

Project Title Code: 2.6	Improvement of Vietnam's capacity for teaching and research in horticultural crop production including vegetables and seeds in order to enhance rural development, through the development of productive partnerships between research and training institutions in Vietnam and NSW Agriculture
Australian Personnel	Dr. Quoc Vong Nguyen
Australian Institution	NSW Agriculture
Vietnam Institution	Research Institute of Fruits & Vegetables, Hanoi; Hue University of Agriculture & Forestry - Hue and Institute of Agricultural Science of South Vietnam, Hochiminh City
Project Duration	July 2001 to June 2003

Project Description

The objective of this program is to improve Vietnam's capacity for teaching and conducting research in modern horticultural crop production with a particular focus on vegetables. This should enhance the ability of Vietnam to promote rural development in these industries and improve the efficiency of and quality of vegetable production. The project aims to achieve this by:

- i) Vietnamese horticultural scientists will visit NSW to collaborate in joint-research projects and to review and learn about the Australian vegetable industry;
- ii) ii) NSW Agricultural scientists will visit Vietnam to lecture and to work for a period with Vietnamese agricultural scientists and students in horticultural research projects; and
- iii) iii) research, training and trading liaisons will be enhanced between Vietnam and Australia.

Objectives

The objective of this program is to improve Vietnam's capacity for teaching and research in horticultural crop production including vegetables and seeds. This will in turn enhance their scientific and practical knowledge to help rural development, resulting in efficient production and quality of vegetables in Vietnam, through:

- a) Horticultural scientists from Vietnamese research institutions and Universities visiting NSW Agriculture to work for a period in Australian research institutions and to inspect and learn about the Australian vegetable industry;
- b) NSW Agricultural scientists visiting Vietnam to lecture, train and to work with Vietnamese agricultural students and conduct research on small highly focused horticultural projects.
- c) NSW and Vietnamese Agricultural scientists would, through a strong link with each other in both public and private sectors, help to facilitate research, training and

marketing liaisons between Australia and Vietnam to promote improved vegetable production in Vietnam.

Outputs and Performance indicators

Outputs	Performance Indicators
<ul style="list-style-type: none"> ◆ Vietnamese scientists who visit Australia to study the Australian vegetable industry will obtain knowledge of modern growing techniques, tomato and cucumber breeding and seed production techniques, pest and disease management, quality assurance, post-harvest management, packaging technologies and wholesale and export marketing ◆ A 2-year research demonstration entitled "Evaluation of hydroponic systems and growing techniques for greenhouse vegetables such as tomatoes (<i>Lycopersicon esculentum</i> Mill.), cucumber (<i>Cucumis sativus</i> L.) and Asian vegetables" will be organised at the NCGH-Gosford, RIFV-Hanoi and IAS-HoChiMinh, for both Australian and Vietnamese scientists to work as a joint research project. Outputs of this research will include improved hydroponic systems, suitable varieties, IPM systems and a better understanding of the constraining factors of greenhouse production. ◆ NSW Agricultural scientists during their visit to Vietnam (plant breeder, entomologist and plant pathologist) will assess Vietnamese vegetable cultivars with a reputation for high insect and disease resistance for possible use under Australian growing conditions. ◆ At Hue University of Agriculture and Forestry, NSW Agricultural scientists will give lectures on Plant Breeding, Pests and Diseases of Vegetables Crops for the 4th year students. The NSW Agricultural scientists will also assist in supervising graduate theses for the university's 4th year students. The ultimate performance indicators for this project will be improved vegetable production in Vietnam in terms of a great variety of vegetables, improved efficiency of production, higher quality of product, reduction in food safety problems and greater exports. 	<ol style="list-style-type: none"> 1) the successful completion of experimental projects in Australia and Vietnam 2) the publishing of scientific papers, reports, technical guidelines and newsletters 3) the publishing of extension material in Vietnamese for use both in Australia and Vietnam 4) the successful examination and completion of graduate theses of Vietnamese 4th year students 5) the publication of a final report on the project recommending, if appropriate, processes to improve training of scientists and commercial horticulturists in Vietnam, opportunities for improved production, food safety and post harvest management methods for the Vietnamese industry and recommendations for Australian horticultural industries in terms of training for Non English Speaking Background farmers and availability of alternative vegetables.

PROJECT COMPLETION REPORT

Executive Summary

The capacity of Vietnam to improve vegetable production and vegetable quality has increased significantly as a result of this project. Achievements include:

- i) Improved research and teaching skills of the Vietnamese horticultural scientists who visited Australia to collaborate in joint research projects and to learn about the Australian vegetable industry. The sophisticated technology used by NSW Agriculture was reviewed for potential adoption in Vietnam. A large number of successful experimental trials, seminars and workshops on safe & quality vegetable production were organised by these scientists in Vietnam based on their experience in Australia. The NSW Agriculture training methodology and the Australian vegetable production techniques have made an impact on the Vietnamese Government as well as Vietnamese horticultural industry.
- ii) Growing systems for the production of safe & high quality vegetables using net-houses, grafted crops grown in cocopeat, and grown under trickle irrigation have been implemented widely in Vietnam, particularly in the southern parts of Vietnam and Lam Dong highland. Implementation has directly resulted from the two-years of research demonstration trials that were organised in both Vietnam and Australia.
- iii) Improved capacity for building agriculture and rural development has occurred through seminars, lectures, workshops, field days etc. These events have attracted participants from all Vietnamese horticultural sectors such as: vegetable growers, university horticultural educators & students, institutional research workers and the local Agricultural Ministry's executive officers (directors, deputy directors, extension horticulturists). Activities have included participants from Hanoi, Hue, Hochiminh cities and approximately 15 provinces in the North Central, Central, South Central and South Vietnam as well as from Laos and Cambodian Governments. The project has also established a relationship with the Asian Regional Centre (ARC) of the Asian Vegetable Research & Development Centre (AVRDC) for future co-operation.
- iv) Survey of major pests and diseases in vegetables in Vietnam were conducted by the NSW Agriculture scientists. In addition, one cultivar each of tomato (*Lycopersicon esculentum* Mill.) and eggplant (*Solanum melongena* L.) with a reputation for disease resistance (*Fusarium wilt*, *Bacterial wilt*), and one variety each of gourd (*Lagenaria siceraria* STANDLEY var. *hispida* HARA) and Japanese kabocha (*Cucurbita moschata* DUCH.) with a reputation of resistance to *Phythium* were collected by the NSW Agriculture scientists. These varieties are now being used as rootstocks for the Australian greenhouse tomatoes and cucumber industries.

- v) “Cocopeat” which is made from coir dust, was used as the growing media in demonstration experimental trials at the National Centre for Greenhouse Horticulture, Gosford (NCGH), has been identified as a potential new product for Vietnam. Coconut coir is abundant in Vietnam and the cocopeat industry could be a potential export market worth approximately 1 million m³ a year, but it needs technical assistance with quality assurance from Australia.
- vi) Excellent working relationship with the Vietnamese Government and the collaborating research organisations in Hanoi, Hue and Hochiminh were satisfied with the project’s achievements (Appendix 1). The Vietnamese Government and Ministry of Agriculture & Rural Development were pleased with the projects’s achievements and have strongly encouraged the development of a new CARD project focussing on:
- Assisting Vietnam to create a model of quality & safe vegetable production nation wide (greenhouse, hydroponic, IPM, QA, post-harvest and packaging);
 - Assisting Vietnam to research and manufacture agricultural by-products such as “Cocopeat” and other growing materials for the horticultural industry; and
 - Assisting Vietnam to train its horticulturists both in Government and NGO levels;
- vii) In response to the requests of the Vietnamese Government, a subsequent research project (CARD-Round 2) has been developed. It is:

Project CARD-Round 2. The development of Vietnamese horticultural coir dust products for the production of high quality and safe vegetables, through improving Vietnam’s teaching and research capabilities, facilitated by collaboration between research and training institutions in Vietnam and NSW Agriculture (*ChŰÖng trìn h®p tác gi»a ViEt Nam và B¶ Nông NghiEp NSW Ç< nâng cao năng l;c giảng dạy và nghiên cŰu ti%on Ç%on viEt phát tri<n mô hình sản xuẤt rau an toàn công nghEt cao và xây d;ng kĩ nghEt môn xŰ dŰa, góp phẢn vào viEt phát tri<n nông thôn ViEt Nam*).

