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project

Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia Component 6 - Program Management and Combined Report

project number HORT/2007/066

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contributors/
collaborators* Much of the information in this component report has been summarised from individual component final reports within this project and thus there are many other contributors to this summary report

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1 Acknowledgments

Nb. This project consisted of five components which are referred to as C1, C2 etc, with each component leader submitting individual final reports. This report is the program management and combined report (C6).

I would like to thank ACIAR for the opportunity to manage this project whilst an employee of NSW DPI and subsequently through Hallways Consulting after I retired in 2010. I would also like to specifically thank Dr Les Baxter, Research Program Manager Horticulture for his flexible and moral support for the management component, together with Betty Robertson, Program Support Officer and at the end of the project Jia Chunyan, Program Support Officer. Dr Caroline Lemerle Research Program Manager, ASEM and Dr Gamini Keerthisinghe, Research Program Manager, SMCN are thanked for their support of the component activities and component leaders.

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2 Executive summary

The project 'Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia' consisted of five components on soils, protected cropping, bacterial diseases, supply chains and economics and policy. This report covers the sixth coordinating and management component and includes brief summaries of the technical work. The five technical components have provided separate final reports.

The soils component benchmarked soil fertility status and management practices through soil surveys and testing, farmer surveys and nutrient omission trials in four provinces.

The protected cropping component demonstrated the financial benefits of protected cropping for farmers and defined key issues affecting profitability and yield including crop type, management skills and pest and disease incidence.

Research on bacterial wilt (BW) characterised the causative strain and races of the bacteria causing BW and developed a sensitive and reliable method for detection of BW from field samples.

Many of the 29 clusters supported by the supply chain component were successful and key issues to ensure clusters are sustainable were identified. An economic impact assessment revealed that after clustering, participating farmers had increased their income by an average of 47%.

The economic and policy component identified key factors affecting vegetable profitability and productivity, the importance of transport infrastructure and regulations on growers and also underinvestment in horticulture R &D. Many economic analyses were prepared on the value of possible technical interventions.

In Australia the financial and biological value of garden organic waste was defined, exhaust fans and screen door modifications to existing greenhouses were shown to be economically feasible, recommendations were made on the management of BW for potato and bacterial canker for tomatoes and gross margins were produced for vegetables.

Having a number of components linked together resulted in improved synergies, monitoring and reporting, sharing of resources and joint experiments. Key across project issues and opportunities were with pests and diseases and the value of training and / or education on profitability. There is a continuing need to develop opportunities for protected cropping and to obtain evidence to support the focus on organic agriculture, both at the soil and plant level and also to reduce vegetable wastage pre- and postharvest.

The component's activities and outputs were monitored by component leaders and management plus there was an internal mid-term and an external final review. Recommendations were made including on future research and management. Two new ACIAR funded vegetable projects on integrated crop management and nutrition and two on postharvest and value chains of fruit and vegetables have been key outcomes.

Each component conducted surveys of farmers and in some components also of wholesalers, transporters, retailers etc. Some of this data has been extensively analysed and published. However, there are still a number of data sets that could benefit from further statistical analysis to either better understand relationships, provide a basis for benchmarking, to assess technical treatments and to characterise farmer and / or value chain production and marketing systems.

Thirteen staff were awarded scholarships or studied for Ph.Ds or Masters including four John Allwright Fellowships to Australia, at least 2500 farmers were estimated to have adopted new technology or marketing approaches, at least 1700 farmers received training (> 1 day) and there were at least 11500 individual farmer or student visitations to field sites or conferences (predominantly VSU Anniversary Days or NOMIARC Field Days). There were at least six journal articles and 93 conference papers published plus 2 videos.

3 Background

3.1 Overall project

The overall vegetable project was based on a Philippines-Australia agricultural R&D priority setting workshop in the Philippines in March 2006. This identified a range of R&D priorities in the horticulture, land and water management and systems agricultural sectors. These priorities formed the basis of the R&D priorities for the 2007-08 ACIAR Annual Operating Plan for the Philippines and were incorporated into the then Philippines Council for Agriculture, Forestry and Natural Resources, Research and Development (PCARRD) Integrated Science and technology agenda for 2006-2010.

The horticultural priorities were further refined at a Horticultural R&D priority setting workshop held at Cebu in September, 2007. The priority areas were:

- Develop lower cost and sustainable production systems that target market opportunities
- Develop and implement more profitable off-season production (particularly protected cropping) of high-value vegetables
- Address major pests and diseases affecting the yield and marketing of solanaceous and brassica vegetables
- Identify and analyse priorities and constraints in key value chains
- Strengthen linkages of participating smallholders with high value markets by design, testing and implementing interventions to improve supply chains
- Program management to foster researcher and business service linkages with industry.

The project HORT/2007/066 '*Enhanced profitability of selected vegetable value chains in the southern Philippines and Australia*' was designed based on these priorities. The goal of the project (similar to the associated fruit project) was to contribute to economic growth through increased income and improved livelihoods of high-value vegetable growers in the southern Philippines. The purpose of the fruit and vegetable program was to improve smallholder and industry profitability and market competitiveness of southern Philippines selected vegetable industries (including potato, tomato, brassica, leafy vegetables).

There were six components:

Component 1 - Integrated soil and crop nutrient management in vegetable crops in the southern Philippines

Component 2 - Development of a cost-effective protected vegetable cropping system in the southern Philippines and Australia

Component 3 - Integrated strategies for the management of bacterial wilt and other wilting diseases in solanaceous crops in the southern Philippines and Australia

Component 4 - Analysis of selected vegetable value chains in the southern Philippines

Component 5 - Economic impacts of new technologies and policy constraints in the production of vegetables in the southern Philippines and Australia

Component 6 - Program Management

The move to a program-based approach for agricultural R&D was in keeping with a strategic decision by ACIAR management for two value chains programs (one for vegetables and one for fruit) that were designed around the priorities identified and prioritised at the Cebu workshop in 2007. The decision to move to a program approach

was based on the potential efficiencies in program management, the potential for integration of program components, the potential to capture synergies between components and the potential efficiencies (eg in resource management, sharing of trial sites, extension etc).

3.2 Project Justification

In 2007, agricultural production and fisheries accounted for 15-17% of the Philippines GDP and employed 35-40% of the workforce. At December 2007 prices, the gross value of Philippines agriculture was PhP 972 billion (\$AUD 26 billion). In 2007, the crops subsector accounted for 47.6% of total agricultural output; this was an increase of 5.6% over the previous year. While rice and coconuts were the two largest agricultural sectors, production of horticultural crops was important both domestically and for export.

In accordance with the Australia aid and development strategy for the Philippines, ACIAR works with partner agencies predominantly in the southern Philippines (Leyte - Region VIII, Northern Mindanao - Region X and Davao - Region XI). Vegetables, in particular are a major source of income for a large number of smallholders in these regions. For Davao and Leyte, brassicas (broccoli, cauliflower, cabbage), solanaceous crops (eggplant, tomato, potato) and leafy vegetables had been identified as important vegetable crops.

This program aimed to further develop technologies and outcomes developed in previous ACIAR projects. For example the biofumigation techniques developed in SMCN/2000/114 '*Evaluating biofumigation for soil-borne disease management in tropical vegetable production*' was to be further developed for use in potato bacterial wilt control strategies through component 3.

3.3 Management project background

In recognition of the size and complexity of this program, a decision was made by ACIAR to commission a major Australian R&D service organisation to provide overall management for each of the fruit and vegetable projects. NSW DPI was appointed as the organisation to carry out the overall management of the Vegetable Program.

Details of the management of the vegetable project are contained within this component (Component 6).

The overall Project was managed by NSW DPI with critical support from the ACIAR Philippines Horticulture Manager who was based in Davao, Mindanao.

The **Vegetable Project Manager (VPM)** was responsible for the overall financial management, reporting, M&E and developing integration/synergies between and within the program components. These integration/synergies were to be achieved through:

- (i) Integration of some activities within Programs
- (ii) Sharing of information and resources
- (iii) Common staff and trial sites
- (iv) Integrated technology transfer activities
- (vi) Annual combined planning and evaluation workshops
- (vii) Program communication strategies

A key part of the management was the **Philippines Horticulture Manager** who had four major roles:

- (i) To support ACIAR with the management of stakeholder and collaborator relationships associated with the program

(ii) Identification and development of potential collaborations between the program, agribusiness and commercial organisations

(iii) Support with program implementation and monitoring and evaluation activities

(iv) Identification and development of potential opportunities for integration, leveraging and collaboration between program components particularly with regard to extension, dissemination and technology transfer activities.

3.4 ABBREVIATIONS

AHR	Australian Horticulture Research
BW	Bacterial wilt
C1	Component 1, Soils
C2	Component 2. Protected cropping
C3	Component 3, Bacterial wilt
C4	Component 4, Supply Chains
C5	Component 5, Economics and Policy
C6	Component 6, Management (this report)
CMU	Central Mindanao University
CUT	Curtin University of Technology
EDC	Energy Development Corporation
GM	Gross margins
IPM	Integrated Pest Management
JAF	John Allwright Fellowship
NSW DPI	NSW Department of Primary Industries
PCAARRD	Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development
RPM	Research Program Manager, ACIAR
RPM SMCN	RPM Soil management and crop nutrition (Dr Gamini Keerthisinghe)
RPM HORT	RPM Horticulture (Dr Les Baxter)
RPM ASEM	Agricultural systems management (Dr Caroline Lemerle)
PHM	Philippines Horticulture Manager (John Oakeshott)
MOSCAT	Misamis Oriental State College of Agriculture and Technology, Claveria
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
UPM	University of Philippines, Mindanao
USeP	University of Southeastern Philippines
VPM	Vegetable project manager (Dr David Hall)
Web2	The publicly available and also part project restricted web site hosted by ACIAR on the internet

4 Objectives

1. Assist in planning, developing and implementing the overall Program.

Review initial project proposals and provide comments and advice through relevant ACIAR Program Manager.

Assist in developing contracts between ACIAR, NSW DPI and between NSW DPI and subcontractors including the Memorandum of Subsidiary Arrangement

Manage annual planning and review meetings in Australia and co-manage (with the Philippines Horticulture Manager) annual planning and review meetings in the Philippines

Participate in two planning trips per year to Philippines to attend annual Philippines planning meetings and to visit Philippines sites.

Provide advice on additional participants within components and in conjunction with ACIAR foster new partnerships with industry groups and other funding sources.

Advise the project staff and ACIAR on possible interaction benefits of other projects conducted in the Philippines and Australia

Assist ACIAR to ensure technical coherence within and between Program Components.

2. Assist in the monitoring, review and evaluation of the overall Program

Review submitted milestones from each component and recommend submission to ACIAR.

Recommend to ACIAR changes in contracted Program objectives, milestones and budgets.

At the second and third planning meetings, document objectives which the final project evaluation will be based on and ensure that appropriate data collection mechanisms are in place.

Identify Program opportunities, gaps and limitations and recommend Program changes to ACIAR.

Develop and implement a formal Monitoring and Evaluation plans as appropriate

In conjunction with Philippines Horticulture Manager arrange for an internal mid-term review and independent end of Program evaluation.

Based on all component budgets, prepare and monitor overall program budgets.

Membership of Program Reference Group

3. Maximise synergies and integration of the Components within the Program.

On the basis of the activities carried out in Objectives 1, 2 and 4, identify potential Program synergies and integration of components and component activities and advise on strategies to capture these commonalities and linkages between components to maximise effective synergies.

Monitor project research activities, workshops, field days and other activities and advise project staff where improved synergies are possible.

Prepare flow charts and tables indicating links between components and common themes

With the component staff develop an overall Program theme and common objectives.

4. Design and implement a communication plan for the Program

Report to ACIAR, participating organisations and component staff on results of annual planning meetings.

Ensure effective communication between components within the Program as part of objective 3.

Develop and enhance the profile of the Program to ACIAR, participating organisations and other agreed stakeholders, in particular the benefits of the Program to Australian Agriculture and Australian Foreign Aid responsibilities.

