Australian Government

Australian Centre for International Agricultural Research

Final report C5

Project

Enhanced profitability of selected vegetable and fruit value chains in the southern Philippines and Australia

Component 5 - Economic impacts of new technologies and policy constraints in the production of vegetables and fruit in the southern Philippines and Australia [1]

project number	HORT/2007/066-5 and HORT/2007/067-5
date published	2022
prepared by	David Hall (previously NSW DPI). Nb. David Hall, the Vegetable Project Manager, collated this report in the absence of an Australian leader for this economic and policy component. David notes he is not a trained economist.
co-authors/ contributors/ collaborators	Roxanne Aguinaldo, Carol Balgos, Jon Marx Sarmiento, Larry Digal (Philippines Component Coordinator), (UPMin), Gilbert. M. Llanto, Mercy A. Sombilla and Karen P. Quilloy (SEARCA), Roehl Briones, Ivory Myka Galang and Francis. A. Quimba (PIDS), Lemuel S. Preciados and Ma. Salome B. Bulayog (VSU) and Jim Page (Queensland DAFF)
approved by	Irene Kernot
final report number	FR2022-024-C5

[1] Whilst the fruit and vegetable economic components were parts of separate projects they were managed together as most activities and staff were the same and both components were led by NSW DPI.

ISBN Refer to FR2022-024-C6

published by ACIAR
GPO Box 1571
Canberra ACT 2601
Australia

Contents

1 Acknowledgments 3

2 Executive summary 4

3 Background 5

4 Objectives 10

5 Methodology 12

5.1 Objective 1: To undertake an economic analysis of the value chain for the crops of interest in the ACIAR Program HORT/2007/066 and 067 12

5.2 *Objective 2:* To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed. 14

5.3 Objective 3: To identify any policy constraints that may affect the adoption of technologies developed by the program, and quantify their impacts at the farm level, and in some cases the industry level. 19

6 Achievements against activities and outputs/milestones 24

7 Key results and discussion 31

7.1 Objective 1: Undertake an economic analysis of the value chain of selected crops in southern Mindanao 31

7.2 Objective 2: To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed. 36

7.3 Objective 3: To identify any policy constraints that may affect the adoption of technologies developed by the program, quantify their impacts at the farm level, and in some cases the industry level and Objective 2, Activity 2.5 41

8 Impacts 57

8.1 Scientific impacts – now and in 5 years 57

8.2 Capacity impacts – now and in 5 years 58

8.3 Community impacts – now and in 5 years 59

8.4 Communication and dissemination activities 70

9 Conclusions and recommendations 75

9.1 Conclusions 75

9.2 Recommendations 76

10 References 78

10.1 References cited in report 78

10.2 List of publications produced by project....80

11 Appendixes....84

11.1 Appendix 1: Data used as background in original fruit and vegetable economic and policy proposals....84

11.2 Appendix 2: Models/Methods used to address Objective 1....88

11.3 Appendix 3: Models/Methods used in Objective 1: Price spread, net margins, price transmission and market integration....89

11.4 Appendix 4. Theoretical Framework for Objective 1....90

11.5 Appendix 5. Objective 1 Research Procedures, Data Used and Respondents....94

11.6 Appendix 6: Value Chains of Selected Fruits and Vegetables....99

11.7 Attachment 7: Example of Australian Budgets....106

11.8 Appendix 8: Abbreviations used in this report....108

11.9 Appendix 9: Definition of fruit and vegetable marketing terms in the Philippines....109

11.10 Documents and spreadsheets from economic and policy component on ACIAR's archive Meridio....110

12 Attachments....111

12.1 Report Domingo *et al*. 2013.'Vegetable production and farmers' profile in the Southern Philippines'....111

12.2 Report: 'Welfare impact simulator for evaluating research: a manual for users'. Briones, R. and Galang, I.M....111

12.3 Report: 'Welfare impact simulator for evaluating research (Spreadsheet version). PIDS WISER spreadsheet'. Briones, R. and Galang, I.M....111

12.4 Report: 'Assessment of prospective impact of fruits and vegetables research at the industry level in the Philippines: The case of the ACIAR-PCAARRD horticulture project'. Briones, R. and Galang, I.M....111

12.5 Report: 'Strengthening markets of high value fruits and vegetables in Mindanao: the case of transport and shipping service improvement'. Llanto, G.M., Sombilla, M.A., Quilloy, K.P., and Quimba, F.M.A....111

12.6 Report: 'Evaluation of workshop on economic analysis techniques for the evaluation of farm fruit and vegetable systems'....111

12.7 Report 'An economic assessment of the contribution of trellising to the economic resilience of Far North Queensland fruit tree crops'....111

12.8 Report 'An economic assessment of better Phytophthora control in papaya through better fallow management'....111

12.9 Report 'Economic assessment of cocoa production- Far North Queensland'....111

1 Acknowledgments

We would like to thank Jeff Davis (ACIAR RPM till 2008) who helped design and set up this project and subsequently Caroline Lemerle, ASEM who was the RPM for the component. Les Baxter is thanked for his ongoing support.

Thanks go to John Mullen who was the initial component leader until his retirement in May 2009, Randall Jones who was involved through to October 2009 and Kirrily Pollock who was the component leader from May 2011 to March 2012. Project Economist Leanne Orr was employed with NSW DPI from the start of the project till March 2011 then occasionally as a contractor and has provided valuable advice, analyses and support. Project Economist Anthea McClintock is thanked for her involvement from February 2010 to May 2011 and has since continued to help with some of the ex ante economic research with VSU and with other advice. Jim Page, Economist Queensland DAFF ran the fruit component from July 2012 until component completion. Lloyd Davies is thanked for his contribution as the external reviewer of this component in late 2011.

Randall Jones (2010) and Fay Rola-Rubzen (2012) are thanked for their contributions to economic training courses.

A number of Philippine economists who contributed to the project design left before the project commenced. The Philippine contributors noted as co-authors of this report are all thanked for their contributions.

John Oakeshott, Mara Faylon, Cecile Honrado are thanked for their Philippine country support.

UPMin specifically thanks the Municipal Agriculturist Office in Tupi (South Cotabato), Island Garden City of Samal (Davao del Norte), Digos City (Davao del Sur), Lantapan and Impasug-ong (Bukidnon) and Claveria (Misamis Oriental) for their cooperation and assistance.

SEARCA noted that both SEARCA and PIDS were the implementing agencies for the transport study.

Qld DAFF noted that Yan Diczballis and Far North Queensland producers gave valuable information and insight that enabled the assessments to proceed.

Susan Watts, updated the GMs for NSW Vegetables and was supported by Sandra McDougall, Tony Napier and Gerard Kelly, all from NSW DPI.

Dr Mike Blyth of Four Scenes Pty Ltd is thanked for his thorough comments and suggestions on the near final copy of this report.

Comment

There were six major collaborators with these project components and each had various thoughts and recommendations on policy issues. However, the opinions expressed in this report are those of the individual collaborators and do not necessarily reflect a consensus of views of ACIAR or NSW DPI.

2 Executive summary

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)[2] 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).

[2] *A full list of abbreviations is in Appendix 8*

3 Background

This component followed the agreements between ACIAR and the Philippines (PCAARRD) in 2007 and 2008 that there be an integrated fruit and vegetable program, Prior to this there had been separate initiatives to conduct related economic and policy research.

The aim of this economics research component was to improve the impact of the fruit and vegetable projects: “Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia’ (HORT/2007/066) and ‘Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia’ (HORT/2007/067). Thus this component planned to measure the profitability of technologies developed in components 1 to 4 of each of these projects and use this to influence the research process, enhance the adoption of technologies and identify policy constraints and options for change.

Workshops identified the major priority components for the Philippines Fruit and Vegetable Program as follows:

Vegetables: 1. Improved integrated soil management practices; 2. Systems to improve the profitability of protected cropping systems; 3. Integrated pest management (IPM) systems for brassicas; and 4. Improved supply chain management systems and;

Fruit: 1. Papaya supply chains; 2. Phytophthora diseases of durian and jackfruit 3. Integrated crop management for papaya, and 4. Mango production including export marketing.

There were a range of current and past projects which overlapped with this work. Those considered to be of most relevance to this activity were:

- An earlier ACIAR project, ASEM/2005/062,related to the vegetable industry in the Philippines, which sought to link smallholder vegetable producers in the Philippines to profitable institutional markets (Batt *et al.* 2007).
- Projects undertaken by Philippines Institute for Development Studies (PIDS) which had examined contract farming and economic issues related to the fruit and vegetable sector in the Philippines.
- The ‘Regoverning Market Program’ conducted across Southeast Asia which analysed research, extension and policy development to improve efficiency in marketing of fruit and vegetables and the welfare of smallholder producers.
- An ACIAR funded small research activity ‘Philippines Policy Linkages Scoping Study’ (Balisacan and Cuthbertson 2008).

In 2007 Southeast Asian Regional Center for Graduate Study and Research Agriculture (SEARCA) and other peak agricultural research agencies in the Philippines were developing a project titled ‘The nature, sources and causes of productivity growth in Philippines agriculture’ with a component dealing with high value fruit and vegetable crops. John Mullen, initial leader of these components was a consultant to this SEARCA project and hence anticipated close links with this new project.

It was planned that the economic analyses would inform the direction of the other Components of HORT/2007/066 and 067. In particular it was expected the results of the economic analyses to be a key component in developing extension programs fostering adoption of the research induced technologies by demonstrating the economic incentives they could provide to farmers and processors. The analyses were also expected to be helpful in directing research resources to potentially higher value outcomes during the course of the research.

Some key data from around 2007 that helped background the component are presented in Appendix 1.

Vegetables

Vegetable production in 2007 was and continues to be an expanding sector in the Philippines and was viewed by the Government as an important sector for increasing incomes of smallholders/farmers and also the nutrition of the population.

Northern Mindanao and Davao were the most important regions for all the selected Project vegetables in the Southern Philippines. Of the crops, tomatoes and potatoes were the most economically significant.

Vegetable production in Australia in 2005-06 was worth $2,616 million, with the major crops being tomatoes, potatoes and brassicas.

Fruit

Mangoes were very important in Northern Mindanao and Davao and durian was also a significant crop in Davao. In fact Northern Mindanao and Davao were the main production areas in this region for all program fruits.

The gross value of production of tropical fruits in Australia in 2007 was around $600 million, largely comprised of banana, pineapple, avocado, mango and melons. Durian and jackfruit were minor crops in Australia, accounting for less than $10 million in annual gross value.

Background to economic analysis of the value chains (Objective 1)

Changes in markets for food and agri-food production systems in the Philippines are part of a global trend, driven by factors such as consumer demands for higher food standards, increasing urbanization and increasing local and foreign investments in food production and processing. These factors have brought about changes in supply chains. Exports and modern retail and fast food chains have increased through the years. In the Philippines, the number of retail stores has significantly increased from 1990-2009, with an average growth rate of 16% per year and a sales growth rate of 26% per year (Planet Retail, 2008).The market share of the top five grocers in the Philippines constitutes about 35% of the total sales of modern food outlets such as supermarkets, hypermarkets and convenience stores. In terms of concentration, particularly the share of the top four grocers in the industry, the Philippines ranked fourth in the Asia Pacific (Planet Retail, 2008). Thus the food retail and processing sectors have modernized and concentrated in response to increasing market requirements. Because of these changes in agri-food systems, which create opportunities and challenges, there is a need for continuous upgrading of smallholder farmers' skills to compete in the global market. However, the production sector is fragmented and many small farmers struggle to access opportunities particularly in high value horticulture markets such as fruits and vegetables. There are various development options that can be pursued including changing policies and business models, influencing institutions and through collective action, support systems and research and development initiatives, but supporting data is required.
The erosion of economic incentives such as fertiliser subsidies and low farm gate prices hinders farmers from making investments to increase production and to improve the quality of their produce. As a consequence, vegetable and fruit production have not kept pace with the food requirements of a fast growing population, making fruits and vegetables less accessible to consumers because of their relatively high price., whilst farmers may not have received higher prices. In the case of tomatoes, imports fill the supply-demand gap that occurs in key market areas.

Hence, this study aimed to assess the performance of selected fruit and vegetable value chains in the southern Philippines. Understanding how prices and costs behave

will help identify opportunities to improve the supply chain such as investing in technologies and policies that will lower costs or improve product characteristics to meet market requirements. This could ultimately help actors in the chain, particularly the farmers, and help alleviate poverty in the Philippines.

Background to estimating the profitability of Program outcomes

Objectives 2.2, 2.3 and 2.4 (Section 4)

One of the important roles of this component was to provide a systematic and consistent financial framework which could be used to assess the relative profitability of technologies and practices developed by the other components. To effectively perform this role, it was crucial that a framework be developed and information collected as quickly as possible for the systems where improved technology was likely to be available. This was necessary so that an initial perspective was developed and so all other components could hopefully be given clear guidance regarding what information they needed to collect and in what form.

There are three possible levels of analysis for whole-farm modelling.

i. Initially, simple whole-farm budgets of current agricultural systems were to be constructed. This would then allow the establishment of a baseline farm plan for selected regions and farm types.
ii. Linear programming models were to be constructed to determine 'optimal' farm plans subject to available resources and policy constraints. These models were expected to be valuable as they provide shadow prices for the resources that constrain production (eg land, labour), and can give important guidance on potential farm-level benefits from improvements in production technologies or key policy constraints (eg fertilisers). A feature of such models is the ability to account for complex biophysical and other constraints (eg labour, capital) on farm production that cannot be captured by simpler budget models.
iii. There was expected to be a need for the development of more complex bio-economic models to evaluate the benefits of key production technologies. Such models generally account for complex dynamic and stochastic processes, often using techniques such as stochastic dynamic programming. These techniques are useful to measure the long-term gains from a technology and can identify whether farm-level risks are increased or decreased with the adoption of a technology.

It was expected that these economic analyses would inform the direction of the other components of HORT/2007/066 and 067. In particular it was expected the results of the economic analyses would be a key contributor to development of extension programs fostering adoption of the research induced technologies by demonstrating the economic incentives they provide to farmers and processors. The analyses were also likely to be helpful in directing research resources to potentially higher value outcomes during the course of the research.

Background to policy constraints that may affect the adoption of technologies developed by the Program (Objective 3)

Another important part of the research was to estimate the aggregate economic impact in the Philippines and Australia of technologies developed within HORT/2007/066 and 067. Welfare analysis (or the economic surplus approach) is a standard and well documented method to measure the economic benefits to society from the introduction of a new technology. It is used to estimate the likely distribution of economic benefits between producers and consumers. The potential benefits to producers may be in the form of higher prices for their produce or lower costs of production (leading to increased supply), while for consumers there may be benefits as the produce they buy

may be lower in cost or of better quality. The share of the surplus that producers and consumers receive will depend on the elasticity of demand and supply for the product, and the magnitude of the shift in supply attributable to the research or technology (Alston *et al.* 1995). The shift in the supply curve brought about by a technological change is referred to as the "k-shift" in welfare economics. Estimation of the "k-shift" associated with the component technologies is the link between the farm level work undertaken in this report (Objective 2) and the welfare analysis prepared by PIDS (see Objective 2.5 and 3.1) to estimate the ex ante net returns from research.

Transport

Mindanao is considered the food basket of the Philippines. However, farmers, traders and transporters (truckers and shippers) in Mindanao have complained about the high cost of transporting agricultural products from the region to demand centres in Metro Manila and the Visayas. Shipping farm produce to Metro Manila and Visayan markets could be problematic because priority is given to the transport of tuna and other high-value fish products especially during the peak production season.

Much of the reported postharvest losses are encountered during the storage and transportation stages of the production to market continuum (Rapusas 2006; Serrano 2006). This limits the potential gains that farmers may realize from their produce, given the size of the markets for the region's agricultural products. When an avoidable supply glut arises from failure to move the commodities out of the region, local prices become greatly depressed and spoilage is increased to the disadvantage of the small producers.

While several studies have recognized the huge impact of logistics on the cost structure of agriculture products being sold in the market, there has been limited research in the Philippines on improving the efficiency in logistics services and transport infrastructures to lower marketing costs and increase financial returns to supply chain players while lowering the cost to consumers through more competitive prices.

Previous studies on Philippine vegetable and fruit supply chains focused on prices and the net margins realized at different nodes in the chain and transport and logistics costs, specifically fuel costs which have been identified as a major component of the cost structure of wholesalers in past studies. However, the role of other factors, such as government policies and regulations especially those related to infrastructure development, on transport and logistics costs which affect the financial returns of participants in the supply chain, have not been analysed to date. Further, most previous studies (i.e. Manalili and Gonzales 2009; Llanto 2009) have only looked at aggregative infrastructure investments in the agricultural and rural sector as a whole to stimulate agricultural production and productivity. To address the above knowledge gap, a transport study was conducted to look at the impact of road and port networks on supply chain players for key fruits and vegetables in Mindanao with a view to determining possible policy reforms to make these networks more efficient.

Australian work

The Australian work was based on opportunities raised by component leaders and management. Whilst the original plan was for some comprehensive studies in Australia, the changes in Australian component leaders meant the focus was much more in the Philippines.

NSW

Gross margins for NSW vegetables had last been prepared in 2001 and thus needed to be updated. Other work was based on the need to supply support for project submissions (fruit spotting bug and lettuce) and to provide support for associated research work on greenhouse improvements and lettuce IPM.

Queensland

Cyclone resilience of tree crops in Far North Queensland (FNQ).

One of the major problems with developing fruit industries in Far North Queensland is the risk of cyclones that can have a severe immediate and also long-term impact on the performance of tree crops in both the wet and dry tropics. Trellising is an option that may increase the economic resilience of fruit tree crops. However, the extra costs associated with structures and the increased plant density is significant. An assessment was done to answer the question: 'Will trellising pay?' Custard apple and rambutan were used as the case study crops.

Papaya

The disease phytophthora is a major problem for papaya production because of its impact on plant survival and fruit quality. In the past a key element of control has been prolonged fallows during which the phytophthora population in the soil falls and the population of neutral and beneficial organisms rise as soil carbon and compost levels improve. It was hypothesised that a shortened carefully managed 3 year fallow will have a more beneficial impact on phytophthora levels than 4 years of unmanaged fallow.

Cocoa – a potential crop for far north Queensland (FNQ).

Cocoa is a relatively new industry in FNQ and is often grown as a sideline with other crops. An assessment was conducted to gain an understanding of the profitability of cocoa production. It considered cocoa as an additional activity on an already established farm with some existing machinery suitable for the production of cocoa.

4 Objectives

The component objectives were:

1. To undertake an economic analysis of the value chains for the crops of interest in the ACIAR Program HORT/2007/066 and 067 in both the Philippines and Australia. In particular, there would be a focus on understanding and measuring the component costs or price spreads at each stage from the farm-gate to the consumer for the commodities relevant to this Program.
2. To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed.
3. To identify any policy constraints that may affect the adoption of technologies developed by the program, quantify their impacts at the farm level, and for a number of key case-studies quantify the industry level impacts. The results were to be used to potentially change the focus of the other Components and/or influence policy change to lead to reduced costs in the value chain where indicated.

For objective 3, activity 2, the transport study, a specific objective was to look at the impact of the road and port network on supply chain players for key fruits and vegetables in Mindanao with a view to determining possible policy interventions to make these networks more efficient. The study aimed:

1. To analyse the inter-regional trade of key fruits and vegetables in the period 1990-2009; and identify the factors that influence the observed trade flows and how the same factors apply to the trade patterns of Mindanao;
2. To quantify the effects of inter-island transport and infrastructure on inter-regional trade of agricultural products through an econometric analysis;
3. To analyze the factors that contribute to high transportation costs and other problems in relation to the flow of goods, focusing on the possible influence of government regulations and investment program using Mindanao as a case study; and
4. To recommend policy directions and development approaches to meet the demand for transportation infrastructure in relation to need, attainment of growth potentials, and competitiveness of the Mindanao region.

NSW vegetables

Objectives were to update vegetable GMs and provide support to research submissions and to analyse economic benefits of research on greenhouse improvements, the value of IPM in lettuce and the value of garden organic compost for vegetable production.

Queensland fruit

Trellising of rambutan and custard apple.

The objective was to compare the profitability of rambutan and custard apple production ‘without’ and ‘with’ trellising to determine if trellising increases profitability in regions exposed to cyclones.

Papaya assessment

The objective was to estimate the benefits and costs of both the conventional production system (4 years fallow) and the proposed system with a shortened (3 years)

fallow period to determine if the extra revenue due to the shortened fallow period will exceed the extra costs incurred during the fallow.

Cocoa assessment

The objective was to review the establishment and operating costs and returns for cocoa over the life of a cocoa plantation to determine its profitability i.e. does it pay?

5 Methodology

The 2008 proposal noted that the expected outcomes of the component were:

1. Enhanced adoption of the outcomes of the other components by strengthening extension messages with information about technology profitability. This was to be done by using a framework consistent across Components 1 – 4. This was anticipated to result in a shortening of the time to adoption.
2. Sharpen the focus of the other work on higher profit areas and issues through the analysis of potential impacts.
3. Reduced costs in the value chain through increased understanding of the policy constraints and identified options for minimising the impacts or possibly changing the policies.
4. Provide support for longer-term policy reform for Philippine agriculture.
5. Provide a consistent economic framework for assessing the relative profitability of the technologies developed in the other Components for use in promoting their adoption; help in bringing the Components together and integrating the results of all the work; ongoing assessments of the potential impact of each technology being developed and implications for strategic reviews of these; and understanding of the potential policy constraints to incentives for adoption and options for minimising their impact.

The methodology described in the project proposal was based on achieving these outcomes. The methodology was changed to some extent because with the change in principal investigators, including the absence of a permanent NSW DPI economist for much of the project, some of the emphasises was changed. There was also more emphasis on the Philippines' work. Additionally, with some difficulties obtaining data from other components, the analyses of some of the technical component outcomes was not completed as anticipated.

The methodology described below was designed to be a 'bottom-up' analysis, whereby farm-level modelling that accounts for the complex biophysical interactions was to be used to provide input into the broader industry/national research evaluation modelling. This would increase confidence in the outcomes of the research evaluation analysis as it was expected to provide a sounder basis on which to estimate production changes and adoption rates.

5.1 Objective 1: To undertake an economic analysis of the value chain for the crops of interest in the ACIAR Program HORT/2007/066 and 067

The first objective was to assess the performance of selected fruit and vegetable value chains in the southern Philippines. Many of the initial analyses made use of available studies and Bureau of Agricultural Statistics (BAS) data and market reports and judgements based on discussions with industry members at various points along the chain.

Value chain

The areas of assessment included the cost structure of the different actors in the chain, distribution of benefits among chain actors, and the efficiency of the markets. The methods used to assess the performance of the value chain were analyses of price spreads, net margins, price transmission, productivity, profitability and technical efficiency analysis. The analyses of productivity, profitability and technical efficiency of selected horticulture crops were completed. Key implications from the results of these analyses were explored, which were then used as the basis for policy recommendations. See Appendix 2 for a diagram showing the methods/model used.

Price spread is the difference between the selling price and the buying price. It provides a measure of the farmers' share of the retail or selling price, and gives an indication of the cost of marketing and the value added to meet consumers' requirements. Price spreads also provide background information on the chain and flag areas to investigate the behaviour of prices and margins.

Since price spreads do not provide information about the profitability of various nodes in the chain (farm, wholesale, retail), net margins analysis were also analysed. Net margins provide more details on the marketing and production costs at each node. Net margins analyses allow examination of the cost structure of each node in the chain and indicate where there are opportunities improving the chain. For example, if costs are relatively high and margins low, there may be an opportunity to reduce costs, depending on the factors contributing to the high costs.

The analysis of price transmission, on the other hand, tells how buying prices are reflected in the selling prices, and flags problem areas that need to be further examined. In addition, market integration analysis examines whether farm, wholesale and retail markets of selected crops are integrated.

Details of methods used are presented in the appendices:
Appendix 3: The detailed matrix of the models used, their importance and the target users of research
Appendix 4: The theoretical and empirical frameworks of these methods
Appendix 5: The data used, respondents and research procedures
Appendix 6: Value chain maps of commodities covered, with net margins for each node of the chain.

Farmers' performance

The performance of farmers in the value chain was also examined. Several approaches were used which include value chain analysis, net margins analysis, and statistical and econometric analyses which involve the measure of productivity, technical efficiency and profitability of farmers.

The respondents included cabbage, potato, tomato, mango and papaya farmers in the southern Philippines. The areas of study included:

Northern and Southern Mindanao for cabbage, potato and tomato;
Davao del Sur, Davao City and Island Garden City of Samal for mango; and
Municipality of Tupi in South Cotabato for papaya.

Extra funding was provided in 2011-12 to increase the sample size and thus the rigour of the research. Costs of inputs and information on yield were collected. The team gathered responses for 101 mango, 61 papaya 110 tomato, 83 potato and 114 cabbage farmers, wholesalers and retailers. About 80% of the surveys of all participating actors provided analysable data.

Cluster sampling, a probability sampling technique, was employed. Farmer-respondents are usually clustered in an area. The judgment of the Municipal/City Agriculture Office (MAO or CAO) on where the farmers are located in the area was

followed. In these areas, farmers were randomly interviewed regarding their farming activities.

The value chain and net margins analyses provide background information on the current status and activities performed by value chain actors across key-producing areas in the southern Philippines.

To assess the performance of farmers involved in the tomato value chain, for example, one of the crucial steps is to measure their productivity. This reflects their ability to transform inputs used to production outputs. This is likely to be influenced by farm attributes such as size and costs of inputs and the farmer's profile including education and training. Technical efficiency is the ability of a firm to produce the optimal output given a set of inputs (Kumbakher and Lovell 2000). The two principal methods that have been used are Data Envelopment Analysis (DEA), which involves mathematical programming, and Stochastic Frontier Analysis (SFA) which involves econometric estimation (Coelli 1996a).

5.2 *Objective 2:* To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed.

Measuring the impacts of component research on the Philippines vegetables and fruits industry, involved preparing an ex ante impact analysis. This was used to estimate the likely benefits from the research activities. As the name suggests, ex ante impact assessments are done before adoption takes place. As a result they offer information about the order of magnitude of a project's effect on an industry. They represent the 'best' estimate available of the benefits anticipated from the R&D process. Using an ex ante benefit-cost analysis, the expected farm level impacts of technologies developed by the research components were estimated and assessed.

Other assessment tools used GMs analysis (fruits and vegetables) and risk programming (vegetables), (See McClintock *et al*. 2012, Appendix A Component 5 Economics – methods and impacts).

GMs are an important first step as they capture variable costs and production data at the field level. This allows the construction of a baseline data set, which involves derivation of baseline data (i.e. yields, costs, etc) for baseline enterprises and baseline farming systems. This is important as it allows measurement of the impact of project components for a with-research (and thus assumed new technology) and without-research or no new technology basis.

The next stage of the analysis is the construction of whole-farm or farming-system budgets. It was anticipated that many farms currently produce a range of vegetable commodities, and have the potential to grow various other agricultural products. Therefore, GM budgets account for a small part of an individual farm's production system and do not indicate whole-farm returns or system-wide effects. A whole-farm model allows examination of complex interactions between available farm resources, the potential suite of activities that can be grown, and the relative returns of the activities. The model is used to determine the optimal mix of crops for a given allocation of resources, costs and prices.

Vegetables – protected cropping

The two main case study regions for the vegetables program were the upland rainfed areas of Eastern Visayas (Region VIII - Cabintan, Leyte) and Northern Mindanao (Region X – Lantapan, Bukidnon). The Eastern Visayas region is most affected by

adverse weather conditions in terms of wind and rain. The farm systems modelling for Eastern Visayas vegetable production was conducted by Visayas State University (VSU) and NSW DPI while the Northern Mindanao modelling was conducted by Sonny Domingo (John Allwright Fellowship, PhD Student Charles Sturt University (CSU), Orange, Australia. This component activity was arranged early in the project through component staff's involvement with CSU.

The analysis started with simple enterprise budgeting. Baseline data was collected through FGDs for a variety of vegetable crops and GM budgets were developed for tomatoes, cabbages, eggplants, lettuce and corn for each of dry, wet and intermediate seasons.

Also GMs were prepared for the dry and wet season for Chinese cabbage and for dry season potatoes, cabbages and broccoli for Mindanao and for the Philippines in general for cabbages, potatoes (Bulayog and Preciados 2009).

Also for Mindanao GMs were prepared for 11 crops: Baguio beans, broccoli, cabbage, carrot, celery, chinese cabbage, lettuce, potato, squash, sweet pepper and tomato as part of Sonny Domingo's Ph.D. (Domingo 2013).

These vegetables GM budgets were used as the baseline budgets in the upland rainfed farming systems model developed by the component 5 team at NSW DPI. The baseline enterprise GMs were circulated to the technology component research teams to confirm if they were reasonable representations of farmers' practices and to identify how the component technologies would change parts of each GM. Assessments of the impact of each technology and its adoptability *viz.* for example cost of adoption, yield improvement and reduction in costs of production were to be assessed based on advice from the research teams.