The above research proposal will be submitted to AusAID.

Performance of the lead and partner institutions

NSW Agriculture – Australia:

- 6) The successful completion of four demonstration experimental trials on hydroponic cucumbers, tomatoes and Asian vegetables at the National Centre for Greenhouse Horticulture, Gosford NSW;
- 7) Dissemination of information through the publishing of two scientific papers, nine reports, one technical guideline in Vietnamese language on cocopeat and one newsletter in Vietnamese;
- 8) The collecting of information on major insects & diseases of vegetables in Vietnam for subsequent publishing in Vietnamese for use in Vietnam and since

many pests are also found in Australia it will be of benefit to Vietnamese vegetable growers in Australia;

- 9) The publication of a final report on the project recommending processes to improve the training of scientists and commercial horticulturists in Vietnam, opportunities for improved production, food safety and post harvest management methods for the Vietnamese industry, and recommendations for Australian horticultural industries in terms of training for non-English Speaking Background farmers and availability of alternative vegetables.

Vietnam partner institutions:

- 10) The successful completion of five demonstration experimental trials on hydroponic cucumber, tomatoes and Asian vegetables at the Research Institute of Fruits & Vegetables, Hanoi; Hue University of Agriculture & Forestry, Hue and Institute of Agricultural Science of South Vietnam, Hochiminh;
- 11) The successful examination of 11 M.Sc. candidates and completion of 29 graduate theses of Vietnamese 4th year students at Hue University of Agriculture & Forestry, Hue;
- 12) The successful completion of three workshops which were organised in Quang Binh on 20 & 21 December 2002 , Nha Trang on 23, 24 & 25 December 2002 and Long Xuyen on 25 July 2003 to train almost 160 local agricultural ministry's executive officers (directors, deputy director, manager, extension horticulturist), representing 15 provinces in the North Central, Central, South Central and South Vietnam in safe & high quality vegetable production. Representatives from Laos and Cambodian Governments were also invited and participated in the workshops. The workshops were run by the horticultural scientists who had participated in the 4-week training in Australia in September/October 2001 and 2002.
- 13) The publication of a Final Report in Vietnamese on the project recommending processes to improve training of scientists and commercial horticulturists in Vietnam and recommendations for Australian horticultural industries in terms of training for non-English Speaking Background farmers and availability of alternative vegetables.

1.0 Project Description

1.1 Background and preparation

On a visit to Australia in November 1999, Professor Ngo The Dan, the then Vice Minister of the Ministry of Agriculture & Rural Development, Vietnam approached Dr. Nguyen of NSW Agriculture requesting co-operation in a research and training program of mutual benefit for both Vietnam and Australia for vegetable crops. The Vietnamese government were concerned that the Vietnamese people were not growing enough or eating enough vegetables, that there have been many deaths directly attributed to contaminated vegetables, that there is underemployment in the rural sector. They have had success in developing and adopting more modern techniques for rice production and are now interested in developing vegetable production with international collaboration. They saw Australia as a source of help and expertise and a particularly good opportunity to work with Dr Nguyen and NSW Agriculture. This AusAID submission was developed in response to Vice Minister Prof. Ngo's request and in further consultation with Vietnam's

Ministry of Agriculture & Rural Development and the General Consulate of Vietnam in Sydney, Australia.

The submission was also discussed in detail within NSW Agriculture including research horticulturists, plant pathologists and entomologists, the Program Leader for Intensive Horticulture, Dr Philip Wright and the Director of Gosford's National Centre for Greenhouse Horticulture, Dr. David Hall. Discussions were had with Vietnamese research institutions including Prof. Tran Van Lai, Director of Research Institute for Fruits and Vegetables in Hanoi; Prof. Tran Van Minh, Rector of Hue University of Agriculture and Forestry in Hue and Prof. Pham Van Bien, Director of Institute of Agricultural Science of South Vietnam in Ho Chi Minh city.

The project built upon a strong existing relationship between NSW Agriculture and the Vietnamese institutions, utilized existing expertise with short and long term benefits for both Vietnam and Australia.

1.2 Context and rational

The Activity Director, Dr. Vong Nguyen, a Vietnamese-Australian brought together a good relationship and deep understanding of Vietnamese horticultural industry, with his involvement with the National Centre for Greenhouse Horticulture. His facility with both languages, his understanding of both horticultural production environments and cultural practices greatly enhances the potential collaborative benefit.

Vietnam, with a population of 77 million people is currently importing vegetables, has inadequate intake of vegetables per capita, has had numerous poisonings due to pesticide contaminated vegetables, has need for greater employment in rural areas, and faces a trade deficit. A collaborative project to transfer some Australian vegetable production techniques to improve both the quantity and quality of vegetables safely was seen to have potential to reduce the need to import vegetables, introduce methods of ensuring food safety, provide employment opportunities in rural areas and help develop a potential export market. It is believed that the development of a hydroponic and greenhouse industry in Vietnam could be worth hundreds of millions of dollars.

To help build the skill base to support the development of covered vegetable growing systems in Vietnam a series of visits by working scientists from Vietnam to the National Centre for Greenhouse Horticulture was the keystone of the project. These scientists not only saw operating greenhouses but they actively participated in running greenhouse trials. The trials were specially timed and prepared to maximise the benefits to the visiting scientists. Although their English was quite good the combination of hands-on experience and working closely with a fluent Vietnamese speaker greatly enhance the potential learning. The scientists also were able to look at examples of all sectors of the vegetable production system from commercial greenhouses, through post-harvest, processing facilities, central markets, supermarkets, as well as visiting broad-acre production areas. Another cornerstone of the project was visits by Dr Nguyen and technical specialists in plant pathology and entomology to Vietnam to help trouble-shoot the trials the Vietnamese scientists set up on their return. These visits also allowed the

Australian scientists to deepen their understanding of tropical agricultural issues, particularly the pests and diseases. These Australian scientists also gave lectures and workshops on their visits which further help develop the horticultural sectors expertise.

There are approximately 300 Vietnamese-Australian growers who are producers of greenhouse vegetables such as tomatoes, cucumber and capsicum (Liverpool NSW, Virginia SA) and Asian vegetables (NSW, Vic, Qld and NT) in Australia. Vietnamese growers in Australia are often not from a rural background and have some English literacy problems. There are many similar pests and diseases in Vietnam and Australia, the broader concepts of integrated pest management, or good agronomic practices for covered cropping systems are the same therefore production of technical materials in Vietnamese will potentially aid both growers in Vietnam and Vietnamese growers in Australia.

Production of Asian vegetables in Australia is currently an A\$135.8 million industry. There is potential to develop this industry further in both the domestic and export markets. Improving the understanding of production methods of Asian vegetables in Vietnam may improve production methods in Australia. There are some insect pests and diseases that cause serious problems in Vietnam which are not found in Australia, therefore it could prove to be beneficial that Australian scientists are familiar with these pests and diseases in the chance that they come to Australia.

This project was seen as a way to improve the quantity of high quality, safe vegetables in Vietnam, improve the capacity for the Vietnamese horticultural workers to develop their industry, as well as improve Australian Greenhouse production, improve the production methods of Vietnamese growers in Australia and to improve the potential for NSW Agriculture to develop Asian vegetables in Australia.