Review, recommend and implement a cost effective communication plan. This may be one or a number of the following: printed newsletter email, web site, internet based project communication system.

Liaise regularly (at least monthly) with the Philippines Program Manager and Project team leaders on progress, challenges, opportunities and any factors likely to limit the planned Program outcomes. Provide monthly update on this liaison to ACIAR RPM.

Communicate at least quarterly with the Philippines Fruit Program to maintain consistency and where possible some integration.

5 Methodology

5.1 Component management

Each of the components was managed by a component leader who was responsible for planning and implementation of the component strategy. The respective ACIAR Research Program Manager (RPM) was responsible for ensuring the overall consistency of the program in relation to ACIAR's, The Philippines' and other relevant strategies and M&E in relation to the program plans.

Table 1. RPMs and component leaders of the Philippines vegetable project

Component	Short name	RPM	Component lead Investigator	Australian organisation	Philippine leader
1	Soils	Dr Gamini Keerthisinghe, RPM SMCN	Dr Yin Chan, then Simon Eldridge with Dr Chris Dorahy, AbleBlue	NSW DPI	Dr Annabelle Tulin, VSU
2	Protected cropping	Dr Les Baxter, RPM Horticulture	Dr Gordon Rogers, Australian Horticulture Research (AHR)	AHR	Dr Othello Capuno, VSU
3	Bacterial wilt	Dr Les Baxter, RPM Horticulture	Dr Anthony Young, then Dr Nandita Pathania	Qld DAFF	Vale Justo, UPLB
4	Supply chain	Dr Caroline Lemerle, RPM ASEM	Dr Peter Batt	Curtin University of Technology (CUT)	Dr Sylvia Concepcion, UPMIn
5	Economics & policy	Dr Caroline Lemerle with Dr Les Baxter	Dr John Mullen, then Dr Randall Jones, then Dr Kिरिल Pollock then administered by Dr Hall	NSW DPI	Dr Larry Digal, UPMIn
6	Management	Dr Les Baxter, RPM Horticulture	Dr David Hall, then Dr Jenny Ekman, then Dr Shane Hetherington. David became a contractor to NSW DPI after October 2010	NSW DPI	Dr Joy Eusebio, PCAARRD with John Oakeshott

5.2 C6 Staffing

ACIAR contracted the whole project to NSW DPI and two of the five technical components were lead by NSW DPI. NSW DPI asked Dr David Hall, to manage the overall project as 'Vegetable Program Manager' (VPM). In 2008 Dr David Hall was employed by NSW DPI as Director, Gosford Horticultural Institute and Research Leader, Plant Health Sciences. He was contracted to ACIAR to spend about 20% of his time managing the this vegetable project. He also had the occasional support of NSW DPI clerical assistants some of who were ACIAR funded.

Dr Hall retired from NSW DPI in October 2010. NSW DPI subsequently contracted David, trading as Hallways Consulting, to continue management of the project.

Dr Jenny Ekman, Research Horticulturist, Postharvest, formally became NSW DPI Vegetable Project Leader in October 2010. She had authority within NSW DPI to approve payments and reports and to assist with other actions. After her resignation in 2013, Dr Shane Hetherington, Research Leader, Horticulture administered the project for NSW DPI based on advice from David Hall.

The NSW DPI Directors responsible for the vegetable project were Dr Helen Scott-Orr until her retirement in 2009 and Dr Trevor Gibson until his retirement in July 2011. Dr Shane Hetherington, as Acting Director of Horticulture and other positions then had project responsibility through to project completion.

5.3 Project management

- 1) On project matters, the VPM worked directly with the component leaders
- 2) On in-country Philippines issues the VPM worked with the Philippines Horticulture Manager (PHM).
- 3) On strategic, technical, monitoring and evaluation issues he worked with the ACIAR RPMs for Horticulture, ASEM and SMCN.
- 4) On across fruit and vegetable issues he liaised with the initial fruit program manager, Bob Williams and for the balance of the project with Irene Kernot (both Qld DPI).
- 5) For financial management he liaised with NSW DPI administrative staff, then after retirement, he worked with the same staff, but through Dr Ekman and then Dr Hetherington.
- 6) Reporting and financial issues were managed with Betty Robertson, Program Support Officer and RPMs.
- 7) For the soils component (C1), which was contracted to NSW DPI, Dr Hall was heavily involved in payments and acquittals and provided significant inputs into the final report.
- 8) For the economic and policy component (C5), which was contracted to NSW DPI, the VPM assisted significantly with payments and acquittals.

With this C5 component, he also acted as coordinator / administrator during more than half the component's life (including for the associated fruit project's economics and policy component) when there was no component leader (September 2009 to May 2011 and March 2012 to final report submission in July 2013).

After March 2012, discussions were held with at least 10 economists, but none of these were willing to lead the C5 fruit and vegetable components in their final phase or had the range of skills to cover all the key activities. Thus no new component leader was appointed.

The VPM also coordinated the writing of the C5 final report and arranged an external review of this report.

5.4 Travel

Funds from C6 were also used to support travel to the Philippines and within Australia.

- The VPM visited the Philippines 1 to 3 times a year from 2008 to 2012. He visited all the main vegetable research sites in the Philippines and to research sites in Australia a number of times including Mareeba, Qld, and Gosford, Camden and Orange in NSW.
- Dr Len Tesoriero, pathologist, NSW DPI visited the Philippines in 2010 to evaluate the importance of diseases within protected cropping systems.
- Dr Jenny Ekman, postharvest researcher, NSW DPI visited the Philippines in 2011 and 2012 to examine opportunities for postharvest R & D for vegetables.
- Dr Sandra McDougall, entomologist, NSW DPI, visited the Philippines in May and October 2012 to investigate and review pest issues with vegetables, particularly on biological control. Dr McDougall also assisted with vegetable pest advice for the project.
- The VPM added extra time to some trips in 2011 and 2012 to assist with coordination of the C5 Economic and Policy component.

5.5 Component funding and financial variations

The components managed their own financial activities, which are described in the component original proposals. During the whole project there were some component variations:

C1 Extra funds were provided by ACIAR in 2011 to enhance VSU soil laboratory infrastructure and develop staff skills.

C2 Extra funds (\$10,000) saved from C5 were provided to evaluate some of the disease incidences and thresholds for protected cropping and to conduct further statistical analyses of the affects of pests, diseases, crop and growing systems on yield and price.

C3 The project budget was increased to fund the scoping study for clean potato seed production through the aeroponic technique. Also surplus (\$70,000) funds from C5 were re-allocated to C3 to evaluate some aspects of the aeroponic technique including potential economic benefits.

C4 An additional \$30,000 was provided from ACIAR to support an additional visit by the Australian team to the Philippines in June-July 2012 and to assist with project finalisation.

During the project, surplus funds from C5 were redistributed to components C2, C3 and C6. These surplus funds mainly came from C5 savings because no economic project officer was employed in Australia from May 2011, there were unexpended travel funds and the VPM coordinated and administered much of the C5 component.

C6 Funds were also used to investigate research gaps (see 5.4) and to extend the VPM's contract for a further six months past 30 April 2012.

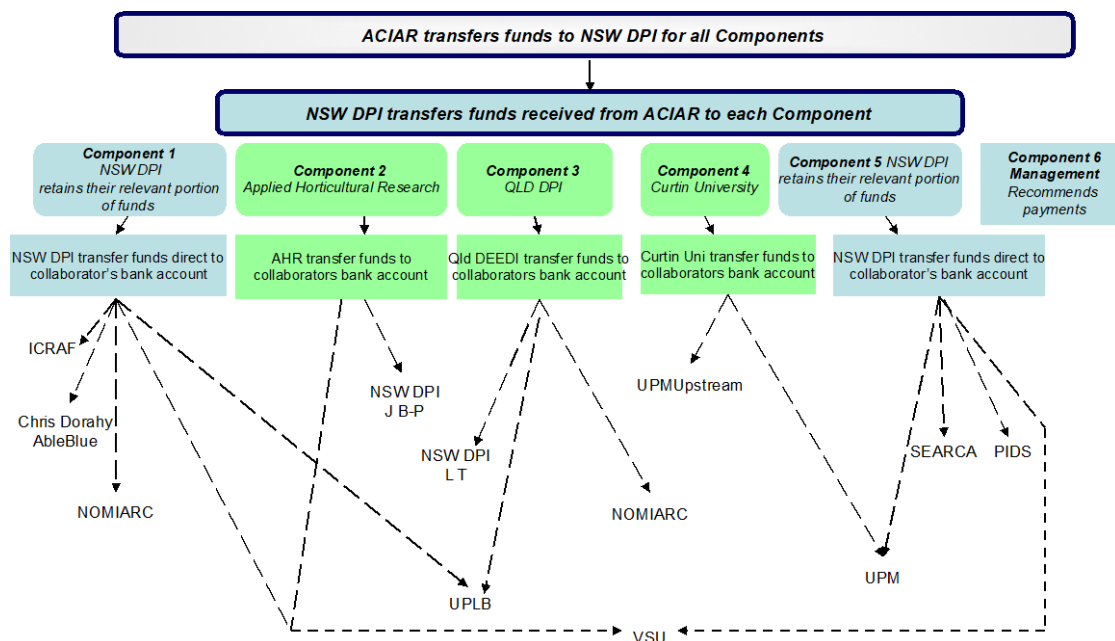
Funding processes

Funds flowed from ACIAR to NSW DPI and then were distributed to the externally lead components, viz. AHR, Qld DAFF and CUT. Some funds from AHR and Qld DAFF were

then sent back to NSW DPI for contracted activities. Acquittal reports flowed back to NSW DPI with consolidated acquittals being provided to ACIAR. See the following figures.

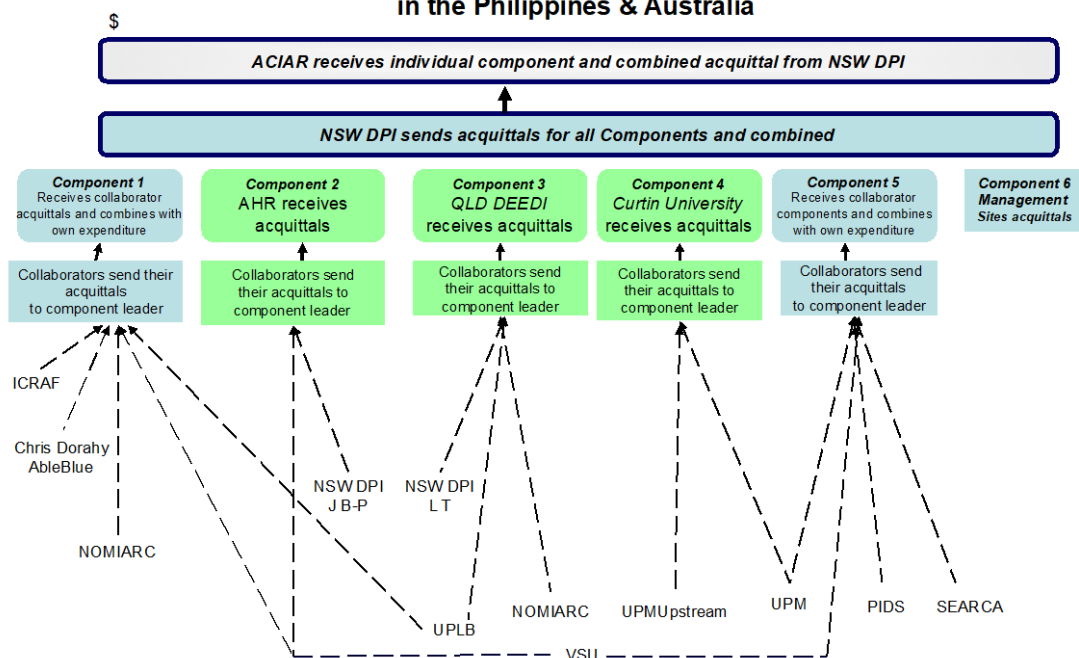
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Vegetable Project Payment Procedures to Component Collaborators in the Philippines & Australia



Responsibilities: Green = External component Leaders, Blue = NSW DPI component Leaders

Vegetable Project Acquittal Procedures for Component Collaborators in the Philippines & Australia



Responsibilities: Green = External component Leaders, Blue = NSW DPI component Leaders

6 Achievements against activities and outputs/milestones

Objective 1: To assist in planning, developing and implementing the overall Program.