A framework for a whole-farm model was developed by VSU / NSW DPI (see Appendix B Vegetable farming system model, McClintock *et al.* 2011) as the next stage of the analysis. The model developed budgets for different production technologies and across a number of production regions. For vegetable production in the Philippines, accounting for risk was considered to be an important element in a farmer's decision to adopt a new technology. The model was designed and developed to assess and compare the net benefits of new technologies developed within the technical components of the Vegetables Project

The design of the farm model also complemented work being undertaken by Sonny Domingo who was investigating a method for segmenting farmer populations based on their relative levels of risk aversion. Combined with the E-V frontier estimated by the farm model, it was planned to generate an estimate of region level impacts which provided an indication of the degree of risk aversion among the target population of farmers.

Data requirements for the whole-farm model developed for the vegetables program were extensive and some data were difficult to ascertain given the ex ante nature of the assessment. Farm level data collected via surveys and farmer FGDs (McClintock *et al.* 2012, Appendix C and D) were used as the baseline against which changes in yields, unit costs of production and whole-farm income associated with a new technology were measured. FGDs were conducted to understand the current practices of upland vegetable farmers in terms of input use, outputs, cropping systems and incidence of crop loss from weather damage, pests and disease.

Information previously collected on crop costs and returns during farm surveys (crop GMs, McClintock *et al*. 2012, Appendix F – Crop Gross Margins per ha -Baseline Farmers' Practice) were presented and discussed at the FGDs to validate the baseline against which measurements of the technology impacts would be made.

The farm level data collected from surveys and FGDs covered:

- Farm area
- Land use and cropping patterns (rotations)
- Input usage (application rates)
- Input prices
- Crop yields and prices (minimum, maximum and most likely).

Published information was collected for area harvested, production and for commodity prices at the farm level. Price data at the wholesale and retail levels were also collected for research being undertaken at UPMin on vegetable supply chains.

Data from agronomic and trial plots were taken into account in the collation of data for the model. The expert opinion of scientists undertaking the research was also sought. Information collected from interviews with the research scientists addressed five main areas:

- Most likely technology or best practice recommendation(s).
- Impact on types of rotations and yields (min, max, most likely)
- Adoption expectations
- Off-site and other costs/benefits
- Costs and Returns (GMs)

The information collected from interviews with scientists (see McClintock *et al.* 2012), Appendix E –Changes in level and range of expected yields, scientist interviews –first round results) was to be reviewed during scientist FGDs, so responses could be discussed and a set of accepted estimates for impact agreed upon by taking on board cross-disciplinary considerations relevant to potential production impacts. As the research progressed and knowledge of farming systems impacts from the technology recommendations improved, the information used in the model was expected to be readily adjusted through the course of the research project.

McClintock *et al.* (2012) observed that a widely-used technique for gathering expert opinion and gaining consensus on a data set is that based on the Delphi method, which was first applied by the RAND Corporation during the 1950's (see Helmer 1967 and Dalkey 1969). The technique is used for gaining judgements about complex problems when available data are limited or there is an absence of reliable information, as is the case for ex ante impact assessments of new technologies. The technique is applied iteratively. The first step is to collect responses from a range of relevant experts, followed by discussion and then review of the responses to reach consensus on the most reasonable expectations of a technology's likely impact. McClintock *et al.* (2012, p36) noted that the technique is widely practiced in ex ante agricultural research evaluation and that a notable example is a recent Philippines fruit and vegetables study into biotechnologies by Norton and Hautea (2009). In this study, information from Farmer Group Discussions were supplemented by interviews with five scientists and eight industry experts to "...elicit information on expected yield and cost changes from using the PRSV-resistant papaya technology effectiveness, and unintended environmental effects" (Norton and Hautea 2009). A similar approach has been used in the research discussed in this report. At a broader level, the World Bank (see World Bank 2010) also refers to the data collection method of estimating likely impacts based on "expert judgements" obtained through interviews and methods such as Delphi, when impacts are uncertain or unknown.

However, preference was expressed by the technical component research teams to rely more on trial data for deriving estimates to evaluate the potential production and income impacts of their technology recommendation rather than relying on scientists expectations and estimates.

Fruit

As part of the fruit project, research was conducted with jackfruit, durian, mango and papaya and this economic component conducted a farm level impact analysis of the research.

Details are published in:

Preciados *et al.* (2013a) for jackfruit

Preciados *et al.* (2013b) for mango

Preciados *et al.* (2013a) for durian

The papaya analysis was not completed.

As part of the analyses, the technical scientists were interviewed to obtain information about the potential impacts of their key research recommendations. The information collected was used as the basis of the "with" technology impact scenario. It was used to compare with the farmers' current practice (the "without" scenario) to estimate the potential net impact of the research outcomes.

The analyses for fruits also started with simple enterprise budgeting. Baseline data were collected through FGDs with farmers, and GMs budgets were developed for jackfruit, durian (for three management options: low, medium and high) mango, and papaya. Budgets were then prepared for jackfruit and durian with phytophthora control and mango with IPM incorporated.

Interviews with key technical scientists

Jackfruit and durian phytophthora research

Interviews were conducted with ten scientists involved with the Fruit C2 component (Phytophthora diseases of durian and jackfruit) in Oct-Dec 2010. Information was collected as part of the process to determine the current extent and impact of phytophthora (yield loss and tree loss), the key cultural and chemical control recommendations to come out of the durian and jackfruit (C2) research and the likely impact (yield loss and tree loss) and extent of adoption of research recommendations on farm. Five of these respondents were involved in research concentrating on jackfruit (Region 8) and five on durian (Region 10).

Mango IPM research

In November 2011 interviews were conducted with scientists from the Fruit C4 Mango IPM research team which worked on Samal Island, Davao Region. These were followed by a FGD with mango farmers. A workshop was also conducted in December 2011 with selected mango growers and key mango researchers to gain consensus on the estimates for the GMs for the "with and without" technology scenarios and impacts of the key recommendations proposed.

Papaya

Baseline data were collected from researchers and papaya farmers in Tupi, South Cotabato in September 2011. Without technology GMs were prepared.

Objective 2.5

Measuring the impacts of component research on the Philippines vegetable and fruit industry, involved conducting an ex ante impact analysis. An assessment of the likely benefits from adoption of the research outputs was conducted. As the name suggests, ex ante impact assessments are done before adoption takes place and often before the research commences. As a result they offer information about the order of magnitude of a project's potential impact on an industry. They represent the "best" estimates available of the benefits anticipated from the R&D process.

The principal tool used in impact assessment was benefit-cost analysis. In the case of agricultural technologies, assessments rely upon a particular set of information, for example:

- Enterprise GM without the technology (ie current or baseline practices);
- The change to enterprise GM, crop rotations and crop yield due to the technology; and
- Information about the population of potential adopters and the rate of uptake, to assess the industry and region level impact.

This tool was used for the benefit –cost analysis conducted for estimating impacts of fruit technologies and the risk programming model was intended to estimate and demonstrate the impact of price and yield volatility on farm income and production decisions, to industry and researchers. (Risk analysis can also be done using BCA by varying the discount rate and/or varying the levels of particular variables such as prices and yields).

Australian research

Vegetables (NSW)

The methodologies used for the analyses of NSW vegetables are documented in the reports of the work:

Farm Enterprise Budgets (gross margins) for ten inland NSW vegetables crops, cabbage, tomaoto, sweet corn, onion, lettuce and summer and winter potato for fresh markets plus tomato, potato and sweet corn for processing (Orr 2009).

Also sixteen gross margin budgets were prepared on inland NSW vegetables crops with GMs estimated on a per ha and per ML water basis (Kelly *et.al*. 2013).

Business case for adoption of IPM in lettuce (McDougall and Orr 2011).

Benefit cost analysis of fruitspotting bug management (Orr 2010).

Evaluation of the economic, environmental and social Impacts of NSW DPI investments in IPM Research in lettuce (Orr *et al*. 2008).

Evaluation of the economic, environmental and social impacts of NSW DPI investments in IPM research in cold disinfestation of citrus (Orr *et al*. 2009, draft only).

Upgrading from low to high technology greenhouses (Parks *et al*. 2011).

Fruit (Queensland)

Analysis of the benefits of IPM research for papaya.

Results were reported at the Annual Program meeting, Canberra, June 2010, but with the departure of Leanne Orr, the work did not progress (Orr *et al.* 2010. A brief summary is in Table 13). B. Queensland.

GM budgets were prepared for the papaya varieties red (solo) and yellow (Queensland) without and with phytophthora control.

Trellising of rambutan and custard apple to increase cyclone resilience.

This assessment used the experience and expectations of producers to assess the contribution of trellising to the resilience of their business (Page 2013a, Attachment 7). Data was collected from producers using an iterative process of data collection, data processing, review of outcomes and then review and change original data as needed. Thus growers had the opportunity to review the data provided and if necessary, revise it after seeing the results. Risk analysis was conducted because the assessments involved a range of uncertain and unpredictable factors such as the occurrence of cyclones.

The risk analysis involved development of an Excel® model that considered the likelihood (probability) of major and minor cyclones and their impact on yield in the year of occurrence and subsequent years and on orchard replanting, repairs and orchard clean-up costs.

Investment assessment procedures for papaya (and for cocoa – see below) were based on discounted cash flow analysis. These procedures took account of the timing and value of cash flows and discounting of future cash flows to present values according to the cost of capital.

Papaya assessment

This assessment used the experience and expectations of a producer to assess the contribution of a shortened fallow period on the profitability of their business (Page 2013b, Attachment 8). An iterative approach was applied where the grower had the opportunity to review the data provided and revise it after seeing the results. Risk analysis was applied because the assessments involved a range of uncertain and unpredictable factors such as price, yields and weather damage.

An Excel® model was developed to compare the papaya production systems 'with and without' a shortened fallow period. The key differences between the 'with and without' comparison was the shortened fallow period and the extra fallow costs assumed for the 'with' option.

Cocoa

A spreadsheet developed and populated by Qld DAFF Economist Bill Johnston was used to assess the net benefits of cocoa investment (Page 2013c, Attachment 9). The data in the original spreadsheet were reviewed and adjusted to fit with the views and experience of those currently growing the crop. In this assessment cocoa was considered to be an additional component of an established farming operation. This meant that many of the capital costs associated with cocoa were shared with other farm activities, thereby greatly reducing the capital outlay associated with establishing a cocoa enterprise.

Most labour costs are included in the cost of contracted activities with the exception of harvesting costs. Hence allowances for on-farm labour were minimal.

5.3 Objective 3: To identify any policy constraints that may affect the adoption of technologies developed by the program, and quantify their impacts at the farm level, and in some cases the industry level.

The third major element of the research was to identify policy constraints in the Philippines and Australia which may inhibit the adoption of technologies developed in HORT/2007/066 and 067 by distorting the economic incentives facing farmers.

Initially a likely set of policy constraints were identified by reviewing the report from the Philippines Policy Linkages Scoping Study (Balisacan and Cuthbertson 2008). The potential economic impact of these policy constraints was to be estimated in ways consistent with the value chain for each of the commodities under consideration with a view to making some judgement about whether they are likely to significantly impede adoption of technologies developed in other Components of HORT/2007/066 and 067. In the course of the research it was anticipated that other constraints may be identified and estimates of policy impacts refined. Where significant policy constraints were

identified, some assessment was expected to be made of their importance to other sectors of the Philippine economy and of prospects for their removal.

Objective 3.1

An important part of the planned research was to estimate the aggregate economic impact in the Philippines and Australia of technologies developed within HORT/2007/066 and 067. This was initially planned to involve the use of economic surplus models (such as DREAM) for each vegetable commodity to allow analysis of changes in equilibrium prices and quantities and changes in economic surplus to producers, processors and consumers. Quantifying these potential benefits with information about the likely rate and extent of adoption to the new technologies and relating this to the investment made by ACIAR and its partners was intended to provide a measure of the returns to the investment in HORT/2007/066 and 067. Similar analyses could be conducted to estimate the economic impact of relaxing policy constraints identified during the research.

The aggregate economic impact in the Philippines and Australia of technologies developed within HORT/2007/066 and 067 was estimated using a spreadsheet-based model called the Welfare Impact Simulator for Evaluating Research (WISER) rather than DREAM as PIDS preferred a transparent model. It was developed to calculate the prospective impact of a new technology generated from fruits and vegetables R&D. The model is based on the framework presented by Alston *et al.*,(1995) for economic surplus analysis. WISER provides estimates of net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) and can be applied to both ex ante and ex post analyses.

Changes in equilibrium prices and quantities and changes in economic surplus to producers, processors and consumers were analysed. These potential benefits were qualified with information about the adoption parameters for the new technologies, and were related to the investments made by ACIAR and its partners. In addition to that, the PIDS team had coordinated with the VSU team to compute the k-shift estimates. The estimates were supposed to be from on-farm trials assessed by the VSU team. Since the k-shifts for mango, papaya and jackfruit were the only ones available, the PIDS team decided to produce some arbitrary estimates for the k-shifts for the other crops.

Apart from direct sources of data, the PIDS team also made use of current and past studies to provide sufficient background on the topic. Related literature on agricultural diversification, agricultural policy, public investment on different commodities with emphasis on R&D, and global trends on the agricultural research intensity ratio were reviewed.

Detailed methodology is provided in the WISER manual and spreadsheet. (Attachment 12.2 and 12.3).

5.3.1 Objective 3.2

For Objective 3.2, which was predominantly achieved through the transport study, there were four aims:

Aim1: To analyse the inter-regional trade of key fruits and vegetables in the period 1990-2009; and identify the factors that influence the observed trade flows and how the same factors apply to the trade patterns of Mindanao.

1.1 Methodology was to describe the agricultural commodity flow across regions including a review of literature on inter-regional trade flows of agricultural commodities, specifically fruits and vegetables.

Aim 2. To quantify the effects of inter-island transport and infrastructure on inter-regional trade of agricultural products through an econometric analysis.

2.1.This involved collecting data on agricultural commodity flows across regions and on the factors possibly affecting flows including secondary data on the value of agricultural commodities trade, specifically fruits and vegetables and GDP, population, number of markets, distance, road condition and number of vessels of the reporting region.

2.2. This involved analysing inter-regional trade of agricultural products at the macro level including use of the gravity model to identify the significant factors affecting trade.

Aim 3. To analyze the factors that contribute to high transportation costs and other problems in relation to the flow of goods, focusing on the possible influence of government regulations and investment programs using Mindanao as a case study. This involved:

3.1 Surveying key actors in the supply chain (growers, traders, truckers, and wholesalers/ wholesaler-retailers) for tomatoes, lettuces and papaya to collect data on production, transportation and marketing/trading for each commodity at each node of the supply chain.

3.2. Conducting FGDs and personal interviews with shipping lines, the Philippine Ports Authority (PPA) and other key informants.

3.3. Analysing inter-regional trade of agricultural products at the micro level including description of the transportation and marketing practices of key actors in the supply chains for tomatoes, lettuces and papaya coming from Mindanao, identifying specific issues and problems affecting their operations, and analysing the effects of the availability and quality of transport and logistics infrastructure and services on the cost of operations.

3.4. Establishing a link between the macro-analysis and micro-analysis results of the study.

Aim 4. To recommend policy directions and development approaches to meet the demand for transportation infrastructure in relation to need, attainment of growth potentials, and competitiveness of the Mindanao region.

4.1. This involved deciding policy implications and recommendations in the final report and to communicate the results to the key stakeholders and relevant policy makers.

There were two levels of analysis used in the transport study. A macro-level analysis was conducted of inter-regional trade flows of agricultural commodities, particularly fruits and vegetables, across the 17 regions of the Philippines, using the Gravity Model defined as:

$$\ln M_{ij} = \beta_0 + \beta^1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln N_j + \beta_4 \ln D_{ij} + \beta_5 \ln L_{ij} + \beta_6 \ln IN_i + \beta_7 \ln IN_j$$

where M_{ij} is the trade flow from origin/reporting region i to destination/partner region j;

Y_i and Y_j is the GDP of regions i and j, respectively;

N_j is the population of the destination region j;

D_{ij} is the distance between regions i and j;

L_j is the presence of supermarkets and markets in region j;

IN_i, IN_j is the level of infrastructure (e.g. vessels in the port, number of markets, length of paved roads) in region i and region j, respectively; and

β_k,(k=1 to 7) are parameters to be estimated, with the expected signs: β_1, β_2, β_5, β_6, $\beta_7>0$, β_3, $\beta_4<0$.

Data used in the macro level analysis were all secondary and were collected from Philippine government agencies such as National Statistics Office (NSO), National

Statistical Coordination Board (NSCB), Department of Public Works and Highways (DPWH), and Philippine Ports Authority (PPA). Specifically, time-series regional data from 2002 to 2009 were used in the gravity mode (see Llanto *et al.* 2013) These included data from the 17 regions of the Philippines, which were matched with each of the study regions to present the trade flow of the selected agricultural commodities from a reporting region (RR) to a partner region (PR). The gravity model was estimated for three commodity groups based on the Philippine Standard Commodity Classification (PSCC). These include total agricultural trade, which is the aggregate of all PSCC commodity groups (001 Live Animals, 034 Fish, 042 Rice, and 054, 056 Vegetables, and 057 Fruits); total vegetables (054 and 056); and total fruits (057).

A micro-level analysis was conducted of the key actors involved in the supply chain or trade in a selected fruit (papaya) and selected vegetables (tomato and lettuce) coming from Mindanao, with particular focus on marketing operations, transportation and shipping services. Field surveys/interviews with 142 growers, 36 traders, and 24 truckers of tomato, lettuce and papaya were conducted in Mindanao, specifically in South Cotabato, Bukidnon and Cagayan de Oro. Additionally, surveys with 18 wholesalers and 109 wholesaler-retailers were conducted in the Visayas, particularly in major urban markets in Cebu and Bacolod and Metro Manila, Luzon.

FGDs with port operators and shipping lines from the PPA in General Santos City (the port of origin of papaya produced in Tupi, South Cotabato going to Manila) and Cagayan de Oro (the port of origin of tomato and lettuce from Bukidnon and going to the Visayas and other parts of Mindanao like Davao City) were also conducted to gather data on shipping services. Finally, key interviews with the Northern Mindanao Vegetable Producers Association (NorMin Veggies) and the Phividec Industrial Authority were conducted to get additional insights on the issues related to the marketing and shipments of the commodities covered as well as to validate some observations and results.

Detailed methodology is provided in the transport report (Llanto *et al.* 2013, attachment 12.5).

5.3.2 Objective 3.3 Assess the feasibility of future changes to constraining policies and assess the implications for adoption of the technologies

This activity involved collaborating with policy makers to determine options for implementing policy reforms and contributing to the policy reform process.

The UPMin team organized a policy reference group (PRG) to serve as panel to provide feedback on the C5 research outputs that were presented during the 3rd Agribusiness Economics Conference in July 2011 and the 4th Agribusiness Economics Conference in July 2012. The policy reference group was composed of representatives from the public and private sectors, non-government organizations and producer organizations.

Policy issues from the farm analyses, the economic surplus models and the transport study flowed through to program and project management and component leaders at annual review meetings and via reports.

General

The overall plan for the component was for all activities to be closely linked (Figure 1).

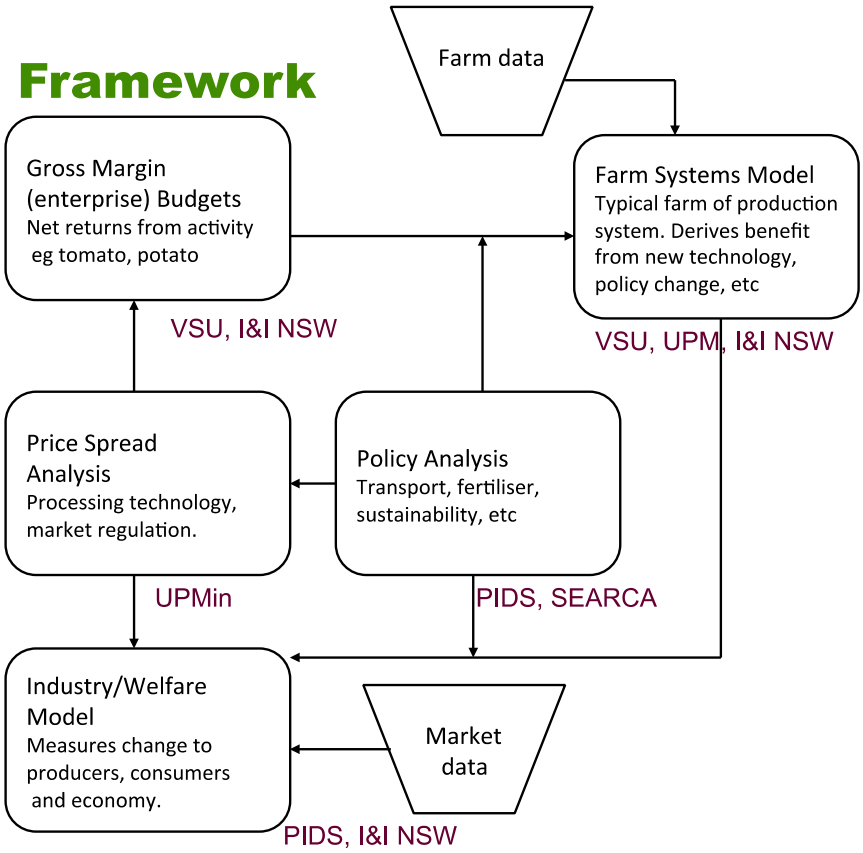

Figure 1. The planned framework for the component (John Mullen *pers. comm.* 2009).

6 Achievements against activities and outputs/milestones

Objective 1: To undertake an economic analysis of the value chain for the crops of interest in the ACIAR Program HORT/2007/066.

no.	Activity	outputs/ milestones	Completion date	Comments
1.1	Develop draft value chains for study vegetables from Mindanao and NSW using available data and expert judgement.	Draft value chains for vegetables in Mindanao and NSW for the major production and marketing pathway	December 2012	Sixteen working papers (see Section 8.4) were prepared and communicated through web2 Economic analyses on the value chain of selected horticulture crops (mango, papaya, potato, tomato, cabbage) were completed for Mindanao. The areas of study included Davao City, Island Garden City of Samal and Davao del Sur for mango; Tupi, South Cotabato for papaya; and Bukidnon, Davao del Sur and Misamis Oriental for vegetables. Costs of inputs and information on yield were collected. The team gathered responses from 101 mango, 61 papaya 110 tomato, 83 potato and 114 cabbage farmers, wholesalers and retailers. Analyses on productivity, profitability and technical efficiency were completed for Mindanao. Australian work was not completed
1.2	Use draft value chains to make preliminary assessments of the economic impact of the technologies to be developed during the Program and of policy constraints.	Preliminary estimates of the likely impact in the farm and processing sectors of new technologies and of policies likely to constrain the adoption of these technologies	December 2012	Working papers are being revised. Analysis of net margins was completed early in the project. Subsequently, with further funds, additional data was gathered and analysed. The analyses and value chains contributed to policy development but not so much to economic impact of technologies
1.3	Identify the range of value chains required for different regions in the Philippines/Australia and different marketing paths.	Use Bureau of Agricultural Statistics (BAS) survey data and other sources of information to identify these value chains	December 2012	Value chains for fruits and vegetables (see Appendix 6) were incorporated into the reports on price transmission, market integration, price spreads and net margins. The areas of study were focused on the areas covered by other components in Mindanao. Profitability of the chains was compared using net margins analyses. Australian work was not completed

no.	Activity	outputs/ milestones	Completion date	Comments
1.4	Refine quantitative analyses of value chains. Integration of findings of policy analysis into farm-level analysis	Quantitative analyses of value chains suitable for impact assessment of new technologies and policy constraints	December 2012	Completed in 2010 but new data were collected in 2012 which allowed further comparisons of the profitability of the chains to be updated. Thus updated analyses on price spreads, market integration, and price transmission were done for 5 crops. Similar to the earlier results of the study, lack of infrastructure facilities and increasing fuel cost were found to be major problems for farmers. In addition, new data showed that farmers became more concerned with the effect of pests and diseases on their crops which resulted in increased field losses.

PC = partner country, A = Australia

Objective 2: To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed.

no.	Activity	outputs/ milestones	due date of output/ milestone	Comments
2.1	Program commencement meeting of all Components Meeting of Component 5 to finalise work plan and allocate resources.	Clear picture of all technologies and common resources Final work plan and resources allocations.	Completed 2009	John Mullen and Randall Jones organised meetings in the Philippines in 2008 and 2009
2.2	Develop enterprise budgets for main commodities	For each enterprise and regional area develop basic enterprise GM budgets to identify farm-level cost structures (A, PC).	Completed 2009	GMs were prepared, generally for baseline (ie 'without technology') and sometimes with technology changes. See Methodology section 5.2 and results section 7.2. Key recommendations from jackfruit and durian phytophthora research, mango IPM and papaya IPM research were also identified
2.3	Measure the technology impacts at an enterprise level	Integrate the impact of Program developed technologies into GM budgets to measure financial changes at an enterprise level (A, PC).	December 2012	Vegetables: An Interim Report *"Economic Impacts of Component 2: Protected Cropping technology for vegetable production in the Southern Philippines* was prepared and posted in web2. The report provided information relevant to technology adoption that could be valuable to researchers as they develop a set of recommendations for farmer adoption. A report was also prepared (McClintock 2010) on the soils experimental designs in the hope that some reviews of the designs would allow economic analyses of the results. New designs were prepared by the C1 team in April 2011 but the implementation of these designs was limited. Fruits: Financial benefits and costs to growers from adoption of recommended technical practices were estimated. Jackfruit phytophthora management (Region VIII) Based on a reduced yield loss of 22% per ha & reduced tree mortality of 11% the GM will increase by 93%. Durian phytophthora management (Region XI) Based on low management option (sanitation, mulching etc) there would

no.	Activity	outputs/ milestones	due date of output/ milestone	Comments
2.3	cont			be an increase in yield of 30% and increase in production costs of 89% which would increase GM by 26%. Medium management option (low + soil amendments+ canker treatments) there would be an an increase in yield by 64% and increase in production costs by 336% resulting in 46% increase in GM. High management option (medium + canker treatment with chemicals+ phosponate). There would be an increase in yield by 128%, increase in production costs by 461% and 107% increase in GM Mango IPM (Region XI) Based on recommendations from new research, losses or rejects would be reduced by 20%per ha, yield would increase by 33% per ha, and therefore cost of production would decline by 16% which would result in an increase in GM of 156% Australian work not completed
2.4	Develop farm system models to measure the system-wide effects of new technologies	Measure the change in whole-farm returns from adoption of ACIAR developed technologies, accounting for resource allocation and risk issues (A, PC).	May 2010	The E-V for the Vegetable component research was developed to the point that it was operational. Baseline data were entered and it was ready to input information on component recommendations as any data became available. Further development of this framework was to proceed when data became available from the components regarding their recommendations and estimates of costs and returns associated with the technology change. The C2 team noted that they felt they did not have the technical expertise to provide accurate estimates of yields and production costs when the protected cropping ex ante analyses were completed in early 2011. Since then they have collected significant extra economic data and analyses have been published (Armenia *et al*. 2013). The bacterial wilt research (C3) was initially considered to be still reasonably basic research and no economic analyses were conducted. See Page (2013a, b and c) for Aust work

no.	Activity	outputs/ milestones	due date of output/ milestone	Comments
2.5	Assessment of return on investment at industry level for individual technologies (impact assessment)	Preliminary analysis of selected technologies (to be defined) using best-bet assumptions from Component 1 to 4 researchers	July 2009	The VSU / DPI farm level analysis was designed to provide information on the technology k-shift and adoption expectations as described in 2.4. Limits on proceeding with these analyses are described above.
		Detailed impact analysis using preliminary results from Component 1 to 4 research	December 2009	Some initial economic surplus analyses were completed based on DREAM and with an early version of WISER (Welfare Impact Simulator for Evaluating Research).
		Comprehensive impact analysis utilising comprehensive data from Component 1 to 4 research	May 2012	Dr Briones developed an early version of WISER and used on-farm trial data from the VSU team to calculate the NPV, BCR and IRR for the horticulture projects. Data on industry production and harvested area of fruits and vegetables were collected by region. Information on rate and extent of adoption was collected via scientist interviews (e.g. at 2011 Bohol annual planning meeting) and by reviewing available relevant data. Cash flow of research and development costs were collated (including in-kind). The spreadsheet-based model, WISER, was developed to calculate the prospective impact of a new technology generated from fruits and vegetables R&D[3]. See summaries of scenarios in section 7.

PC = partner country, A = Australia

[3] WISER was developed by Roehlano M. Briones of Philippine Institute for Development Studies with financial support of the Australian Centre for International Agricultural Research. The spreadsheet is available upon request but use of WISER requires proper acknowledgement and citation.