1.3 Project objectives and scope at design

The objective of this program was to improve Vietnam's capacity for teaching and research in horticultural crop production including vegetables and seeds. This was to in turn enhance their scientific and practical knowledge to help rural development, resulting in efficient production and quality of vegetables in Vietnam, through:

- i) Horticultural scientists from Vietnamese research institutions and Universities visiting NSW Agriculture to work for a period in Australian research institutions and to inspect and learn about the Australian vegetable industry;
- ii) NSW Agricultural scientists visiting Vietnam to lecture, train and to work with Vietnamese agricultural students and conduct research on small highly focused horticultural projects.
- iii) NSW and Vietnamese Agricultural scientists would, through a strong link with each other in both public and private sectors, help to facilitate research, training and marketing liaisons between Australia and Vietnam to promote improved vegetable production in Vietnam.

1.4 Implementation arrangements

Australian Agency:

In Australia, NSW Agriculture's head office and the Management Information Officer at the National Centre for Greenhouse Horticulture, Gosford, have controlled the management and accountability of funds independent of research staff. From a technical aspect, the Program Manager (Horticultural Products & Plant Protection), the Program Leader (Intensive Horticulture), the Director of the National Centre for Greenhouse Horticulture and the Activity Director and nine professional officers in the Intensive Horticulture Sub-Program have been responsible for organising research activities, visits and discussions for both Australian and Vietnamese scientists in Australia and Vietnam.

Vietnamese Institutions:

In Vietnam, each of the research institutes have supported this project by providing research facilities, research workers and labour for demonstration trials, seminars, workshops, training courses and lectures. The Ministry of Agriculture & Rural Development, Vietnam, has been responsible for control of the project in Vietnam.

2.0 Appropriateness of Project Design and Objective

2.1 Appropriateness of Objectives

Objective No.	Objective Description	Appropriateness Rating
1. Visit of Vietnamese horticultural scientists	Invite six Vietnamese scientists to collaborate in joint research projects to review and learn about the Australian vegetable industry.	5. Best Practice
2.NSW Agricultural Scientist visiting Vietnam.	Activity Director/Plant Breeder; Entomologist and Plant Pathologist from NSW Agriculture visit Vietnam to lecture, train and work with Vietnamese scientists.	5. Best Practice
3.Enhance research, training and trading liaisons between Vietnam and Australia	Establishment of demonstration experimental trials at the National Centre for Greenhouse Horticulture, Gosford NSW, Australia and Vietnam to evaluate hydroponic systems (RtW [cocopeat] and NFT) and grafting techniques in vegetables.	5.Best Practice

2.2 Appropriateness of Design

The project design led to all objectives being met:

- Vietnamese scientists were extremely keen to learn about the Australian vegetable industry;
- NSW Agriculture horticultural scientists trained a large number of Vietnamese horticultural workers and students in quality & safe vegetable production projects; and
- The model of hydroponic systems for “clean & green” vegetables proved promising, receiving positive response from the Vietnamese horticultural industry.

Description of design feature	Appropriateness rating
1. Invite six Vietnamese scientists to collaborate in joint research projects to review and learn about the Australian vegetable industry.	5. Best Practice
2. Activity Director/Plant Breeder, Entomologist and Plant Pathologist from NSW Agriculture visit Vietnam to lecture, train and work with Vietnamese scientists.	5. Best Practice
3. Establishment of demonstration experimental trials at the National Centre for Greenhouse Horticulture, Gosford NSW, Australia and Vietnam to evaluate hydroponic systems (RtW [cocopeat] and NFT) and grafting techniques in vegetables.	5. Best Practice

3.0 Implementation Performance

3.1 Project Components and Outputs

Project components including specific outputs for the activity were as follows:

- i) Vietnamese scientists who visited Australia to study the Australian vegetable industry obtained knowledge of modern growing techniques, tomato and cucumber breeding and seed production techniques, pest and disease management, quality assurance, post-harvest management, packaging technologies and wholesale and export marketing.
- ii) A 2-year research demonstration entitled "Evaluation of hydroponic systems and growing techniques for greenhouse vegetables such as tomatoes (*Lycopersicon esculentum* Mill.), cucumber (*Cucumis sativus* L.) and Asian vegetables" was organised at the NCGH- Gosford, RIFV-Hanoi and IAS-HoChiMinh, for both Australian and Vietnamese scientists to work as a joint research project. Outputs of these research trials included improved hydroponic systems, screening of suitable varieties, use of IPM strategies to manage pests and diseases, and a better understanding of the constraining factors of greenhouse production.
- iii) NSW Agricultural scientists during their visit to Vietnam (plant breeder, entomologist and plant pathologist) assessed Vietnamese vegetable cultivars with a reputation for high insect and disease resistance for possible use under Australian growing conditions, and conducted a general survey of the pests and diseases found in each of the three production areas visited.

- iv) At Hue University of Agriculture and Forestry, NSW Agricultural scientists gave lectures on Plant Breeding, Pests and Diseases of Vegetables Crops for the 4th year students. The NSW Agricultural scientists also assisted in supervising graduate theses for the university's 4th year students. The ultimate performance indicators for this project will be improved vegetable production in Vietnam in terms of a great variety of vegetables, improved efficiency of production, higher quality of product, reduction in food safety problems and greater exports.

Performance indicators met are:

- 1) The successful completion of experimental projects in Australia and Vietnam;
- 2) The publishing of 2 scientific papers, 9 reports, 1 technical guideline in Vietnamese language (cocopeat) and 1 newsletter in Vietnamese;
- 3) Collecting of the materials for publishing of extension material in Vietnamese for use both in Australia and Vietnam;
- 4) The successful examination of 11 M.Sc. candidates and completion of 29 graduate theses of Vietnamese 4th year students; and
- 5) The publication of a final reports on the project in both English (NSW Agriculture) and Vietnamese (Vietnam partner institutions) languages recommending processes to improve training of scientists and commercial horticulturists in Vietnam, opportunities for improved production, food safety and post harvest management methods for the Vietnamese industry and recommendations for Australian horticultural industries in terms of training for Non English Speaking Background farmers and availability of alternative vegetables.

Component No.	Component Description	Outputs	Performance Indicators	Performance Rating
1. Visit of Vietnamese scientists.	Vietnamese scientists who visit Australia to study the Australian vegetable industry will obtain knowledge of modern Australian horticulture	Seven Vietnamese scientists were invited to NSW Agriculture	Four "Reports on Travel to Australia" by Vietnamese scientists	5. Exceeding time & quality targets
2. NSW Agricultural scientists visit Vietnam	Activity Director/Plant Breeder, Entomologist and Plant Pathologist of NSW Agriculture visit Vietnam to lecture, train and work with Vietnamese scientists.	Six trips (Activity Director/Plant Breeder: 4 trips; Entomologist and Plant Pathologist: 1 trip each)	Five 'Report on Travel to Vietnam' by QV Nguyen (4 reports) and McDougall S & Tesoriero L (1 report)	4. Achieving time & quality targets and on budget
3. Enhance research, training and trading	Establishment of experimental trials at the National Centre for	Demonstration trials were organised in Australia	Two papers submitted to the 7 th Aust. Horticultural	4. Achieving time & quality targets and on budget

liaisons between Vietnam and Australia	Greenhouse Horticulture, Gosford NSW, Australia and Vietnam to evaluate hydroponic systems (RtW [cocopeat] and NFT) and grafting techniques in vegetables	(Gosford NCGH: 4 trials) and Vietnam (RIFV: 2 trials; IAS: 3 trials)	Conference organised by The Australian Society of Horticultural Science, Sydney Univ., October 2002	
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3.2 Project Outcomes

3.2.1 Inviting Vietnamese horticultural scientists to visit NSW Agriculture:

In April 2002, which was nearly the end of the first year of the project, the Activity Director, Dr. Vong Nguyen, was approached by Dr. Do Nang Vinh, Deputy Director of Agricultural Genetic Institute (AGI) requesting to include the AGI into the project as another partner institution in Vietnam. The AGI wanted to send its horticultural scientist to NSW Agriculture, with funds coming from the Vietnamese Government. However, Vietnam's Ministry of Agriculture & Rural Development (MARD) expressed some concerns about the participation of AGI in the project and requested that with AusAID-CARD and NSW Agriculture's approval financial support for the traineeship of the AGI scientist could be covered by sharing the travel costs with other three scientists from Hanoi RIFV, Hue UAF and Hochiminh IAS. The request was approved by NSW Agriculture and Dr. Do Nang Vinh was invited to visit NSW Agriculture in August 2003 for ten days.