No.	Activity	Outputs/ Milestones	Planned Completion date	Comments
1.1	Review initial project proposals and provide comments and advice to ACIAR	Advice to ACIAR regarding suggested changes to proposals to allow better implementation	April 2008	Completed 2008
1.2	Assist in developing contracts relevant to the Program	Appropriate contracts developed and implemented	April 2008	Completed 2008
1.3	Manage annual planning and review meeting in Australia and co-manage annual planning and review meeting in the Philippines	Meeting held as agreed between stakeholders	June 2008-2010 (Australia) July-August 2008-10 (Philippines)	Annual planning meetings were held in Canberra in 2008, 2009, 2010 and 2011. They were jointly managed by Les Baxter and the VPM with help from the PHM Annual Philippine Planning Meetings were in held in Davao 2008, Leyte 2009 and 2010 and Bohol in 2011. These were jointly managed with the PHM. In 2010 and 2011 vegetable meetings were combined with the fruit project and were supported by Irene Kernot and Bob Williams the fruit project managers. At the 2010 and 2011 meetings, separate 'discipline' discussions occurred with the participants who were soil scientists, entomologists, pathologists and economist / supply chain staff. Reports were prepared on discussions including future opportunities, linkages and improving science within the discipline areas.
1.4	Participate in two planning trips per year to the Philippines	Planning meetings organised and held	July and December 2008-2010	The VPM had from 1 to 4 Philippine visits in each of 2008 through to 2012. These coincided with Annual planning meetings (See 6.1.3) and / or were separate trips to participate in component meetings and monitoring trips to all sites plus meetings with PCAARRD in Los Baños. The aims of these trips were also to progress component linkage opportunities and to increase involvement of C5 with C1-C4 in both fruit and vegetables. See also Section 6.1.5.

1.5	Provide advice on additional participants and partners for Program components	Appropriate additional partners participating and investing in Program activities	Ongoing	In the Philippines this role was predominantly the PHM's rather than the VPM. The VPM helped investigations of potential partners in postharvest projects (PhilMech Munoz, DOST Packaging, Manila, UPLB, UPMIn and VSU) and on pest and disease management (Regional Crop Protection centres) and helped finalise collaboration with SEARCA for C5. The VPM also participated in meetings with non-collaborating staff from and / or visited Xavier University, CMU, Landcare, USEP and MOSCAT. The VPM provided some liaison for components for the major field days at VSU in 2010 and 2011 and at NOMIARC in 2011. In Australia the VPM nominated staff for involvement or assisted with their contribution to the project including Drs Ekman, Tesoriero, McDougall, Jones, Pollock and also Simon Eldridge and Anthea McClintock. The other NSW DPI staff involved had been nominated by NSW DPI managers before the project commenced. The VPM visited 'Valley Fresh Farms', part of the NORMIN group, in November 2009 and August 2010 and the Kaanib foundation in Aug 2010. He also contributed to meetings with potential partners for protected cropping development and clean seed for potato production.
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PC = partner country, A = Australia

Objective 2: To assist in the monitoring, review and evaluation of the overall Program.

No.	Activity	Outputs/ Milestones	Planned Completion date	Comments
2.1	Review submitted milestones from each Component and submit to ACIAR	Milestone reports submitted to ACIAR	May 2008-2010	From 2009 through to early 2013 the VPM reviewed many trip and project reports, papers and presentations. All C1-C5 vegetable annual reports were reviewed and submitted to ACIAR. Substantial assistance with editing and layout was required and sometimes coercion to get annual reports submitted to RPMs for their approvals. The VPM did much of the writing for the C5 economic and policy fruit and vegetable 2012 annual report and was lead author for the final report. He also contributed significant editing time to the C1 final report.

2.2	Recommend to ACIAR changes in contracted Component objectives, milestones and budgets	Advice to ACIAR on proposed changes to budgets, objectives etc	Ongoing	Changes were recommended/ supported for Australian staff (C1, C3, C5 and C6), budgets (all components), objectives (C3) and activities (mainly C3 and C5). See Component reports.
2.3	Document objectives for final evaluation of Program and ensure information collection mechanisms are in place	Objectives for final Program evaluation documented	December 2010	Assistance was provided to RPM Horticulture and PHM for external reviews on objectives and processes. The VPM assisted sourcing of the C5 external reviewer and briefed him in conjunction with the RPMs Horticulture and ASEM. The VPM collated and advised on reports for evaluation of C1-C5 and prepared the C6 report for the reviewers. He prepared a complete publication list and impact table for all components. Subsequently he summarised the external reviewers recommendations into 13 key recommendations for ACIAR
2.4	Identify Program opportunities, gaps and limitations and recommend appropriate changes	Advice to ACIAR on proposed changes to Components	Ongoing	Numerous opportunities, gaps and limitations were recommended throughout the project. C6 and / or the VPM is not claiming credit for these as most key final decisions were made by or in conjunction with RPMs, PHM and / or component leaders. Some documentation and / or activities were: C1 Documenting new opportunities and suggesting alternative design and analysis techniques for C1 (VPM with Simon Eldridge). Documenting and progressing an audit of soil testing laboratories in the Philippines Provision of further lab equipment to VSU Advising on completion of the economic analysis of stage 2, garden compost research in Australia C2 Suggestions for additional detailed statistical and economic analysis of pest and disease data and determining key variables affecting yield and profit of protected cropping and field vegetable production Assisting the Philippines visit of Dr Len Tesoriero and his review of diseases of crops under protected cropping structures C3 (+pests) Progressing aeroponics to produce clean seed potatoes

2.5	Develop and implement formal M&E plan as necessary and appropriate	Formal M&E plan developed and in use	June 2013	M & E was predominantly through reviewing reports, face-to face discussions, meeting attendance and site visits M & E included defining staff roles in projects, and encouraging project implementation and reporting plus reviewing of publications. Evaluation followed monitoring activities, annual reviews and the final review. C5 also contributed to evaluation but this was not as beneficial as originally planned because some activities were too early in the R & D cycle to be subjected to economic evaluation. See C5 report. C4 conducted their own impact assessments Evaluation also occurred through the VPM's inputs to all vegetable component final reports
2.6	Arrange for internal mid-term review and independent end of Program evaluation	Mid-term and End of Program evaluation completed	Dec 2009 and June 2011	The mid-term review was completed in August 2010. The main activity was the 2010 annual meeting plus RPMs, PHM and PCAARRD site visits and the subsequent report and its dissemination. (The VPM did not participate in the review tour of key sites as his c.20% annual contribution was already exhausted). The external review was completed in October and November 2011. See also 6.2.3 above. The VPM assisted in editing the final external review report and prepared a summary of key recommendations for ACIAR
2.7	Prepare and monitor overall Program budgets	Overall Program budgets submitted to ACIAR	Ongoing to Feb 2013	With a large number of collaborators and the complicated flow of funds (Section 5.5) monitoring of the budgets was difficult. This was exacerbated by limited clerical support from NSW DPI. 10% of the final payment was withheld from some collaborators and was paid when their component final report was submitted. Most budget changes happened with C5 where the initial allocations were 'to be determined', and unfortunately the principal investigator retired before the 'determining' happened. The VPM facilitated internal fund transfers from the C5 component to other components within the project in 2012. The VPM also assisted with the budgets for the C5 fruit component that had no principal investigator for much of the time.

				2.7 continued.... Acquittals from NSW DPI to ACIAR were all completed as were those for 3 external providers (AHR, Qld DAFF and CUT). The component acquittals to Philippine collaborators were completed as far as possible. They were complicated as some acquittals were in \$A, others in pesos (PhP) and different accounting periods were used.
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PC = partner country, A = Australia

Objective 3: To maximise synergies and integration of the Components within the Program.

No.	Activity	Outputs/ Milestones	Planned Completion date	Comments
3.1	Identify potential Program synergies and integration of Components and advise on strategies to capture these	Advice to ACIAR management team	Ongoing	Synergies developed between Components C1 and C2 and between C1 and C3. It was hoped that C4 would develop synergies with C2, but C2 was essentially too early in its vegetable marketing to involve C4. C5 developed some analyses with C2 and C3. C4 and C5, both lead through UPMIn, shared workshops, conferences and some approaches. C4 used some of C1's training material. The discipline meetings on entomology, pathology, supply / value chain and soils / physiology across all the fruit and vegetable projects increased links. C3 Veg also worked with C3 fruit (papaya).
3.2	Monitor Program activities and advise on improvements for greater synergies	Program monitoring reports and advice to ACIAR on potential improvements	Ongoing	Program monitoring occurred through site visits, component and annual meetings and reading and reviewing annual and final reports. Regular meetings involving RPMs, VPM, PHM and component leaders occurred. The VPM conducted significant monitoring of all programs through Philippine visits from 2008 to 2012 and site visits to EMAI, Gosford, Orange and Cairns.
3.3	Prepare flow charts and tables indicating links between projects	Flow charts and tables developed and in use	Ongoing	A number of flow charts and figures were prepared and used in reports or presentations See also section 5

PC = partner country, A = Australia

Objective 4: To design and implement a communications plan for the Program.

No.	Activity	Outputs/ Milestones	Planned Completion date	Comments
4.1	Report to stakeholders on annual planning meetings	Report circulated to stakeholders	May and November 2008-2010	The VPM submitted reports on the Australian and Philippines annual meeting to NSW DPI, ACIAR and other associated people including component leaders and project staff. Other reports included internal travel reports which were prepared by most project members for trips and submitted to their own organisations, ACIAR and the VPM. Philippine component leaders submitted reports to PCAARRD.
4.2	Ensure effective communication between projects	Communication plan developed and implemented	Ongoing	Communication occurred between projects through emails, Skype and face-to-face meetings included 4 annual meetings in the Philippines and Australia. See also 3.2 above. VPM attended the following meetings and initiated most Aus meetings. (Annual meetings are reported in Section 7.1.3). C1 meetings in NOMIARC (3 in total), Camden (1), Sydney (1) & Canberra (1) C2 meetings in Leyte (2), Gosford (3). C3 meetings at UPLB (1), NOMIARC (3) and Cairns (3) C4 meetings in Davao (2) and C5 meetings at UPLB (1), Davao (3), Leyte (3), Manila (6), Orange (2), Armidale (2) and Gosford (1). He often prepared notes that were circulated after these meetings. Effective communication also occurred through the PHM's newsletter 'What's Cropping Up', quarterly teleconferences, annual meetings, copious, emails, Skype and Web2

4.3	Develop and enhance the profile of the Program to ACIAR and other stakeholders	Other stakeholders engaged with and investing in the Program	Ongoing	The VPM promoted the Philippines program to many senior NSW DPI managers and others whenever possible. Some promotion was through meetings and some through circulating reports on outcomes Web2 provided a profile for the program The soils (C1) and protected cropping (C2) videos prepared by Sharron Olivier and Gordon Rogers with separate funding have resulted in good publicity. The VPM promoted the project at the C4 /C5 supported Agribusiness Economic (ABE) Conferences in Davao in 2011 and 2012. The VPM suggested some media articles and some of their content. He will attempt to progress these as part of his role in the new Philippines program. Les Baxter, PHM and C2 helped develop relationships with East West Seeds, Leyte based local Governments plus other organisations like Energy Development Corporation (EDC). C4 developed a strong Davao profile. The profile of the program was also raised through the Postharvest scoping study The VPM hosted Philippine project visitors in March and August 2010, March and June 2011, March and June 2012, and February and March 2013 at Gosford Research Station, the Central Coast area, Sydney and at his home
4.4	Review, recommend and implement a cost-effective communication plan	Communication plan developed and implemented	September 2008	Basic communication plans were prepared in 2008. Reporting is inherent in earlier sections of this report. Effective communication also occurred through site visit meetings, web 2 and reviews of reports proposals and plans
4.5	Liaise regularly with the Philippines Horticulture Manager and the Component team leaders	Monthly meetings held at least monthly with Philippines Horticulture Manager and Component team leaders	Monthly April 2008 to March 2011	Discussions occurred at least fortnightly with the PHM. VPM had regular teleconferences and meetings with Australian component leaders. Other communication included emails 'ad nauseam'. See also 4.2.