Objective 3: To identify any policy constraints that may affect the adoption of technologies developed by the Program, and quantify their impacts at the farm level, and in some cases the industry level.

no.	Activity	outputs/ milestones	due date of output/ milestone	Comments – detail outputs here
3.1	Identify the set of key policy issues that affect the outcomes of HORT/2007/066	Extract and expand on the Policy Linkages Scoping Study, with emphasis on land tenure, transport, and fertiliser duties (A, PC). Measure size of markets, and understand supply and demand conditions (A, PC)	December 2010	Discussions in the first 2 years identified key policy issues as: • Inefficient transport and limited supporting information to recommend where research should occur • Lack of information on the amount of funds allocated to fruit and vegetable research and likely return on research • Lack of information on returns to farmers and their technical and financial efficiency No studies were done on land tenure or fertiliser duties. Subsequently, value chain analysis identified these issues : • The ratio of farm price to retail price is decreasing due to limited access to high value markets, limited value adding to crop product, limited bargaining power • Productivity is low due to high production losses(eg pests), limited access to credit, high cost of inputs and thus low useage, inadequate use of technology, limited extension services • High marketing costs due to high transportation cost (land and sea transport), poor infrastructure facilities (roads, logistics/storage, shipping) • Production and marketing costs are increasing faster than price and productivity, thereby decreasing profitability • Producers are fragmented and not well organized (other nodes of the chain are concentrating) • High cost of doing business relative to other countries and much higher for small investors Australian work was not completed
3.2	Assess the economic significance of key policy constraints	Identify 2 to 3 case-study policy issues. Quantify impacts at the enterprise and farm level (A, PC).	December 2012	SEARCA – transport A report with a section on policy implications and costs has been published. (Llanto *et al.* 2013) PIDS – research intensity (level of expenditure on R&D), for fruit and vegetables compared to other industries is low. UPMin- 7 papers, which report policy constraints, are being prepared. Australian work was not completed

no.	Activity	outputs/ milestones	due date of output/ milestone	Comments – detail outputs here
		Reassess policy constraint impacts with information arising from the value chain analysis (A, PC)	December 2012	Some policy constraints are noted in section 7, Objective 3 Australian work was not completed
		Undertake detailed analysis of reform of the 2 to 3 key policy issues at the macro scale (A, PC)	December 2012	Key areas were: Value Chain often inefficient Transport inefficiency Research intensity for horticulture is low Australian work was not completed
3.3	Assess the feasibility of future changes to constraining policies and assess the implications for adoption of the technologies.	Collaborate with policy maker to determine options for implementing policy change and contribute to the policy change process (PC).	December 2012	Policy recommendations were provided that may improve transport efficiency. See Sections 7 and 9 Policy recommendations are noted in the conclusions and recommendation (Section 9).

PC = partner country, A = Australia

7 Key results and discussion

7.1 Objective 1: Undertake an economic analysis of the value chain of selected crops in southern Mindanao

All analyses are summarised in Table 1. A series of papers is being prepared and some have been published (Aguinaldo *et al.* 2013 and Sarmiento *et al.* 2013). Thus only a snapshot of results are presented here. A comprehensive across commodity paper is being prepared by the UPMin team.

Prices and marketing

Farm prices are generally decreasing faster than wholesale and retail prices. Costs of marketing are also increasing faster than production costs. Value adding costs are increasing due to an increasing proportion of crops sold to modern outlets.

Top producing areas for mango, papaya, cabbage, eggplant, tomato and potato in the Southern Philippines, were included in a market integration analysis.

Mango prices are better integrated than the other crops. The NCR retail market is believed to influence mango price formation at the farm level because it is the dominant market. Changes in wholesale prices influence the farm gate price movements for eggplants and tomatoes. Analyses of papaya and potato suggested that these are segmented markets, especially in the NCR retail market. Thus, initiatives to improve farm productivity should be focused on mango, cabbage, eggplant and tomato. Market inefficiencies could be due to logistics and marketing losses.

The analysis of net margins generally showed that all actors are gaining positive net margins and that farmers are receiving considerable net margin values.

However, there are still several issues affecting small-scale producers:.farmers lack capital for production, have very poor access to market information and take prices as dictated by their buyers.

Based on initial findings, fruits have leaner marketing layers than vegetables. That is, there are less market intermediaries along the fruit supply chain as compared to the vegetable supply chain. Initial findings also show that vegetable farmers in the study areas have less market channel choices than farmers of mango and papaya. One of the reasons for this is that fruits are high value crops in the Philippines and are largely exported by multinational companies, thus giving farmers incentives to produce and sell to different markets. In the case of papaya, there has been a significant decline in farmers' profitability now (2012) from three years ago. Due to market requirements (i.e. quality assurance/quality grading) and governance mechanisms imposed by the exporting firm, papaya farmers growing under contract have experienced declining recovery rates and downgrading of their produce, putting Class A papaya into a lower grade and thus a lower price is being offered. There are also a number of papaya growers in Tupi, South Cotabato who ship in bulk to local markets (Cebu, Bacolod, Cagayan de Oro and Manila). They appear to be more profitable than papaya farmers who are growing under contract for export markets.

The rise of modern retail formats requires producers to adapt to meet the demand of the market. However, producers have been unable to meet market demand due to issues affecting their production and marketing practices. Hence, the performance of farmers in the southern Philippines was analysed in terms of profitability, productivity, and technical efficiency. Crops analysed were potato, cabbage, tomato, mango and papaya.

Table 1. Summary of price spread, net margin, price transmission and market integration analyses, significant factors affecting profitability, productivity and technical efficiency and what crops had value chain mapping conducted. Further details can be found in papers Aguinaldo et al. (undated) and Sarmiento et al. (undated).

Analysis	Mango	Papaya	cabbage	Potato	Tomato	Eggplant	Durian	Methods[4]
Price spread	Declining share of farm price to retail price	NR [5]	Wholesalers & retailers make more per kg than farmers	Declining share of farm price to retail price	Declining share of farm price to retail price in Davao del Sur Declining retail share in Northern Mindanao	NR	NR	A3, A4, A5
Net margin	Farmers get the least net margins while wholesalers get the highest net margins	Contract growers gain higher net margins than non contract growers	Davao del Sur farmers gain higher net margins than Bukidnon farmers	Kapatagan (Davao del Sur) farmers gain higher net margins than Bukidnon farmers	Claveria (Misamis Oriental) farmers gain the highest net margins			A3, A4
Price transmission	Changes in the buying price are reflected in the selling price	NR	NR	Changes in the buying price are reflected in the selling price	Changes in the buying price are reflected in the selling price	NR	Changes in the buying price are reflected in the selling price	A3, A5
Market integration	High integration	Segmented	High integration	Segmented	Segmented	High integration	NR	A3, A4, A5

[4] Details of the analyses are in numbered appendices in this report

[5] NR: No report generated due to data not collected or incomplete data

Analysis	Mango	Papaya	cabbage	Potato	Tomato	Eggplant	Durian	Methods[4]
Value chain mapping [6]	Figure A5	Figure A4	Figure A8	Figure A7	Figure 9		Figure A3	Appendix 7
Profitability[7] [8]	> [9] price > yield > farmer's share < cost	> contracted > yield	> price > yield > price of good quality cabbage	> price > yield > financing status > fertiliser > education	> yield < fertiliser < pesticides > training	NR	NR	
Productivity	NR	> land area > fertiliser applied > contracted > own the land > frequency of harvest < labor (in man-days) <cost of seeds	> land > labor > organic fertilizer > inorganic fertilizer > cost of pesticide > cost of seed	> land > labor > organic fertilizer > inorganic fertilizer > cost of pesticide	> land > labor > organic Fert > inorganic Fer > pesticide > seed > sticks > years of farming > land Tenure	NR	NR	
Technical efficiency	n/a	< own capital	> land > farming experience < Bukidnon farmers	> male < education < coop Memb < trainings > motorized transport	> age > household Size > education			

[6] Jackfruit value chain is in Figure 6, Appendix 7

[7] Only P < 0.05 independent variables noted

[8] Variables expected to be related to profitability such as land area, total cost of production and unexpected variables excluded

[9] > means profitability, productivity or technical efficiency goes up with this variable, < means goes down

Potato is one of the vegetables imported into the Philippines because it is highly demanded by institutional buyers, specifically fast food chains. While national potato production has increased in the past ten years, production in Northern Mindanao declined by about 58%.

Potato farmers in the Davao del Sur are efficient and are gaining higher net margins than farmers in Bukidnon. Farm efficiency was identified as the main source of differences of net margins among the two areas with Davao del Sur being more efficient.

The main source of differences between the two areas were the use of motorized transportation (70% in Bukidnon; 96% in Davao del Sur, $P<0.05$) and attendance at potato farming training opportunities (39% in Bukidnon; 76% in Davao del Sur).

In Bukidnon farm productivity is declining. The performance difference can be explained by Davao del Sur farmers having higher capital inputs, high level of land ownership, and better infrastructure facilities. Prices received by farmers in Davao del Sur are better than those received by farmers in Bukidnon. Farmers in Davao del Sur are older, with more experience and are better trained than farmers in Bukidnon. Less profitable farmers have higher total costs and have borrowed/financed capital for production purposes.

For potato farmers, output is more responsive in decreasing order to land use, pesticide use, organic and inorganic fertilizer use. Farm profit analysis shows that education, volume sold, organic fertilizer use and prices of big classification potatoes have significant and positive influences on profit. Costs and farmers having their own source of capital decreases farm profit.

For potato farmers, output is more responsive to land use, pesticide use and inorganic and organic fertilizer use and farm profit analysis shows that education, volume sold, organic fertilizer use have significant influences.

Cabbage

Cabbage in the southern Philippines is largely produced in the provinces of Bukidnon in northern Mindanao and Davao del Sur in southern Mindanao. With declining farm gate prices coupled with increasing production costs, farmers' profit is being squeezed. Results of the net margins analysis showed that per kg, wholesalers, followed by farmers, gain the highest net margin among the three actors in the chains considered. Net earnings of farmers are affected by the level of rejects which constitute about 20% of the total production of Bukidnon farmers and 15% of the total production of Davao del Sur farmers. It is suggested the poor quality produce is associated with limited training on cabbage production and postharvest practices, poor road condition and poor storage facilities.

For cabbage, econometric modelling of production suggests that farmers become more productive as they age and when they have more education. The age of the farmer has a positive relationship with the volume of production. Farmers who are younger than 40 years old are producing 11,652 kg per ha while those 40 years and above are producing 16,078 kg per ha. On average, the latter group of farmers is producing 38% more than the former group. The education level of the farmer also is positively related to the level of output. Farmers with elementary and high school education are producing 12,553 kg per ha and 12,560 kg per ha respectively while farmers that received a college education are producing at the rate of 19,292 kg per ha.

Econometric modelling for farm profitability shows that price of good cabbage classification and total yield positively contribute to farm profitability. An additional 1 ha of land devoted to cabbage farming would increase profit by PhP 77,390 per ha. This finding is consistent with productivity and technical efficiency analysis. The price of good quality grade of cabbage will also positively influence profit. Also an increase in the total cabbage output by 1 kg increases farm profit by PhP 7.6 per ha.

.

Efficient cabbage farms are those that are relatively large, at least 1 ha, with older and more experienced farmers located in Kapatagan, Davao del Sur. The analysis of the surveys data showed the more efficient Davao del Sur farmers have approximately four cropping periods in a year while Bukidnon farmers have two cropping periods per year at the most. The latter farmers do not plant the same crop continuously for two reasons: (1) demand is not stable, so they plant cabbages when they anticipate higher prices and (2) pests will easily adapt and reproduce so they have to change the crop to manage the pests. A different variety of cabbage was planted in each location. Farmers in Davao del Sur planted *Wakamini* variety while farmers in Bukidnon planted the *Resist Crown* variety. The reason why different varieties are planted in each location should be studied in future research.

Trained cabbage farmers had a 55% ($P<0.05$) higher profits compared to non-trained farmers which was mainly due to low quantities of reject cabbages, lower production costs and higher yields.

Farmers with good access roads had 85% higher profit than those with poor access roads.

For **tomatoes**, results show that farmers in Misamis Oriental gain the highest net margin per kilogram (Aguinaldo *et al*. undated). Furthermore, they have the highest yield per ha and have the more efficient farms compared to those in Bukidnon and Davao del Sur in the southern Philippines.

In terms of productivity, econometric analysis suggests that the quantity of production inputs positively affects farm productivity. Additional expenditure on seeds and pesticides also contribute to farmer's productivity Results reveal that an increase in the farm size increases farmer's productivity and profitability but decreases the farm's technical efficiency. The researchers suggest this is because smaller areas are more manageable than larger farm areas especially as tomato is a delicate crop and requires more intensive farm management. Trained compared to non-trained farmers, more farming experience and farmers who own their land vs. those who do not are more profitable, more productive and more technically efficient. Other factors affecting farmers' returns include poor infrastructure facilities which can cause significant increases in the marketing losses for farmers. The marketing losses of farmers who have experienced poor road conditions are significantly higher than farmers who experienced good road conditions. Due to poor roads, it is suggested farmers experienced a decline in the quality of tomatoes, which corresponds to a relatively lower price.

For **mango,** econometric analysis identified volume sold and prices received by growers as drivers of profitability while cost of production negatively influenced profitability. It identified financing arrangement as significantly affecting profit. Non-financed farmers are more profitable compared to financed farmers.

For **papaya**, it is observed that inputs such as land area, fertilizer applied, farmers owning their land and frequency of harvest are positively related to papaya production, while labour inputs and cost of seed are negatively related. Farmers that are contracted and have higher yields are more profitable.

.The total cost of inputs as a factor of profitability is consistently significant and negatively related to profit for cabbage, mango, papaya and potato. For tomato, marketing cost is negatively related to its profitability. Farm size is positively related to the profitability of cabbage and tomato, and negatively related to mango profitability. The price of produce per kg is significant for all crops except tomato while volume is also significant and positively related to profit on all crops except papaya. Fertilizer input cost is significant for papaya, potato and tomato, with both organic and inorganic being significant for papaya and potato. The cost of pesticides is significant and negatively related to profitability of papaya and tomato. Financed production is negatively related to profitability for mango and positively related for potato. Based on the farmer's profile, education is positively related to profitability for papaya and potato, while training positively contributes to the profitability of tomato farmers.

Postharvest losses

The surveys allowed some estimates to be made of pre and postharvest losses (Table 2).

Field losses are defined as losses preharvest and are mainly due to diseases, pest infestation, weather conditions.

Marketing losses are defined here as wastage / spoilage losses postharvest. Respondents said these were mainly due to poor postharvest handling.

Most of the losses for fruits and vegetables in the UPMin studies were attributed to field losses, which are mainly caused by pests and diseases. The postharvest losses for papaya occur during marketing and for fruit which is rejected by the exporting firm.

Table 2. Estimates of field and postharvest losses for 5 crops.

Crop	Field losses (Percentage to total yield)	Marketing losses (Percentage to total yield)
Tomato	60.6	2.4
Cabbage	68.4	9.7
Potato	24.0	7.0
Papaya	15.0	9.7
Mango	20.3	nd[1]

[1] No data. The majority of the mango farmers do not deliver their produce to wholesale markets since they have financiers/financier-traders who go to production areas during harvest.

Issues of poor infrastructure facilities, increasing fuel cost, poor technical know-how and knowledge of proper postharvest handling remain a major concern in the fruit and vegetable industries.

Summary of objective 1 results

A huge amount of data has been collected and detailed analyses conducted. The analyses are ongoing and were not been completed when this final report was submitted. These analyses may reveal more after further data checking and ensuring any relationships of the independent factors are not influencing the analysis.

There is a challenge of how to take advantage of the wealth information collected on fruit and vegetable farmers in Mindanao so that livelihoods of smallholders famers can be improved.

7.2 Objective 2: To estimate the profitability of HORT/2007/066 and 067 program outcomes developed under components 1 to 4 and to use this to measure the component impacts upon Philippines vegetable and fruit industries and to enhance adoption of the technologies developed.

These activities depended on information being provided from members of each component. This information was harder to obtain than originally envisaged, partly because the component research was often at a very early stage in the research cycle and because potential yield increases, cost savings and risks were very hard to estimate. Scientists, extension officers and farmers indicated they wanted to see a range of seasons, pest and disease incidences and market prices before they were confident about making assumptions in areas in which they have little experience. This was acknowledged

by McClintock *et al*. (2012) p36. Also, researchers were often unconvinced of the value of ex ante analyses and were often more interested in completing experiments and analysing their data.

Vegetables

The GMs budgets were prepared for cabbage, tomato, cauliflower, chinese cabbage, eggplant, lettuce for the Visayas, covering one or more seasons, and potato, cabbages and broccoli for Mindanao. Current practice budgets for cabbage, potato and tomato (Philippines general) are available from VSU researcher (Lemuel Preciados) and are on the ACIAR archive website. The Mindanao GMs are available from Sonny Domingo and are on Meridio, the ACIAR archive website.

Another important part of the Component 5 research was the development of representative farming systems models for vegetable production in the Southern Philippines. The E-V for the Vegetable component research was developed to the point that it was operational. Baseline data were entered and it was ready to input information on component recommendations as they became available. The three files to run the sample farm systems model are available.

An interim report *"Economic Impacts of Component 2: Protected Cropping technology for vegetable production in the Southern Philippines (*McClintock *et al.* 20120 was prepared and posted on web2. The report provided information relevant to technology adoption that could be valuable to researchers as they developed a set of recommendations for farmer adoption.

The initial report on protected cropping was prepared in 2010 and 2011 (McClintock *et al*. 2012). The method relied on the Delphi technique. However, with hindsight it relied on people who generally had little experience with protected cropping production systems and the risks involved with protected cropping. See Appendix G, McClintock *et al.* 2012. As the C2 project research and extension processes developed, they either independently or through issues raised in C5, refined crops and management systems so that they are now able to recommend to Filipino farmers how they can profitability use protected cropping technology. See C2 component final report Rogers *et al.* (2013) and Armenia *et al.* (2013).

The resignation from the project of the NSW DPI researcher meant that the potential for further economic analysis of this technology using whole farm models became limited. Without the data estimates required for the whole-farm model, the model could not be employed in this research and key questions relating to adoption and risk could not be examined.

No ex ante analyses were completed for component 1 (soils). The component was reluctant to provide data and / or their designs did not allow an easy interpretation of results. A report was prepared (McClintock 2010) on the soils experimental designs in the hope that some reviews of the designs would allow economic analyses of the results. New designs were prepared by the C1 team in April 2011 but the implementation of these designs was limited.

Some basic GMs analyses were performed on the bacterial wilt work - without new technology then with some or all of the IPM options. These showed that GMs increased as disease controls increased and clean seed and soil were used, but a number of assumptions were necessary (Pathania *pers. comm*.)

The vegetable supply chain component (C4) conducted their own analyses (Rola-Rubzen *et al.* 2013, Batt *et al*. 2013).

Fruit

Jackfruit

The jackfruit and durian phytophthora research as well as mango IPM research being undertaken by Fruit components C2 and C4 was intended to increase the volume and quality of mango production. The research should lead to a shift in the supply curve of these fruits as production increases. If the increase in the production of these fruits is large enough to affect the prices received by farmers in the region, consumers will benefit mostly through lower prices. However, if the demand for these fruits is very strong and producers have good access to large markets or demand centres, the increase in production may have little effect on prices and producers will benefit from the research. The magnitude of the shift of the supply curve is estimated by aggregating farm level impacts using information about the extent and rate of adoption expected. The shift in supply is referred to as "k-shift" in welfare economics. Estimation of the "k-shift" associated with the component technologies is the link between the farm and regional level work undertaken in this report and the welfare analysis prepared by PIDS to estimate the ex ante net returns from research.

It was estimated that approximately 57.5% of 578 ha jackfruit area in Region VIII is affected by phytophthora. Key recommendations from the research team were

- Drain and mound the trees
- Remove diseased trees/ branches, sanitation, and pruning
- Apply chemicals eg. phosphonate by trunk injection
- Add compost
- A combination of both the chemical and cultural control practices for phytophthora control comprises the best practice recommendation.

Preliminary research has indicated that effective management of phytophthora can significantly reduce yield losses by approximately 22% per ha and reduce tree mortality by approximately 11%. Changes in yield and production cost associated with the adoption of best practice for phytophthora control will increase the GM per ha by 93%.

Based on the results of benefit-cost analysis and expectations of the level and rate of management practice adoption, the expected NPV of benefits from collaborative phytophthora research in Region VIII for jackfruit is approximately PhP 225 million (AUD 5.5 million) with a benefit-cost ratio of about 48:1 and an internal rate of return of approximately 43%.

Complete information for this analysis is in Preciados *et al*. (2013a).

Mango

It was estimated that 40% (7,255ha) of the total mango production area in Region XI (18,137ha) is affected by severe pest damage caused by cecid fly, thrips and scab which contribute to a yield loss or rejects of 40% of the total potential yield per ha.
Key recommendations from the research ream were:

- Prune overcrowded branches and disease affected parts of the tree to prevent pest and disease build up
- Introduce hygiene practices such as weed management, picking damaged fruit and collecting fallen fruit from the ground.
- Implement smudging (flower induction)
- Balanced fertilization – apply fertilizer based on soil analysis
- Regularly monitor pest and diseases
- Ensure appropriate timing of sprays

The suggested IPM practices for effective management of pests and diseases in mango orchards are expected to reduce yield losses or rejects by 20% and improve yields by about 33%. The recommended practices would also reduce the cost of production by 16% because there would be a 75% reduction in chemical control cost. Together this translates to about a 156% increase in income.

Based on the estimates of and expectations of level and rate of management practice adoption, the expected NPV of benefits from collaborative IPM research in Region XI for mango is approximately PhP 1.25 billion ($A30.55 million) with a benefit-cost ratio of about 51:1 and an internal rate of return of approximately 59%.

Complete information on this analysis is in Preciados *et al*. (2013b).

Durian

Part of the recommendation of the durian phytophthora research was to develop different levels of management options so that cash constrained farmers can choose the level or kinds of practices they adopt, depending on their financial resources and management skills.

Key recommendations from the research ream were:

- Apply effective micro-organisms + chicken dung
- Treat using bio-control (eg garden balsam extract)
- Apply Trichoderma
- Inject with phosphonate
- Introduce sanitation
- Improve drainage with better canal construction

Summary of financial benefits and costs to growers per ha with durian phytophthora management based on a comparative GMs analysis:

- Increase in yield by 30% and increase in production costs by 89% for low management option
- Increase in yield by 64% and increase in production costs by 336% for medium management option
- Increase in yield by 128% and increase in production costs by 461% for high management option
- Increase in GM by 26% if low management option is applied.
- Increase in GM by 47% if medium management option is applied.
- Increase in GM by 107% if high management option is applied.

Complete information on this analysis is in Preciados *et al*. (2013c).

Papaya

Baseline data were collected and 'without technology' GMs were prepared (Lemuel Preciados *pers. comm*. 2013). The 'with technology' GMs were not finalized as the availability of data from the production staff was delayed.

General

It is noted that the results above are for a particular nominated adoption rate. The rates may differ widely depending on future circumstances such as prices, yields and level of extension activities. Also the 5% discount rate may be regarded as low. Sensitivity analyses were conducted with jackfruit and mango at 0% and 10% discount rate (Preciados *et al*. (2013a, b and c).

NSW Vegetables

The GMs for NSW vegetables ranged from $155 to $3916 /ha and $31 to $951 / ML water. The full set of results including input costs are available at the NSW DPI website http://www.dpi.nsw.gov.au/agriculture/farm-business/budgets/vegetable. A sensitivity analysis of price vs yield for each vegetable crop was also documented

Kelly *et al.* (2013) and G. Kelly *pers. comm*. (2013) noted the figures in the 2013 'Gross Margin Budgets' will be easily transferrable into the VegTool program. VegTool is a

grower friendly Gross Margin Comparison Tool developed specifically for growers and the vegetable industry. The tool aims to assist growers with decision making about management practices and to improve financial understanding of the potential income and operating costs of vegetable crops. The VegTool program was funded by Horticulture Australia Limited with support from the vegetable industry levy. VegTool is currently being distributed to growers throughout Australia.

Queensland fruit

Economic assessments for trellising, phytophthhora of papaya and cocoa production suggested that the production options had the potential to increase farm returns. Consumers are also likely to gain from increased production of higher quality, moderately priced fruit as a result of trellising and better disease control.

An analysis in 2009 (Orr *et.al.* 2010) estimated that the benefit-cost ratio for the 2003-09 research into Phytophthora control was 49:1 and the net present value from adopting the results of the research was $28.5m.

GMs were prepared in 2009 for papaya production with and without control of Phytophthora and they showed GMs were respectively -$15,912 and +$46,484 /ha respectively for yellow Queensland papaya and -$22,672 and +$18,770 /ha for red solo papaya. (Orr *et al*. 2010).

An important benefit of both trellising of rambutan and custard apple and better disease management in papaya is the creation of more resilient industries, *viz*. industries better able to cope with and recover from cyclones and disease.

The economic assessment (Page 2013a, Attachment 7) found trellising of rambutan may increase long term production. With custard apple the cheaper lower yielding palmet system may be a better option than the higher yielding ‘V” system which requires higher capital investment for trees and trellises.

Tropical fruit producers who exited the industry following wipe-outs by cyclones Larry (March 2006) and Yasi (February 2011) should be encouraged to re-examine establishing tree fruit production operations based on trellised trees. An ability to explore and test the impact of trellises on the resilience/ profitability of their planned projects (using the spread sheets developed for these assessments) will enable them to see gains that were not otherwise evident.

Hypothetically when the fallow period used to control Phytophthora in papaya (Page 2013b, Attachment 8) is reduced from 4 years to 3 years and the production cycle is reduced from 7 to 6 years, an economic assessment using simulation found the changes would be very profitable. The system of a shortened fallow period is likely to have a 93% chance of outperforming the conventional system, with an average gain in excess of $23,000 per ha, per year.

This potential profitable change has added to the impetus of research into the management of crop fallows in papaya production systems. It has also highlighted the need to assess the profitability of the farming system as a whole rather than focussing exclusively on per hectare measures of performance such as GM per hectare.

An economic assessment of cocoa (Page 2013c, Attachment 9) suggested that it would be profitable if considered as an adjunct to other profitable farm activities.

Page (2013a) has suggested that DAFF (Qld) needs to consider conducting workshops to help producers explore the options of trellising and fallow management and that it is important that scientists and producers take ownership of economic assessments if they are to have any faith in them. They need to test their own expectations and perceptions by conducting their own assessments thereby building the capacity of individuals and communities to deal with complex issues.

In conclusion, it is suggested the Queensland economic assessments of trellising of rambutan and custard apple and reduced fallow for papaya should be reviewed, spread sheets be made more user friendly, user guidelines be prepared and then workshops be conducted so that farmers and advisors can do their own risk analyses.

7.3 Objective 3: To identify any policy constraints that may affect the adoption of technologies developed by the program, quantify their impacts at the farm level, and in some cases the industry level and Objective 2, Activity 2.5

Dr Briones, PIDS, prepared a paper 'Addressing Policy Issues and Constraints in Agricultural Diversification: the Potential Contribution of the Fruits and Vegetables Subsector' (Briones 2009) on policy issues in fruit and vegetable industries in the Philippines. It described the current situation and identified some potential areas for future research for Component 5. This policy paper was important in identifying regulation and monopoly power which was reflected in the price spreads and which may impede adoption of technology at the farm level.

Briones and Galang (2012) reviewed research spending in the Philippines including for fruit and vegetables. They noted the total research spending of the Philippines in 2003 was 0.11% of the GDP and that this is very low compared to Malaysia with 0.69% and Thailand with 0.24% (Stads *et al.* 2007).

The spreadsheet-based model, WISER, was developed to calculate the prospective impact of a new technology generated from fruits and vegetables R&D. It offers opportunities to view scenarios of different industry size.

The WISER model offers opportunities to view scenarios of different industry size, adoption rates, changes in supply etc. Thus outputs are not RESULTS in their own right, but give a guide to managers when they are deciding research priorities or to assist policy decisions. The following research note from Briones and Galang (2012) is included as an example of how WISER can assist in prioritising research strategies:

Prospective impact of a vegetable R&D program in selected regions in the Philippines

Philippine agriculture has experienced slow output growth since 1980s while it continues to employ one-third of the labour force. It is not surprising that poverty incidence is greater for agricultural households than non-agricultural. Among the possible solutions for the low productivity of Philippine agriculture is crop diversification. This entails planting of crops (e.g. horticultural crops) other than traditional ones (e.g. rice).

Research and development (R&D) is a potent instrument for realizing the potential contribution of horticultural crops in the development of the agricultural sector. However, R&D in Philippine agriculture has received around 5 % of the total budget for support services as indicated in the budget of the Department of Agriculture disaggregated by Major Final Output. This contrasts with the international trend of rising public agricultural research spending, especially for developing countries in Asia and the Pacific.

The Welfare Impact Simulator for Evaluating Research or WISER has been developed to assess the impact of horticultural R&D at the industry level in the Philippines. This mainly produces measures of project worth i.e. NPV, BCR and IRR.

This tool was used to compute for probable values of NPV, BCR and IRR for a vegetable research project that could be funded by ACIAR [10]. The project aims to develop the vegetable subsector in selected regions in Visayas and Mindanao by developing technologies through R&D. The focus for this example of estimate of value were the vegetables ampalaya, stringbeans, eggplant, okra and tomato while the selected regions are 7, 8, 10 and 11.

The baseline data were collected from these four regions and averaged from 2008 to 2010. Two scenarios were posited for comparison. High adoption refers to the calculation wherein maximum adoption and adoption after 20 years are 40% and 30%, respectively. Low adoption refers to estimates with lower adoption parameters —30% for the adoption ceiling and 25% after 20 years. Also, in each scenario, there are three categories—A, B, and C. The categories correspond to various farm-level reductions in cost per kg of output, also known as *k-shift*. A is for 20% k-shift, B is for 25% k-shift and C is for 30% k-shift. Aside from varying k-shifts in each scenario, there are two different amounts of estimated research costs in every category: PhP 4 M and PhP 8 M per year.