In conclusion, seven Vietnamese horticultural scientists instead of six, visited Australia from September to October, 2002; September to October 2003 and August 2003 for research and training focusing on greenhouse cucumber, tomatoes and Asian vegetables production.

The seven nominators were:

1. Mrs PHAM MY LINH, research scientist, Division of Vegetables & Spices, Research Institute of Fruits & Vegetables, Hanoi;
2. Mr NGUYEN NGOC MAI, Chief, Division of Vegetables & Spices, Research Institute of Fruits & Vegetables, Hanoi;
3. Dr. LE THI KHANH, Head, Department of Horticulture, Faculty of Agronomy, Hue University of Agriculture & Forestry; Hue;
4. Dr. NGUYEN MINH HIEU, Dean, Faculty of Agronomy, Hue University of Agriculture & Forestry; Hue;
5. Dr. NGO QUANG VINH, Head, Department of Vegetables, Institute of Agricultural Sciences of South Vietnam, Hochiminh;
6. Mrs LE THI VIET NHI, Deputy Head, Department of Vegetables, Institute of Agricultural Sciences of South Vietnam, Hochiminh and
7. Dr. DO NANG VINH, Deputy Director, Agricultural Genetic Institute, Hanoi.

The Vietnamese scientists were extremely keen to learn about the Australian vegetable industry. They were satisfied with the training they received. The highly organised Australian horticultural production systems had a great

impact on the seven Vietnamese scientists, one of which wrote in their report: “This is the first time we Vietnamese scientists experienced and eye witnessed vegetables grown in a hi-tech environment of a developed country such as Australia.”

3.2.2 Scientists from NSW Agriculture visiting Vietnam:

- 1. Visit No. 1:** Dr. Vong Nguyen, Activity Director/Plant Breeder (14th July – 27th July 2001: 14 days):

Aims: Discussion with Vietnamese counterpart organisations the 2 years’ working plan, lecture series and helping to conduct experimental trials.

Outcomes: The trip was successful and achieved the following results:

- Three research organisations including the Research Institute of Fruits & Vegetables (Hanoi); Hue University of Agriculture & Forestry (Hue); and the Institute of Agricultural Sciences of South Vietnam (Hochiminh) were extremely keen to co-operate with NSW Agriculture.
- NSW Agriculture approved the three horticultural scientists nominated from the Vietnamese counterpart organisations to visit Australia during mid-September, 2001 to participate in research and training primarily focusing on greenhouse cucumber production.
- Agreement was made for another three horticultural scientists to be nominated to visit Australia in mid-September, 2002 to participate in research and training primarily focusing on greenhouse tomato and Asian vegetables production.
- Agreement was made that all paperwork including: agreements, invitation letters, allocation of funds, design of experimental trials to be conducted in both Vietnam and Australia, and the preparation of experimental materials should be prepared in July and August each year, thus ensuring the working plan would be on target.
- Agreement was made that experimental trials in Hanoi and Hochiminh were to be organised soon after the scientists returned to Vietnam, late 2001 (cucumber) and 2002 (tomato).
- At Hue University of Agriculture & Forestry, Dr. Vong Nguyen was requested to give a course on “Advances in Plant breeding - Improvement of Vegetable Crops” for an M.Sc class rather than the previously agreed 4th year class. This request was accepted by Dr. Vong Nguyen.
- An agreement was made that the most convenient time for scientists from NSW Agriculture to visit Vietnam would be early 2002.
- The Activity Director was requested by the Vietnamese organisations to increase the number of visits to Vietnam for more frequent technical assistance in conducting the experimental trials. To accommodate this the duration of stay in Vietnam for each visit was shortened, still totalling 84 days as was written in the project submission. To off-set the additional airfare costs the Vietnamese government agreed to help discount air tickets for domestic flights for Dr. Nguyen’s.
- Agreement was made for a thorough evaluation of the project at the end the first year between the Project Activity Director and Vietnamese counterpart organisations, and discussions begin on the potential for future co-operation

2. Visit No. 2: Dr. Sandra McDougall & Len Tesoriero (18th January 2002 – 04th February 2002: 17 days):

Aims: Lectures, inspection and investigation of major insects and diseases on vegetables in Vietnam.

Outcomes: The visit of Dr. Sandra McDougall (entomologist) and Mr Len Tesoriero (Plant pathologist) helped horticultural scientists in Hanoi, Hue and Hochiminh research institutions to confirm some major diseases & pests of vegetables in Vietnam. Greenhouse trials were inspected and discussions on strategies to handle their pest and disease problems were had. Seminars were given to staff and students on the process of developing IPM strategies for both pests and diseases. Discussion and field tours helped identify the key pests and diseases affecting Vietnamese vegetable crops, as well as highlight some of the issues around food safety and current pest management practices. It was agreed that production of information sheets on pests and diseases to be translated into Vietnamese would be useful. It was noted that access to pest and disease identification materials was very limited and some Australian IPM manuals, vegetable production handbooks and field guides to aid in pest and disease recognition and management were provided to each institution.

Discussions on future collaboration included:

- Pest & Diseases surveys for accurate record of the incidence, distribution and relative importance of pests, beneficials and pathogens;
- Production of a pocket book guide and/or an IPM manual for pests and diseases of Vietnamese vegetable crops;
- Grower training programs to develop: crop monitoring skills, basic pest, beneficial and disease recognition and safe and responsible pesticide application;
- Improving spray application, particularly the introduction of backpack sprayers;
- Developing diagnostic capability for diseases (laboratories equipped with basic needs such as light microscopes and pathogen culture equipment);
- Research to optimise intensive production (development of soil-less production of tomatoes with emphasis on the use of locally-produced coir fibre in root substrates, evaluation of improved cultivars and net-house design);
- Quality Assurance schemes to meet safe food standards;
- Potential for production of beneficial insects, entomophagous pathogens, antagonist pathogens and other ‘bio-pesticides’;
- Development of insecticide resistance management strategies particularly for Diamond back moth; and
- Production of IPM guidelines for covered cropping systems.

3. Visit No. 3: Dr. Vong Nguyen, Activity Director/Plant Breeder (31st March – 22nd April 2002: 22 days):

Aims: Lectures, inspection and evaluation of the 1st year experimental trials. At Hue University of Agriculture and Forestry, Dr Vong Nguyen gave a course on “Advances in Plant Breeding: Improvement of Vegetables Crops”

for the M.Sc course's students. There was an examination at the end of the course.