4.6	Participate quarterly in the Program Reference Committee Meetings	Quarterly meetings held with the Program Reference Committee	Quarterly 2008-2011	Reference Meetings were held in June 2011, July 2011 and May 2012. A number of other meetings involving some of PCAARRD, PHM, RPMs and the fruit program manager and the VPM occurred. All dates not recorded.
4.7	Communicate at least quarterly with the Philippines Fruit Program to maintain consistency and integration	Quarterly meetings held with management of Philippines Fruit Program	Quarterly April 2008 to March 2011	The VPM attended fruit planning meetings in both of June and July 2008 and 2009, June and August 2010 and June and July 2011. VPM also attended fruit review meetings in July 2011(Bohol), November 2011 (Brisbane) and April 2012 (Brisbane). He had meetings with the Fruit Project Manager in August, November and May 2011, April, July and August 2012 and April 2013. He visited a Jackfruit site in July 2009, August 2010 and March 2011, papaya sites (2) in February 2011 and mango sites on at least 3 occasions.

PC = partner country, A = Australia

7 Key results and discussion

Technical results are obviously the responsibility of each component and are recorded in component final reports. Only a selection of outputs (summary of component final reports and recommendations plus recommendations from the external review) and impacts are included in this report (section 7.4).

7.1 Management

7.1.1 General

The original completion date of 30 April 2012 was extended to 31 December 2012. Final reports for all components were not submitted until October 2013, mainly because of some limited ongoing component leadership at the end of the project.

Most of the management activities are documented in Section 5, Methodologies of this report.

The main issue with this component (C6) was the excessive amount of time that the VPM has had to devote to administering the C5 fruit and vegetable C5 components (See C5 final report).

7.1.2 Budget management

Acquittals were required from NSW DPI by ACIAR for each six-month period to June and December. There was also an expectation that collaborators would provide acquittals to their component leader each six months. These were usually provided but were often hard to obtain. We often found Philippines acquittals were provided for the 6 months ending on April 30 or October 31 each year. Also some acquittals were in Pesos and some in \$A even from the same collaborator.

7.1.3 Monitoring and evaluation

The VPM contributed through attendance at many meetings, including annual meetings, the mid-term review and the end of project review (Chapman *et. al.* 2012). The summary of activities is in Section 6.2.1, 6.2.2 and 6.2.4 to 6.2-7. The major M & E role of the VPM was through commenting on and suggesting many changes to annual, final and other reports and papers.

7.2 Linkages and themes across components

Common staff, sites, institutions, meetings

The opportunity to value add to components was mainly through some common staff and common institutions for some components eg UPLB for C1 and C3, VSU for C1, C2, C5, NOMIARC for C1 and C3 and in Australia with NSW DPI for C1, C2, C3 and C5.

Some experimental sites were shared at NOMIARC, Bukidnon, VSU, Leyte and in Kapatagan, Davao del Sur.

Staff from the economic and policy component, C5, had a number of joint meetings and workshops with the other components.

The opportunities to utilise skills in one component to assist other components is an opportunity that needs to be progressed in new projects. As the 5 technical projects were initially scoped and essentially developed independently, across component collaboration was initially limited. The program meetings addressed this to some extent, but in the future this needs to be more pro-active.

The overall link of course was that all components were working on vegetables.

During the annual review and planning meetings in Ormoc 2010 and Cebu 2011, the VPM assisted in organising some meetings of i) entomologists ii) pathologists iii) agronomists and soil scientists and iv) economists and or value chain staff. The notes from the 2011 meetings are in attachment 1.

These meetings helped scientists and extension officers who had similar interests to meet and develop better working relationships. Some of the suggestions from these meetings were implemented in following years and / or contributed to the new Philippines Horticulture Program. With hindsight, some of the suggestions should have been followed through further within the vegetable project.

It would be valuable in the future to promote these across project link meetings so staff benefit from more interaction, scientific debate and sharing of resources.

Some common messages and themes across components

1. Across the project including all of the technical components, C1, C2, C3 and C4, pest and diseases had major affects on yields in many experiments and both C1 and C3 had near complete crop failures because of diseases and thus no results were obtained from some experiments. It is acknowledged that this is not unusual for tropical vegetables but it seemed to reflect limited pest and disease management skills from some technicians rather than random uncontrollable events Similarly, in Australia, pest and diseases had major affects on yields of C1 and C3 experiments.

To assess pest and disease research priorities, Drs Tesoriero and McDougall were supported by the C2 and C6 components to participate in separate review studies in 2010 and 2012. This has resulted in a new vegetable project 'Integrated crop management (ICM) to enhance vegetable profitability and food security in the Southern Philippines and Australia' (HORT 2012 /020) which has a strong emphasis on identifying pest and disease knowledge gaps, developing capability and implementing new pest and disease research and extension programs.

At some stage there may also be an opportunity to involve the Philippines plant protection research stations. A visit to the NOMIARC plant protection facility by John Oakeshott, Les Baxter and David Hall highlighted high industry involvement, but a lack of resources, commercialisation skills and networking.

2. This vegetable project, particularly C4 and C5 (both the transport and market analysis studies), highlighted variable quality and losses of vegetables after harvest and figures on losses were documented in final reports for components C4 and C5.

Some unexpended funds in C6 were used to investigate research opportunities, possible collaborators and priority vegetables through a study conducted by Dr Ekman, the VPM and PHM in September 2011 and February 2012 (Ekman *et. al.* 2012). This has resulted in a new project proposal 'Improved postharvest management of fruit and vegetables in the Southern Philippines and Australia', (HORT 2012/098) being considered by ACIAR.

3. The C4 and C5 components both emphasised the benefits of clusters and marketing groups on profitability of smallholder farmers.

4. Gross margins (GM) from various vegetable cropping enterprises were documented from components 2, 4 and 5 (Some of these are summarised in Table 9, Component 5 final report, page 61).

5. Within C5, the SEARCA and UPMIn studies highlighted the effects of high transport costs on profitability of vegetable production. The results of the SEARCA study were widely disseminated throughout the Philippines.

6. Both C2 and C5 found significant relationships between yield and / or profitability of vegetables and the education and / or training level of farmers. Level of pests and

diseases (C2) and expenditure on chemicals (C5) were also found to significantly affect yield and or profitability of vegetable production.

7. It is believed that across the components there was under reporting of outputs. For reporting of outputs in any new program, it is suggested a section on the web site be devoted to communication outputs. It needs to include draft outputs and final outputs. Also it needs to say what outputs were refereed and to define workshop, training, presentation and other terms better.

8. There were some common issues with capacity building that are noted in the next section.

7.3 Capacity building

A key objective of ACIAR is to have a *capacity-building impact* through 'a change in the knowledge and skills of individuals (particularly those in the partner country) that has occurred through their participation in the project and its training elements'. A summary of capacity building from internal component training activities is documented in Section 8.2. With hindsight it would have been valuable to have more of these training activities.

It was apparent from the M & E process, including the reading of reports and papers, that the Philippines collaborator's staff and also with Australian staff, that there were varying levels of competence in many of the key skill areas. These included:

- i) Statistical analyses. In 2010 and 2011 there were a number of discussions with researchers on the need for improved statistical analysis skills and for some training in basic statistics. This need remains. The VPM had discussions with two Australian statisticians about a possible role. However, we considered it also beneficial to include Filipino statisticians as trainers. The PHM investigated the IRRI program 'CropStat'. A number of the projects in the new Philippines Horticulture Program are considering some early training on experimental design and data analysis.
- ii) Extension skills. There was recognition that extension skills and processes could be improved. Thus at the 4th year fruit and vegetable planning and review meeting in Bohol, 2011 an extension workshop was conducted. This followed the Australian ABC's Q and A concept, including a panel of experts. It was lead by Irene Kernot and Noel Vock, Qld DEEDI and the expert panel included the RPM HORT.
- iii). Economic analyses. It is critical that when new farmer recommendations are made that they are checked to ensure they are likely to improve farmer livelihoods. In some cases some recommendations were not subjected to basic checking of likely benefits within cropping systems.

Participants in a training course 'Economic Analysis Techniques for the Evaluation of Farm Fruit and Vegetable Systems' at VSU made some valuable 'generic' suggestions and comments in November 2012. (See Attachment 12.6, C5 final report for more notes on this evaluation). The suggestions and comments may have wider implications than just farm economic analyses training and thus are repeated here.

The VPM helped plan, implement and evaluate this course. The workshop was originally intended for junior economists from the C5 economic program. However, there was significant interest from others and thus economists also attended from the C4 vegetable supply chain component, plus some VSU staff, other senior economists as well as some non-economists from other components of the fruit and vegetable program.

The 'generic' comments and suggestions documented as part of the evaluation included:

- Attendees appreciated having a Filipino as the trainer (even though she is now an 'Australian').
- Appreciation of the value of the exercises which were relevant to Philippine agriculture

- Participants would have liked to have had more exercises
- They would have liked more training time (up to 5 days, rather than 2).
- Handouts to be in bigger print
- It was appreciated that topics were basic and there was a lot of discussion on applications of the techniques
- They would like to have a 'reflective' or further training course in another year
- They would have liked to have had smaller groups
- They appreciated the interactive session which identified the strengths and weaknesses of each analytical tool and when appropriate to use
- For other training courses they suggested having groupings set up at the start of the training across institutions but with one advanced person in each group
- Other training courses they would like to attend were: Technical writing, data analysis for researchers and photographic techniques to capture events or good agricultural practices or symptoms of pests / diseases to support the results of projects.

Suggestions for training in any new program are also documented in section 8.2.

7.4 Technical results for components 1 to 5 and external review recommendations

7.4.1 Component 1

Executive summary from C1 final report

An integrated research program was developed which involved assessment, field research, communication and capacity building activities in the Southern Philippine regions. Key outcomes of the Philippines work included the benchmarking of the soil fertility status and management practices through soil surveys and testing, farmer surveys and nutrient omission trials. Nitrogen and phosphorus were found to be the key nutrients controlling vegetable yields in most soils. A useful approach for calculating the cost of nutrients in fertilisers was developed to allow farmers to compare the price of nutrients in different inorganic and organic fertilisers. Further carefully designed field trial research is recommended to allow the fine tuning of recommendations for optimal N, P and K fertiliser applications for the main vegetable crops in these regions.

Capacity building was a highlight of this program and activities included; the participation of four Philippine soil scientists at the World Congress of Soil Science in Brisbane and visiting the NSW DPI field trial site at Camden in 2010, two ACIAR funded professional development studies to Australia, the completion of one MSc and three BSc student projects, training for VSU Lab Technician (Cynthia Goddoy) at the NSW DPI soils laboratory in Wollongbar, and ACIAR funded laboratory upgrades for the VSU soils laboratory. In addition, there were a series of farmer technical forums and training workshops to help extend basic soil science skills to advisors and farmers in Southern Philippines regions, and these attracted a lot of interest and high attendances from the communities.

A key message arising from the project is that recycled organics alone are unlikely to provide all the nutrients required to achieve the productivity required to meet the food demands of the Philippines. Nevertheless, they have great potential to be used in conjunction with inorganic fertilisers to increase fertiliser use efficiency, provide some nutrients, and in some instances help to improve crop yields by improving soil quality. Sustainable soil fertility and nutrient management entails understanding soil fertility status, matching inputs to outputs and monitoring soil conditions to ensure nutrients do not accumulate or diminish over time.