The aggregate results of the five focus vegetables are shown in table 3. Both adoption scenarios suggest very high returns given the high NPV, BCR and IRR values Doubling the research cost reduces the return on investment; however in no case does the NPV fall to zero. In fact the minimum BCR is 4.81 under the low adoption scenario with PhP 8 million research cost.

Table 3. Estimated NPV (PhP), BCR and IRR (%) for possible vegetable research impacting on regions 7, 8, 10 and 11 based on low and high adoption rates, varying research costs and k-shifts

		High Adoption			*Low Adoption*		
Research Cost (PhP millions)	**K-shift**	**NPV**	**BCR**	**IRR**	**NPV**	**BCR**	**IRR**
4	A	263,785	13.13	19.65	187,361	9.61	17.62
8		242,034	6.56	15.02	165,610	4.81	13.19
4	B	357,572	17.44	21.77	256,323	12.78	19.66
8		335,822	8.72	16.84	234,573	6.39	14.94
4	C	463,923	22.33	23.74	334,690	16.39	21.57
8		442,173	11.16	18.52	312,940	8.19	16.55

A = 20% k-shift, B is for 25% k-shift and C is for 30% k-shift

The prospective net economic benefit from the vegetable R&D program is positive based on the results of the simulations. Whether the adoption rate is 30% or 40% and the k-shift is 20%, 25% or 30%, the measures of project worth reveal that investing in research and development for key vegetables would be a worthwhile investment.

Another scenario-building exercise was done but this time, the postharvest loss was added as a variable. The focus vegetables include ampalaya, cabbage, eggplant, okra and tomato for the regions 7, 8, 10 and 11. The assumed annual cost of research is PhP 1

[10] This analysis was computed in late 2012. The data was used to support a new vegetable project submission and the project HORT 2012 / 20 has now been contracted.

million for each vegetable commodity for four years. For comparison, adoption parameters still vary. High adoption refers to the calculation wherein maximum adoption and adoption after 20 years are 50% and 20%, respectively. Low adoption refers to estimates with lower adoption parameters —25% for the adoption ceiling and 10% after 20 years. Each scenario has three categories—A, B, and C—corresponding for the k-shift. A is for 8% k-shift, B is for 18% k-shift and C is for 37% k-shift. Aside from varying k-shifts in each scenario, there are three different degrees of postharvest loss: 0%, 5% and 10%.

The aggregate results of the focus vegetables are shown in table 4. Both scenarios suggest positive impact given the high NPV, BCR and IRR values. The case with the highest return is the one with zero postharvest loss and greatest k-shift under the high adoption scenario.

Table 4. Estimated NPV (PhP), BCR and IRR (%) for possible vegetable research impacting on regions 7, 8, 10 and 11 based on low and high adoption rates, varying estimated postharvest losses and k-shifts.

		High Adoption			*Low Adoption*		
Postharvest Loss (%)	**K-shift**	**NPV**	**BCR**	**IRR**	**NPV**	**BCR**	**IRR**
0	A	54,453	3.32	10.36	16,578	1.71	7.41
5		52,511	3.24	10.24	15,572	1.66	7.29
10		50,570	3.15	10.11	14,567	1.62	7.17
0	B	171,921	8.32	15.18	77,226	4.29	12.10
5		167,012	8.11	15.03	74,688	4.18	11.95
10		162,103	7.90	14.87	72,150	4.07	11.80
0	C	474,300	21.20	21.23	234,809	11.00	18.03
5		461,532	20.65	21.02	228,237	10.72	17.83
10		448,765	20.11	20.82	221,664	10.44	17.63

The same results are obtained as compared to the previous scenario-building exercise—the prospective net economic benefit from the vegetable R&D program is positive. Whether the adoption rate is 25% or 50% and whether the k-shift is 8%, 18% or 37% (cost reduction due to new technology adoption) the measures of project worth reveal that the investment would be worthwhile.

These finding are consistent with the findings of other studies that show highly competitive commodities have high returns to investment in R&D, for example Pascual-Gapasin (2006) noted fruits and vegetables are commodities that have ‘high market potential and competitiveness’. With these kind of research projects, the technologies they generate benefit horticulture farmers in many ways (e.g. yield improvement, reduction in postharvest loss, etc.). Moreover, these improvements in farm productivity help to alleviate rural poverty.

Transport study (Objective 3.2)

Results have been published in Llanto *et al*. (2012) and (2013) and only summary information is provided here.

Mindanao is the major source of agricultural commodities in the Philippines, hence is considered the food basket of the country. In 2009, it produced about 1.54 million tons of food and live animals, of which a combined volume of 1.43 million tons were exported to the islands of Luzon (49%) and the Visayas (44%). During the same year, Mindanao imported only 272.3 thousand tons of food and live animals from Luzon and the Visayas. Particularly for fruits and vegetables, around 70 % of the total volume of major fruits and vegetables of the country are produced in Mindanao, of which more than 90% are transported to major urban centers in Luzon and the Visayas.

Being a key supplier of fruits and vegetables to Luzon and the Visayas, transportation and logistics play an important role in Mindanao's inter-regional trade. However, in an island archipelago like the Philippines, the movement of highly perishable crops like fruits and vegetables from key production areas in Mindanao to intermediate and terminal markets within and outside the island-region is hampered by the inadequacy of efficient and effective transport systems and port and shipping services. This then limits the potential gains that supply chain participants may realize from their produce, given the increasing demand for high quality and safe fruits and vegetables in the Philippines and abroad.

This study examined the inter-regional trade of major fruits and vegetables in the Philippines and identified the factors influencing the observed trade flows and how the same factors apply to the trade patterns of Mindanao. Using Mindanao as a case study, this study also analysed the factors contributing to high transportation costs and other problems in relation to the flow of goods, focusing on the possible influence of government regulations and investment program.

Macro-analysis using the gravity model (Table 5), revealed that economic size, level of market development, presence of good quality transport infrastructure particularly road network and ports and geographical proximity are important determinants of inter-regional agricultural trade in the Philippines. Specifically, results showed that a one percentage increase in the gross regional domestic product of the destination region would lead to an increase in the total trade for the three selected commodity groups by between 2 and 3%. Distance was found to have a negative effect on the inter-regional trade of agricultural commodities while length of paved road in the reporting region was positively related to the value of trade of fruits and vegetables. Availability of more markets in the destination region was also found to significantly increase the inter-regional trade of fruits and vegetables. As denoted by the model estimates, a one percent increase in the number of markets in the destination region boosts the total agricultural, vegetable, and fruit trade between regions by eight to nine percent.

Table 5. Regression results of the gravity model for total agriculture trade for vegetables and fruits

Explanatory Variables	Total Agricultural Trade	Total Vegetables[a]	Total Fruits[b]
GDP-reporting region	2.12***	0.67^{ns}	-1.22**
GDP-destination region	3.00***	2.09***	3.26***
Population of destination region	-4.36***	-5.58***	-7.16***
Distance	-0.61**	-0.40***	-0.41***
Paved road of reporting region	0.35^{ns}	1.81***	2.67**
Paved road of destination region	0.41^{ns}	0.35^{ns}	0.72^{ns}
Markets-destination region	9.84***	8.40***	8.73***
No. of vessels in port of origin	0.44***	0.25***	0.33***
Constant	-24.38***	0.54^{ns}	15.00***

[a] include PSCC codes *054* (vegetables, fresh, chilled, frozen or simply preserved (including dried leguminous vegetables); roots, tubers and other edible vegetable products, n.e.s., fresh or dried) and *056* (vegetables, roots and tubers, prepared or preserved, n.e.s.)

[b] include PSCC code *057* (fruit and nuts (not including oil nuts), fresh or dried)

Note: *** and ** mean significant at 1% and 5% probability level, respectively while “ns” means not significant

Economic growth and inter-regional trade in particular depend on access to markets by various economic agents such as growers, traders, truckers, wholesalers and shippers, and on the necessary hard and soft infrastructure that make inter-regional transactions and exchanges possible. Because distance drives up transport and marketing costs, a good network of roads and ports that links production areas to consumer markets is necessary.

These results are supported by analysis at the micro level. For all key actors in the fruit and vegetable supply chains, transport and logistics were identified as crucial components in their operations and further detail can be found in Llanto *et al*. (2013) including figures 10,11 and 12. Among the key transport-related issues and problems identified by the supply chain players interviewed are the high cost of transport rental and transport inputs (e.g. fuel), the absence of good quality road infrastructure from the source to the market, and, in some areas, the absence of connecting roads, inconsistent government regulations on trucking operations, occurrence of bribery or “informal payments” at the local level that increases the cost of trucking, and spoilage/wastage, quality deterioration and varying quality standards of the produce at the wholesale and retail levels.

Below is a summary of the findings of the micro-analysis of each key player in the supply chains for tomato, lettuce and papaya.

Growers. Availability of markets is not a problem but accessing these markets to dispose their crops is a challenge to the growers. While the poverty status of growers and their means of transportation were not found to be a major constraint to growers' access to markets, perceived or actual quality of road networks may have influenced the cost of going to market, which is a major factor affecting their decision to sell their produce to the market. Data showed that the more passable/better the quality of the road network is (as perceived by the growers), the lower is the transport cost associated with it. Since the majority of farm to market roads in the study areas in Mindanao are found to be of earth or gravel type, many growers may have been discouraged to bring their produce to the markets by themselves. This is despite the better opportunities to earn more from their produce in terms of higher prices received. The common alternative seems to be the convenience and the certainty of disposing their commodities through traders which is a common practice among growers.

While the use of traders assures growers a market for their produce without undergoing the hassles of transport, there is an opportunity cost related to the price differential between trader's buying price at the farm gate and the price that their produce can command outside the farm (Table 6). However, farmers may need a quick turnaround of their investments in production and thus, will settle for the lower prices offered by traders. The volume of produce may also be relatively small, which does not encourage a trip outside the farms. Clustering of farmers to consolidate individual produce into a larger volume to warrant sale outside the farms is an option but this entails strong coordination and cooperative behaviour. On the other hand, it may also be true that growers are unaware of market prices. Lack of access to timely and accurate market information in rural areas makes transactions inefficient.

Table 6. Distribution of growers and farm gate price of crops by method of disposing crops

Method of Disposing Crops	Percentage of Respondents			Farmgate Price (PhP/kg)		
	Lettuce	Tomato	Papaya	Lettuce	Tomato	Papaya
Bring personally to the market	13	16	3	30.23	8.19	9.63
Bring personally to the trader	21	37	14	29.93	9.87	3.20
Trader buys directly from growers	1	2	21	10.00	9.67	3.32
Consolidation	0	2	5	-	13.33	9.50
Contract buyer	4	0	3	50.00	-	6.83

***Traders*.** From the traders, papaya, tomatoes and lettuces are sold to different buyers or market outlets. The majority of the traders sell their produce to other traders and some sell their produce in municipal markets primarily because of the higher prices and thereby, the profit margin they receive from selling to these buyers. In going to the farm to source their produce and bringing this produce to traders or to markets, trading costs are incurred, of which transportation comprises a significant portion.

While traders cum truckers have the advantage of information, organizational capacity, and ownership of transport assets, which makes them better prepared to structure purchasing arrangements more favourable to them at the expense of small growers, they are the ones who are directly affected by the inadequacy of good quality transport

infrastructure and logistics facilities. Field data show how poorly constructed roads negatively impact on transport costs of participants in the food supply chain (Table 7).

Table 7. Travel time, transportation cost, and type of road traversed by traders in sourcing their crops

Commodity	Average time (minutes/trip)	Average cost [11](PhP/ trip)	Percentage of respondents that indicated the presence of road	No of traders by type of road traversed		
				Concrete & Asphalt	Gravel	Earth
Papaya	68.3	630	100	2	1	7
Lettuce + Tomato	57.3	285	77	5	18	7
Average	60.1	379	83	-	-	-

On the average, transportation comprises 11% and 26% of the total trading cost of tomato/ lettuce traders and papaya traders, respectively. Adding to these costs are the losses incurred during transport. For papaya traders, transport losses due to spoilage/wastage comprises about 13% of the total volume traded while it is 9% for tomato and lettuce traders. It is notable that the average transportation cost and transport losses (both in terms of percentage share) of papaya traders are substantially higher than that of tomato and lettuce traders. This is despite the fact that the travel time to locate and buy these commodities are almost equal and the selling destinations are the same. The large difference in transport cost between papaya traders and tomato/lettuce traders is attributed to the difference in the traders' mode of transportation and in the availability, accessibility and type/quality of road they traverse.

The majority of papaya traders use their own vehicles (i.e., trucks), to buy and sell their supply of commodities while none of them reported using a public utility vehicle (PUV). The higher transportation costs incurred by the papaya traders could be due to the reason that truck owners cum traders have to fully shoulder their fuel cost relative to smaller types of vehicle like public utility jeepneys, motorcycles and tricycles, which are more common to the tomato and lettuce traders and incur lower fuel cost since expenses are shared by other cargoes, including passengers. Moreover, since trucks load and unload larger volumes of commodities compared to other modes of transportation, the risk of having a higher amount of transport loss is greater. It should also be noted that a number of tomato and lettuce traders transport their produce through freight handlers, who are often the most organized and skilled in handling of goods, which could have contributed to the lower transport loss.

In terms of type and quality of roads, all papaya traders reported the presence of road that connects them to their sources of papaya. But most of these roads are of earth type. Only two out of the nine papaya traders indicated traversing concrete roads. On the other hand, 20 out of the 27 traders of lettuce and tomato reported the presence of road connections, which are found to be mostly gravel type.

Truckers. The truckers provide transport services from the farm to the markets as well as cargo handling and warehouse services. Such services are very important to ensure that the growers' produce will arrive at the destination in the best condition possible. However, the survey revealed that there is limited provision of trucking, handling and warehousing services provided by the truckers in Mindanao. For papaya, seven out of the 11 truckers

[11] *This is per trip, not cost per km*

provide handling services and only 3 truckers provide warehousing services. The case of tomato and lettuce is worse, wherein only about half of the truckers provide handling services and none provides warehousing services. One reason why these are limited is the huge capital required to invest in such services, particularly in the vehicles and equipment needed for the operation.

Another key finding is the positive relationship between the distance travelled and the trucking cost of the commodities. In the survey, 25 routes were identified – 11 routes for papaya and 14 for tomato and lettuce. All the routes going to Davao, which have a travel distance of about 350 km to 370 km, reported the highest trucking cost of around PhP1,000 to PhP 1,167 per ton. On the other hand, the routes with the shortest travel distance such as Imbayao-Malaybalay (12 km) and Cawayan-Valencia (50 km) routes had the cheapest trucking costs of PhP 330/ton and PhP 600/ton respectively. The report, Llanto *et al.* (2013) does an extra analysis relating the cost to distance. The trend is also exhibited in papaya trucking but not as distinct as that for tomato and lettuce. This could be due to other factors such as the quality of road infrastructure.

The presence of competition among truckers in the routes served is also identified as one factor that could have affected the cost of trucking. Competition among truckers is beneficial for the growers because it will promote efficiency in the services and can reduce transportation rates. This is very evident particularly in the trucking of tomato and lettuce, wherein routes which are serviced by more truckers posted lower trucking cost compared to those with less number of truckers, given the same distance travelled. However, such potential benefits of competition are clearly not being realized by the growers, as 17 out of the 25 routes are serviced by only one trucker. Field data also showed that there is an inverse relationship between the volume transported and the trucking cost. This implies that growers could take advantage of the economies of scale when loading greater volume of their produce per trip in order to reduce trucking cost.

The dearth of trucking services for papaya, tomato and lettuce could be attributed to the following problems and constraints raised by the truckers interviewed: (1) poorly constructed farm to market roads, which increase the incidence of truck breakdowns, lead to high maintenance costs, and increase road accidents, increase risks of spoilage and deterioration of the quality of the produce; (2) inconsistent government regulations, specifically in terms of honouring permits and detaining of the trucks at the barangay due to “lack of permit”, which in turn increases the cost of transportation and contributes to the spoilage and deterioration of the quality of farm produce; and (3) occurrence of “informal payments” at the local level, which augments the cost of trucking.

Based on the survey of 24 truckers of papaya, lettuce and tomato in 2011, more than 62% experienced informal payments. For papaya, truckers paying for informal payments had an average trucking cost of PhP1,286 per ton while those not experiencing informal payments only incurred PhP1,000 per ton. The same is observed for lettuce and tomato where costs were PhP 865 and PhP 735 respectively.

Proper cargo handling and warehousing services to avoid wastage and undue deterioration of the quality of produce, which impact on the bottom lines of growers, is also very critical. However, the survey showed that there is limited handling and warehousing services provided by the truckers in Mindanao, with only 7 out of 11 papaya truckers providing handling services and only 3 providing warehouse services. For lettuce and tomato, none of the 13 truckers interviewed provide warehousing services and only 7 have handling services. This is primarily due to huge capital required to invest in trucks and associated equipment. On the average, the minimum capital required for trucking services totals PhP834,545 for papaya and PhP600,211 for tomato and lettuce.

While there are inadequacies in the government’s related functions, the shortcomings on the side of the truckers in terms of following the government regulations and meeting the requirements also contribute to the inefficiency of the trucking services. To be eligible to transport cargo, truckers are required to follow strict standards by acquiring certificates of conformity, have proof of capable staff, pay for a business permit and conveyance permit,

and make a detailed business plan. The survey revealed that except for securing the necessary permits, the rest of the requirements, especially the certificates of conformity, professional trade registration and proof of staff capability were not met by many truckers.

***Ports and Shipping*.** Improvements in the ports and in portside facilities such as container yards, transport terminal and gantry cranes are also crucial to seamless transport and shipping services. For high value commodities like papaya, lettuce and tomato, local shippers usually ship under 'less-than-container' load (LCL) because they cannot meet the required volume to fill a 'full container load' (FCL), which commands lower freight rates. Hence, domestic shipping costs for such commodities tend to be much higher than shipping costs for exportable crops like pineapples and bananas. With LCL, shipping is more tedious because there is a need for an area where the shipper assembles or aggregates commodities before loading them as LCL. The consolidation can be done in a container yard but there are associated fees for the use of the container yard and for loading of the produce in the container ships.

Due to high cost associated with shipping under LCL, RORO ships are used as an alternative for small growers who want to ship their commodities directly to wholesalers or wholesalers-retailers in the urban centers in Metro Manila and in the Visayas. Shipping of commodities destined for domestic markets using RORO ships is more affordable and convenient to local producers, traders, truckers or shippers than shipping under LCL. However, small growers do not have transport vehicles and are not properly organized and thus are still not able to take advantage of the RORO facilities in the area. They have to invest in their own trucks for transport of farm produce in and out of the RORO upon reaching the ports of destination rather than rely on shippers or truckers for transport services, so that they will have direct access to urban markets, which can offer better prices for their produce. The container shipping is a much cheaper method of shipping than via RORO vessels, LCL and FCL cargos but because of the lack of capacity of growers to consolidate the volume of produce that will fill the container ships, the growers are constrained to using RORO vessels.

***Wholesalers and Wholesaler-retailers*.** Most of the wholesalers and wholesaler-retailers purchase their supply of papaya, tomato and lettuce from the traders (who are also consolidators) primarily due to reasons of convenience and custom. Unlike growers or traders and truckers, transportation costs incurred by the wholesalers and wholesaler-retailers comprise a relatively smaller percentage of their marketing costs. On average, transportation costs make up only 7 to 9% of the total marketing costs of papaya, tomato and lettuce. This could be expected since most of the wholesalers and wholesaler-retailers are located in the urban areas where road condition is relatively good and where the markets are proximate to one another. Besides, their supply of commodities is usually delivered to them by the traders while their buyers (retailers and end consumers) often go to their stalls/storehouse to buy their commodities. However, the transportation costs and the related problems directly borne by the other key players (growers, traders and truckers) who are in the early stages of the supply chain are passed on to the wholesalers and wholesaler-retailers in another form, primarily in the form of postharvest losses (spoilage/wastage) and poor quality standards.

Other serious transport-related problems that were identified in the study include the postharvest losses and the poor quality standards of the commodity when it reaches the retail level. These are attributable to the inadequate transport and logistics services, which delay the delivery of the commodities and to the poor handling and storage practices from the farm down to the wholesale and retail level, which hasten the deterioration of the commodities.

Spoilage is one of the most important factors affecting the operations of the wholesalers and wholesaler-retailers interviewed. On the average, 11 to 12 % of the total volume of tomato and lettuce transported and marketed are not sold due to spoilage/wastage (see Table 29, Llanto *et al.* 2013). For papaya, about 15 % are spoiled or wasted at wholesaler-retailers' stage. This could be attributed to the inadequate transportation, shipping and logistics services and poor handling and storage practices particularly at the

level of farmers, traders, truckers and shippers. This leads to delays in delivery, hastening of the deterioration of the produce, and consequently an increased rate of postharvest losses at the wholesale and retail level.

Another critical issue identified by the wholesalers and wholesaler-retailers is the varying quality standards of the produce. During transport of the commodities from growers down to the last links of the supply chain, quality of the commodities is expected to vary or deteriorate. However, because of the lack of capacity to properly sort and grade the produce, the wholesaler-retailers are prevented from getting the best price paid .Sorting and grading of commodities at their level is tedious and difficult for the wholesalers and wholesaler-retailers due to inconsistent grading and standardization of size and quality of fruits and vegetables acceptable to the market.

Lastly, market information, particularly on prices, is very crucial to the operations of wholesalers and wholesaler-retailers. Those with knowledge on prices could sell their commodities at a higher price and achieve higher GMs compared to those without access to price information (Table 8).

Table 8. Selling price and GM for wholesalers and wholesaler-retailers, by access to price information and by location

With access to price information	No. of respondents			Selling price (PhP/kg)			Gross margin (%)		
	Tomato	Lettuce	Papaya	Tomato	Lettuce	Papaya	Tomato	Lettuce	Papaya
Manila									
No	13	8	4	33.00	.	.	29	.	.
Yes	25	5	11	34.00	.	.	4	.	.
Bacolod									
No	0	0	1	.	.	30	.	.	66
Yes	26	2	3	34.38	90.00	33	17	24	34
Cebu									
No	6	1	5	28.00	58.50	20.40	26	30	62
Yes	14	6	10	34.00	76.25	16.88	29	39	57

Discussion of transport study

Sustained economic growth and proliferation of business and other users are key determinants to expanded inter-regional trade

The estimated gravity model provided insights into the key determinants of inter-regional trade. As predicted by the model economic size of the trading regions is a significant determinant. Economic growth in both reporting and destination regions is necessary for inter-regional trade to flourish. Because distance drives up total transport and marketing costs, the necessity of a good network of roads and ports that links production areas to consumer markets cannot be underestimated. Inadequacy of infrastructure has been a major reason for the country's lack of competitiveness and attraction as a viable and profitable business destination.

Improving markets to enhance growers' viability and profitability

The production of high value crops such as papaya, lettuce and tomato is largely in the hands of a large number of small, unorganized farmers who act independently and are faced with a few big buyers/traders and truckers who move the produce to wholesale and retail markets. It will be possible for small farmers to generate bigger profit margins if they themselves are able to bring their produce directly to urban markets in Mindanao such as the cities of Cagayan de Oro and Davao, Metro Manila, and urban centers in the Visayas. Alternatively, if farmers are finally able to consolidate the required volume of produce in the farms they can ask for containers to be loaded and filled with produce right on the farms for quick loading to container ships waiting in the ports. With limited options and capacity, small growers are dependent on traders and wholesalers-retailers for disposing or selling their crops. With the advantage of information, organizational capacity, and ownership of transport assets, traders are better prepared to structure purchasing arrangements more favourable to them at the expense of small producers/growers.

Strengthening grower's market capacities including their access to good quality market information

The need to strengthen market capacities of growers to be at par or close, at least to the market capability of traders with traders is essential. Interviews with growers show the

relatively lower level of education and technical training of these respondents compared with those in the marketing and distribution nodes of the supply chain. There is a need for more investment in education and technical training for growers or producers, and for the government to improve the accessibility of market information, modern inputs and technology. Availability of and access to market information will make the food market more competitive.

Road and port linkages to production areas and proper cargo handling

A third result of the study stresses the importance of having the proper road and port network, and portside facilities, and linking these to production areas. The objective is to have a seamless transport and shipping service, which produces or generates value addition at each node of the supply chain for the benefit of players in the chain and ultimately end-consumers. Field data show how poorly constructed roads negatively impact on transport costs of participants in the food supply chain. The analysis also shows the critical importance of proper cargo handling and warehousing services, in short, logistics services to avoid wastage and undue deterioration of the quality of produce, which impact on the bottom lines of growers. Improvements in the ports and in portside facilities, e.g. container yard, transport terminal, gantry cranes, etc. are crucial to seamless transport and shipping service.

Linking or integrating production areas to the destination areas or urban markets through efficient transport infrastructure and logistics facilities will improve the competitiveness of those economic agents and contribute to the availability of lower priced food to consumers. Investments in hard infrastructure, specifically quality roads and ports, and development of trade-enhancing logistics such as efficient container and terminal yards and other port side facilities will reduce the time and cost of doing business of participants or economic agents in the food supply chain. Major transport and logistical bottlenecks worsened by the poor condition of farm-to-market roads that have hampered the export of agricultural commodities from Mindanao and have impeded growth (NEDA-UNDP 2005)[12].

Market regulation and good governance

Finally, the impact of regulation and good governance on the supply chain has also been highlighted in the interviews of truckers. Informal payments ('bribes') and inconsistent application of rules (the case of permits honoured in one barangay but not recognized in another barangay) are hard realities in the supply chain. Corrupt practices by local officials, which increase the costs of transport and shipping of produce from production areas to the urban markets, may get translated into higher prices for the end-consumer. There is a case for improving governance on the part of government but as well, there is a need to strictly monitor and impose regulations especially those pertaining to safety and soundness of transport and shipping. Good governance is indispensable to reduce the cost of doing business and to ensure efficient market exchange especially for small players in the food supply chain.

Objective 3.3 Assess the feasibility of future changes to constraining policies and assess the implications for adoption of the technologies.

Based on value chain analysis, UPMin identified these issues:

- The share of farm price to retail price is decreasing due to limited access to high value markets, limited value adding and limited bargaining power
- Productivity is low due to production losses, limited access to credit, high cost of inputs, inadequate technology, limited extension services

[12] See for example, Kimura, Fukunari and Mitsuhiro Maeda (2005), "Transport Development in Japan and Korea: Drawing Lessons for the Philippines," November. http://www.bnm.gov.my/microsites/rcicc/papers/s5.kimura.pdf (date accessed November 10, 2011)

- Production costs are high due to the high costs of inputs and production losses
- Marketing costs are high due to high transportation costs (land and sea transport), poor infrastructure facilities (roads, logistics/storage, shipping)
- Production and marketing costs are increasing faster than price and productivity thereby decreasing profitability
- Producers are fragmented and not well organized (other nodes of the chain are concentrating).
- There is a high cost of doing business relative to other countries and costs are much higher for small investors

To resolve these issues UPMin suggested there is a need for policies to be reviewed in the following areas:

- Competition policy (sea-transport, price fixing, under-pricing, etc)
- Agricultural ventures agreements (eg papaya, tomato, Department of Agrarian Reform Administrative Order DAO 9)
- Local Government Unit (LGU) cost sharing of infrastructure budgets from foreign funds (eg. World Bank and International Fund for agricultural development). Low income municipalities lack resources to come up with counterpart funding to to take advantage of infrastructure budgets from foreign funding
- Decentralization of agricultural extension services under local government code of 1992 (convergence of Department of Agriculture (DA), DAR, Department of Environment and Natural Resources (DENR), National Technology Commercialization Program (NTCP)
- Reinforcement or promotion of planned government initiatives (such as the SAFDZ) and current initiatives such as Agrarian Reform Clusters to promote consolidation of small farms.
- As the market is better integrated for mango, cabbage, eggplant and tomato, i.e. farmers benefit from retail changes, it is suggested these should be the focus crops for development rather than the other crops studied *viz.* papaya and potato.

SEARCA

Based on the transport study, SEARCA identified these issues:

- Inadequacy of infrastructure has been a major reason for the country's lack of competitiveness and attraction as a viable and profitable business destination.

- With limited options and capacity, small growers are dependent on traders and wholesalers-retailers for disposing or selling their crops.

- There is a need for more investment in education and technical training for growers and for the government to improve the accessibility of market information, modern inputs and technology.

- Field survey data and interviews showed how poorly constructed roads negatively impact on transport costs of participants in the food supply chain. The analysis also showed the critical importance of proper cargo handling and warehousing services

- The impact of regulation and good governance on the supply chain was highlighted in the interviews with truckers.

To address these issues SEARCA suggested:

- A good network of roads and ports that links production areas to consumer markets is a necessity

- When farmers are finally able to consolidate the required volume of produce in the farms they maybe able to ask for containers to be loaded and filled with produce on the farms for quick loading to container ships waiting in the ports
- Availability of and access to market information will make the food market more competitive.
- Linking or integrating production areas to the destination areas or urban markets through efficient transport infrastructure and logistics facilities will improve the competitiveness and contribute to the availability of lower priced food to consumers..
- Good governance is indispensable to reducing the cost of doing business and to ensure efficient market exchange especially for small players in the food supply chain.

