-89.

105. Holt, J.E., Schoorl, D. (1985). Quality and price models for managing horticultural distribution. Post Harvest Conference, Melbourne (submitted).

106. Schoorl, D., Holt, J.E. (1985). Texture and Bruising measurement of Apples. Post Harvest Conference, Melbourne (submitted).

107. Schoorl, D., Holt, J.E. (1985). Design of packing shed for the ripening, packing and handling of tomatoes. Queensland Agricultural Journal 3 (4) 185-190.

108. Franklin, T.G., Jamieson, G.I., Schoorl, D. (1985). Handling bananas with a mechanical dehander. Queensland Agricultural Journal 3(5).

109. Schoorl, D., Mayer, D.G., Holt, J.E. (1985). Modelling the horticultural production. (In preparation).

110. Schoorl, D., Holt, J.E. (1985). Price-Quantity studies of a range of horticulture produce. Agric. Syst. (In preparation).