The ACIAR funding from this project allowed the NSW DPI long-term compost vegetable field trial in the Sydney Basin at Camden, NSW to be extended for another five crops following a repeat application of blended green waste compost. This work has generated some important findings relating to compost use in intensive vegetable production systems. These include:

Capsicum responded to compost applications by achieving near maximum yield. Two one off applications of compost at 60 dry t/ha and 125 dry t/ha application rates, each followed by 5 vegetable crops with supplementary N fertiliser in later crops, achieved a benefit: cost ratio of 2.63 and 3.33 respectively, when compared to farmer practices. Most of the economic benefit was due to the yield improvement for capsicum. The larger application of compost (125 dry t/ha) resulted in significant ($P<0.05$) improvements in soil quality parameters (physical, chemical, biology) immediately after application compared to the farmer practices. These measures included percentage water stable aggregates, carbon %, CEC %, pH, cations, nutrients and soil microbial biomass. Some of these improvements (e.g. soil structure) dissipated over time with successive crops and associated tillage. Resultant elevated soil P levels eventually provide an environmental upper limit for the number of such large compost applications.

Recent increases in the promotion of organic farming in the Philippines means that it is important to conduct further research comparing vegetable production between organic, inorganic, and integrated mixed organic – inorganic systems, to provide guidance for farmers to help them to optimise food production with their available resources.

Summary recommendations from the external review (Chapman *et al.* 2012):

1. Future research with soils should focus on refining soil test calibration studies to more accurately establish critical soil test limits for N, P and K in vegetable production systems.
2. Soil experiments should be conducted to determine the need for and interaction of inorganic fertilizers with organic fertilizers for flowering and fruiting crops and to determine the potential of micronutrient-containing fertilizers for increasing yield and improving product quality.

Other comments on C1

Initially there were delays in processing and analysing soil and plant samples collected during field and greenhouse research activities. Additional funds were provided for soil testing laboratory and for additional equipment and training in Australia of a technical officer. There was a plan in April 2011 to review the soil testing laboratories including their accessibility, QA systems, needs and costs to clients to potentially enhance capability of testing of soils used for vegetables in the Southern Philippines. Unfortunately this review did not progress.

There were some questions over the design, analysis and interpretation of some of the soils research. Simon Eldridge and the VPM reviewed the situation in July 2012 and a report (Eldridge and Hall 2012) highlighting opportunities was provided to RPM SMCN and a general summary was circulated to collaborators. We believe this had some influence on the proposed new soils project 'Soil and nutrient management strategies for sustainable vegetable production in Southern Philippines' (SMCN 2012/029) including collaborators and project objectives. It is hoped that evidence based best practice farmer guides will be produced by the new vegetable nutrition soils project.

7.4.2 Component 2

Executive summary from C2 final report

This project aimed to develop and test an appropriate and effective protected annual crop production system in Leyte, determine whether the production of vegetable crops using

protected cropping systems in Leyte is economically viable at both farm and market level, and promote adoption/modification of protected cropping systems.

The project with the support from LGUs constructed and evaluated 34 structures across five project sites in Ormoc, Maasin, Bontoc, Bato, and at VSU. Two types of structures were evaluated: the *house-type structures*, built from either bamboo or coco lumber with an effective growing area of 200m² (5m x 40m) or *tunnel-type/igloo type structures* made of either bamboo or steel frames, with either plastic or net coverings and with a growing area of 60m² (1.5m x 40m). The VSU sites were mainly used for experimentation of crop suitability, pests and disease impacts and nutrition. The farmer sites were mainly used to collect information to support the assessment of economic viability, and to monitor the emergence of new production challenges.

House-type structures made of bamboo are stronger than that of coco lumber and are more suited for taller crops such as tomatoes, sweet pepper, ampalaya and beans. Low tunnels have great potential for low growing crops such as lettuce, pechay and muskmelon especially when covered with fine netting rather than plastic.

The Australian team (NSW DPI) designed a modular curved roof bamboo greenhouse and this was tested in the Philippines at three sites and found to be successful under local conditions in the Philippines. A new greenhouse was then designed by the Philippine project team and farmers, based on the NSW DPI design. The new locally designed curved roof bamboo greenhouse has out performed all other designs. It is highly resistant to wind damage and the plastic and bamboo structure lasts for longer than all other structures.

Vegetables crops grown under protective structures regardless of design and type overwhelmingly yielded higher compared to those grown in the open field. Average yields were higher under protected cropping for cauliflower, green onion, lettuce, chilli pepper, tomato, sweet pepper, bitter melon, pechay, muskmelon, broccoli and string beans. There was no impact on yield for sweet corn, cabbage, watermelon, bottle gourd, cucumber or winter squash. Protected cropping can result in higher yields in both the wet season and the dry season. Foliage diseases were easier to control under protected cropping structures but whiteflies, aphids and mites were more difficult to control.

The magnitude of this extra yield was highly dependent on crop management, especially in relation to the choice of crop, irrigation management and pest control.

The yield improvement under the protective structures, especially in the wet season usually resulted in higher gross margins as well. Economic analysis of data collected from commercial farmer co-operators showed that positive and higher gross margins were achieved for crops grown under the protective structures as compared to crops grown in the open fields, but there were some exceptions to these especially during the dry seasons. Moreover, growing vegetables in the open field during the wet season is either not possible or not economically viable in most circumstances.

Higher profits from top performing farmer co-operators were attributed to timing of planting, choice of crop planted, and good management skills that enabled them to attain higher yields and prices of vegetables sold. This observation was confirmed by a regression analysis of economic data, and this showed that, in addition to the positive effect of protective structures, other important factors that affect farmer profitability are: (a) choice and timing of crop (e.g., sweet pepper), (b) management skills of the farmers, (c) control and prevention of pests/diseases, and (d) rainfall (cropping season). The analysis showed that a 10% increase in management ability would increase returns by around 10%, equivalent to about a 33 % increase in net present value of the investment or PHP 10,000 for a 200 m structure, given a NPV from structures at current levels of skill of around PHP 30,000 This gives a strong indication of the value of farmer training.

Strong economic benefits can be expected from increases in other inputs including additional fertilizer and expenditure on better pest control.

Protected cropping is an important adaptation to climate change and had great potential in this area irrespective of positive productivity and profitability impacts

Some efforts outside of the project have involved structures being shared among groups of farmers, with the groups having more responsibility than individuals, and some of these have foundered, because of the difficulties in equitable sharing of responsibilities and rewards.

Australian project activities evaluated common low technology systems to reduce excessive heat, which is a major productivity constraint in low-tech structures in Australia. Modifications to existing greenhouses (exhaust fans and screen doors) were shown to be economically feasible and effective at reducing excessive heat. The screening had the added benefit of excluding insects from the crop, potentially reducing the need for insecticide.

Summary recommendations from the external review (Chapman *et al.* 2012):

3¹. That opportunities to use protected structures in Southern Leyte, Samar, Biliran and Bohol be examined, with co-operator farms located close to big towns.

4. That further research be conducted on low tunnel protected cropping structures, net coverings, pests and diseases and improved irrigation systems

Other comments on C2

There are opportunities to further analyse the large data sets collected to examine the affects of pests, diseases, crop type, structure type, season and farmer skills on yield and profitability of vegetables. The research and extension of protecting cropping is continuing with the new project 'Integrated crop management (ICM) to enhance vegetable profitability and food security in the Southern Philippines and Australia' (HORT 2012 /020).

Further to the above C2 Executive summary, the Australian component on low-cost protected cropping modifications for low technology systems showed that increased ventilation can limit summer temperature increases above ambient to 8°C compared to traditional vented system where the temperature increase can be up to 15°C.

7.4.3 Component 3

Executive summary from C3 final report

Bacterial wilt, caused by strains from the *Ralstonia solanacearum* species complex, is the most important disease of potatoes in Mindanao, Philippines. The project has developed a better understanding of the pathogen *Ralstonia solanacearum* enabling formulation of sustainable management strategies for bacterial wilt disease of solanaceous crops in Philippines and Australia and also bacterial canker of tomato in Australia.

Bacterial wilt: An extensive survey has confirmed the presence of bacterial wilt (BW) in all the potato and vegetable growing areas of Northern and Southern Philippines. Molecular and morphological studies have identified two strains of BW from the Philippines and Australia. The tropical strain, Phylotype I (race 1, bv 3) was found to be the major cause of bacterial wilt disease in Mindanao and Australia. The cooler strain, Phylotype II (race 3, bv 2) has been isolated from northern Philippines and highland areas of Mindanao, Philippines and potato growing areas of the Atherton Tablelands, Australia and indicates introduction through planting material. The optimization of a sensitive and reliable method for detection of BW from field samples has made it possible to determine the source of infection, and to

¹ Numbers are the same as in external review summary

make pre planting decisions to avoid the risk of introduction and spread of the disease to non infected areas. The management of bacterial wilt disease through chemicals is ineffective. Therefore use of other strategies such as soil amendment with biofumigant and non biofumigant crops has been evaluated for suppression of BW populations in the soil. Wild sunflower, a readily available common weed in Mindanao was found to be effective in bacterial wilt suppression and resulted in higher yields. These effects are attributed to increased organic matter content and build up of microbial communities in the soil. Likewise the use of other strategies including combinations of clean seed, crop rotation, tolerant varieties, planting time and clean cultivation have been evaluated as practical and cost effective options for bacterial wilt management for both countries. Availability of bacterial wilt free planting material is the major constraint for commercial potato cultivation in Mindanao. Aeroponic technologies are being evaluated as a method of producing clean potato seed in sufficient quantities and at a cost effective prices.

Bacterial Canker (BC) is a devastating disease of both field and greenhouse tomatoes, caused by the bacterium *Clavibacter michiganensis* subsp. *michiganensis* (*Cmm*). *Cmm* isolates have entered Australia on many occasions, most likely with imported seed. Research has shown, for the first time, resistance to Cu fungicides in *Cmm*. The finding has significant implications for tomato growers, both in Australia and the Philippines. In particular, growers will be able to judge risks of Cu resistance. The chemical industry will also be able to respond and improve efficacy of copper-based products. Sodium hypochlorite and Calcium hypochlorite were the most effective disinfectants, their effectiveness depending on contact time with green house surfaces and tools.

Research and Extension: A participatory action research approach was implemented to disseminate technologies for management of bacterial wilt disease of solanaceous crops and bacterial canker disease in tomatoes. The research trials were conducted in collaboration with potato farmers, researchers, agriculture extension officers and Landcare groups. Results from the trials were used in the formulation of management strategies. Extension material was developed in the common dialect to promote best practices for BW management in potato Technology demonstrations and exhibits were presented during NOMIARC annual field days which were attended by approximately 3000 farmers from Mindanao plus some farmers from Luzon and the Visayas. In Australia fact sheets were developed for management of both diseases and delivered to farmers and industry representatives during field days and workshops.

This project improved facilities and equipment at both the University of the Philippines Los Baños (UPLB) and NOMIARC. This enabled the institutions to carry out further research activities and provided opportunity and support to three UPLB students to complete their bachelor's and master's research studies in Plant Pathology. The support was also extended to project team members to attend and present their research at national, international conferences and symposia. It is recommended that further research be conducted on aeroponic production of potatoes and integrated potato management systems.

Summary recommendations from the external review (Chapman *et al.* 2012):

5. That systems be further investigated for commercial production of clean seed, including involvement of NOMIARC and / or a commercial partner to develop a system for foundation seed.
6. Systems be refined and demonstrated on integrated disease management of potato production including the use organic amendments to suppress disease.

Other comments on C3

The key limitation of developing a profitable potato industry in Mindanao was found to be the supply of low cost clean seed. A scoping study assessed the feasibility of producing clean seed through aeroponics. Some extra funds were provided in 2012 to commence aeroponic research and this has been incorporated into the new project 'Integrated crop management (ICM) to enhance vegetable profitability and food security in the Southern Philippines and Australia' (HORT 2012 /020). Integration of aeroponics into Philippine seed production systems should allow the production of low cost certified disease free seed.

There is an opportunity to prepare some further extension material for the Philippines BW and Australian bacterial canker research that highlights the need for integrated disease management. An economic analysis to determine the actual and relative importance of components such as clean seed, clean soil, rotations, potato variety, fumigation and weed control within an integrated potato production system, then developing some extension material with some 'smart graphics' may assist in the adoption of the research by farmers.