PIDS

Based on the policy paper (Briones 2009) and WISER Manual for Users'. Briones and Galang (2012) identified, amongst others, these issues:

- Regulation and monopoly power are reflected in the price spreads and may impede adoption of technology at the farm level.
- There is a lack of information on the amount of funds allocated to fruit and vegetable research and likely return on research

To address the research allocation issue they found using the WISER model to evaluate proposed research with vegetables, and scenarios of adoption rate of 30% or 40% and the k-shift is 20%, 25% or 30%, that investing in R&D for key vegetables would be a very worthwhile investment.

Comments on results, component management and future direction.

1. **A summary of the economic analyses** is in Section 8.3.1, Economic impacts. The various economic analyses revealed that many of the new farmer recommendations would be economically viable and much of the current or proposed research should be supported.

It is a 'given' that where some component experiments did not suggest possible new interventions that would be viable or possible research activities would have low BCRs, that no economic analyses occurred. Thus this table of economic results is 'biased' in favour of positive outcomes.

2. **Gross margins and input costs**

As reported above, GMs were prepared for both NSW and Philippine vegetable crops.

An interesting observation was the relative differences in input costs. Of course GMs are always specific for region, crop, year etc. and are not directly comparable.

For Australia (Kelly *et al.* 2013) found a large portion of the input costs for the 16 vegetables were labour, with other costs including water, fuel, electricity and in some cases bee hives. They also included selling commissions and statutory levies. On average across the 16 crops, fertiliser costs averaged 8.2% and chemicals 3.4% of total costs.

In the Philippines input data was collated by surveying farmers. The information was primary collected so budgets could be prepared and used for baseline information for 'without technology' costs and then to subsequently compare GMs with those 'with technology'.

For Leyte (Preciados *et al.* 2013d), average costs of inputs for:

fertiliser were recorded as 41.2% and chemicals at 10.1% of total variable costs

For Mindanao (Domingo *et al.* 2013) average costs of inputs for:

fertiliser were recorded as 37.0 % and chemicals at 14.5% of total variable costs

There is an opportunity to do further analysis of fruit and vegetable production and marketing costs. Such an analysis may give insights into where savings could be made with a view to increasing profitability. Other data available includes that obtained through the C5 UPMin studies on farmer technical efficiency and the C4 supply chain component which assessed the costs and returns for a number of vegetable cluster groups. The transport study also documented some farmer costs and returns.

PCAARRD and other Philippine organisations have also produced information bulletins for many fruit and vegetable crops and these include GMs based on recommended fertiliser, chemical and other inputs.

GMs were also prepared for papaya in Queensland (Orr *et al.* 2010) and in the Philippines for papaya (Preciados unpublished report), mango (Preciados *et al.* 2013b), durian (Preciados *et al.* 2013c and jackfruit (Preciados *et al.* 2013a).

3. Note on component management

Whilst the fruit and vegetable economic components were part of separate projects they were managed together as most activities and staff were the same for both the fruit and vegetables C5 components.

The C5 components had a wide range of aims and many of the planned activities to help achieve the aims were very dependant on information supplied from the other technical components (C1 to C4 for fruit and vegetables). The information was more difficult to obtain than was anticipated, despite a number of processes being used. Some of this was due to the technical research being very early in its research cycle and thus some of the accuracy of the data could be questioned. Consequently some of the potential results and directions from the farm analyses were less than originally planned. This limited the components planned outputs particularly those for objective 2. Thus with hindsight, C5 had a very ambitious agenda.

Some funds were saved because of staff vacancies in Australia and these were redirected to other components or for extra activities in the Philippines. Also some Australian work did not proceed due to changes in NSW DPI priorities or lack of staff.

There were three separate principal investigators over the life of the component and 2½ years when there was no principal investigator. Also a number of key (and very experienced) staff were only involved for 1 to 2 years. Of the 7 key staff involved with the original proposal, only one was employed by the same organisation in the same capacity at the end of the project.

4. Notes on component issues

Some of the issues that arose with the project were beyond the control of ACIAR or NSW DPI eg

i) the resignations from the project of Australians Randall Jones, Anthea McClintock and Kirrily Pollock (new jobs) and Leanne Orr (NSW DPI office location issues) and retirement of John Mullen,
ii) There were overseas travel issues which limited initial planning,
iii) Some of the Philippines work was very early in the research cycle and arguably did not need detailed economic analysis.

Other issues were more controllable.

i) Some experiments were not designed appropriately to yield robust data that could be subject to economic analysis. It is acknowledged that new Philippines projects need to devote extra resources to capacity building including experimental design.

ii) No impact pathway was developed for some of the economic outputs including a communication plan and the involvement of extension / adoption experts was limited. However, this would have taken additional resources.
iii) There was separate leadership of the economic components to the technical components and this limited integration.
iv) There was no consistent Australian policy economist involved with the studies. The policy work was valuable and well conducted, but the value of it was possibly limited because it was subsumed within a large fruit and vegetable production projects. It is suggested that policy research needs to be conducted in close liaison with policy makers and senior managers to increase the chances that policy recommendations will be considered.

5. As a result of some of the issues noted above, three suggestions are made on economist analysis with new planned Philippine projects.

While these have been discussed with other C5 present and past members, they are essentially the opinion of David Hall, vegetable project manager and final 'administrator' of C5.

- It may be preferable if economists are embedded within projects, not part of a separate project / component and are thus directly involved in the planning and subsequent analysis of technical work including ex ante impact analysis. This means they would have had more of a 'service' role rather than putting effort into say economic modeling or policy research in its own right. This is not suggesting that policy research is not important, just maybe not a priority for the 2013-17 Philippines Horticulture Program.
- That very basic economic analysis training be provided to some staff within new projects and the booklet being prepared as part of this component 'Farm economic analyses, with Philippine examples' be disseminated.
- A small review be conducted: Suggested review plan

1. Identify areas where economic analyses can make a contribution within each project eg farm analyses, partial budgeting, market studies, value chain, econometrics, farm or market models, ex and post -ante analyses, DREAM etc
2. Decide what role economists have with each project (eg service, lead separate activities, ongoing or ad hoc) and thus what skills are required.
3. Identify potential Australian and Philippine economists who have a focus on the Southern Philippines
4. Recommend a strategy to ensure that the skill gaps of nominated Australian and Philippine economists are addressed through relevant training, mentoring and supervised work experience.
5. Develop a process for cross-project economics meetings to increase co-operation and sharing of experiences and skills.

6. Final comment to results and discussion section

It needs to be noted that there were a large number of outputs including refereed reports and papers from this economic and policy component, despite the comments above.

8 Impacts

A Policy Advisory Reference Group (PARG) was established through UPMin as part of this component. The group, comprising influential people from government and industry, met in 2011 and 2012 and provided feedback on project results as they were developed and advice on whether or not it would be feasible to pursue reforms to the policies identified. However, members of the group may not have been able to influence all areas of policy identified by the project. Nevertheless, they expressed interest in applying the UPMin research findings and implications in their involvement and linkages with government programs to improve the livelihoods of smallholder farmers. For example, it is planned that policy issues and research findings be disseminated to include presentations to the regional competitive council[12]. The PARG may have longer term impacts beyond the term of the project.

Measures of the impacts of the economic studies reported here (summarised in Table 9, Section 8.3.1) can be assessed in future years. The results presented here are estimates of potential net benefits based on various assumptions drawn from the results of trials and surveys of farmers and service providers along relevant commodity supply chains.

8.1 Scientific impacts – now and in 5 years

Existing knowledge was applied to develop a completely original and user-friendly impact assessment tool, WISER, which can be utilized by economists and trained technical staff from research and development and extension agencies. The model can be used to inform decisions on policy change and research priorities.

The use of the Gravity model demonstrated that product flows between sites in the Philippines can be mapped to help explain trade patterns. The model can be used more widely to support policy recommendations affecting the efficiency of supply chain operations.

The interaction between production scientists and economists should increase the understanding by scientists of how technology uptake is influenced by several factors including potential returns, grower attitudes towards risk and uncertainty, and factors in the institutional environment including policy and regulations and access to credit.

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.

Qld fruit

The risk analyses of trellising for rambutan and custard apple and phytophthora control in papaya used grower expectations with some input from Qld DAFF staff. The results generated were based on distributions rather than single point estimates and included estimates of the average return as well as the range of returns and associated probability. This method of assessment removes the need for sensitivity analysis.

[12] This is a Public-Private task force on Philippine Competitiveness by virtue of Presidential Executive Order No. 571 to address the improvement of the country's competitiveness. The Council is co-chaired by the Secretary of the Department of Trade and Industry for the public sector and Ambassador Cesar Bautista for the private sector. See http://www.dti.gov.ph/dti/index.php?p=421

8.2 Capacity impacts – now and in 5 years

Objective 1. The surveys by UPMin and by SEARCA for the transport study employed local government employees, aides and college students who gained experience in undertaking interviews, collecting data and conducting basic surveys, for which they received a small remuneration.

Glory Dee Romo, Research Associate UPMin, was awarded an ACIAR John Allwright Fellowship to study for a Ph.D in Australia. She commenced her studies at University of Queensland in January 2012. Thesis title "Scale analysis on technology adoption under production uncertainty"

Francis Quimba, PIDS research associate, who contributed to the transport study, commenced PhD studies at the National Graduate Institute for Policy Studies in Tokyo, Japan in 2011 with his thesis study area in an agricultural area.

Lemuel Preciados, VSU was awarded an ACIAR John Allwright Fellowship for a Masters degree program in international economics and finance at University of Queensland and commenced in March 2013.

Roxanne Aguinaldo, Glory Dee Romo, Nikko Laorden and Jon Marx Sarmiento from UPMin attended the ACIAR echo seminar on 'Impact assessment frameworks' in November 2010, Los Baños.

Jon Marx Sarmiento and Lemuel Preciados (VSU) attended the training on 'Technology evaluation and impact assessment' in Los Baños in July / August 2011.

Sally Bulayog, VSU, attended an impact assessment workshop in March 2009 in India.

Lemuel Preciados, partly through Anthea McClintock and Leanne Orr learned how to prepare GM budgets both 'with' and 'without technology' recommendations for fruit and vegetable crops, learned how to work with and explain concepts underpinning economic research activities and objectives to people from a range of backgrounds, gained experience in the Delphi Technique for gaining consensus for uncertain data and also in facilitating workshops and preparing and analysing survey data. He also gained experience in benefit-cost analysis and also became familiar with methods such as E-V analysis to examine trade-offs between risk and income and welfare analysis to examine changes in consumer and producer surplus associated with the adoption of new technologies affecting agricultural production.

Ivory Myka Galang, PIDS was able to develop analytical skills in economic surplus modelling using the WISER model and increased her capacity in research-related data gathering and dissemination.

Karen Quilloy, research assistant SEARCA, gained considerable research, writing and economic analysis experience through the project including the farm economic analysis training and this has assisted her in gaining a teaching (includes research) position at the Institute of Cooperatives and Bio-Enterprise Development, College of Economics and Management, University of the Philippines Los Baños. She has acknowledged that this project was of great benefit to her, even though only being involved for about 18 months.

At UPMin, nine thesis students strengthened their research capacity through training within the project. Students names, the year and thesis titles were:

Abenoja, N.A. (2009). *The Philippine fresh solo papaya industry: price transmission elasticity, net margins and value chain analyses*

Aguinaldo, R.T. (2009). *Marketing margins analysis of the Philippine mango industry: price transmission and net margins*

Cabrera, M.M.B.M. (2009). *Marketing margins analysis of durian from Davao city: price transmission and net margins*

Castillo, A.K.C. (2012). *Mango production in major areas in Davao region: Efficiency, margins and markets*

Castro, M.M.C. (2012). *Value chain of potato in Bukidnon and Kapatagan: Net margins, market options and price analysis*

Laorden, N.L. (2009). *Marketing margin analysis of potato in Bukidnon: price transmission and net margins*

Naparan, R.M.P. (2012). *Value chain of potato in Bukidnon and Kapatagan: Net margins, market options and price analysis*

Talo, G.A. (2012). *Value chain of potato in Bukidnon and Kapatagan: Net margins, market options and price analysis*

Vicencio, M.J.D. (2009). *Marketing margin analysis of tomato from barangay Kapatagan sold in Bankerohan public market: price transmission and net margins*

A workshop on farm budget modelling was conducted at UPMin by Dr Randall Jones in February 2010. UPMin team members, Glory Dee Romo, Nikko Laorden, Roxanne Aguinaldo and Larry Digal and also Luis Hualda from Component 4 (Supply Chain) attended the workshop. The workshop included hands-on exposure on the farm budget modelling and some discussions on the possibility of using the model for evaluating effects of quality differentiation (variable price due to quality premia), market outlet differentiation and post-production costs (eg cost of transportation/shipping).

A workshop on 'Economic analysis techniques for evaluation of farm fruit and vegetable systems' was held at VSU, Leyte in November 2012. Attendees from the C5 component included Roxanne Aguinaldo, Carol Balgos, Larry Digal, Nikko Laorden and Jon Marx Sarmiento (UPMin), Lemuel Preciados and Sally Bulayog (VSU), Ivory Myka Galang (PIDS) and Karen Quilloy (SEARCA). The course included a module on the need to perform economic evaluations and modules on techniques including GM analysis, productivity analysis and indicators for productivity, partial budgeting, whole farm income analysis, cash flow analysis, benefit-cost analysis and economic surplus modelling using the WISER model. An evaluation of this course is in attachment 6.

There were 12 other participants from other components or institutions in the training program.

8.3 Community impacts – now and in 5 years

The Component 5 research was designed to produce research outputs that will aid in formulating policies which will benefit industry stakeholders. Research outputs are being and will continue to be disseminated over the next few years through forums and conferences and by producing policy briefs and research notes which will be made available and accessible online. These reports may also be submitted to the local government units of the areas considered in the studies.

Hopefully the policy briefs and research notes will be used by policy-making bodies to reform existing policies or create new policies which will contribute to improvements to the livelihoods of smallholder farmers.

Improvement of transport and logistics infrastructure will ultimately benefit farming communities in Mindanao and the other players in the fruit and vegetable supply chains.

8.3.1 Economic impacts

The research outputs of C5 seek to understand the activities along the chain, pricing and governance mechanisms, and changes in value chains over time. Research outcomes can contribute inputs for policy and program implementations through policy briefs which contain issues, key findings, conclusions and recommendations of the research and will be distributed to different stakeholders and institutions for review and appropriate action. These findings can be the basis for policy and program reforms or new initiatives for the benefit of smallholder farmers.

From the farm level analysis studies, advice can be provided on the relative profitability of proposed technologies for farmers and extension staff. These studies provide indications of the likely benefits from investment in research and development of production factors which are critical to profitability and will increase income and / or reduce farmer's production risk across growing seasons.

The GMs analyses may help farmers increase their understanding of their costs of production to enable informed decisions about marketing (eg. the feasibility of a fixed price contract), input usage (return from changes in input use) and technology adoption. This will provide opportunities for farmers to develop their financial skills and move towards profitable commercial horticultural production.

The GMs budgets developed in this project may be used as baselines for further research and any research related to vegetable production. They are available from the ACIAR archive web site Meridio.

The information contained in the enterprise budgets can also be used by agricultural producers, extension specialists, financial institutions, government agencies and other advisers making decisions in the fruit and vegetable industries to assist say loan applications for developing infrastructure.

The UPMin and transport studies (SEARCA) may increase incomes of small farmers/producers and other players in the food supply chain as a result of increased inter-regional trade in high value produce.

Based on the assumptions used in the WISER models, mango had the highest measure of project worth among the fruits. This reflects the larger size of the industry and optimistic views when providing adoption rates and k shifts. Mango project research worth amounted to PhP 1B under the low adoption scenario and PhP 3.4 B under the high adoption scenario. For the vegetable research, as much as PhP1.3 billion is the expected benefit from research into the key vegetable commodities.

Estimates for the high adoption scenario's threshold k-shift (20% maximum adoption) reveal that most of the commodities need small k-shift values to positively respond to investments. Some of the commodities such as potato, eggplant, tomato, stringbeans, and mango obtained very high NPV, BCR and IRR which implies that they only needed small units of k-shift. This also means that investing in these commodities is likely to be socially profitable as well.

R&D investment in most of the vegetable crops is likely be worthwhile even with modest k-shifts (i.e. lower than the imputed 25%). In contrast to this, lettuce, brocolli, radish, and cauliflower, are likely to require large farm-level productivity shifts for R&D investment to be worthwhile.

If public sector agencies accept the recommendations of this study, then potentially there are large and long-term positive net gains from funding horticultural research and development.

The WISER model allows scenarios to be analysed which can provide supporting information when research priorities and / or funding allocations are being made.

Summary of economic analyses

We recognise there are a large number of economic analyses conducted within this project. The potential farmer, regional, national, crop or project financial benefits are summarised in Table 9.

Table 9 Summary of economic analyses conducted within the Philippines fruit and vegetable program.

These are possible economic outcomes of the research for the program, farmers etc. assuming nominated adoption rates occur, ongoing funds are available for extension etc. They are provided as a 'snapshot' for some of the economic analyses conducted and are not a complete set of analyses. More information on these and other analyses is available in the papers and reports or from the authors. As noted, a number of these analyses were done by other components

Great care needs to be taken when looking at these values. As with all analyses such as these, the underlying assumptions are critical. Some of the outputs have been peer reviewed, others are more 'in-house' or preliminary. Some do not take into account costs and / or risk.

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
C1 Veg Soils Australia	Estimate the net benefits of using composted garden organics (CGO) for vegetable production in Australia compared to conventional fertilizing or soil treatment practices	Experimental field trials were conducted over 6 years for current fertilizer practice, two applications of CGO at 125 t/ha three years apart and two applications of CGO at 62.5t/ha three years apart for 10 vegetable crops. Analysis based on GMs, experimental field trail data and *ex-post* benefit-cost analysis	Incremental benefits for CGO applied at 125t/ha: BCR: 3.33 NPV: $58,856/ha IRR: 48% Incremental benefits for CGO applied at 62.5 t/ha: BCR: 2.63 NPV: $20,568/ha IRR: 28% Break-even cost of CGO well above market price. Discount rate 4%	C5 Component	Orr and Eldridge (2012) report within Dorahy *et al.* (2013) Paper in preparation
C2 Veg Protected cropping Australia	The net financial benefits of reducing temperature extremes in greenhouses by retrofitting devices to increase ventilation	Partial analyses based on incremental costs and benefits for two devices: 1. Exhaust fan 2. Screened side vent panels with exhaust	Install exhaust fan BCR: 5.75 NPV: $6433 (area unknown) Screen side vents and fan BCR: 2.88	C2	Badgery-Parker and Jarvis 2012 within C2 final report

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
	and air exchange with cucumbers in Australia	fan Estimated avoided losses by reducing greenhouse temperatures for a 5 year period and a 5% discount rate	NPV: $10,165 (area unknown)		
	What are the net benefits of increasing control of heating and cooling in Australian greenhouses for vegetable production?	Incremental benefit-cost analysis using experimental trial data for cucumbers grown in 4 different greenhouse conditions: no control, minimum control, moderate control and full control. Analysis conducted for a 10 year period using trial data for 2 years and projections for other years. Ten years is the assumed life of a greenhouse and equipment. Discount rate 4%	Incremental net benefits of changing from: 1. No control to minimal control: BCR: 65.7 NPV $45.50/$m^2$ 2. Minimal to moderate control: BCR: 1.7 NPV: $43.50/$m^2$ 3. Moderate to full control BCR: 0.1 NPV: -$50.40/$m^2$	C5	Parks *et al*. 2011
C2 Philippines	What are the net benefits of protected cropping (PC) for production of selected vegetable crops	Financial analysis of on-farm trial data for 4 vegetables grown under protective structures compared to traditional production with protective structures. GMs comparisons and benefit-cost analysis of protected cropping.	Average GM for vegetable crops grown with protective structure was PhP 112/m^2,virtually double the without structure GM of 55 PhP / m^2 Benefit-cost analysis of a 200m^2 structure, 5 year life:	C2	Armenia *et al.* (2012)

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
		Discount rate 20% Regression analysis of factors contributing to productivity (PhP/m^2)	NPV: PhP29,825 IRR: 103% Regression analysis revealed that a protective structure would increase crop revenue by 84%. Other significant variables included skills training.		
	What is influencing farmers' adoption of protected cropping technology? How does risk affect decisions?	Benefit-cost analyses of protected vegetables compared to open-field vegetables in 2 locations Outlined a Delphi technique to obtain expert's opinions on technology adoption Proposed the Expected-Mean Variance method for assessing the relationship between risk and income. Specified a whole farm model incorporating risk using a quadratic programming framework.	At one site, initial results for both production methods were negative while for the other site protected crops generated a NPV of PhP525/m^2 compared to PhP195 for open-field crops. Water, capital costs and marketing were key issues for adoption raised by experts. Identified that high establishment costs, complexity and riskiness as key factors in adoption of protected cropping structures. Analysis not competed.	C5	McClintock *et al*. 2012
C3 Potato Bacterial wilt (BW)	What is the benefit of BW control treatments and clean	GMs Relied on a number of estimates rather than actual	Baseline: GM = PhP 133,000/ha Full IDM strategy: GM= 365,900 PhP/ha	C3	Nandita Pathania (unpublished spreadsheet &

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
Philippines	soil and seed?	data			report)
C4 Veg Supply Chain Philippines	Are famers more profitable if they join clusters?	GM analysis and cost and returns analysis, then compared: 1. Cluster vs. non-cluster 2. Before cluster vs. after joining cluster	1. Farmers have 18% more income from involvement in a cluster than non cluster farmers 2. Farmers increase income by 47% after joining a cluster	C4	Rola-Rubzen *et al*. (2013)
	Selling to traditional vs alternative buyers ('focal')	GM	A number of examples: eg Sweet pepper (49.1 vs. 59.5 PhP / kg Tomatoes 8.9 vs. 29.8 PhP /kg	C4	Batt *et al.* (2013)
	Value of C4 research	Benefit cost analysis	BCR 2.47 NPV PhP 35.3m IRR 48.6%	C4	Rola-Rubzen *et al*. (2013)
C5 Vegetables general Philippines	What are the GMs of various vegetable crops Leyte (9 crops) Mindanao (11 crops)	GMs	Range from PhP / ha Leyte 17,172 to 1,512,122 Mindanao 31,300 to 235,000	C5	Orr *et.al* or Preciados *et al* Domingo (2013)
C5 Vegetable general	Does IPM pay for lettuce production in	Partial budgeting with GMs for non-IPM and IPM lettuce for inland and coastal field grown	Incremental net benefit per year: Inland field grown: $3,175 per ha	C5	McDougall and Orr (2011)

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
Australia	Australia?	lettuces and for hydroponic fancy lettuce production. Produced estimates of the incremental net benefit from adopting IPM	(a 6.4% increase) Coastal field grown $2,419 per ha (a 4.8% increase) Hydroponic production (1,000 m^2) benefit of $6,287 or 17.9% increase		
	Vegetable production farm budgets for 16 crops	GMs	GMs ranged from $155 to $3916 /ha and $31 to $951 / ML water	C5	Kelly *et al*. (2013) + website address
C2 Fruit - Jackfruit Philippines	The benefits of phytophthora disease control in jackfruit for Region VIII, the Philippines	GMs and ex ante benefit cost analysis. Discount rate of 5%	Jackfruit GM increased by 93% NPV: PhP 225 million BCR: 48 IRR: 43% Expected adoption: 77% after 4 years	C5	Preciados *et al*. (2013a)
C2 Fruit – Durian Philippines	The benefits of phytophthora disease of durian control for Region XI, the Philippines	Comparative GMs analysis for three levels of management for phytophthora control – low, medium and high	Estimated change in GM: Low management: 26% Medium: 47% High: 107% Expected adoption: 30% after 6 years	C5	Preciados *et al*. (2013c)
C4 Fruit Mango Philippines	Benefits of adopting IPM for mango production in Region XI of the Philippines	GMs and ex ante benefit cost analysis Discount rate of 5%	Increase in mango GM associated with adoption of IPM: 156% NPV: PhP 1.25 billion	C5	Preciados *et al*. (2013b)

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
			BCR: 51 IRR: 59% Based on estimated adoption of 80% after 7 years attributable to C4 mango research		
C5 Fruit & Vegetables Philippines	Should R&D funds be spent on fruit and vegetable research?	PIDS developed the Welfare Impact Simulator for Evaluating Research (WISER) spreadsheet model to provide ex ante measures of value of research investment in horticulture for the ACIAR-PCARRD project Estimated k-shifts (supply curve shift due to adoption of improved technology) for 15 fruit and vegetable commodities Discount rate 5%	Estimated total value of research: Low adoption (5% max) NPV: PhP1,405 million BCR: 11.3 IRR: 23% High Adoption (20% max) NPV: PhP4,682 million BCR: 35 IRR: 30%	C5	Briones and Galang (2012) (Table 11)
C5 – Transport Philippines	Factors affecting inter-regional trade of fruits and vegetables	SEARCA Gravity model	A 1% increase in various factors increases the total trade of fruits and vegetables by the following percentage points: GRDP of destination region: 2% - vegetables; 3% - fruits Length of paved road in reporting	C5	Llanto *et al.* (2013),

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
			region: 2% - vegetables; 3% fruits No. of markets: 8% - vegetables; 9% fruits …and a decrease in total trade of fruits and vegetables by 0.4% as distance between regions increases by 1%		
C5 – Market analyses Philippines	Factors affecting profitability, productivity and technical efficiency of papaya production in South Cotabato, the Philippines.	UPMin Value chain analysis, net margins analysis and econometric modeling to estimate productivity (production function), technical efficiency and profitability of farmers growing **papaya**	Net margin is highest for Contracted growers: PhP7.2/kg vs. non-contracted: PhP1.05/kg Profitability: Contract growers earn much higher profits as they sell a higher share of their crop as Class A. Profitability is also affected by farm size, volume of production and years of experience. Productivity 10% extra average land area increases papaya average yield by 6% 10% extra average labour days reduces production by 9% 10% increase in fertilizer increases average yield by 6.8%	C5	Aguinaldo *et al.* (2013a)

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
	Similar analyses are available for mango, potato, tomato and cabbage		Contract farmers achieve higher average yields Technical efficiency: Growers using own funds have a decreased technical efficiency compared to growers using borrowed capital.		
C5 fruit Australia	Will trellising increase the cyclone resilience of rambutan and custard apple?	A spreadsheet model that incorporated risk and investment analysis methodology was developed	Trellising estimated to increase resilience/ profitability of rambutan and custard apple.	C5	Page (2013a)
	Papaya- a hypothetical system that managed phytophthora with a shortened fallow was assessed	A spreadsheet model that incorporated risk and investment analysis methodology was developed	Was shown to be an attractive proposition	C5	Page (2013b)
	Is cocoa production likely to be profitable?	A spreadsheet model developed by Bill Johnston (DAFF Qld) was used. Investment analysis methodology was applied	Profitable if assessed as a sideline on an established farm.- Standalone performance was not assessed.	C5	Page (2013c)
	What is the value of research with Qld Papaya 1999-2011.	GMs	BCR: 49 NPV: $28.5m	C5	Orr (2010b)

Component	Issue	Method of analysis	Financial outcome	Funding / responsibility	Paper / Report. Details in Section 10.2
	IPM (multi-target approach) for controlling fruit spotting bugs (FSB) in macadamia, mangoes, avocado and papaya in Australia. Estimate returns to investment in RD&E for control of FSB	Industry-level ex ante benefit-cost analysis over 12 years for planned RD&E investment in FSB control using a multi-target approach – estimates or assumptions made for adoption, costs of adoption, control level, cost savings and yield increases Estimates of net benefits for avocados for 2 scenarios 5% discount rate	Industry NPV: $136.3 million BCR: 117.9 Avocado 1. Full control of FSB BCR: 7.9 NPV: $4.4 million IRR: 36% 2. Partial control BCR: 13.1 NPV: $7.75 million IRR: 48%	C5	Orr (2010a)

8.3.2 Social impacts

Improved production resulting from successful implementation of policies will increase efficiency, marketing, and distribution of high value produce, will improve the living standards of participants in the food supply chain and contribute to poverty reduction.

Qld fruit

Improving the capacity of individuals to make better decisions is likely to improve the ability of communities to survive and thrive. Being able to assess complex issues such as the value of trellising can add to the motivation and confidence of both producers and scientists.

8.3.3 Environmental impacts

An important environmental benefit of investing in and improving the road and port infrastructure that connects producing areas to markets could be a reduction in energy use and reduced emissions of greenhouse gases. As transportation becomes faster and more efficient, traffic jams and air pollution, problems which have become serious in most urban cities, can also be reduced. There is an opposing argument that better roads may mean more motor vehicles and use of fossil fuels and less use of animals for transport resulting in more greenhouse gasses! (Actually more CO^2, but less methane).

The GMs allow the costs and amounts of inputs such as pesticides and inorganic and organic fertilizers to be assessed which could encourage review of these inputs and thus potential environmental benefits.

Qld fruit

The papaya assessment may encourage a more environmentally friendly approach to production as it is based on increasing the level of soil organic matter (carbon) as a way of increasing bacterial and fungal activity which, in turn will hopefully help control soil pathogens.