Outcomes; The visit achieved the following results:

- Three Vietnamese scientists, who were trained in Australia in September-October 2001, had set up similar trials in Hanoi and Ho Chi Minh in December 2001. These trials focused on greenhouse-hydroponic cucumber production, using cocopeat and NFT, and using grafted plants to prolong production and increase disease resistance. The trials had drawn a very positive response from local industry.
- As a result, the Activity Director, Dr. Vong Nguyen was approached by the Agricultural University No. 1 (Hanoi) to include 2 students: a M.Sc student and an undergraduate student, into the research team of Research Institute of Fruits & Vegetables, Hanoi.
- Similarly Dr Nguyen was approached by Dr. Do Nang Vinh, Deputy Director of Agricultural Genetic Institute (AGI), Hanoi to include the AGI into the project as another partner institution in Vietnam. The AGI wanted like to send its horticultural scientist to NSW Agriculture for training funded by the Vietnamese Government. However, the Ministry of Agriculture & Rural Development preferred that the visit of the scientist from AGI to NSW Agriculture be covered by existing funds from CARD-0016.
- At Hue University of Agriculture & Forestry, Dr. Vong Nguyen gave a course on "Advances in Plant Breeding - Improvement of Vegetable Crops" for an M.Sc class of 10 students. These students were from either the university's academic staff or the local agricultural ministry's executive officers.

4. Visit No. 4: Dr. Vong Nguyen, Activity Director/Plant Breeder (21st December 2002 – 04th January 2003: 17 days):

Aims: Lectures, inspection & evaluation of the 2nd year's experimental trials, evaluation of project and preparation of Completion Report.

Outcomes: The trip achieved the following results:

- The trials of three of the Vietnamese scientists, who were trained in Australia in September-October 2002 were inspected and evaluated. These trials were on greenhouse-hydroponic tomato production methods, using cocopeat and NFT, and using grafted plants to prolong production and increase disease resistance were set up in Hanoi and Ho Chi Minh in December 2002.
- The Activity Director, Dr. Vong Nguyen, was asked by Can Tho University to supervise a lecturer, Mrs Tran Thi Ba, who is currently a Ph. D. candidate, for one year training at the Horticultural Research & Advisory Station on a Cucurbitaceae research project. The traineeship was to be at no cost to NSW Agriculture. All expenses for the traineeship were to be charged to Vietnamese Government.
- "Cocopeat", made from coconut coir, is used as a growing media in Australia was identified as a potential new export product for Vietnam. Coconut coir is abundant in Vietnam. Dr. Vong Nguyen met with two

cocopeat manufacturers in Ho Chi Minh City to discuss a potential Business Plan for commercialisation of Vietnam's cocopeat.

- Ministry of Agriculture & Rural Development suggested that the CARD project Round No. 2 be developed focussing on:
 1. Assist Vietnam to create a model of clean & safe vegetable production national wide (greenhouse, hydroponic, IPM, QA, post-harvest and packaging);
 2. Assist Vietnam to research and manufacture Vinacoco (coconut coir) and other materials as growing media for horticultural industry; and
 3. Assist Vietnam to train its horticulturists both in governmental and NGO levels.
- Vietnamese Government expressed its interest in establishment of a more formal bilateral relationship between Vietnam and Australia at all levels from Research Institution, Departmental Organization to Government.

5. Visit No. 5: Dr. Vong Nguyen, Activity Director/Plant Breeder (20th July – 05th August 2003: 17 days):

Aims: Finalizing of Completion Report and discussion with Vietnamese counterpart organisations on future collaboration.

Outcomes: The trip was planned for March, April 2003 but was postponed due to the risks of SARS in Vietnam to mid July 2003. Unfortunately this coincided with University vacation so scheduled lectures for the M.Sc course at Hue University of Agriculture and Forestry had to be cancelled.

The trip achieved the following results:

- Very positive feedback was given on the success of the CARD project by Prof. Dr. Tran Van Lai, Director RIFAV-Hanoi; Dr. Do Nang Vinh, Deputy Director AGI-Hanoi; Associate Professor Tran Van Minh, Rector, HUAF-Hue; Prof. Dr. Pham Van Bien Director IAS- Hochiminh and Prof. Dr. Vo Tong Xuan, Rector, An Giang University. These research institutions felt the benefits from this project were sufficient to warrant further work and requested a follow-on project.
- Further discussions with the Ministry of Agriculture & Rural Development reiterated their support for a second CARD project outlined above.
- In Long Xuyen, the Activity Director gave a lecture on “Clean & Green vegetable production systems for Vietnam” to approximately 60 participants. These participants were local agricultural ministry's executive officers (directors, deputy directors), representing provinces of An Giang, BacLieu in the South Vietnam and the staff of Faculty of Agriculture & Natural Resources, An Giang University.
- The second set of trials by three of the Vietnamese scientists, who trained in Australia in September-October 2002 were inspected and evaluated. These trials, planted in June 2003 were again on greenhouse-hydroponic tomato production methods, using cocopeat and NFT, and using grafted plants to prolong production and increase disease resistance. Again a lot of interest in the trials has been shown from the Vietnamese horticultural industry, particularly in Lam Dong highland areas.

- Hanoi Municipal Council expressed its interest in establishment of more formal bilateral ties between Vietnam and Australia and are willing to send a high-level delegation to discuss the establishment of this relationship.
- It was agreed that Dr. Do Nang Vinh, Deputy Director of Institute of Agricultural Genetics (AGI), Hanoi, would visit Gosford's National Centre for Greenhouse Horticulture for ten days from 17th – 27th August 2003.
- It was also agreed that Mrs Tran Thi Ba, a Ph.D. candidate, who will be in Australia for one year training at Gosford HRAS, on a Cucurbitaceae research project, will begin late September, 2003.

The assessment by Dr. Vong Nguyen of insect and disease resistant vegetable cultivars in Vietnam for possible trialing under Australian conditions resulted in a successful introduction into Australia of one cultivar each of tomato and eggplant for rootstock.. However, one cultivar each of Brinjal (*Solanum undatum*) and hot chilli with reputations for *Anthracnose* resistance were rejected at Sydney Airport by AQIS on quarantine grounds. The introduction of Vietnamese vegetable cultivars into Australia has proven difficult due to the strict quarantine systems in Australia.

3.2.3 Enhance research, training and trading liaisons between Vietnam and Australia:

A 2-year joint research project entitled "Evaluation of hydroponic systems and growing techniques for greenhouse vegetables such as tomatoes (*Lycopersicon esculentum* Mill.), cucumber (*Cucumis sativus* L.) and Asian vegetables" was organised at the NCGH- Gosford, RIFV-Hanoi and IAS-HoChiMinh from July 2001 using Australian greenhouse and hydroponic technologies (cocopeat, NFT, drip irrigation). Germplasm collections (tomato, cucumber, Asian vegetables) were collected and maintained at Gosford's NCGH. Results achieved from this research project were reported in the VIIth Australian Horticultural conference which was held at the University of Sydney, 29th September – 2nd October 2002 and the Vietnamese magazine which was published in Hochiminh, Vietnam.

i) Demonstration Experimental Trials in Australia at the National Centre for Greenhouse Horticulture, Gosford:

Four demonstration trials were organised at the National Centre for Greenhouse Horticulture, Gosford, from June 2001, with the following details:

Aims: Study the grafting techniques on hydroponic cucumber, tomatoes and Asian vegetables.

Plant Materials: Cucumber including Japanese (cv. Status) and Australian cultivars (Yara); Tomato including Japanese (Momotaro, T1-105, T1-176 and Tohoku Cherry tomato) and Australian (cv LaBelle) and Asian vegetables including kangkong, basil, perilla and mitsuba .

Rootstock materials: Rootstock for cucumber: Japanese kabocha and gourd.
Rootstock for tomatoes: tomatoes and eggplant.