7.4.4 Component 4

Executive summary from C4 final report

A comprehensive market report has been published describing in detail, the institutional market for fresh vegetables in Metro Manila, Mindanao and the Visayas. Qualitative interviews with wholesalers and retailers in traditional vegetable markets, supermarkets, food caterers and restaurateurs revealed that both the supply and the demand for fresh vegetables was vastly different between islands and even within the one island. Given the many different ways in which fresh vegetables are used, the institutional market was segmented according to the role market intermediaries performed, where they were, what customers they served, the range of products required, the volume of product required and the quality specifications. Given the highly unpredictable nature of supply and demand, and significant variations in product quality, most institutional buyers transact with more than one supplier. While most institutional buyers associate one or more vegetables with a particular region or area of production, there is no evidence to suggest that institutional buyers are prepared to pay any more to procure fresh vegetables from their preferred source or origin.

In those areas of the Philippines with a Type IV climate, protected cropping becomes almost mandatory. However, almost without exception, institutional buyers do not differentiate between that product which has been produced outdoors and that which has been cultivated under protected structures.

Some 29 collaborative marketing groups in Bukidnon, Davao and South Cotabato were assisted to develop effective market linkages with institutional buyers in traditional and high value markets.

Clustering seldom reduced the length of the supply chain, for many of the activities that were performed by the displaced market intermediaries had to be undertaken by the cluster. However, clustering did facilitate the transfer of more timely market information, which enabled smallholder farmers to gain a better understanding of their downstream customers' requirements. As a result, farmers generally received a higher price from their focal buyer. However, as the focal buyers often had very specific quality requirements, the clusters needed to maintain their relationships with traditional or alternative buyers to dispose of that product which failed to meet specifications, was surplus to the focal buyer's requirements or where the focal buyer failed to honour their commitments.

An economic impact assessment revealed that after clustering, participating farmers had increased their income by an average of 47%. Moreover, the income of farmers in clusters was 18% higher than farmers who had not joined a cluster.

For clustering to be successful, the cluster must: (i) offer a comparative advantage; (ii) cluster members must have a common goal; (iii) have multiple buyers; (iv) strong leadership; (v) be transparent and have timely communication; (vi) have trust and social cohesion; and (vii) have strong institutional support.

In their transactions with focal buyers, the clusters encountered a number of constraints including: (i) extreme weather events; (ii) a lack of knowledge; (iii) a lack of capital; (iv) market impediments; (v) institutional impediments; and (vi) poor infrastructure. To improve the capacity of the cluster to transact with focal buyers, the project facilitated and delivered almost 70 training programs and technical visits.

To reach more smallholder farmers, the project developed a revised and improved exit strategy whereby the more mature clusters were encouraged to become more independent.

With the total investment in this project exceeding AUD 1 million, the internal rate of return over 20 years was estimated to exceed 48.6% with a benefit cost ratio of 2.47. When spillover effects were considered, with a 5% adoption rate, the IRR and BCR increased to 81.5% and 3.8, respectively.

Summary recommendations from the external review

(Chapman *et al.* 2012)

7. That a follow up study be conducted to determine the consumption level of vegetables consumed, how and how often.

8. That intervention opportunities in the vegetable value chain be identified

Other comments on C4

There is still a need to explore a mechanism whereby the marketing operations of the clusters can be sustained in the longer-term.

Specific pest, disease and agronomy issues were raised as major limitations in the development of vegetable farming clusters. These issues need to be collated and evaluated to assist with the design and implementation of the new or proposed vegetable, soils and value chain projects.

7.4.5 Component 5

Executive summary from C5 final report (This also included the research with fruit)

The economic and policy components of the Philippine fruit and vegetable projects have provided an understanding of the economics underlying the technical research, new gross margins GM and recommendations on policy. Many technical recommendations for farmers and / or their advisors can now be valued economically

The research aimed to understand the markets, profits, prices and cost structures of horticulture crops in Mindanao. Economic analyses of the value chains for mango, papaya, cabbage, eggplant, tomato, potato, eggplant and durian were completed, as were analyses of the profitability, productivity and technical efficiency of the growers of the initial five of these crops. Smallholder farmers in Southern Mindanao do not have sufficient capital for production, thus they rely heavily on financiers (external loans) for the production and marketing of their produce. In addition, they usually did not have adequate technical knowledge that may help them improve productivity. There were many associations for example, trained cabbages farmers had a 55% increase in profit ($P<0.05$) compared to non-trained cabbage farmers whilst the comparable value for tomato farmers was 48% ($P<0.05$).

The impacts on farm level profitability of increased technology for three fruit crops and using protected cropping for vegetables were assessed. To support these analyses GMs

were prepared for many crops. A farming systems model for vegetable production, the Expected Mean – Variance framework (E-V) was developed to examine the implications of production risk on farm income. An ex ante analysis of protected cropping raised some issues that could help subsequent adoption. Using assumptions for supply changes, costs and adoption rates, the benefit cost ratio (BCR) for phytophthora research with jackfruit was 48:1 and for integrated pest management (IPM) of mango was 51:1. For durian, high management options to control phytophthora will provide farmers with estimated increases in GM of 107%.

Studies were conducted on the Philippines' investment in research and development (R&D) for the fruit and vegetable sector. A model, called 'WISER', was developed and was used to calculate measures of project worth (i.e. net present value, BCR and internal rate of return). The prospective impact of an ACIAR-PCAARRD horticulture project at the industry level had very positive outcomes; hence it is recommended that resources be reallocated in favour of public investment in horticultural R&D.

A macro-level analysis of transport revealed that economies of size, level of market development, presence of good quality transport infrastructure, particularly road networks and ports, and geographical proximity are important determinants of inter-regional agricultural trade in the Philippines. A micro-level analysis of tomato, lettuce and papaya crops found for all key actors in the supply chains, inefficient transport and logistics resulted in increased transport costs, reduced product quality and quantity and diminished viability and profitability. The recommendations were widely disseminated.

In Australia, analyses of the economic benefits of research on fruit spotting bug and, lettuce IPM, the value of organic waste for vegetable production, improvements in greenhouse control systems, crop resilience to cyclones and phytophthora management in papaya were conducted. GMs were prepared and disseminated for 16 NSW vegetable crops.

Capacity development included 25 project staff completing training courses on economic analysis and a further 7 staff attended 3 specialized impact assessment courses. Three component research assistants received postgraduate scholarships (a PhD to Japan, and a Masters and a PhD John Allwright Fellowship to Australia).

Summary recommendations from the external review (Chapman *et. al.* 2012):

9. That an economic assessment be done on the benefits of effective Bacterial Wilt control for potatoes.

10. That for future research, economists be embedded in each project, they be networked and they define at the outset the measures required to assess the returns to research. In addition, ex-ante analysis of proposed research should occur and there be careful site selection and project design to ensure that results generated are applicable over a wide, economically significant area.

Other comments on C5

The absence of a principal investigator from October 2009 to May 2011 and from March 2012 plus the resignation two project officers affected this component. More details are provided in the component final report. Also the C5 component was over ambitious in its objectives.

Nevertheless, the component did undertake a large number of economic analyses of work conducted in the technical fruit and vegetable components. Some of the analyses have also been used as support for projects in the new Philippines Horticulture Program.

Further analyses of data may be useful to Philippines fruit and vegetable research. In particular, the UPMIn team have large data sets obtained from surveys of potato, cabbage and tomato farmers (plus mango and papaya). This data covers both financial and

production areas and includes fertiliser, pest and disease control costs and marketing costs. The types and amount of inputs as well as the importance of educational level, training, membership etc are being analysed to see if they are associated with vegetable profitability, yield and farmer technical efficiency. Whilst some of the work is being published there is a further opportunity to conduct secondary analyses of the data and to document typical farmer practises of the over 300 fruit and vegetable farmers surveyed. Any further analyses need to consider how this can be used to improve smallholder livelihoods. The data set will be provided to ACIAR.

Some of the UPMIn studies on marketing issues with farmers and others in the value chain would have benefited if they had involved production people in the studies, whether from ACIAR funded projects or other sources. This would have benefited the economists as they would be working with people who understand the technical farming issues and production staff would have gained a better understanding of costs and where research and extension could be focussed.

The project also contributed to policy development. SEARCA as part of C5, widely promoted their policy recommendations on transport infrastructure and the annual Agribusiness Economic Conferences at UPMIn (C4 and C5) provided researchers and students opportunities to interact with senior policy makers particularly on issues that affect smallholder farmers. Forums need to be used to debate issues and assist in formulating policies and recommendations that will benefit smallholder farmers. There is a need to develop skills in policy analysis so that policy recommendations are based on sound evidence derived from rigorous investigations.

As a result of some of the issues in the C5 component, some suggestions have been made on the role economists within new Philippine projects (See Section 7, page 55, C5 final report). These included: it may be preferable if economists are embedded within projects and not be part of a separate project, very basic economic analysis training be provided to some staff within new projects, the booklet being prepared as part of this component 'Farm economic analyses, with Philippine examples' be disseminated and process be implemented for cross-project economics meetings to increase co-operation and sharing of experiences and skills.

7.5 Management opportunities

The C6 executive summary is in Section 2.

Obviously as the project progressed there were many new ideas generated on ways to improve management for a large project such as this one.

The key opportunity is to build on the gaps and opportunities highlighted in this now complete vegetable project to develop new vegetable projects that will enhance farmer profitability, food security and stakeholder capacity.

See also section 8.2 Capacity

Management guidelines for new projects

The VPM and PHM prepared some guidelines for new projects in the Philippines. These were incorporated directly into the external review (Chapman *et. al.* 2012). The suggestions were:

- Involve existing Philippines extension and training organizations from the outset
- Involve southern Philippine's Universities more in future programs.
- Include individuals who have been successful and highly committed to R&D & E for the Philippines
- Ensure that standard remuneration rates are paid across projects for research assistants.

- Involve commercial organizations more
- Project Leaders must be good managers and team players as well as good researchers
- Develop a truly bilateral program with clear benefits to Australia and Philippines and capture bio-security implications for both countries.
- Suggested new project areas for reporting and ACIAR financing might include:
 - Extended value chain research on fruits and vegetables with more crop targeting.
 - Postharvest
 - Soils and plant nutrition
 - Integrated crop management for vegetables
 - Integrated crop management for fruits
 - Assist strengthening diagnostic labs across disciplines (eg. Residue testing, insect and disease identification, etc.)
- No separate economics and policy project. Include economists within each project as an objective. One project economist from Australia could coordinate the economics across each project.
- One management project would be enough to handle both a future fruits and vegetable program (i.e. no separate fruit and vegetable manager) with the support of the ACIAR in-country program manager
- Projects must utilize opportunities to be flexible and for example support conference attendance of key persons involved in relevant projects
- Capacity development should begin early in projects
- Communication, reporting M&E systems need to be revised by ACIAR.
- Revise the annual reporting and final reporting systems

Summary recommendations from the external review (Chapman et al. 2012) were

11. That for a new program, ACIAR consider involving more Philippines agencies, a more detailed monitoring & evaluation framework, documenting of gross margins or net profit benefits from introducing new interventions and incremental annual reporting to better link past outputs to present reports. ACIAR could also consider the other suggestions in section 4 of the C6 review report.

12. That for new fruit and vegetable projects in the Philippines, ACIAR consider crop targeted value chain research with new research on postharvest, integrated crop management for selected vegetables and fruits, including soils and plant nutrition, capability development, the strengthening of diagnostic laboratories across disciplines and coordination through one management project.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Obviously any scientific impacts will come from the 5 technical components, not directly from a management activity! However, the VPM (Dr Hall), Drs Peter Batt, Fay Rola-Rubzen and Roy Murray-Prior are all on the scientific committee for the UPMin hosted International Conference on Agribusiness Economics and Management held each year in Mindanao and hopefully they will have some ongoing scientific impact.