8.4 Communication and dissemination activities

With this component, communication and dissemination activities are primarily targeted at policy makers and research and extension managers with one ultimate aim of increasing adoption of new technology. There are many ways to increase adoption of research. Some of these issues were discussed by McClintock *et.al.* (2012, p.40). With this component the main communication focus was through University presentations and industry, agribusiness and economic conferences, component reports, annual ACIAR reports and policy briefs.

The importance of adoption has been recognised through Glory Dee Romo's Ph.D. candidature and thesis titled 'Scale analysis on technology adoption under production uncertainty' and also how estimates of adoption affect the estimates of benefits, NPV and IRR of research.

Technical workshops and/or conferences were venues for sharing the key findings of the studies. These included

- 7th Asian Society for Agricultural Economists International Conference, Hanoi, Vietnam, October 13-15, 2011
- End-of-Program Conference for the ACIAR-PCAARRD Southern Philippines Fruits & Vegetables Programs (Cebu July 2012)
- 1st, 2nd, 3rd & 4th Agribusiness Economics International Conference (Davao 2009, 2010, 2011 & 2012)

Publication of technical reports, monographs, policy briefs, and journal articles were also part of the dissemination activities of this activity.

For objective 1, papers presented were:

Aguinaldo, R.T. and Digal, L.N., 'Marketing margins analysis of the Philippine mango industry: Price transmission and net margins'. Presented during the 1st Agribusiness Economics Conference, September 2009, Davao City, Philippines

Aguinaldo, R.T., Digal, L.N., Laorden, N.L., Romo, G.D.A. and Balgos, C.Q 'Analysing small farmer performance in selected fruit value chains in the Southern Philippines.' Mindanao Conference on Issues in Development, November 2010, Davao City.

Aguinaldo, R.T., Digal, L.N., Laorden, N.L., Romo, G.D.A., and Balgos, C.Q. 'Analyzing small farmer performance in selected fruit value chains in the Southern Philippines'. 24th Regional Southern Mindanao Agriculture Resources and Research Development Consortium (SMARRDEC) Symposium on 4 August 2011 at Davao del Norte State College, Panabo City, Davao del Norte

Aguinaldo, R.T., Digal, L.N., Laorden, N.L., Romo, G.D.A. and Balgos, C.Q 'Analysing small farmer performance in selected fruit value chains in the Southern Philippines'. Mindanao Conference on Issues in Development, November 2010, Davao City.

Aguinaldo, R.T., Digal, L.N., Laorden, N.L., Sarmiento, J.M.P. and Romo, G.D.A., 'Mango and papaya value chain: Price spread, price transmission, and net margins analysis'. Second Agribusiness Economics Conference, August 2010, Davao City, Philippines.

Aguinaldo, R.T., Digal, L.N., Laorden, N.L., Sarmiento, J.M.P. and Romo, G.D.A., 'Price spread analysis of selected fruits and vegetables in the Southern Philippines'. Sixth Supply Chain Management Forum on 7 February 2011 at UP Mindanao, Davao City.

Aguinaldo, R.T., Digal, L.N., Sarmiento, J.M.P., and Balgos, C.Q. 'Value chain issues and opportunities in selected horticulture crops in Southern Mindanao, Philippines'. Third Agribusiness Economics Conference on 13-14 July 2011, Davao City, Philippines

Aguinaldo, R.T., Digal, L.N., Sarmiento, J.M.P. and Balgos, C.Q. 'Value chain issues and opportunities in selected horticulture crops in Southern Mindanao, Philippines'. Seventh Asian Society for Agricultural Economists (ASAE) International Conference on October 13-15, 2011, Hanoi, Vietnam (was presented but draft still being updated).

Aguinaldo, R.T., Sarmiento, J.M.P., Digal, L.N. and Balgos, C.Q. 'Analysing performance of farmers in the mango value chain of key producing areas in Davao Region, Philippines.' Fourth Agribusiness Economics International Conference on 10-11 July 2012, Davao City, Philippines.

Aguinaldo, R.T., Sarmiento, J.M.P., Digal, L.N. and Balgos, C.Q 'Economic impacts of new technology and policy constraints in the production of fruits and vegetables in the Southern Philippines'. Fourth Agribusiness Economics International Conference on 10-11 July 2012, Davao City, Philippines.

Aguinaldo, R.T., Sarmiento, J.M.P., Digal, L.N., and Balgos, C.Q. 'Price spread analysis of mango in Southern Mindanao, Philippines'. Fourth International Symposium on Improving the Performance of Supply Chains in the Transitional Economies on 4-7 July 2012, Cebu City, Philippines.[13]

[13] *Now published in Oakeshott and Hall (2013).*

Laorden, N.L., Aguinaldo, R.T., Digal, L.N., Romo, G.D.A., and Balgos, C.Q. 'Performance and productivity of small farmers in selected vegetable chains in Mindanao'. 24th Regional Southern Mindanao Agriculture Resources and Research Development Consortium (SMARRDEC) Symposium on 4 August 2011 at Davao del Norte State College, Panabo City, Davao del Norte

Laorden, N.L., Aguinaldo, R.T., Digal, L.N., Romo, G.D.A., and Balgos, C.Q 'Logistics decision and implications on net margins.' Sixth Supply Chain Management Forum on 7 February 2011 at UP Mindanao, Davao City.

Laorden, N.L., Aguinaldo, R.T., Digal, L.N., Romo, G.D.A., and Balgos, C.Q 'Enhancing performance and productivity of small farmers in selected vegetable chains in Mindanao'. 2010 Mindanao Conference on Issues in Development, November 2010, Davao City.

Laorden, N.L., Aguinaldo, R.T., Digal, L.N., Romo, G.D.A., and Balgos, C.Q 'Analyzing small farmer performance in the chain: the case of potato and cabbage'. Second Agribusiness Economics Conference , July 2010, Davao City, Philippines.

Laorden, N.L., Aguinaldo, R.T., Digal, L.N., Sarmiento, J.M.P., and Balgos, C.Q. 'Net margins analysis of selected fruits and vegetables in Southern Mindanao, Philippines'. Seventh Asian Society for Agricultural Economists (ASAE) International Conference on October 13-15, 2011, Hanoi, Vietnam.

Laorden, N.L., and Concepcion. S.B. 'Marketing margins analysis of potato in Bukidnon: Price transmission and net margins'. First Agribusiness Economics Conference, September 2009 at Davao City, Philippines.

Sarmiento, J.M.P., Romo, G.D.A., Digal, L.N., Aguinaldo, R.T. Laorden, N.L., and Balgos, C.Q 'Small farmers and market efficiency in selected fruit and vegetable sectors in Mindanao.' 2010 Mindanao Conference on Issues in Development, November 2010, Davao City.

Sarmiento, J.M.P., Romo, G.D.A., Digal, L.N., and Aguinaldo, R.T. 'Market integration of selected crops in Mindanao'. Sixth Supply Chain Management Forum on 7 February 2011 at UP Mindanao, Davao City.

Sarmiento, J.M.P., Romo, G.D.A., Digal, L.N., and Aguinaldo, R.T. 'Vertical price integration of selected fruits and vegetables in Southern Philippines'. Seventh Asian Society for Agricultural Economists (ASAE) International Conference on October 13-15, 2011, Hanoi, Vietnam.

Other communications

Economic analysis of the value chain of selected horticulture crops in Southern Mindanao, Philippines:

Five working papers have been submitted to *Banwa*, a multidisciplinary, peer-reviewed journal of UP Mindanao. Comments have been received from external reviewers and papers are being further revised. Titles and authors are:

- Economic analysis of the value chain of potato and tomato in the Southern Philippines: Price Transmission and net margin analysis *Nikko L. Laorden, Roxanne T. Aguinado, Larry Digal, Glory Dee A. Romo and Michelle Joy D. Vicencio*
- Economic analysis of the value chain of mango in Southern Mindanao, Philippines *Roxanne T. Aguinaldo, Larry N. Digal, Glory Dee A. Romo, Jon Marx P. Sarmiento, Nikko L. Laorden, Carol Q. Balgos*
- Economic analysis of the value chain of durian in Southern Mindanao, Philippines *Roxanne T. Aguinaldo, Larry N. Digal, Glory Dee A. Romo, Nikko L. Laorden, Jon Marx P. Sarmiento, Ma. Monica Beatriz Cabrera, Carol Q. Balgos*

- Economic Analysis of the value chain of papaya in the Southern Philippines. *Nadine Abenoja, Roxanne T. Aguinaldo, Larry N. Digal, Glory Dee A. Romo, Nikko L. Laorden, Jon Marx P. Sarmiento, Carol Q. Balgos*
- Are fruits and vegetables market efficient?: Vertical and spatial price integration of selected crops in southern Philippines.

Value chain of selected horticulture crops in Southern Mindanao: net margins, market options and price analysis.

Seven working papers on mango, papaya, potato, tomato, cabbage are being completed.

Drafts are

- Roxanne T. Aguinaldo, Jon Marx P. Sarmiento, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Assessing the distribution of benefits in the tomato value chain in Bukidnon, Davao del Sur and Misamis Oriental, Philippines
- Roxanne T. Aguinaldo, Jon Marx P. Sarmiento, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Assessing the distribution of benefits in the cabbage value chain in Bukidnon and Davao del Sur, Philippines
- Jon Marx P. Sarmiento, Roxanne T. Aguinaldo, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Profitability, productivity and efficiency of cabbage farmers in Digos City, Davao del Sur and Lantapan, Bukidnon
- Roxanne T. Aguinaldo, Jon Marx P. Sarmiento, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Rica Marie S. Naparan, Carol Q. Balgos, David G. Hall. Assessing the distribution of benefits in the potato value chain in Davao del Sur and Bukidnon, Philippines
- Roxanne T. Aguinaldo, Jon Marx P. Sarmiento, Larry N. Digal, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Assessing the distribution of benefits in the mango value chain in Southern Mindanao, Philippines
- Jon Marx P. Sarmiento, Roxanne T. Aguinaldo, Larry N. Digal, Alex Kavin C. Castillo, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Profitability performance of farmers in mango producing cities in Davao Region
- Larry N. Digal, Roxanne T. Aguinaldo, Jon Marx P. Sarmiento, Miko Mariz C. Castro, Sherleen M. Comidoy, Carol Q. Balgos, David G. Hall. Value chain analysis of solo papaya in Southern Philippines: contractual arrangements, profitability, productivity and technical efficiency

There were numerous other C5 technical meetings where results were discussed within the team and debate held on how the program could contribute to smallholder farmer's resilience against poverty, improved environmental sustainability and livelihoods.

SEARCA

The results of the transport study were disseminated in international conferences such as the 7th Asian Society for Agricultural Economists International Conference and the 4th Agribusiness Economics International Conference, Davao July 2012. Technical papers, monographs and journal articles are being prepared for publication.

Karen Quilloy of SEARCA (now of UPLB) presented the results of the paper entitled 'Strengthening markets of high value fruits and vegetables in Mindanao: The case of transport and shipping service improvement' at the Cebu final project meeting, Cebu, July, 2012. [14]

[14] *Now published in Oakeshott and Hall (2013).*

Recommendations from the transport study were publicised widely eg.

http://ph.news.yahoo.com/study-recommends-more-investments-mindanao-roads-port-infrastructure-125356981--finance.html (16 Feb 2013)

http://www.philstar.com/agriculture/2013/02/24/912304/more-investments-needed-boost-mindanaos-vegetable-fruit-industries (24 Feb 2013)

http://ph.news.yahoo.com/better-cheaper-farm-produce-improved-mindanao-shipping-services-185512375--sector.html (12 Feb 2013)

http://www.portcalls.com/ph-study-urges-investments-in-road-port-infrastructure/ (27 June 2012)

http://www.mindanews.com/top-stories/2013/02/14/mindanao-needs-better-road-and-port-facilities-to-boost-vegetable-and-fruit-sectors/ (14 Feb 2013)

http://businessmirror.com.ph/index.php/en/business/agri-commodities/9379-vegetable-fruit-industries-in-mindanao-need-more-infra-investments-says-study?tmpl=component&page= (17 Feb 2013)

http://www.sunstar.com.ph/davao/business/2013/02/14/better-road-port-facilities-needed-boost-veggie-fruit-sectors-study-268094 (14 Feb 2013)

PIDS

Ivory Myka Galang of PIDS presented the preliminary results of the paper entitled 'Assessment of prospective impact of fruits and vegetables research at the industry-level in the Philippines: The case of the ACIAR-PCAARRD horticulture project' in the Cebu final project meeting, Cebu, July 3, 2012.[15]

Briones, R., and Ivory Myka Galang 'Assessment of prospective impact of fruits and vegetables research at the industry-level in the Philippines: The case of the ACIAR-PCAARRD Horticulture Project'. Fourth Agribusiness Economics International Conference on 10-11 July 2012, Davao City, Philippines.

At the 'Workshop on economic analysis techniques for evaluation of farm fruit and vegetable systems', VSU, November 2012. Dr. Roehlano Briones and Ivory Myka Galang gave a presentation about the use of the Welfare Impact Simulator for Evaluating Research (WISER) and trained people in its use.

SEARCA

VSU

Preciados, L.S. (2010). Ex ante impact assessment on phytophthora disease control for jackfruit, Southern Philippines. 3rd ABE Conference, Davao City Philippines

Bulayog, S.B. and Lemuel Preciados, L.S. (2012). Farm-level impact assessment of ACIAR HORT Fruit Technologies: The case of phytophthora control in jackfruit and durian. 4th International ABE Conference, Davao City, Philippines.

The jackfruit, durian and mango papers economic assessment papers were also presentd at the Cebu workshop, July 2012. [15]

Other

Pollock, K. P. (2012). Economic Impact Assessment. Presentation to ACIAR PCAARRD vegetable planning meeting, Davao 2 Feb 2012. Powerpoint presenation.

Presentations were made by the C5 team at each of the annual Philippines meetings from 2008 to 2011.

---

[15] Now published in Oakeshott and Hall (2013).

9 Conclusions and recommendations

9.1 Conclusions

Objective 1 The changing agri-food system has brought changes to the supply chain. For example, the farmer's share of the retail price has decreased over time in Mindanao, prices are inefficiently transmitted between nodes in the chain and prices are not well integrated between markets because of the number of marketing layers along the chain. This inefficient transmission of prices is an indication of distortion associated with market power at nodes along the chain. Despite the increasing productivity of farmers, production and marketing costs are increasing faster than the increase in prices. This is due to inadequate logistics and infrastructure facilities and increasing fertilizer, pesticide and fuel costs. Hence, farmer's net earnings remain low, despite higher productivity

The analysis of profitability, productivity and technical efficiency of cabbage, tomato, potato, cabbage, mango and papaya farming found higher prices and yield consistently increased profitability whilst more land area, and higher use of organic and inorganic fertilizer, and pesticides generally increased productivity. There were also differences between regions which need to be explored further, e.g. are different varieties grown or are fertiliser practices more efficient.

UPMin concluded a value chain approach is important not only to understand issues but also to develop an integrated package of interventions that make use of the resources of the private sector and augment public funds to help the small producers in the chain. They considered there is a need for :

i) An integrated package of advice to address multi-dimensional issues affecting small scale producers. ie Government and non-government organization's support for regular training of farmers, particularly in the efficient use of production inputs to increase the productivity of farmers. Capacity building activities for farmers are important to lower production costs and production losses.

ii) Government to initiate the finding of other market outlets for farmers, within and outside Mindanao. The possible market outlets are institutional buyers such as hotels, restaurants and supermarkets, which have been proliferating in urban areas.

iii) More initiation and organization of collaborative marketing groups or clusters, in order to meet the volume requirement of high-value markets. Maybe government could remove any barriers to cooperative ventures and should ensure that appropriate legislation is in place to protect members' rights.

iv). More help for small producers to get the best possible price for their produce by the provision of timely and accurate market information. This could be through various means of communication (including the internet) and by imposing more effective regulations on maintenance of quality and more consistent product standardization There are roles for government working in association with industry to establish agreed quality standards based on market requirements. Market information can be provided by government and private services. Independent and reliable sources are needed.

Objective 2.2 to 2.4

Comparing the GMs 'without (ie current farmers practice or FP)' and 'with the recommended practice' shows that with the adoption of recommended strategies for jackfruit and durian phytophthora management and adoption of suggested IPM practices for mango farmers there will be an increase in farmer income and reduction in the risk of crop damage from pests and diseases. The financial analysis using an ex ante benefit cost framework (micro level) shows that investment in phytophthora research for jackfruit as well as investment in IPM for mango is financially worthwhile showing high expected

NPVs (jackfruit, and mango PhP 223 million PhP and PhP 1.25 billion respectively) and BCRs significantly greater than 1 (jackfruit BCR: 47, mango BCR: 51) at a 5% discount rate, whilst for durian GMs could increase by up to 107% depending on which management option was adopted.

Objective 2.5 and 3.1

A key contribution was the development and application of a simple spreadsheet approach to evaluate the impact of R&D using a model called WISER. With this model, researchers can generate data on the potential impact of their research and compare it with the cost of the research investment. The value of the BCR, NPV and IRR indicates how much impact a research investment can create, allowing researchers to justify funding for their research program. Likewise it also allows the funding agencies to evaluate and compare the significance of research proposals. The results show that in general the horticulture research projects were worth supporting as there were high estimated values for of NPV, BCR and IRR.

Objective 3.2

The estimates from the gravity model confirmed that the economic size of trading regions is a significant determinant of inter-regional trade. The surveys and their analysis showed that it would be possible for small farmers to generate bigger profit margins if they were able to bring their produce directly to urban markets. Field data showed how poorly constructed roads negatively impact on transport costs. The analysis also shows the critical importance of proper cargo handling and warehousing services to avoid wastage and deterioration of produce quality. The impact of regulation and good governance on the supply chain has also been highlighted. Informal payments and inconsistent application of rules (e.g. the case of permits honoured in one barangay but not recognized in another barangay) are realities in the supply chain.

9.2 Recommendations

Policy and regulations

Recommendation 1: That an integrated packages of advice be provided to farmers and they be encouraged to form marketing groups or clusters.

Recommendation 2: That the net benefits of privatising the port operations or allowing competition for port services should be reviewed by government and port stakeholders including for Roll-on Roll-off services. This will assist efficient marketing of farmers' produce and reduce marketing losses.

Recommendation 3: That policymakers should reallocate resources favouring public investment for R&D in horticulture. Fruits and vegetables are commodities that have 'high market potential and competitiveness' and the industry models showed high investment returns from R & D.

Recommendation 4: That Government should also ensure that regulations affecting the supply chain be properly implemented. Examples include systems of permits and licensing, regulations that encourage more efficient markets, safety and soundness standards for road and sea transport and strengthening of regulatory institutions in general.

Adoption

Recommendation 5: That the financial benefits of new technology produced from the fruit and vegetable program be refined by researchers, and where beneficial, used to promote the benefits of the new technology to farmers and advisors.

Recommendation 6: A framework or policy needs to be developed to guide researchers on choosing innovations that are likely to have high adoption rates. Adoption rates will be a crucial factor in determining the economic merits of a project.

Recommendation 7: That further studies be undertaken on adoption with a focus on what influences adoption. For example, why is the technology incompatible with the farmers' needs or is adoption due to inadequate support services or lack of credit?

Research and extension priorities

Recommendation 8: That the NSW vegetable gross margins be promoted and Qld fruit economic analyses be developed.

Recommendation 9: That there be future assessment studies on the impact of horticulture agricultural R&D on other fruits and vegetables to assist in developing research priorities.

Management

Recommendation 10: That economists be directly involved (or embedded) in the planning and subsequent analysis of technical research and development activities whether it be for analysing farmer benefits or industry benefits or the value of the research providers' investments. A clear understanding between technical and economics on the needed data and the methodologies of doing the analysis is essential.

10 References

10.1 References cited in report

Also see section 10.2

Aldaba, R., *et al*. (2010). ERIA Study to Further Improve the ASEAN Economic Community Scorecard: the Philippines.

Ali, I., and E. Pernia (2003), "Infrastructure and Poverty Reduction – What is the connection?" ERD Policy Brief No. 13 Asian Development Bank. Carrere (2006).

Alston, J., G. Norton, P. Pardey, (1995). Science under scarcity: principles and practice for agricultural research and priority setting. New York: Cornell University Press.

Armenia, Pedro T., Kenneth M. Menz, Gordon S. Rogers, Z.C. Gonzaga, Reny G. Gerona and Elsie R. Tausa (2013) 'Economics of vegetable production under protected cropping structures in the Eastern Visayas, Philippines' pp.112- 122. In. 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.

Balisacan, A. M., and Cuthbertson, S. (2008). Philipiines policy linkages scoping study. Report of ACIAR SRA PLIA/2005/151.

Batt, P. J., Concepcion, S., Dagupen, K., Lizada, C., Murray-Prior, R. (2007). The vegetable industry in the Philippines, November 2007. ACIAR SRA ASEM 2005/062.

Batt, P. J., Murray-Prior, R., Axalan, J.T., Lambdan, R.J., Montiflor, M.O., Real, R.R., and Rola-Rubzen, M.F. (2013). Final Report ACIAR Project: HORT 2007/ 066-4. 'Enhanced profitability of selected vegetable value chains in the Southern Philippines. Component 4: Analysis of selected value chains in Southern Philippines.

Bureau of Agricultural Statistics (BAS). www.bas.gov.ph

Carrere, C. (2006), "Revisiting the effects of regional trade agreements on trade flows with proper specification of the gravity model." European Economic Review 50 pp. 223-247.

Coelli T.J. (1996a). A guide to DEAP Version 2.1: A data envelopment analysis (computer) program. Centre for Efficiency and Productivity (CEPA) working papers, University of New England, Australia.

Dalkey, N.C. (1969). The Delphi Method: An Experimental Study of Group Opinion. RM-5888-PR, RAND Corporation, Santa Monica, California.

Dorahy, C., Tulin, A., and Eldridge, S. (2013). Final Report ACIAR Project: HORT 2007/ 066-1. 'Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia' - Component 1 – Integrated soil and crop nutrient management

Eskola, E. (2005) 'Agricultural Marketing and Supply Chain Management in Tanzania: A Case Study'. ESRF Study on Globalisation and East Africa Economies Working Paper No. 16.

Fan, S. Zhang, L., and Zhang, X. (2002), 'Growth, inequality and poverty in rural China', Washington DC. International Food Policy Research Institute, Research Report No. 125.

Fan, S.J., Jitsuchon, S., and Methakunnavut, N. (2004). 'The importance of public investment for reducing rural poverty in middle-income countries: The case of Thailand.' Washington DC., International Food Policy Research Institute, Development Strategy and Governance Division, DSGD Discussion Paper No. 7.

Fan, S., P.L. Huong, and T.Q. Long. (2004). 'Government spending and poverty reduction in Vietnam.' Project report prepared for the WorldBank- funded project 'pro-poor spending in Vietnam,' by the International Food Policy Research Institute and the Central Institute for Economic Management (Hanoi).

Helmer, O. 1967. Systematic Use of Expert Opinion. The RAND Corporation, Santa

Monica, California. http://www.rand.org/content/dam/rand/pubs/papers/2006/P3721.pdf

Johnson, G.I., Weinberger, K., and Wu, Mei-huey. (2008). The vegetable industry in tropical Asia: The Philippines An overview of Production and Trade. AVRDC Publication: 08-712

Kimura, Fukunari and Mitsuhiro Maeda (2005). 'Transport development in Japan and Korea: Drawing Lessons for the Philippines,' November http://www.bnm.gov.my/microsites/rcicc/papers/s5.kimura.pdf (date accessed November 10, 2011).

Kumbhaker S.C. and Lovell, C.A.K. (2000). Stochastic frontier analysis. Cambridge University Press: Cambridge.

Llanto, Gilberto. M. (2005). The impact of rural infrastructure on agricultural productivity, A study submitted to SEARCA under the Productivity Growth in Philippine Agriculture Project. SEARCA: Los Baños, Philippines. Monograph to be published by SEARCA in 2013

Llanto, Gilberto M. (2009). 'Infrastructure', Chapter 6 in 'Diagnosing the Philippine economy: Toward inclusive growth', edited by D. Canlas, M.E. Khan, and J. Zhuang, London: Anthem Press

Llanto, Gilberto. M. (2011). 'Investing in local roads for economic growth' PIDS Discussion Paper Series 2011-38, December. Makati City, Philippines

Llanto, Gilberto. M., Leilanie Basilio and Enrico Basilio (2005) 'Competition policy and regulation in ports and shipping,' PIDS Discussion Paper No. 2005-02, February. Makati City, Philippines.

Manalili, R. and L. Gonzales. (2009). 'Impact of infrastructure on profitability and global competitiveness of rice production in the Philippines.' http://www.irri.org/publications/wrrc/wrrcPDF/session10-06.pdf - Jan 12, 2009.

National Economic Development Authority and United Nations Development Programme (2007). Philippines: Midterm progress report on the millennium development goals. NEDA: Pasig City.

NEDA-UNDP (2005). Enhancing the capacity for the effective management of ODA (00032905) From seed to shelf: A logistical evaluation of the Philippine agriculture main report. July. Pasig City, Philippines.

Norton, G.W. and Hautea, D.M. (eds.) 2009. Projected impacts of agricultural

biotechnologies for fruit and vegetables in the Philippines and Indonesia.

International Service for the Acquisition of Agri-biotech Applications and the

SEAMEO Southeast Asian Regional Centre for Graduate Study and Research in Agriculture.

Orr, L.M., McClintock, A.M., Bulayog, S.B. and Preciados, L. (2010). 'Economic impacts of new technologies and policy constraints in the production of fruit in the Philippines and Australia'. Powerpoint presentation, Annual Program meeting, Canberra, June 2010.

Pascual-Gapasin D. (2006). Philippines: rural growth and development revisited study: Agricultural research, development and extension. World Bank Publications and Documents, Report Number 36684. World Bank: Washington, DC.

Pathania, N. (2013). Final Report ACIAR Project: **HORT 2007/ 066-3.** 'Enhancing profitability of selected vegetable value chains 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

Rapusas, R.S., (2006). Philippines (2). In: R.S. Rolle, ed. Postharvest Management of Fruit and Vegetables in the Asia-Pacific Region. Asian Productivity Organization, Tokyo. Country paper. pp. 227-244

Planet Retail (2008). ?

Rola-Rubzen, Maria Fay,. Roy Murray-Prior, Peter J. Batt, Sylvia B. Concepcion,

Rodel R. Real, Ruby Jane G. Lamban, Jerick.T. Axalan, Malou O. Montiflor Floro T. Israel, Dante Apara and Ricarte H. BacusIn (2013). 'Impacts of clustering of vegetable farmers in the Philippines' pp 190-202. In 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.

Rogers, G. (2013). Final Report ACIAR Project: HORT 2007/ 066-2. 'Enhancing profitability of selected vegetable value chains in the southern Philippines and Australia'. Component 2: Development of a cost-effective protected cropping system in the southern Philippines and Australia

SeemaVyas and LilaniKumaranayake. (2006). Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan 21(6): 459-468. first published online October 9, 2006doi:10.1093/heapol/czl029

Serrano, E.P., (2006). Philippines (1). In: R.S. Rolle, ed. Postharvest management of fruit and vegetables in the Asia-Pacific region. Asian Productivity Organization, Tokyo. Country paper. pp. 216-226

Stads, G., Faylon, P., and Buendia, L. (2007). Agricultural R&D in the Philippines: Policy, Investments, and Institutional Profile. Agricultural Science and Technology Indicators Country Report. International Food Policy Research Institute and Philippine Council for Agriculture, Forestry and Natural Resources Research and Development.

World Bank (2010). Economic evaluation of climate change adaptation projects: Approaches for the agricultural sector and beyond. Development and climate change series, International Bank for Reconstruction and Development/ The World Bank, Washington D.C

Zwinkels, R., and S. Beugelsdijk. (2010). Gravity equations: Workhorse or Trojan horse in explaining Trade and FDI patterns across time and space? International Business Review 19 pp. 102-115.

10.2 List of publications produced by project

Philippines

Refereed reports and papers

Briones, R. (2008). Agricultural Diversification and the Fruits and Vegetables Subsector: Policy Issues and Development Constraints in the Philippines. Philippine Journal of Development No. 65, Second Semester 2008, Vol. 35, No. 2.

Briones, R. and Galang, I.M. (2012). Welfare Impact Simulator for Evaluating Research (Spreadsheet Version). See attachment 12.3

Briones, R. and Galang, I.M. (2012). Welfare Impact Simulator for Evaluating Research: A Manual for Users. See attachment 12.2.

Briones, R. and Galang, I.M. (2012). Assessment of prospective impact of fruits and vegetables research at the industry level in the Philippines: The case of the ACIAR-PCAARRD horticulture project. Final Report

Llanto, G.M., M.A. Sombilla, K.P. Quilloy, and F.M.A. Quimba (2013). 'Strengthening Markets of High Value Fruits and Vegetables in Mindanao: The Case of Transport and Shipping Service Improvement'. Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Los Baños, Philippines. ISBN 978-971-560-159-7. 66 pp.

McClintock, A., Preciados, L., Orr, L., and Bulayog, S. NSW Department of Primary Industries and Visayas State University (2012). Economic Impacts of Component 2: Protected Cropping technology for vegetable production in the Southern Philippines Interim report prepared for ACIAR Project No. HORT/2007/066/5. NSW Department of Primary Industries and Visayas State University.