Growing techniques: NFT and cocopeat

Planting: Trial 1: Cucumber; 14th June – 21st Sep. 2001

Trial 2: Cucumber; 12th Sep. 2001 – 9th Jan. 2002

Trial 3: Tomatoes for grafting only; 12th Sep. 2002 – Oct. 2002

Trial 4: Tomatoes & Cucumber; 6th March – 30th July 2003

Grafting techniques: Results from these trials showed that the tube grafting, pin grafting and tongue-approach grafting were all suitable for both cucumber and tomato with Japanese pumpkin and eggplant rootstocks, respectively. Grafting should be carried out in a shady place to avoid wilting and be healed and acclimatized in controlled environmental conditions such as plastic tunnel, maintained at 28^oC and 95% RH. Since grafting can increase resistance to soil born diseases and give vigour to crops, it is considered to be useful for low-input sustainable horticulture such is desired in Vietnam. These grafting techniques were also used in the experimental trials organised in Vietnam.

Hydroponic cucumber and tomatoes:

These experiments were primarily to train the Vietnamese scientists in Australian hydroponic techniques. The secondary aim was to compare yields of three cucumber varieties (mini-cucumber, Japanese and Vietnamese cucumber) and three tomato varieties (Australian, Japanese and Vietnamese tomatoes) grown using three hydroponic systems (RtW [cocopeat], NFT and Foam boxes) and two growing techniques (grafted vs ungrafted). Research was conducted at the National Centre for Greenhouse Horticulture, Gosford NSW, Australia.

Results have shown that:

1. Hydroponic cucumbers and tomatoes grown in greenhouses achieved good results in both yield and fruit quality;
2. There was no significant difference in yield and fruit quality of cucumber and tomato between RtW (cocopeat) and NFT systems (introduced from Australia).
3. There was no significant difference in yield and fruit quality of cucumber and tomato grown in Sri-Lankan and Vietnamese cocopeats.
4. Grafted cucumbers using Japanese pumpkin rootstock were shown to be strongly tolerant of *Phythium*.

Hydroponic Asian vegetables:

Demonstration experimental trials of hydroponic Asian vegetables including green perilla (*Perilla frutescens* Britton), mitsuba (Japanese hornwort; *Cryptotaenia japonica* Hassk.), basil (*Ocimum basilicum* L.) and water convolvulus (Kangkong; *Ipomoea aquatica* FORSK.) were conducted at the NCGH Gosford over the 2 years to develop a model for producing Asian vegetable using greenhouse hydroponic and NFT systems. The hydroponic solution which was most suitable for the above 4 crops was:

Solution A:

Calcium Nitrate	7333g/100L
Iron EDTA	100g
Ammonium Nitrate	667g

Solution B:

Potassium Nitrate	1703g/100L
Mono Potassium nitrate	1193g
Magnesium Sulphate	2571g
Manganese Sulphate	41.7g
Boric Acid	25.0g

Zinc Sulphate	2.6g
Copper Sulphate	2.0g
Ammonium Molybdate	1.02g
Solution's pH = 5-6 ; EC= 0.8 – 1.4	

ii) **Establishment of demonstration experimental trials in Vietnam:**

Hydroponic cucumber and tomato: Experiments examining cucumber and tomato production in greenhouses using RtW-cocopeat technique at the Research Institute of Fruits & Vegetables, Hanoi and at the Institute of Agricultural Science of South Vietnam, Hochiminh, were organised in early December, 2001 and early December 2002. They aimed to look at:

1. The growth and yield of cucumber grown on foam boxes, RtW and NFT systems;
2. Comparison of tomatoes grown on Sri-Lankan and Vietnamese cocopeats;
3. Developing a Model of “safe & high quality” vegetable production for Vietnam.

Results have shown that:

1. Hydroponic cucumbers grown in greenhouses achieved good results in the winter-spring production season in Hanoi and Hochiminh, Vietnam.
2. The hydroponic foam box technique, which is currently a major hydroponic system in Vietnam, achieved the lowest yield in comparison with RtW (cocopeat) and NFT systems (introduced from Australia).
3. Although both RtW (cocopeat) and NFT systems are promising for large-scale cucumber production in Vietnam. RtW (cocopeat) has greater potential as it requires less technological input and because cocopeat is readily available locally.
4. Introduced cultivars from Australia and Japan yielded better than local cucumber cultivars in Hanoi, Vietnam.
5. Experimental trials in Vietnam have shown that grafted tomatoes were strongly tolerant of *Fusarium* and *Bacterial* wilts.

Hydroponic Asian vegetables: Trials for developing a model of bitter melon and kangkong production in greenhouse was also conducted at the Institute of Agricultural Science of South Vietnam, Hochiminh in October 2002.

Results have shown that:

1. Water convolvulus grown using RtW (cocopeat) and NFT systems in greenhouses achieved good results in Hochiminh, Vietnam.
2. Water convolvulus was harvestable four weeks after sowing in the summer season in Hochiminh, Vietnam.
3. Nutrient solutions, which were modified from cucumber and lettuce solutions, have been found to be suitable for water convolvulus.
4. RtW (cocopeat) system has great potential for large-scale production in Vietnam as it requires less technological input and because cocopeat is readily available locally.
5. A model, large-scale greenhouse hydroponic water convolvulus production system has been suggested for both the Vietnamese and Australian horticultural industries.

iii) Outcomes from demonstration experimental trials: Production of Cocopeat in Vietnam:

“Cocopeat”, made from coconut coir, is used as a growing media in Australia was identified as a potential new export product for Vietnam. Coconut coir is abundant in Vietnam. Five hundred kilos of Vietnamese cocopeat (Vinacoco) was shipped to Australia in December 2002, for experimental trials as a growing media for greenhouse hydroponic tomato experiments at the NCGH. Results have shown that there were no significant differences in yield and fruit quality of tomato and cucumber grown on the currently used Sri-Lankan cocopeat compared to the Vietnamese cocopeat.

Coconuts are widely grown in Vietnam (163,219 ha) with a total production of approximately 1 million tonnes per annum (Vietnam’s Agricultural Statistics, 2000). The production areas are located mainly on the coastal areas of Central Vietnam and the Mekong River Delta of South Vietnam. For hundreds of years, coconut has been used in many ways including as food products (coconut milk, coco yoghurt, candies, coco cheese, coco flesh), coconut oil, charcoal (from coconut shell), fine arts and for the production of coir fibre. The long fibres of coconut coir, derived from the husk, are used for producing ropes and matting. However in their production large quantities of short fibres and coir dust are produced as a waste product in much larger quantities than the commercially valuable long fibres. The waste is usually dumped in rivers and canals, creating a serious industrial waste and pollution problem.

The potential demand for coir dust as a component of horticultural growing substrates on a world wide basis greatly exceeds current production. Coir dust is often a substitute for peat in horticultural growing substrates. However there has been little research into its use as a component of growing media. In Australia it is a common component of growing media especially for nursery production and flower and vegetable growing. Coir dust is a relatively uniform material and like peat it can hold up to 1000% of its own weight of water whilst still maintaining good aeration in the growing media. Unlike peat, coir dust is a natural, continually renewable resource. Increasing restrictions are being placed on the mining of peat from traditional sources due to environmental concerns. Global exports of coir dust are estimated to be about one million cubic metres per annum.

Sri Lanka is the main exporter of coir dust, selling under such trade names as Cocopeat™ and Canna Coco™. There are lessons to be learned from the Sri Lankan coir dust industry. Sri Lanka has developed a reputation as a quality supplier, compared to others such as Mexico, although this was not always so. During the 90’s coir dust from Sri Lanka developed a poor reputation which it is to yet fully overcome. This was largely due to poor quality control. Some batches of coir dust contained so much salt and /or phenols and tannins due to improper aging that they actually caused the death of plants. Higher quality coir dust is “mined” from large heaps that have accumulated over the last 100 years or so. However, these heaps have now been exhausted, restricting the supply of good quality, aged material (Simple Grow, *personal comm.*, 2002). A quality assurance program and research on the technologies of aging and

grading of coir dust will ensure that Vietnam avoids repeating such problems. A reputation for being a supplier of quality materials is a valuable marketing tool.