A brief summary from component reports is

C1 The characterisation of the soil fertility status in Claveria, Cabintan, Kibangay, Mapayag and Kapatagan provided valuable baseline data and the nutrient omission trials helped identify the key nutrients which are driving the production system

In Australia soil chemistry including carbon and microbial biomass was measured for applications of nil, 62 and 125 tonne garden organic waste to vegetable crops. This provides a better understanding of how waste biomass can improve soil quality.

C2 Highly innovative and inexpensive modular structures were designed and evaluated in the Visayas with adaptations for redirecting rainfall for irrigating crops. These are likely to have potential for adoption in other parts of the Philippines and in Australia.

The relationships between yield and profitability with education status, pest and disease incidence in over 100 crops should provide impetus for implementing processes that will impact on the expansion of protected cropping.

C3 The causative strain of BW in different regions of both Australia and Philippines was identified and used to formulate sustainable BW strategies. This study was novel and will contribute to mapping the phylotypes of *Ralstonia solanacearum* in the vegetable growing regions and will contribute to more stable and region specific management strategies.

Similarly the optimization of a molecular detection method, evaluation of tolerant varieties and evaluation of extracts of bamboo shoots (cyanide), tea tree oil and papaya seeds (Benzyl isothiocyanate) for BW suppression may provide new management options including commercial products. Wild sunflower, a readily available common weed in Mindanao was found to be effective in BW suppression and resulted in higher yields. These effects were attributed to increased organic matter content and build up of microbial communities in the soil.

The optimization of molecular method for detection of BW pathogen *Cmm*. and real time PCR for bacterial canker of tomato will encourage planting decisions based on the inoculum level of soil and planting material and will be useful to regulate and improve the seed certification and quarantine regulations and also crop management. The research conducted in this project has shown, for the first time resistance to copper fungicides in *Cmm*.

C4 This component developed a revised three-phase process to improve the Catholic Relief Service (CRS) Eight Step Plan for Agro-enterprise Development. This improvement will enable future development projects to more readily replicate, to extend their reach, and for the more mature clusters to become independent.

C5 A completely original and user-friendly impact assessment tool, WISER, was developed. It can be utilized by economists and trained technical staff from research and development and extension agencies to inform decisions on policy change and priorities for research investment and is much more flexible than the DREAM model.

The detailed mathematical analyses of variables that help explain profitability, productivity and technical efficiency of cabbage, tomato, potato, mango and papaya farmers will

contribute to farm modelling literature and have impacts in resource allocation of smallholder farmers.

8.2 Capacity impacts – now and in 5 years

Capacity impacts with farmers were predominantly through workshops, field days, farmer field schools etc and are reported in component final reports. An attempt to collate the numbers of farmers and staff involved in training is made in Table 2. This data was not always collected and / or documented actively and comparisons between components should not be made. The table more reflects the need for a more thorough collation of project outputs and also defining the capacity categories better in future projects. For example C4 and C5 did not have experimental trial sites, but they used farms and retail shops for meetings with their stakeholders.

Table 2. Some capacity impacts, Philippines, minimum values ¹

Capacity Impacts, Philippines					
Capacity area	C1	C2	C3	C4	C5
Number of farmers trained	400	131	nd ¹	1242	0
Workshops	5	3+	nd	14	nd
Field days	17	1+	12	nd	nd
Undergraduate students trained	2	2			9+
Postgraduate students trained	1 M.Sc. 3 B.Sc.	2 M.Sc. 2 Ph.D	1 M.Sc. 2 B.Sc.	4	nd
Specialist training or 'Train the Trainer', minimum 2 days	25	1	4	3	19
Postgraduate scholarships received by staff JAF ²	1 M.Sc. Germany 1 M.Sc. Belgium	2 JAF: M.Econ. +Ph,D	1 JAF Ph.D (but withdrawn)	nd	1 Ph.DJapan 2 JAF: M.Econ. +Ph.D.
Study tours JD: John Dillon to Australia ³	1 + 1 JD	5 + 3 JD	1	1	nd
Participants in study tours	4	126	4	1	
Number of farmers and students visiting trial sites	150+ 3000 (incl. NOMIARC)	4000 + 1500 students (incl.VSU)	3000 (incl. NOMIARC)	nd	nd
Estimate of number of adopters of new strategies	150	169	50	1242	nd

¹ ND. No data available. But there would be more numbers for many of the categories if pursued.

² John Allwright Fellowship to Australia

³ There was also a John Dillon Fellow from PCAARRD (C6)

A number of components had specific training activities to improve staff skills including C1 conducted internal training workshops on:

Research review and planning

Scientific writing

Designing nutrient omission demonstration trials

Cynthia Godoy, Technical Officer, VSU, enhanced her soil laboratory skills in Australia in 2012 and Nelda Gonzaga (MOSCAT) was awarded a John Dillon Fellowship.

C2 conducted a workshop aimed at improving the design of structures for staff from Department of Agriculture and other agencies as well as farmer co-operators.

Jonathan Mangmang (research assistant, VSU) received a JAF for Ph.D. studies and Elsie Tausa (research assistant, VSU) received a JAF for a research Masters in Australia in Economics. Both are at the University of Sydney.

Dr Reny Gerona, Dr Zenaida Gonzaga and Dr Roberto Acosta were awarded John Dillon Fellowships.

C3 staff, both in the Philippines and Australia, have enhanced their skills in molecular biology relevant to BW diseases as well as increased diagnostic capacity.

C4 had a number of staff and project officers who gained considerable experience from their participation in farmer training programs including (1) cluster formation and agro-enterprise planning; (2) product supply; (3) market visits; (4) trial marketing; (5) negotiation; (6) basic record keeping; (7) pest and disease control; (8) the making of biological and organic fertilisers; (9) natural farming and vermicomposting; (10) crop protection; (11) postharvest; and most recently (12) the formation of a confederation of clusters

Mr Recarde Bacus, UPMIn Agro-Enterprise Coordinator, Davao, was awarded a six-week training scholarship under the Crawford Fund to work with farmer groups in Western Australia to improve the marketing of fresh vegetables.

C5 Workshops on 'Farm budget modelling' were conducted at UPMIn in February 2010 and on 'Economic analysis techniques for evaluation of farm fruit and vegetable systems' at VSU in November 2012.

Staff also attended workshops on 'Technology evaluation and impact assessment' in Los Baños in 2011 and an Impact assessment workshop in India,

Glory Dee Romo (research associate UPMIn) is studying for a Ph.D and Lemuel Preciados (research assistant, VSU) for a Masters degree in international economics and finance. Both are at University of Queensland and both are JAFs.

C6 David Hall, (VPM) participated in the ACIAR workshop 'Developing an impact pathway for research projects', in November 2010.

Throughout the project various training courses and workshops were suggested to improve the capacity of staff. These included

- Evaluating research priorities
- Preparing impact pathways
- Writing research proposals including ACIAR and PCAARRD proposals
- How to conduct literature reviews
- Experimental design
- Quality management systems for laboratory and field trials
- Specific training in for example pest, disease and nutrient deficiency diagnosis, designing nutrient omission demonstration trials

- Cultural training
- Photography
- Statistical analysis
- Extension skills
- Scientific writing
- Report writing
- Monitoring and evaluation
- Preparing publicity for media outlets including media releases

8.3 Community impacts – now and in 5 years

All components nominated the value of the field days, cluster groups, trial sites as foci for improving community impacts.

All components had a range of partners. For example, C4 acknowledged 20+ partners including supermarkets and other commercial and NGO groups.

A specific community impact was through C2. VSU, Ormoc and Maasin City administrations, East West Seeds, the Energy Development Corporation (EDC) and ACIAR collaborated closely on the initiatives with implementing protected cropping structures.

The project also helped strengthen the linkages between institutions such as VSU and UPM in economics and business groups.

8.3.1 Economic impacts

As part of the VPM's inherited role in administering the C5 component, he prepared a summary table of many economic analyses (C5 final report, page 61: Table 9, section 8.3.1). These are not necessarily impacts, but will be impacts if the assumptions are correct eg. Increased yields, reduced costs and appropriate funds are allocated for extension, suggested adoption rates are realised and supply demand relationships are correct.

Many of the suggested technology changes were estimated to be very profitable.

The analyses included changes in GMs 'without technology' (*viz.* baseline GM) and GM 'with technology' (*viz.* GM when the new technology from the component is adopted) through to the net value of the research on a regional or wider level and returns on investment for the cost of the ACIAR research.

8.3.2 Social impacts

All components reported increased involvement of farmers through field days, workshops and cluster activities.

The C5 component had a number of policy recommendations, which if implemented should have significant society impacts. These included recommendations on transport infrastructure, logistics and regulations, involvement of regional economic boards and more R & D investment in horticulture. With better information, decision makers should be able to make valid policy decisions that will benefit both producers, especially small producers, and consumers.

8.3.3 Environmental impacts

The overall issue has been improved technology to reduce the number of chemical sprays used and to reduce chemical fertiliser use, which should then mean better environment outcomes. Also more efficient farming may mean a lesser use of sloped land that is erosion prone or less future use of forested land.

The component projects showed there is strong interest in organic agriculture that should have a beneficial affect on the environment, assuming yields are maintained and more land does not have to be used to produce the same production outputs.

8.4 Communication and dissemination activities

Major across component communications were through:

- The initial planning meeting in Canberra, June 2008, followed by annual planning and review meetings in Canberra from 2009 to 2011.
- The project inception meeting, Davao, Philippines in July 2008 followed by annual planning and review meetings in Ormoc, Leyte in July 2009 and August 2010 and in Bohol, August 2011.
- A final technical workshop held in Cebu in 2012.
- Reports were prepared for most meetings and proceedings of the 2012 Cebu workshop were published (Oakeshott and Hall 2013).
- The PHM's newsletter 'What's Cropping Up'
- The Web2 website

Web2 was an effective site to maintain reports, papers etc but not so effective as a site for regular communication between groups. The site was disabled in 2013. Some of the definitive information which was not published elsewhere was put on the ACIAR archive site Meridio.

For further communication and dissemination activities details, see component reports. Some communication outputs are documented below.

Videos: A video on protected cropping (C2) was produced with additional funding from ACIAR (Sharron Olivier and Gordon Rogers). It is mainly in the local Filipino language spoken in Mindanao and The Visayas (Cebuano) with English subtitles. They also produced a soils video (C1). These are both on YouTube and DVD copies were distributed.

Protected vegetable cropping video (2010),
http://www.youtube.com/watch?v=jFI_94S4OIs

Soils video 'Dirt Rich - Balancing the soil bank'
<http://www.youtube.com/watch?v=vTZYKEHYCpQ> (2011)

ACIAR helped support the NOMIARC field day in September 2011. There were 3000 attendees plus a significant number of regional managers and other dignitaries. C1 and C3 had field displays demonstrating some of their treatments. C3 also had a site where posters and the effects of BW on potatoes were displayed and technical advice was provided.

ACIAR provided support to the VSU anniversary "Farmer and Fisherfolk Day" in August each year. In 2010 there were 2500 attendees with the CEO of ACIAR, Dr Nick Austin opening the forum. The protected cropping video was also launched at this forum and there was a Q & A session on protected cropping.

Agribusiness Economics Conferences were held in Davao in 2009, 2010, 2011, 2012 and 2013 with many papers presented by the C4 and C5 components. ACIAR through C5 provided some support. This Conference was attended by a number of RPMs, plus the VPM and PHM in 2011 and / or 2012 and 2013.

C2 managed its own website (www.protectedcropping.com) with dedicated sections for team members and the general public. It augmented material in the web2 project site.

Summary of communication and dissemination activities

An attempt was made to summarise the number of outputs for each component. This was not an easy task because

- 1) Posters and conference presentations overlapped
- 2) Many working papers were noted and some became conference or other papers
- 3) Not all media reports were captured
- 4) Each component had a different level of commitment to recording outputs

The attempt is tabled in Appendix 1. It's incompleteness did not warrant its inclusion in this full report.