Conference and workshop papers (Peer reviewed)

Aguinaldo, Roxanne T., Jon Marx P. Sarmiento, Larry N. Digal, Carol Q. Balgos, and Alex Kavin C. Castillo (2013). 'Analysing the performance of farmers in the mango value chain in major production areas in Davao Region, Philippines' pp 264-271. In. Oakeshott J. and Hall D.

Armenia, Pedro T., Kenneth M. Menz, Gordon S. Rogers, Z.C. Gonzaga, Reny G. Gerona and Elsie R. Tausa. Economics of vegetable production under protected cropping structures in the Eastern Visayas, Philippines pp.112- 122. In. Oakeshott J. and Hall D.

Briones. Roehlano M., and Ivory Myka Galang (2013).'Assessment of prospective impact of fruits and vegetables research at the industry level in the Philippines: the case of the ACIAR–PCAARRD horticulture project' pp. 272-286. In. Oakeshott J. and Hall D

Llanto, Gilberto M., Mercedita A. Sombilla, Karen P. Quilloy and Francis Mark A. Quimba (2013). 'Market structure analysis: the case of some high-value fruits and vegetables in Mindanao' 287-298. In. Oakeshott J. and Hall D.

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.

Preciados, Lemuel S., Ma. Salome B. Bulayog, Lucia Borines and Gil Guadalquever (2013a) Ex ante impact assessment of Phytophthora disease control for jackfruit in Region VIII, southern Philippines. Pp. 234-41. In. Oakeshott J. and Hall D.

Preciados, Lemuel S., Ma. Salome B. Bulayog and Anastacia Notarte (2013b). 'Ex ante impact assessment of the adoption of IPM strategies for mango in Region XI of the southern Philippines' pp 226-233. In. Oakeshott J. and Hall D.

Preciados, Lemuel S. Ma. Salome B. Bulayog, Concepcion Soguilon and Cyril Montiel (2013c). 'Gross margin impact analysis on adoption of Phytophthora control strategies for durian in Region XI, southern Philippines' pp 242-247. In. Oakeshott J. and Hall D.

Rola-Rubzen, Maria Fay,. Roy Murray-Prior, Peter J. Batt, Sylvia B. Concepcion, Rodel R. Real, Ruby Jane G. Lamban, Jerick.T. Axalan, Malou O. Montiflor Floro T. Israel, Dante Apara and Ricarte H. BacusIn (2013). Impacts of clustering of vegetable farmers in the Philippines 190-202.. In Oakeshott J. and Hall D.

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.

Papers presented in National and International Conferences.

Bulayog, M.S., and Preciados, L. (2012). Farm-level impact assessment of ACIAR HORT fruit technologies: The case of phytophthora control in jackfruit and durian. Davao, City Philippines. Other details not available

Preciados, L.S. 2010. Ex ante impact assessment on phytophthora disease control for jackfruit, Southern Philippines. Davao City, Philippines. Other details not available

Other papers and reports

Briones, R. (2009). Agricultural Diversification and the Fruits and Vegetables Subsector: Policy Issues and Development Constraints in the Philippines. PIDS Discussion Paper No. 2009-02. Philippine Institute for Development Studies, Makati City.

Domingo *et al*. 2013.'Vegetable Production and Farmers' Profile in the Southern Philippines. Draft report from Ph.D. Part funded by project, See Appendix 12.1.

Domingo *(*2013). Gross margins for eleven vegetable crops in Mindanao. Unpublished spreadsheet. Available at ACIAR Archive website, Meridio

Previously on Web2, now available from senior author or on ACIAR archive site, Meridio.

Aguinaldo, R.T., Digal, L.N., Sarmiento, J.M.P., Balgos, C.Q., Romo, G.D.A.R, Laorden, N.L. Economic Analysis of the Value Chain in Southern Philippines: Price Spread, Price Transmission and Net Margins Analyses of fruits and vegetables" (Lettuce, Potato, Tomato, Cabbage, Eggplant, Mango, Durian, Jackfruit and Papaya). Was on web2,

Aguinaldo, R.T., Digal, L.N., Sarmiento, J.M.P., Balgos, C.Q., Romo, G.D.A.R, Laorden, N.L. Price spread, Net Margins Analyses and Market Integration for fruits and vegetables (three working papers). Were on web2, now available from senior author.

Bulayog, S.B. and Preciados, L.S., (2009a). Upland rainfed cabintan cropping systems and the different seasons (Working Paper No. 1). Was on web2, now available from senior author.

Bulayog, S.B. and Preciados, L.S. (2009b). Region VIII Cabintan, Leyte Vegetables Enterprise Budgets..Available at ACIAR Archive website, Meridio

Bulayog, S.B. and Preciados, L.S. (2009c). Gross margins, Leyte, Mindanao and Philippines Vegetables Enterprise Budgets. Available on ACIAR Archive website, Meridio

Bulayog, S.B., Preciados, L.S, McClintock, A., and Orr, L. (2010). Cabintan Vegetable Farm Model. Was on web2, now available from senior author.

Laorden, N.L, Digal, L.N., Aguinaldo, R.T., Sarmiento, J.M.P., Balgos, C.Q., Romo, G.D.A.R, Analyzing Small Farmer Performance and Productivity in Selected Fruits and Vegetable Value Chains in Mindanao (three working papers). Were on web2, now available from senior author.

McClintock, A., Orr, L., Bulayog, M.S.B., Preciados, L.S. (2009). Baseline Vegetable Budgets for region VIII, Philippines. Was on web2, now available from senior author.

McClintock, A, Orr, L, Bulayog, M.S.B., Preciados, LS. (2009). Upland rainfed farming system model. Was on web2, now available from senior author.

Orr, L - Philippine Agricultural Statistics for fruit and vegetables. Summary was on web2.

Orr, L., Preciados, L.S., McClintock A, Bulayog, M.S.B. (2010). Draft of scientist interview responses C2 Fruit – Phytophthora disease for Durian and Jackfruit, Was on web2, now available from senior author.

Preciados, L.S., (2011). Farm level impacts of fruit technologies: The case of mango ICM recommendations (A trip report). Was on web2, now available from senior author.

Preciados, L.P. (2013). Papaya production baseline data and 'without technology' gross margins. Unpublished report. Was on web2, now available from senior author

Australia

Kelly, G., Napier, T., and Watts, S. (2013). Farm enterprise budgets for NSW vegetables . NSW DPI. http://www.dpi.nsw.gov.au/agriculture/farm-business/budgets/vegetable

McDougall, S., and Orr, L. (2011). Benchmarking vegetable IPM Adoption: Business case for adoption of integrated pest management (IPM) in lettuce. Part of report for National Vegetable IPM Coordination project (VG09191).

Orr, L. M. (2009). Australian (NSW) vegetable gross margin budgets for selected ten vegetables, Internal NSW DPI Report. Available on ACIAR Archive website, Meridio

Orr, L. M. (2010a). Benefit cost analysis of a multi target approach to fruitspotting bug management. Internal report. Philippines Web 2 site

Orr, L.M. (2010b). Analysis of papaya research with and without technology. In 2010 C5 annual report. Available on ACIAR Archive website, Meridio

Orr, L., Bulayog, S.B., McClintock A. and Preciados, L.S., (2010). Economic impacts of new technologies and policy constraints in the production of fruit in the Philippines and Australia. Presentation of component research, June 2010, Canberra

Orr, L., and McDougall, S. (2011). Benchmarking vegetable IPM Adoption: Cost-benefit analysis of IPM Adoption by NSW lettuce growers. Part of report for National Vegetable IPM Coordination project (VG09191). Available on ACIAR Archive website, Meridio

Orr, L., and Al-Khawaldeh (2010). Assessing the benefits from improved environmental controls in greenhouse vegetable production in NSW. Internal report NSW DPI. Available on ACIAR Archive website, Meridio

Orr, L., and McClintock, A., (2009). The fruit and vegetable industry Southern Philippines 2000-2009, Key statistics. Available on ACIAR Archive website, Meridio

Orr, L. M., Mullen, J.D., and Jones, R. (2009). An Evaluation of the Economic, Environmental and Social Impacts of NSW DPI Investments in IPM Research in Cold Disinfestation of Citrus for Quarantine Restricted Markets. Unpublished Economic Research Report.

Page, J. (2013a). An economic assessment of the contribution of trellising to the economic resilience of Far North Queensland fruit tree crops. Internal Queensland DAFF report.

Page, J. (2013b). An economic assessment of Phytophthora control in papaya through better fallow management. Internal Queensland DAFF report

Page, J. (2013c). Economic assessment of cocoa production in Far North Queensland. Internal Queensland DAFF report

Parks., S., Orr., L., and Al-Khawaldeh, B. (2011). Is upgrading from low to high tech greenhouses profitable? Protected Cropping Australia Conference, Adelaide.

Parks S, Orr L and Al-Khawaldeh,B. (2012). Is upgrading from low to high tech greenhouses profitable? Hydroponic Farmers Federation Conference 2012 July 18-20, Ballarat, Victoria.

11 Appendixes

11.1 Appendix 1: Data used as background in original fruit and vegetable economic and policy proposals

The following notes (with some editing) are copied from the original 2008 HORT 2007/066 and 067 Component 5 proposals

Vegetables

The vegetables of interest in this Program in 2008 were tomatoes, potatoes, brassicas, leafy vegetables and bell peppers. There was little information in program component submissions about the economic significance of these vegetables. Price data and value of production for tomatoes, potatoes, brassicas, leafy vegetables were available from the CountrySTAT Philippines database available at the BAS website (see summaries Table A1 and A2). Production data in terms of quantity and area were obtained from the BAS publication 'Crop statistics of the Philippines 2001–2006: National and Regional'. Value of production estimates for other crops were derived from price and quantity data from these two sources. It was noted in 2008 that small inconsistencies apparent. There was no information available on bell peppers (nor in 2013).

Value of production data was used because the economic size of the industry is a key indicator of potential total economic gains from research. For small crops research has to deliver far larger per unit economic gains to match the benefits of small gains in the larger crops.

Table A1: Value of Production, Price and Production Statistics for Program Vegetables for 2006, Philippines

\	Value of Production		Area of Production	Quantity of Production	No. of growers	Price
	PhP m	$A m	ha	tonnes		P/kg
Tomatoes	2,177	56.341	17,128	175,596	na	11.77
Potatoes	1,388	35.917	5,451	69,461	na	19.98
Brassicas (cabbage)	1,153	29.840	7,323	91,243	na	12.55
(broccoli)	45	1.162	229	2,265	na	19.83
(cauliflower)	170	4.398	975	10,489	na	16.2
Lettuce	56	1.449	407	3,348	na	16.72
Bell Peppers	na	na	na	na	na	na

na not available

Table A2: Regional Value of Production, Price and Production Statistics for Program Vegetables for 2006

Crop	Region	Production mt	Area ha	Yield t/ha	Value PhP m	Value $A m
Tomatoes	Eastern Visayas	732	102	7.2	8.6	0.223
	Northern Mindanao	40,262	2,301	17.5	473.9	12.264
	Davao	4,347	618	7.0	51.2	1.324
	Caraga	308	72	4.3	3.6	0.094
White Potatoes	Eastern Visayas	0	0	0.0	0	0
	Northern Mindanao	6,745	548	12.3	134.8	3.488
	Davao	9,436	1,280	7.4	188.5	4.879
	Caraga	0	0	8.0	0	0
Cabbage	Eastern Visayas	160	27	6.0	2.0	0.052
	Northern Mindanao	3,052	392	7.8	38.3	0.991
	Davao	5,100	675	7.6	64.0	1.656
	Caraga	219	38	5.8	2.7	0.071
Broccoli	Eastern Visayas	0	0	0.0	0	0
	Northern Mindanao	518	68	7.7	10.3	0.266
	Davao	0	0	0.0	0	0
	Caraga	0	0	0.0	0	0
Cauliflower	Eastern Visayas	0	0	0.0	0	0
	Northern Mindanao	387	53	7.3	6.3	0.162
	Davao	190	37	5.1	3.1	0.080
	Caraga	0	0	0.0	0	0
Lettuce	Eastern Visayas	1	0.4	1.4	0.0	0.000
	Northern Mindanao	1,673	157	10.7	28.0	0.724
	Davao	5	4	1.1	0.1	0.002
	Caraga	0	0	0.0	0	0

Northern Mindanao and Davao were the most important areas for all the Program vegetables in this region. Of the crops tomatoes and potatoes were the most economically significant.

Vegetable production in Australia was worth $2,616 million in 2005-06, primarily comprised of tomatoes, potatoes and brassicas.

Fruit:

Table A3: Value of Production, Price and Production Statistics for Program Fruits for 2006, Philippines

	Value of Production		Area of Production	Quantity of Production	No. of growers	Price
	pesos m	$A m	ha	tonnes		P/kg
Durian	1,531	40	15,673	48,465	Na	31.58
Jackfruit	na	na	Na	na	Na	10.70
Mangoes	22,746	589	171,711	919,030	Na	24.75
Papaya	1,089	28	9,280	157,120	na	6.93

na not available

Table A4: Regional Value of Production, Price and Production Statistics for Program Fruits for 2006

	Production	Area	Yield	Value	Value
	Mt	ha	t/ha	Pesos m	$A m
Durian					
Eastern Visayas	6	24	0.3	0.2	0.005
Northern Mindanao	1,331	1,154	1.2	42.0	1.088
Davao	28,293	9,168	3.1	893.5	23.124
Caraga	890	1,656	0.5	28.1	0.727
Mangoes					
Eastern Visayas	547	712	0.8	13.5	0.350
Northern Mindanao	33,581	8,657	3.9	831.1	21.510
Davao	33,518	9,038	3.7	829.6	21.469
Caraga	15,955	3,325	4.8	394.9	10.220
Papaya					

Eastern Visayas	2,723	455	6.0	18.9	0.488
Northern Mindanao	32,496	929	35.0	225.2	5.828
Davao	13,496	590	22.9	93.5	2.420
Caraga	2,096	274	7.7	14.5	0.376

NB: Insufficient jackfruit data currently available

Mangoes are very important in Northern Mindanao and Davao and durian is also a significant crop in Davao. In fact Northern Mindanao and Davao are the main production areas in this region for all program fruits.

11.2 Appendix 2: Models/Methods used to address Objective 1

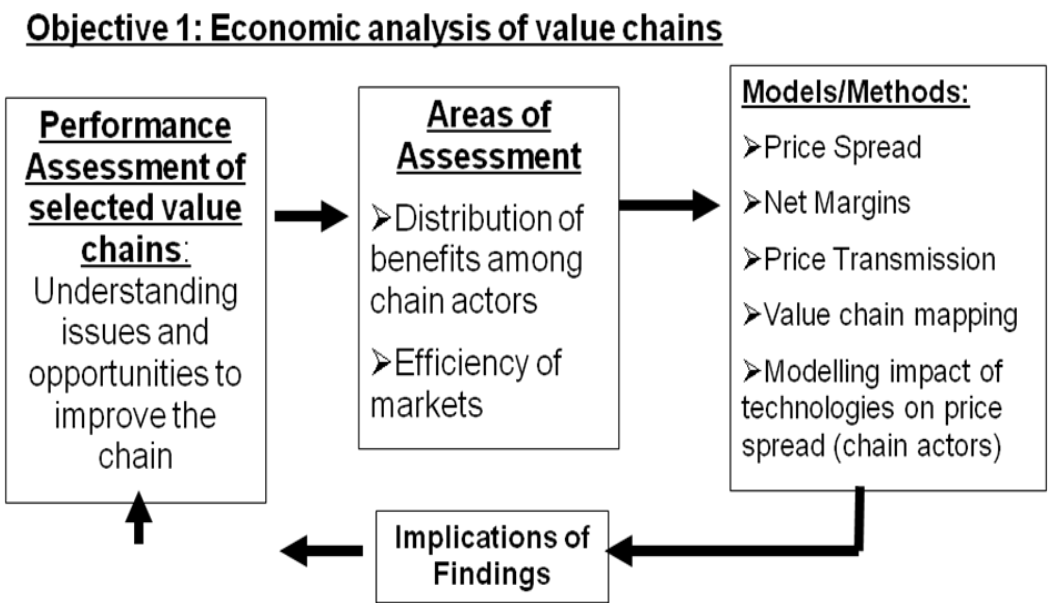

Figure A1. Processes for economic analyses of value chains

11.3 Appendix 3: Models/Methods used in Objective 1: Price spread, net margins, price transmission and market integration

Table A5. Models/Methods used in Objective 1: Price spread, net margins, price transmission and market integration

Method Objective 1	Why we're doing these	Data/Information Generated	Use	Target Users
Price Spread Analysis	• Provides a picture of the share of farm price to retail or selling price • Gives an indication of the cost of marketing, the value adding required by consumers	• Margins from farm to wholesale, wholesale to retail and farm to retail • % share of farm price to retail price • Trends (variability of prices and margins), regional, national, chains (region to region) • Factors affecting price spread trends	• Indicates value adding, production and marketing costs, distribution of benefits, issues in the chain (inefficiency-costs and distribution of benefits) • Provides background information of the chain and flags areas to probe why prices/margins are behaving as such • Policy implications	• PCAARRD • Department of Agriculture • Policy Analyst • Policy makers • Researchers • Other stakeholders who are interested of issues affecting the product/ sector of interest (including those who support the farmers-eg LGUs, NGOs, producer organizations, development agencies)
Net Margins Analysis	• Provides more details on the costs of marketing and production	• Cost structures of different nodes in the chain (farm, wholesale, retail and other market outlets eg traders), • Chain specific (case studies) • Profitability/net margins per node • Value Chain maps	• Indicates where the opportunities lie in terms of improving the efficiency of the chain (costs and market outlets, quality premium) or areas to probe further in terms of research	• Actors in the chain (farmers, wholesalers, retailers) • Same as price spread analysis
Price Transmission Model	• Provides an indication of whether farm prices are reflected in selling prices (or if markets are competitive)	• price transmission elasticities	• How buying prices and costs are reflected in selling prices • Indicates efficiency or inefficiency of the markets (trade barriers, market integration) • Flags problem areas that need to be further examined	• Same as price spread analysis
Market integration analysis	To determine whether prices are transmitted between two markets and move together in the long-run.	• Market integration results where prices of two markets are integrated or move together in the long-run.	• Indicates market efficiency • Indicates presence of trade barriers such as poor infrastructure, market power distortion, inefficient market information system.	• Same as price spread analysis

11.4 Appendix 4. Theoretical Framework for Objective 1

Marketing margins are the differences between prices at two market levels. Marketing margins have been examined on the basis of data obtained on prices at different stages of the marketing chain. Marketing margins have been calculated through computing the absolute margins or price spread, which is essentially the same as the difference between the prices, paid and received by each specific marketing agency (Khusk *et al*., 2001).

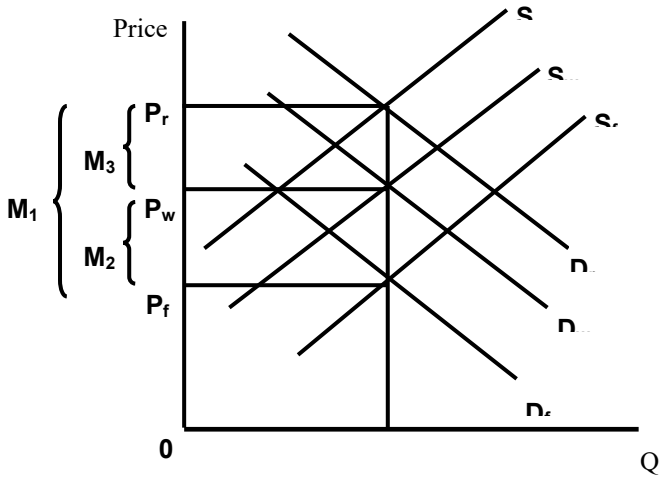

Figure A1. Demand and supply curves at farm, wholesale and retail levels reflecting marketing margins and price differences

Where: D_F, D_w, D_r = demand at the farm, wholesale, and retail levels

S_f, S_w, S_r = supply at the farm, wholesale, and retail levels

P_f, P_w, P_r = prices at the farm, wholesale, and retail levels

Q_f, Q_w, Q_r = quantity produced and consumed at the farm, wholesale, and retail levels

M_1, M_2, M_3 = margins at farm-wholesale, wholesale-retail, and farm-retail levels

It is assumed in Figure 1 that the quantity demanded and supplied are equal across the levels and no losses were incurred. From the farmgate to wholesale levels, there are value-added services such as cleaning, handling, packaging, quality grading. This would lead to a new equilibrium point, which is the basis for the new selling and the buying price of a particular farm product. P_w is normally higher than P_f due to the additional costs incurred by the wholesaler. When this product reaches the retail level, another set of value-added services would result to a new equilibrium point. It follows that P_r is higher than P_w to reflect the additional costs incurred by the retailer. The change in prices results in changes in the margins at each level. As depicted in the graph, margins vary depending on the value added services provided by a higher marketing level.

The GM between two marketing levels was estimated by taking the difference between the two prices.

Gross Margin

$$Gm = Pw - Pf$$

where:

Gm is the gross margin,

Pw is the wholesale price of crop product,

Pf is the farm price of crop product

Following the marketing levels above, Pf and Pw, the formula used to compute net margin as earned by each marketing level in the marketing of potato is as follows:

Net Margin

A net margin analysis is essential to examine the benefits of the different players across the supply chain. The net margin for a specific marketing level is equivalent to the net earnings after paying all the marketing costs. Net earnings of various marketing levels involved in the supply chain will be computed using following formula:

$$Nm = Gm - MC$$

where:

Nm is the net margin,

Gm is the gross margin

MC is the marketing costs incurred by a particular marketing level.

Moreover, the responsiveness of prices across the food chain was also determined. The elasticity of price transmission from one level, e.g., the farm to wholesale, was derived by estimating the coefficient for buying to selling with the following theoretical model:

$$P_s = f(P_B, MC) \quad ...(1)$$

where:

P_s is the selling price,

P_B is the buying price,

MC is the vector of marketing costs which includes the costs of grading, packing, cleaning, transporting, hired labour, and other costs.

From farm to wholesale, Pb refers to the farm price (Pf) paid by wholesalers to the farmers. In this case, P_b (buying price) is the same as P_f (farm price) as the wholesaler buys directly from the farmer.

On the other hand, Ps refers to the selling price of wholesalers to the next marketing level, commonly the retailers. Similarly, from wholesale to retail, Pb refers to the wholesale price paid by retailers to the wholesalers and Ps refers to the retail price paid by the consumers in wet markets.

Empirical Framework

An econometric model relating prices across the supply chain is estimated to get the coefficients of the buying price to selling price. The empirical counterpart of equation (1) becomes:

$$\boldsymbol{P_s = \beta_0 + \beta_1 P_B + \beta_{2i} \sum_{i=1}^{n} MC_i + \varepsilon} \qquad \textbf{.....(2)}$$

where:

P_S is the selling price,

P_B is the buying price,

n

$\sum$ **MC_i** is the aggregated marketing cost from C1 to C_n.

i=1

e is the margin for error.

From equation (2), the elasticity of price transmission is:

$$\varepsilon = \frac{\%\Delta P_S}{\%\Delta P_B} = \frac{\Delta P_S / P_S}{\Delta P_B / P_B} = \beta_1 \frac{P_B}{P_S}$$

The additive function was assumed because an increase in the production and marketing costs would also mean an increase in the selling price of the product. However, this may vary depending on the nature of data used for the estimation.

Price Spread Analysis

A price spread is the difference between the value of a product at two different levels in the industry. To ensure we are comparing 'apples with apples' all prices need to be expressed on a price per equivalent retail unit. For example, if the relationship between the quantity of papaya produced on farm and the quantity that eventually arrives at the retail sector is:

Y = a . X

where Y is tonnes of papaya at retail in Manila and X is tonnes of papaya at the farm gate in Mindanao then *a* is the losses incurred between the farm and the retailer.

If W is farm price for X then W/a is the price of the amount of papaya at the farm needed to give one tonne of Y. You can see that (a.X).(W/a) is WX, revenue at the farm gate.

This means that farm prices have to be divided by the adjustment factor 'a' when we are estimating price spreads.

Because price spreads are to be compared over time then all prices must be expressed in real Pesos. The GDP deflator for the Philippines has been used to express prices in 2007 pesos.

Expressed in this form we can estimate the farmers share of the consumer's Peso as the farm price as a percentage of the retail price. Similarly we can express the farm price as a share of the wholesale price.

Price spreads reflect the cost of services added at each stage in the marketing chain. The farm to wholesale price spread reflects the cost of getting the product from the farm gate to the wholesale market. Transport, labour and product wastage are some of the more obvious costs. Similarly the wholesale to retail price spread reflects the costs of getting the product from the wholesale market to the retail market.

Market integration

This analysis examines whether the farm, wholesale, and retail markets for relevant crops in the Philippines are integrated. Econometric models were used in the analysis of market integration.

The necessary precondition for a market integration is the assumption that there are homogeneous preferences and technologies. This is applicable for a spatial competitive equilibrium where *n* regions trade with fixed transport costs. There are also restrictions on the continuity, slope and curvature and domain of utility and production functions (Alexander and Wyeth 1994). In testing for market integration, prices between two markets are traditionally correlated assuming fixed transportation costs. If markets *a* and *b*, for example, are integrated, the difference between their prices is the transportation cost ie. $p^a - p^b = T$. Several approaches have been utilized to test this emprically including correlation of prices, Ravallion model, error correction model, cointegration of prices, and parity bounds model. Since the correlation analysis and Ravallion model do consider the non-stationarity of data, the problem of spurious regression is encountered. And, even though cointegration analysis acccounts for non-stationarity of data, this does not test for full market integration which requires that the cointegration vector must be equal to one as in the Ravallion model or its error correction form which addresses non-stationarity. The summary of the market integration procedure to be conducted in this study is shown in Figure A3.

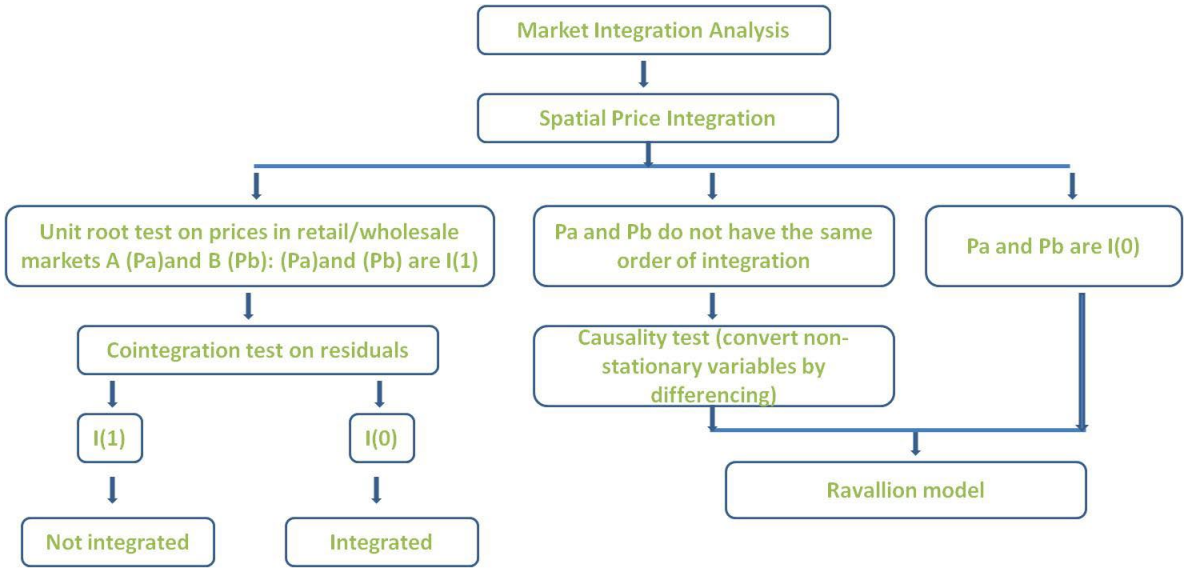

Figure a2. Market integration analysis procedure

Co-integration can only be tested if both price series are non-stationary with the same order of integration. To check this, the Augmented-Dickey Fuller unit-root test is conducted. To determine if prices in two market locations are integrated, if the price series are stationary or have different levels of integration, the framework used by Ravallion (1986) is applied. Using the Three Stage Least Squares, the Ravallion model is estimated. In this framework the following are assumed: a) p_{ct} is the price of the central market and p_{it} is the price of *i*th peripheral market; b) the price of the central market is exogenous, transportation is fixed and lags exist in price adjustment due to marketing inertia. The model is then estimated:

$$p_{it} = \sum_{j=1}^{n} a_{ij} p_{it-j} + \sum_{j=0}^{n} b_{ij} p_{ct-j} + \varepsilon_{it} \qquad (1)$$

The models to test the hypotheses of market segmentation, short-run integration and long-run integration can be tested in this model are as follows (see Ravallion 1986[16], pp. 104-105 for details):

Market segmentation: $b_{ij} = 0 \qquad (j = 0, \ldots . n)$ (2)

Short-run market integration: $b_{i0} = 1 \text{ and } a_{ij} = b_{ij} = 0 \quad (j = 1, \ldots, n)$; the weaker form in which the lagged effects disappear on the average is: $\sum_{j=1}^{n} a_{ij} + b_{ij} = 0$ (3)

Long-run market integration: $\sum_{j=1}^{n} a_{ij} + \sum_{j=0}^{n} b_{ij} = 1$ (4)

It is assumed that the central market is the downstream node. If the chain consider is wholesale to retail node, then the central market is the retail node. And if the nodes considered are farmgate and wholesale, then the central market is the wholesale node.