It is clear that there is great potential for the use of Vietnamese coir dust for nursery and greenhouse growing media. There is a need to develop a project to commercialize coir dust to support greenhouse horticultural industry in Vietnam. To achieve this, the following specific objectives are essential. These are:

- (1) Research on technologies of aging and grading coir dust;
- (2) Development of a basic quality assurance (QA) system for coir dust production;
- (3) Experimentation with coir dust products in Vietnam and Australia;
- (4) Development of Coir dust products for both the Vietnam and Australian nursery and greenhouse industries;
- (5) Commercialization of coir dust products; and
- (6) Export of Vietnam's coir dust products to Australia and international markets.

The Activity Director, Dr. Vong Nguyen, has already approached the directors of several Vietnamese cocopeat companies in Hochiminh city in January and July-August 2003 for discussions on a Business Plan for Commercialisation of "Vietnam's Vinacoco".

3.3 Sectoral Impact

In comparison with other research groups working in areas such as rice, corn, and root crops (sweet potatoes) vegetable researchers and institutes are considered to be the least skilled and resourced of any research institutions in Vietnam. This project, CARD0016, has given significant help to vegetable researchers in Vietnam through the training of seven Vietnamese vegetable research scientists who visited Australia and through the trials that these scientists conducted in Vietnam. Additionally this project also improved the training of a number of Vietnamese vegetable research workers and students through lectures and training given by the three NSW Agriculture scientists who visited Vietnam.

As a flow-on three workshops on "safe & high quality vegetable production" were organised by the Vietnamese scientists who came to Australia for almost all extension officers in the Northern Central, Central, Southern Central and South of Vietnam make a very strong impact even on women, minority, Laos and Cambodian communities.

3.4 Costs and Financing

NSW Agriculture proposed to contribute all of the salaries of our professional staff when they are working in Australia, plus all of our direct infrastructure and management costs (Total \$301, 131). The Vietnamese institutions made a similar contribution (\$116,280). The in-kind contribution from Vietnamese counterpart institutions included the use of land, equipment and consumables for experimental

trials, which was calculated at A\$10,000 per annum. The salary sum was calculated as 3 participants' salary x % of time to activity.

There were no significant deviations in costs from those estimated for the initial proposal.

3.5 Monitoring of project

Australia: NSW Agriculture established a review committee for the project, made up of Mr D. Hocking, Program Manager Horticulture Products and Plant Protection, Dr Philip Wright, Program Leader Intensive Horticulture and Dr. David Hall, Director, National Centre for Greenhouse Horticulture, Gosford. The committee sought input from the collaborating institutions in Vietnam and from NSW Agriculture staff involved. The purpose of the committee was to ensure effective project implementation.

Vietnam: The Activity Director, Dr. Vong Nguyen, together with the Ministry of Agriculture and Rural Development, Vietnam and the Directors of the Institute of Fruits & Vegetable, Hanoi; Hue University of Agricultural & Forestry, Hue and the Institute of Agricultural Science of South Vietnam, Hochiminh sought input from the collaborating institution in Australia and from Vietnamese research institutions' staff involved. The purpose of this activity was to ensure effective project implementation in Vietnam.

The Strengths in monitoring of this project was that the Activity Director, Dr. Vong Nguyen, is a Vietnamese-Australian who speaks fluent Vietnamese and has a good understanding of the horticultural industries both in Australia and Vietnam. He could therefore facilitate more easily the running of the project. The establishment of the National Centre for Greenhouse Horticulture to promote high technology in hydroponic vegetables also contributed to the success of the project.

3.6 Technical Assistance, Training and Capacity Building

Production of 'clean and green' vegetables such as cucumber, tomatoes and Asian vegetables in greenhouse with hydroponic systems was a research demonstration in the AusAID-CARD0016 project. This project should help Vietnam to achieve their goals in production of safe vegetables in the future and also help the Australian vegetable growers to improve their production to achieve a larger share of the domestic Asian vegetable market. This market was valued at A\$135.8 million in 2002.

The aims of the project's experiment were to develop a model greenhouse hydroponic vegetable production system using RtW (cocopeat) and NFT systems. Research was conducted at the Research Institute of Fruits & Vegetables, Hanoi; Hue University of Agriculture & Forestry, Hue and the Institute of Agricultural Science of South Vietnam, Hochiminh City in Vietnam and at the National Centre for Greenhouse Horticulture, Gosford NSW, Australia.

During the two year research period, a model of net-house, grafted vegetables grown on cocopeat with trickle irrigation system was shown to be effective in producing high quality and safe vegetables for Vietnam. Three workshops on the above theme, organised in Quang Binh on 20 & 21 December 2002, Nha Trang on 23, 24 & 25 December 2002 and Long Xuyen on 25 July 2003 attracted almost 160 participants,

mostly local agricultural ministry's executive officers (directors, deputy director, manager, extension horticulturist), representing 15 provinces in the North Central, Central, South Central and South Vietnam. Representatives from Laos and Cambodian Governments were also invited to the workshops. The speakers of the workshops were the horticultural scientists who visited Australia in September/October 2001 and 2002. The Activity Director, Dr. Vong Nguyen also participated as an invited speaker in two of these three workshops. The workshops were funded by the Asian Regional Centre (ARC) of the Asian Vegetable Research & Development Centre (AVRDC). A relationship between the CARD-0016's Activity Director, Dr. Vong Nguyen and Dr. Koizumi, Director, ARC has been established. ARC has agreed to assist financially to promote the research outcomes of CARD-0016 into Vietnamese horticulture, particularly towards the remote areas and the ethnic minority communities.

These new techniques are being actively introduced into the Vietnamese horticultural industry by the Ministry of Agriculture & Rural Development's extension officers. As a result growing grafted tomatoes on cocopeat in net-houses with trickle irrigation has already been adopted by a large number of leading vegetable producers, particularly in Hanoi, Lam Dong highland and suburbs of Hoc Mon, Cu Chi of Hochiminh city.

As another sign of success the Activity Director, Dr. Vong Nguyen, has been approached by another four research institutions and universities for co-operation. They are:

1. Southern Fruit Research Institute, TIEN GIANG;
2. Department of Crop Science, College of Agriculture, Cantho University, CANTHO;
3. Faculty of Agriculture and Natural Resources, Angiang University, LONG XUYEN; and
4. Hanoi Agricultural University, HANOI

3.7 Management of Constraints, Issues, Risks and Change

The major risk identified at the beginning of the project was a failure in the demonstration trials in Vietnam, however, the demonstration trials over the two years of the project were a success. Although yields of cucumber and tomato in Vietnam's experimental trials were lower than those of Australia, caused by higher temperatures, disease and insect damage, they were acceptable to the Vietnamese. It is believed that yields could be improved with new varieties and some technical help from Australia.

3.8 Project management

Lead Institution (Australian Agency):

Mr. Graham Denney, Manager (External Funding), Head Office, NSW Agriculture and Mr. Rod Tabrett, Management Information Officer, National Centre for Greenhouse Horticulture, Gosford, have controlled the management and accountability of funds independent of research staff. From a technical aspect, the Program Manager (Horticultural Products & Plant Protection), the Program Leader (Intensive Horticulture), the Director of the National Centre for Greenhouse Horticulture, the Activity Director and nine professional officers in the Intensive Horticulture Sub-Program were responsible for organising research activities, visits

and discussions for both Australian and Vietnamese scientists in Australia and Vietnam.

Rating scale: 5. Best Practice.