In the new program it is suggested a section on the web site be devoted to communication outputs. It needs to include draft outputs and final outputs. Also it needs to say what outputs were refereed and to define workshop, training, presentation and other terms better.

9 Conclusions and recommendations

9.1 Conclusions

Components 1 to 5

The soils component benchmarked soil fertility status and management practices through soil surveys and testing, farmer surveys and nutrient omission trials in four provinces. Nitrogen and phosphorus were found to be the key nutrients controlling vegetable yields in most soils. There is new knowledge of the properties of organic amendments in the Philippines and in Australia.

The protected cropping component demonstrated the financial benefits of protected cropping for farmers and defined key issues affecting profitability and yield including crop type, management skills and pest and disease incidence. In Australia, modifications to existing greenhouses (exhaust fans and screen doors) were shown to be economically feasible and effective in reducing excessive heat.

The research on BW characterised the causative strain and races of the bacteria causing BW and developed a sensitive and reliable method for detection of BW from field samples. The component provided integrated recommendations for the control of BW and also for the control of bacterial canker in Australia. The key to increased production of potatoes in the Southern Philippines could be through the use of aeroponic systems.

The supply chain component defined vegetable marketing opportunities through an institutional market study. Many of the 29 clusters supported by the component were successful and key issues to ensure clusters are sustainable were identified. An economic impact assessment revealed that after clustering, participating farmers had increased their income by an average of 47%.

The economic and policy component identified key factors affecting profitability and productivity of potato, cabbage and tomato farmers, the importance of transport infrastructure and regulations on costs of tomato and lettuce growers and also the underinvestment in horticulture R & D. Many GMs, benefit: cost analyses and factors affecting profitability were prepared, for example trained cabbage and tomato farmers had a 55% and 48% respective increase in profit compared to non-trained farmers. Opportunities are available to utilize the 'WISER' model, developed within C5 to evaluate the potential value of planned new research.

General management and opportunities

Having a number of components linked together as an overall project and the annual meetings in Australia and the Philippines (the latter including discipline workshops on pathology, entomology, soils and production and supply / value chains in 2010 and 2011) had advantages including sharing of resources and joint experiments, use of resource material provided by other components and contributions to economic analyses. There were also many synergies developed within institutions by having two or more components located at the same location. Having a number of vegetable components in the project also gave an opportunity to view and review project leadership styles. One limitation with having the linked projects was that when there were administrative issues with some components (eg. C1 and C5), the VPM ended up spending an excessive amount of time on administration and some technical coordination.

The component's activities and outputs were monitored by the component leaders, the VPM, RPMs and PHM plus there was a project internal mid-term and final external review. Key opportunities are to increase vegetable yields and / or reduce costs, overcoming constraints to protected cropping and limiting wastage pre- and postharvest of vegetables.

Across the project, pest and diseases had major effects on experimental work, and thus results were not obtained from many experiments. In some cases there was undue reliance on biological control agents where there was little efficacy data available. Evidence is required to support the Philippines goal of a greater use of organic agriculture, both at the soil and plant level.

ACIAR has supported the development of a new vegetable project and is developing new projects on vegetable nutrition and postharvest. There were many recommendations noted in Section 9.2 of each component final report and it would be valuable if some of these recommendations could be further assessed and possibly be progressed.

A common theme across the projects was that a number of research and demonstration trials resulted in inconclusive results and would have benefited from improved staff skills in experimental design and analysis.

Each component conducted surveys of farmers and in some components also of wholesalers, transporters, retailers etc. Some of this data has been extensively analysed and published. However, there are still a number of data sets that could benefit from further statistical analysis to either better understand relationships, provide a basis for benchmarking, to assess technical treatments and to characterise farmer and / or value chain production and marketing systems.

Adoption of the research

Extension processes varied across the components including the extent of involvement of farmers in demonstrations, use of key farmers and farmer field schools. Two videos were prepared (soils and protected cropping) and C4 prepared 'vignettes' or small stories on some farmers.

Recognising the importance of extension processes, at the 4th year planning and review meeting in Bohol, 2011, all participants participated in an interactive extension skills development workshop.

To further improve adoption of the research, there is a need to explore a mechanism whereby the marketing operations of the clusters can be sustained in the longer-term and this can be used as a process to implement technical recommendations.

9.2 Recommendations

Recommendation 1: That in future programs, extra resources should be devoted to building project leadership capacity in both countries.

Recommendation 2: That the recommendations provided in Section 9.2 of each component final report and the external review be considered by ACIAR and PCAARRD, and if supported, every effort be made to implement these recommendations

Recommendation 3: That significant effort be devoted to improving capacity of all staff in experimental design and analysis and reporting.

Recommendation 4: That there be a focus on improving skills in pest and disease management and evaluation of biological control agents

Recommendation 5: That where data has been collected through well designed surveys, but not reported, that this data be further analysed and resulting information disseminated.

Recommendation 6: Further 'case-studies', small videos and practical extension material needs to be prepared as a way of promoting messages to farmers and other stakeholders and to promote the work of ACIAR.

Recommendation 7: Similar to the need for improved skills in experimental design and analysis, skills need to be developed in policy analysis and implementation that will affect the livelihoods of smallholder farmers.

10References

10.1References cited in C6 report

Batt, P. (2013). Component 4: Analysis of selected value chains in Southern Philippines Final report to ACIAR.

Chapman, K., Batugal, P., and Davies, L. (2011). Improved domestic profitability and export competitiveness of selected vegetable value chains in the southern Philippines and Australia. External review of Project HORT 2007/066. Report to ACIAR.

Dorahy, C., Tulin, A., and Eldridge, S. (2013). Component 1 – Integrated soil and crop nutrient management. Final report to ACIAR.

Ekman, J.H., Hall, D.G., and Oakeshott, J. (2012). A scoping study on a possible research and development project on postharvest issues of vegetables in the Philippines. Report to ACIAR.

Hall, D.G. *et al.* (2013). Enhancing profitability of selected fruit and vegetable value chains in the southern Philippines and Australia. Component 5: Economic impacts of new technologies and policy constraints in the production of fruit vegetables in the Philippines and Australia. Final report to ACIAR

Pathania, N. (2013). Component 3 - Integrated strategies for the management of bacterial wilt and other wilting diseases in Solanaceous crops in the Southern Philippines and Australia. Final report to ACIAR.

Rogers, G. (2013). Component 2: Development of a cost-effective protected cropping system in the southern Philippines and Australia. Final report to ACIAR.

10.2 List of publications produced by C6 component staff

This list also includes where the VPM was a co-author of publications.

Aguinaldo, R., Hall, D.G., and Digal, L. (2012).). Annual report 'Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia'. Component 5: Economic Impacts of New Technologies and Policy Constraints in the Production of Vegetables in the Philippines and Australia' and 'Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia'. Component 5 - Economic impacts of new technologies and policy constraints in the production of fruit in the southern Philippines and Australia. Combined component report to ACIAR.

Aguinaldo, R.T., Sarmiento, J.M.P., Digal, L.N., Castro, M.M.C., Comidoy, S.M., Balgos, C.Q., and Hall, D.G. (2013). Assessing the distribution of benefits in the tomato value chain in the provinces of Bukidnon, Davao del Sur, and Northern Mindanao, Philippines. Presentation at 'Fifth International Conference on Agribusiness Economics and Management, Davao, 27-28 November 2013.

Ekman *et al.* (2012). See 10.1

Eldridge, S., and Hall, D. (2012). Notes on soils project (Hort 2007/066/1) after discussions with Philippines collaborators. Unpublished review report.

Hall, D.G. (2010). Summary of discussions of researchers and colleagues in supply chain, soils, entomology, pathology and economic workshops during ACIAR-PCARRD southern

Philippines fruits & vegetables review and planning meetings, Ormoc, August 2010. Unpublished report to ACIAR.

Hall, D.G. (2011). Summary of discussions of researchers and colleagues in supply chain, soils, entomology and pathology workshops during ACIAR-PCARRD southern Philippines fruits & vegetables review and planning meetings, Bohol July 2011. Unpublished Report to ACIAR. report.

Hall, D.G. (2013). Using data and information to improve the livelihoods of farmers. Presentation at 'Fifth International Conference on Agribusiness Economics and Management, Davao, 27-28 November 2013.

Hall, D.G. (2009, 2010, 2011 and 2012). Annual report "Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia. Component 6: Program management and combined report.

Hall, D.G. *et. al.* (2013). Final report "Enhancing profitability of selected fruit and vegetable value chains in the southern Philippines and Australia. Component 5: Economic impacts of new technologies and policy constraints in the production of fruit vegetables in the Philippines and Australia". Report to ACIAR

Oakeshott J. and Hall D. (eds) 2013. Smallholder HOPES—horticulture, people and soil. Proceedings of the ACIAR–PCAARRD Southern Philippines Fruits and Vegetables Program meeting, 3 July 2012, Cebu, Philippines. ACIAR Proceedings 139. Australian Centre for International Agricultural Research: Canberra. 298 pp.

Oakeshott, J., Hall, D.G., and Williams, B. (2008). Report on the ACIAR–Philippines Fruit & Vegetable Programs Inaugural Meeting 15-16 July 2008 Davao, Mindanao, Philippines. Report to ACIAR.

Oakeshott, J., Hall, D.G., Williams, B. (2009). Report on the ACIAR–Philippines Fruit & Vegetable year 2 meetings, 12-13 July 2009, Davao, Mindanao and 16-17 July 2009, Ormoc, Leyte, Philippines. Report for the Australian Centre for International Agricultural Research (ACIAR).

Orr, L., Pollock, K., and Hall, D.G. (2011). Annual report "Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia. Component 5: Economic impacts of new technologies and policy constraints in the production of vegetables in the Philippines and Australia". Report to ACIAR

Orr, L., Pollock, K., and Hall, D.G (2011). Annual report 'Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia. Component 5 - Economic impacts of new technologies and policy constraints in the production of fruit in the southern Philippines and Australia". Report to ACIAR.

Sarmiento, Jon Marx P., Roxanne T. Aguinaldo, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos and David G. Hall (2013). 'Analysing the performance of smallholder cabbage farmers in the southern Philippines' 248-264. In. Oakeshott J. and Hall D. (eds) 2013 see above.

Sarmiento, Jon Marx P., Roxanne T. Aguinaldo, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Gellie A. Talo, Carol Q. Balgos and David G. Hall (2013). Modelling of production and profit performance of tomato farmers in Bukidnon, Davao del Sur, and Misamis Oriental, Philippines. Presentation at 'Fifth International Conference on Agribusiness Economics and Management, Davao, 27-28 November 2013.

Tesoriero, L., Hall, D.G. and Rogers, G. (2011). Assessment of disease issues in protected cropping and recommendations for future activities. Working paper 16.

Protected cropping website (2011)

SEARCA Report. David Hall was included by the transport report authors as a number of the 'Technical advisory team'.

Other informal reports were also prepared eg C5 plans for 2011-12 (with Kirrily Pollock), summary of Sydney vegetable planning meeting 22 March 2012 (with Sandra McDougall).

A large amount of material was prepared for the External Review in late 2011. Some of this has been incorporated in the report prepared by the reviewers and submitted to ACIAR.

11 Appendixes

11.1 Appendix 1: Numbers of communication outputs

Table A1. Summary of the number of communication outputs in the Philippines and Australia ^{1 2}

	C1	C2	C3	C4	C5
Leaflets			9		
Presentations	3	16		65	29
Publications					
Conference papers	17	2 (all cebu proceedings)	13 (4 were cebu)	41 (4 were cebu)	20 (7 were cebu)
Refereed reports				1	3
Journal papers	6	1 Book chapter			
Working papers on Web2 or C2 web site		19		Many. Web2 now disabled	Many
Videos	Soils	Cropping			
Website		Protected cropping website			

¹ These numbers were collated from component final reports. They would definitely be an underestimate. An attempt was made to capture the number of posters, but this was too complicated and they overlapped with presentations.

² Annual and final component reports, trip reports and presentations at ACIAR annual meetings are not recorded

12 Attachments

12.1 Notes from discipline meetings at annual review and planning meeting, Cebu 2011