Vietnamese partners institutions:

Each of the research institutes in Vietnam, including the Research Institute of Fruits & Vegetables (Hanoi), the Hue University of Agriculture & Forestry (Hue) and the Institute of Agricultural Sciences of South Vietnam (Hochiminh) supported this project by providing research facilities (research farms, greenhouses, net-houses, nurseries, laboratories), research workers and labour for demonstration trials, seminars, workshops, training courses and lectures. The Ministry of Agriculture & Rural Development, Vietnam, was responsible for control of the project in Vietnam.

Rating scale: 5. Best Practice.

4.0 Performance and Outcomes

4.1 Assessment of Performance Against Objectives and Design

- 1) Performance and Objective 1: Six out of seven horticultural scientists from the Vietnamese research institutions and Universities who visited NSW Agriculture to work for a period in Australian research institutions and to inspect and learn about the Australian vegetable industry, have successfully completed five experimental trials on hydroponic cucumber, tomato and Asian vegetables in Vietnam. They also organised three workshops to train the Vietnamese extension officers on “safe & high quality vegetable production”;
- 2) Performance and Objective 2: Three NSW Agricultural scientists who visited Vietnam to lecture, train and to work with Vietnamese agricultural students and conduct research on small highly focused horticultural projects, have successfully examined 11 M.Sc. candidates and 29 graduate theses of Vietnamese 4th year students. They have also introduced new cultivars of tomato, eggplant, Japanese pumpkin and gourd as rootstocks into the Australian horticultural industry. They successfully published two scientific papers, eight reports, one technical guideline in Vietnamese language (cocopeat) and one newsletter in Vietnamese. Information on insects & diseases on major vegetables in Vietnam was also collected. The data could be used for a “Handbook of insects & diseases on major vegetables in Vietnam” in Vietnamese;
- 3) Performance and Objective 3: NSW Agricultural scientists, through a strong link with Vietnam in both public and private sectors, helped Vietnam to promote the model of “clean & green vegetable production systems”, to train more Vietnamese horticultural scientists and to assist Vietnam with coir dust (Vinacoco) R&D.

4.2 Sustainability

The project achieved significant results, progressing smoothly with no significant variations from the approved project. Demonstration trials in Vietnam showed that net-houses, grafted crops, cocopeat and drip irrigation are the keys for producing high quality vegetables that meet food safety requirements for its domestic market and offer significant potential for export to Asia.

Rating scale: 5. Best Practice

4.3 Development Impact

This project has helped develop the potential of the Vietnamese horticultural scientists, who visited Australia, to introduce new technology into Vietnam and modify it for their specific conditions. They have the tools to further assess other vegetable crops with potential to be grown in net or glasshouses. It has improved their understanding of the high input, technological agriculture practiced in Australia and look at aspects that may be appropriate for Vietnam. The project also reached widely through the government and other horticultural sector people via seminars and workshops given by the visiting Australians or the collaborating Vietnamese scientists. The project identified coconut coir dust as a potential new commercial industry for Vietnam

5.0 Conclusions

5.1 Overall assessment

In Vietnam, in the first 6 months of 2002, 1,869 Vietnamese were poisoned because of vegetable consumption. Of those, 41 died. Chemical residues left from fungicides and insecticides were identified as the cause. Vegetable poisoning is a very big issue in Vietnam and safe methods of vegetable production need to be developed.

The two-year AusAID-CARD-0016 project, that started in July 2001 at the National Centre for Greenhouse Horticulture, Gosford NSW and in Vietnam, has helped Vietnam to initiate the development of a “clean & green” vegetable industry. By introducing Vietnam to IPM and QA and assisting in the development of protected cropping, the feasibility of a “clean & green” vegetable industry has been demonstrated. It has been identified, for example, that a net-house using new vegetable varieties, growing in “cocopeat” as a substrate and irrigating by drop-irrigation, is suitable for the Vietnamese environment. Importantly “Cocopeat” has been identified as a potential new product for Vietnam as coconut is abundant in that country. However, the commercialisation of coir dust is still a long way off. There is a need to continue the work begun in this project. The areas of greatest need are to improve Vietnam’s capacity for teaching, conducting research and implementation of modern horticultural crop production methods with a particular focus on Quality Assurance systems for ‘clean & green’ vegetable production. This should enhance the ability of Vietnam to promote rural development in these industries and improve the efficiency and quality of vegetable production.

5.2 Lessons Learned

Technical Lessons Learned: The difference in vegetable production techniques between Vietnam and Australia is one of the major lessons learned from the project. Vietnamese horticultural industry is based on the traditional Vietnamese-styled system where vegetables are produced on very small-scale, farms which are geographically dispersed; fertilisers and pesticides are not used correctly; varieties are not those being demanded in the market place; and quality of vegetables are poor, especially for export markets. The adoption of Australian horticultural technology such as grafting techniques, trickle irrigation systems, cocopeats, net-house etc. are therefore difficult and timely.

The project did show that glasshouses and particularly net-houses, using cocopeat substrate and drip irrigation could successfully be installed and run in Vietnam. Suitable cucumbers and tomatoes varieties were selected for this growing system.

Grafting on more resistant root stock proved to enhance disease resistance and plant vigour. Widespread adoption of these techniques by small farmers is probably not possible and really only available to the more affluent, government supported or some sort of co-operative arrangement.

The collating of what are the key pests and diseases was incomplete and potentially inaccurate. The pathologist and entomologist were only in Vietnam for two weeks and saw only those pests and diseases found in the crops at the time. With no basic laboratory facilities and almost no written materials available for identification the lists are less than perfect. There are some previously published materials for south east Asia generally but very little for Vietnam and it did not appear that the Vietnamese Horticulturists were familiar with it or wish to acknowledge it. The Vietnamese scientists did say whether the insects on a list collated from wider sources were found in their area and on which crops. There may be some species which are different but the main groups are probably the correct.

Training Lessons Learned: The demonstration trials prepared for the visiting Vietnamese scientists were very effective, particularly having the visitors collect data and participate in the management of the trials while they were in residence.

The structure of agriculture in Vietnam is such that the Vietnamese horticultural scientists need to be both researchers and extension officers at the same time. Extension methodology needs to also to be included in any future training of Vietnamese scientists.

Project management lessons learned: Although the Activity Director, Dr. Vong Nguyen, is a Vietnamese-Australian who speaks fluent Vietnamese and has a good understanding of the horticultural industry in Vietnam, management of project in terms of writing reports, preparing financial reports etc. in Australian way are sometimes unfamiliar with the Vietnamese institutions, particularly with the ones which are not in big cities such as Hanoi and Hochiminh.

Communication lessons learned: Communication with the Vietnamese vegetable growers was an issue since there is a gap in the level of knowledge between the horticultural scientists and vegetable growers in Vietnam. Posters, pictures, handbooks etc. would be useful tools for an effective communication with this community.

Having 'hands-on' activities and tours where things can be observed helps overcome the language barrier for both the Vietnamese scientists visiting Australia and the Australian scientists visiting Vietnam. Having the Activity Director, Dr. Vong Nguyen, fluent in Vietnamese made a big difference in facilitating oral communication.

The Vietnamese Government concerns: The Vietnamese Government are particularly concerned with solving the problem of contaminated vegetables in the local market. Although the project conclusively showed that vegetables can be produced with minimal or no pesticides in the net-houses, using grafted root stock, cocopeat media and drip irrigation in Vietnam it is not a system that can be afforded by the majority of the farmers. The issue of pesticide related contamination is complex and given the spray application practices are almost universally very poor they were not going to be solved entirely by this project. As mentioned above there is not an established system of extension and Vietnamese scientists had to extend their own work. This being the case and with the few resources they had to work with they are unlikely to be able to make major changes very quickly.