11.5 Appendix 5. Objective 1 Research Procedures, Data Used and Respondents

Research procedures

The data used for the price spreads and price transmission analysis were time-series data gathered from the BAS database. These include farm price, wholesale price, retail price, lending rates and agricultural wage rates. Moreover, the data on fuel prices were taken from the Department of Energy.

Issues encountered in the estimation of the models such as autocorrelation and multicollinearity were addressed by making use of different methods such as the

[16] Ravallion, M. (1986). *Testing Market Integration*. American Journal of Agricultural Economics 68, 102-109.

logarithmic form of the data, deflated data and first difference models. The best result from among the methods used was then utilized for the analysis.

On the other hand, net margins analysis required data obtained from survey and key informant interviews. The respondents for the net margins analysis were farmers, wholesalers, and retailers. There were also other actors in the supply chain who were interviewed such as farm labourers, storekeepers, "*kargadors*" (a local term for a labourer who loads and unloads sacks of vegetable from a transport vehicle), and service providers. These actors provided information which are relevant in understanding the entire supply chain and in the computation of the net margins per different marketing levels.

As seen in Table A6, there are a total of 118 key informants used in the net margin analysis of fruits. Key informants ranged from farmers to different business units and government institutions. However, only farm cases to different marketing nodes in different value chains are included in the net margin analysis. Some fruits like durian and papaya also have unique actors like viajeros and contract growers.

Table A6. Summary of respondents and key informants for the net margins analysis of fruits

Actors	**Number of respondents and key informants for Fruits**				Total
	Durian	Jackfruit	Mango	Papaya	
Farmer	3	5	90	20	118
Wholesaler	1	4	3		8
Retailer	3	1	5		9
Farmer/Wholesaler/Retailer	1				1
Wholesaler-Retailer	1		1	7	9
Trader-Shipper				12	12
Middleman	6				6
Contract Grower				20	21
Viajero		1		1	2
Business Units			1	1	2
Government Institutions			1		1
Total	15	11	101	61	188

On the other hand, Table A7 shows the total number of respondents included in the analysis of vegetables. More respondents were actually interviewed by the researchers, however, some of the informants especially the farmers gave answers that were irrational or inconsistent with the answers of other farmers and secondary data reviews. Moreover, some of them can hardly remember the inputs used in production as well as the exact amount and prices for each input since most farmers do not keep records of their financial expenses. Only 80 respondents and key informants were included in the net margins analysis.

Table A7. Summary of respondents and key informants for the net margins analysis of vegetables

Actors	Number of key informants for Vegetables				Total
	Cabbage	Eggplant	Potato	Tomato	
Farmer	91	6	60	82	239
Wholesaler	11	4	7	10	32
Viajero	1		1	1	3
Retailer	13	8	12	15	48
Producer Organizations			1		1
Government Institutions			2		2
Resource Person			1	2	3
Total	116	18	84	110	328

The price spread analysis, on the other hand, used secondary data of farm, wholesale and retail prices in the Philippines, Northern Mindanao and Southern Mindanao areas. In the market integration analysis, the data used are sourced from the BAS. The period covered for each crop is dependent on the availability of data as shown in Table A8

Table A8: Data series used in the Market Integration Analysis

Crop	Period	Farmgate (F)	Wholesale (W)	Retail (R)
Cabbage	annual 1990-2009	Manila, Region X, Region XI	Manila, Region X, Region XI	Manila, Region X, Region XI
Potato	monthly 1999-2009	Manila, Region X, Region XI	Manila, Region X, Region XI	Manila, Region X, Region XI
Eggplant	monthly 1999-2009	National, Region X, Region XI	National, Region X, Region XI	National, Region X, Region XI
Tomato	monthly 1990-2009	National, Davao del Sur,	National , Region XI, Region X	National , Davao City, Bukidnon,
Durian	annual 1990-2008	Region XI	Region XI	Region XI
Mango	monthly 1992-2009	National, Davao del Sur, Bukidnon	National	National, NCR

Sampling Procedures

This research study used simple random sampling in identifying the respondents of the study. Some important guidelines were considered in choosing the supply chain under assessment. Net margin cases were taken from key production areas in Mindanao and in regions where projects of other components in the ACIAR project HORT 2007 /066 and 067.

However, there were limitations observed in gathering the data for net margins and these limitations vary across different crops. This is due to the fact that every crop has its unique marketing structure such that different types of actors exist for each type of crop. The researchers were also constrained with the number of respondents who were willing to be interviewed and with the information they want to disclose. Furthermore, the data gathered for the net margins analysis were based on the recall of the respondents on their recent production or marketing activities due to lack of financial records on their end.

Issues and Limitations

One of the issues involved in the selection and computation of net margin cases is the tracing of fruits and vegetables from farm to retailer since the cases are not under the same transaction as it can hardly be done by the researcher. This means that the vegetable marketed by the wholesaler respondent, for example, does not really come from the farmer respondent or the vegetable procured by the retailer respondents does not really come from the wholesaler respondent. The cases have comparable time of occurrence but on different transactions. For the cases in net margin analysis, computing the percent distribution of net margins may not be appropriate and precise as what is typically done in value chain analysis.

Nevertheless, the cases for the net margins analysis were rigorously examined and presented in such a way that real case scenarios were actually included in the computation. Take for example the computation for the cost in wholesaling. It may appear to be easy but there are cases that a particular wholesaler markets a specific vegetable along with other vegetables. This means that you cannot just directly divide all the cost items for marketing to the number of kilograms of the vegetable under consideration since the costs are now distributed to a variety of vegetables. Ideally, the exact number of kilograms per vegetable should be identified in order to get the percent share of cabbage to the total number of kilograms involved in the transaction. However, this is such a tedious task since not all retailers can recall the exact number of kilograms they procured for each vegetable.

To address that particular issue, the study accounted for the ratio of the number of other vegetables involved in wholesale or retail to the total number of vegetables marketed. This ratio or percentage is then deducted to specific marketing costs that are distributed to all vegetables like stall rental, plastic bags, meal expenses and cost for depreciation items in order to get the marketing costs specifically for cabbage.

11.6 Appendix 6: Value Chains of Selected Fruits and Vegetables

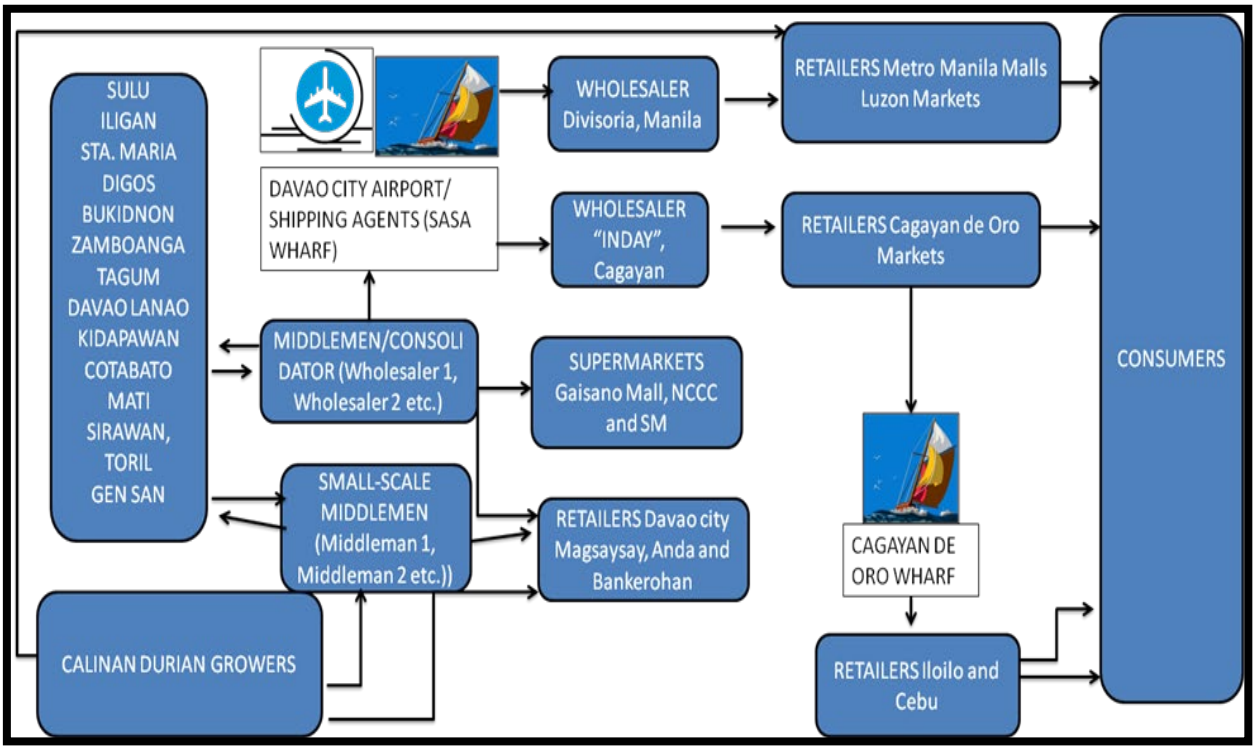

Figure A3. Value chain for Durian (Source of Production: Davao City)

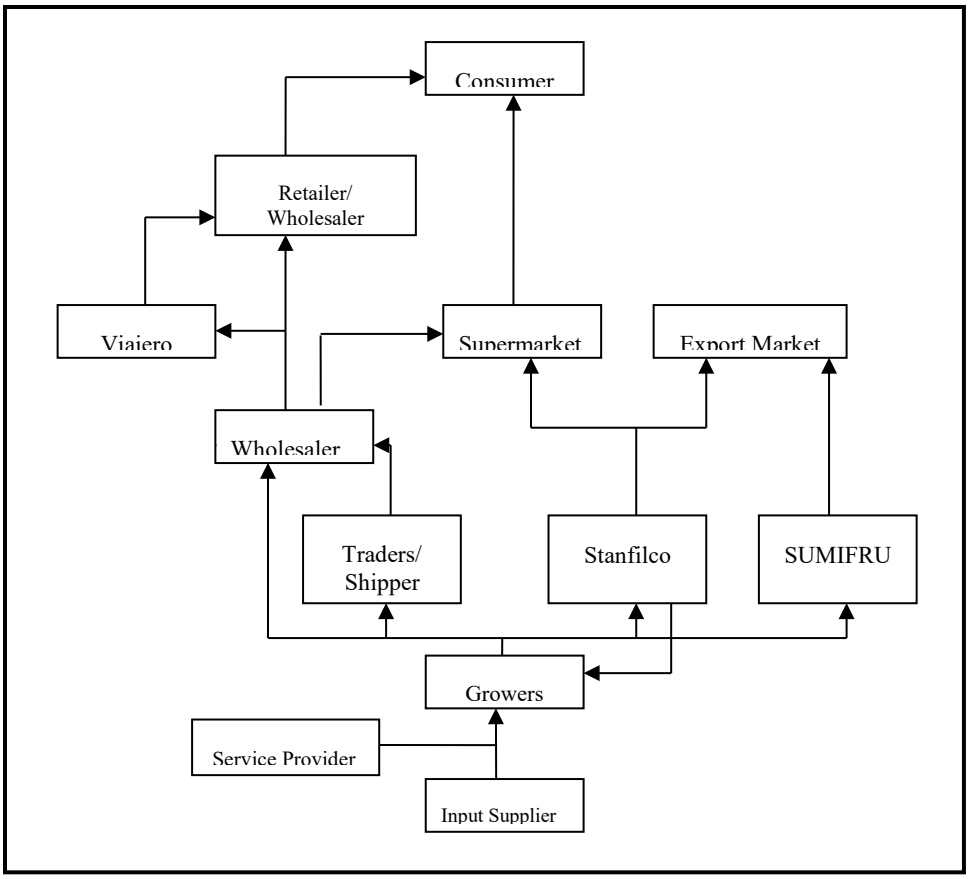

Figure A4. Value chain for papaya (Source of Production: South Cotabato)

.

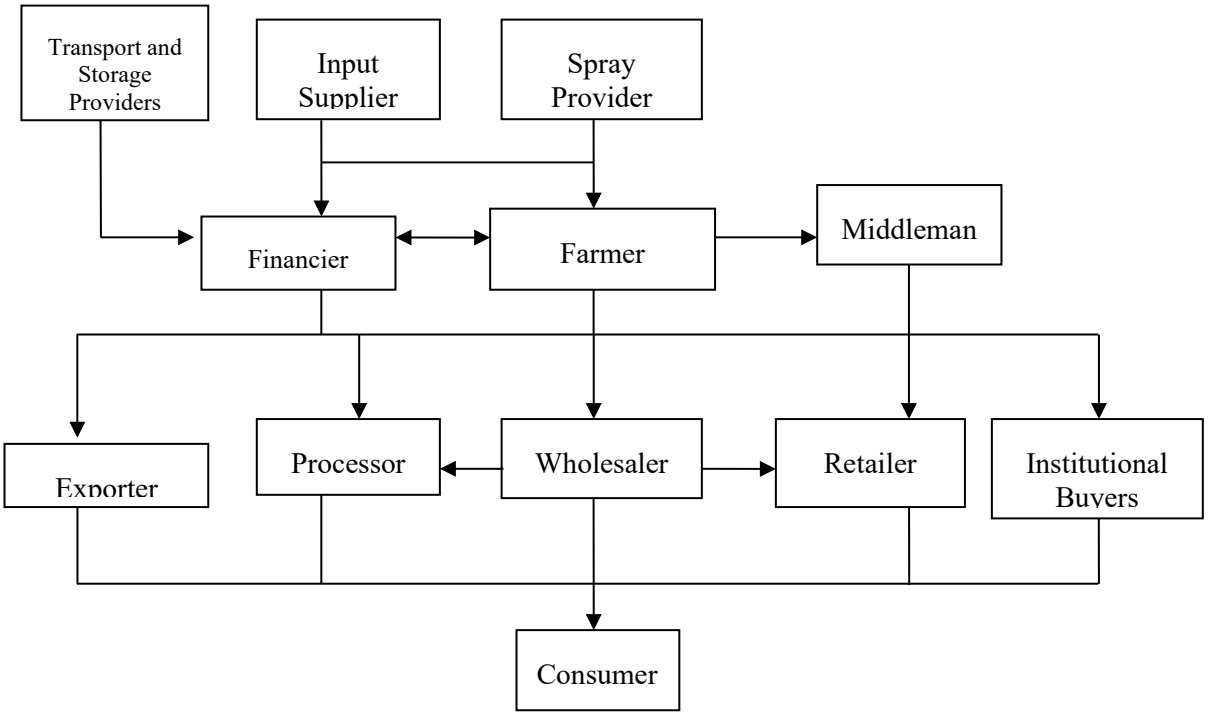

Figure A5 Value chain for mango (Source of Production: Davao City, Digos City and IGACOS)

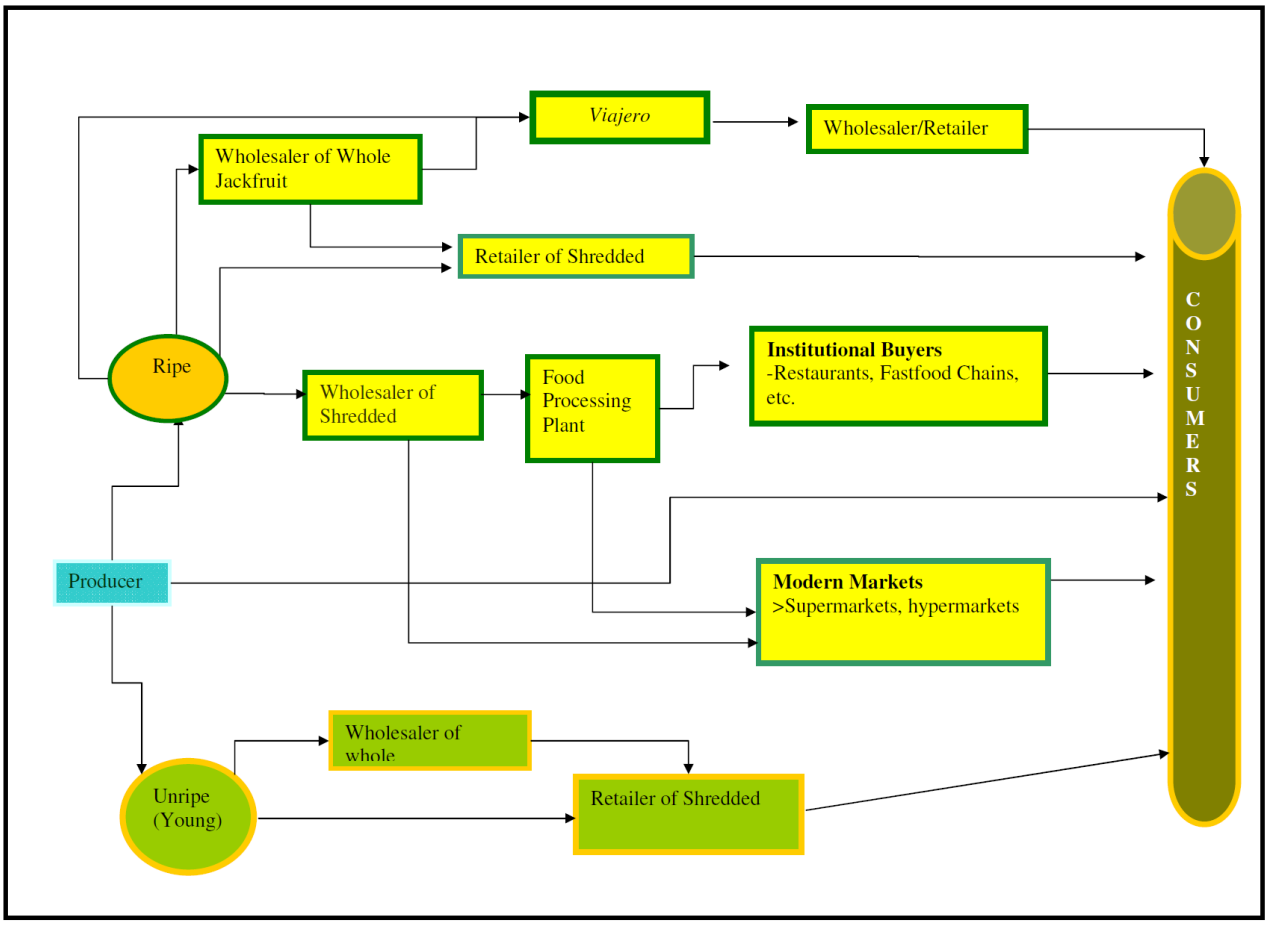

Figure A6. Value chain for jackfruit (Source of production: Davao City)

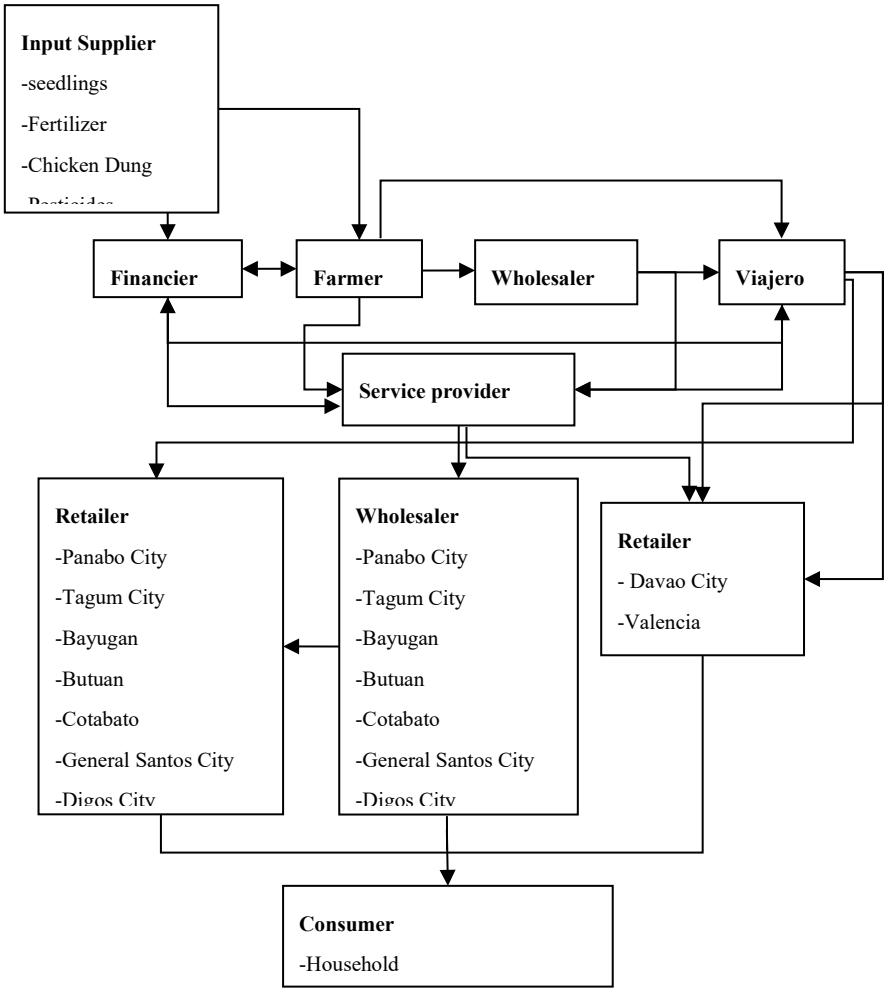

Figure A7. Value chain for potato (Source of production: Bukidnon and Davao del Sur)

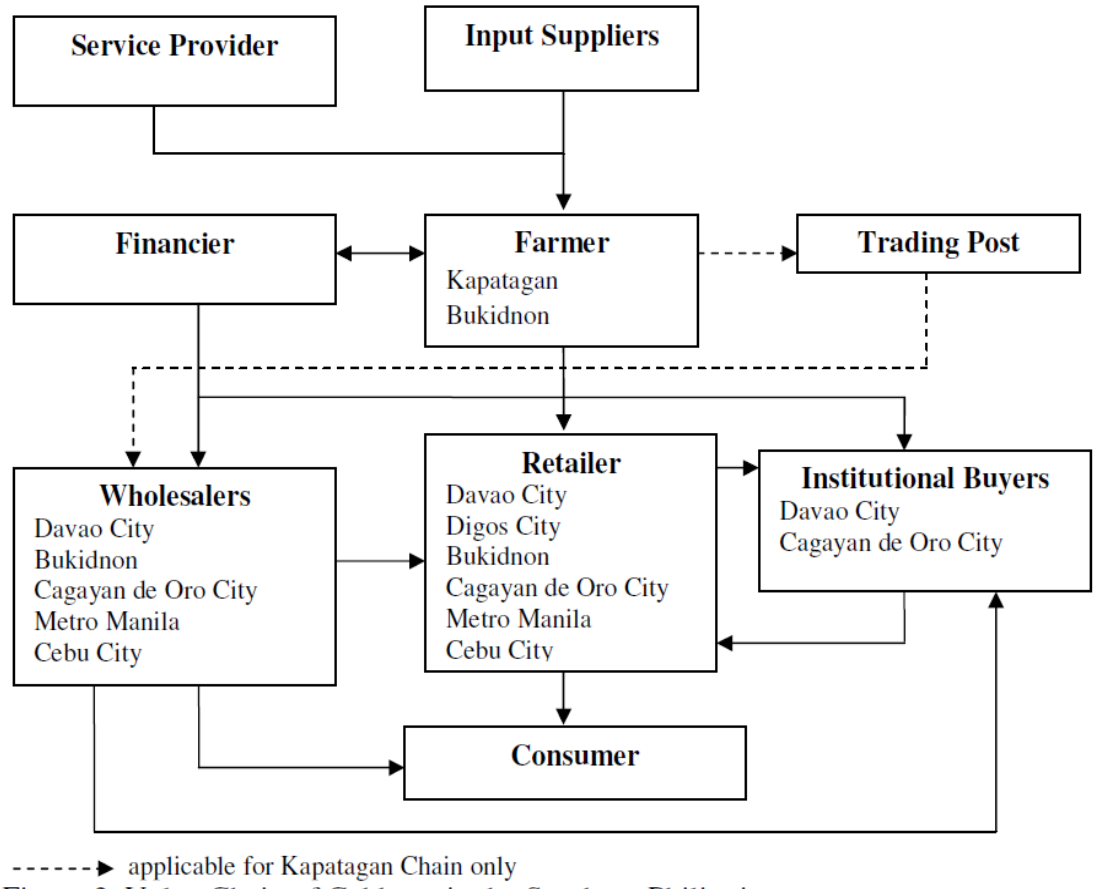

Figure A8. Value chain for cabbage (Production source: Bukidnon and Davao del Sur).

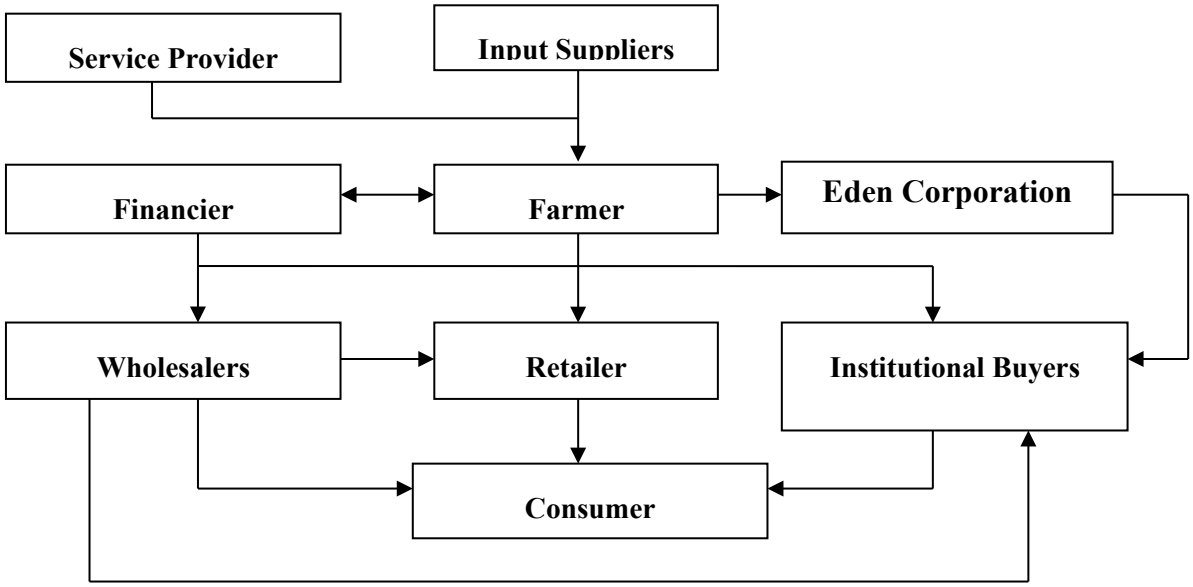

Figure A9 Value chain for tomato

11.7 Attachment 7: Example of Australian Budgets

Kelly, G. and Watts, S. (2013). Farm Enterprise Budgets for Zucchini etc. NSW DPI

Area Unit = 1ha — **CAPSICUM** — **2013**

INCOME:	Item	Quantity	Rate	Price	standard budget	your budget
Anticipated Yield	1st Grade	3000 cartons/ha	@	$ 10.50 /carton	$ 31,500.00	
			A. Gross Income/ha		**$ 31,500.00**	
OPERATING COSTS:				**$ Cost**		
Seed and Plants	Seedling Transplants		25000 plants/ha	$ 200.00 /1000	$ 5,000.00	
Fertiliser	Single Super		450 kg/ha	$ 0.48 /kg	$ 216.00	
	Calcium Nitrate		300 kg/ha	$ 0.76 /kg	$ 228.00	
	Potassium Nitrate		360 kg/ha	$ 1.32 /kg	$ 475.20	
	Magnesium Nitrate		400 kg/ha	$ 1.28 /kg	$ 512.00	
	Micro Nutrients		5 L /ha	$ 6.50 /L	$ 32.50	
Fuel	Ground/Bed Preparation	15 L/hr	4 hr/ha	$ 1.15 /L	$ 69.00	
	Lay Mulch/Drip Tape	12 L/hr	1.3 hr/ha	$ 1.15 /L	$ 17.94	
	Transplanting	12 L/hr	7.0 hr/ha	$ 1.15 /L	$ 96.60	
	Chemical Applications	12 L/hr	7.0 hr/ha	$ 1.15 /L	$ 96.60	
	Fertiliser Applications	12 L/hr	4.0 hr/ha	$ 1.15 /L	$ 55.20	
	Harvesting & Bin Pick up	10 L/hr	6.0 hr/ha	$ 1.15 /L	$ 69.00	
Chemicals	Insecticide	2 applications	1.0 kg/ha	$ 48.60 /kg	$ 97.20	
	Insecticide	2 applications	0.75 L/ha	$ 11.00 /L	$ 16.50	
	Insecticide	1 application	0.3 L/ha	$ 64.65 /L	$ 19.40	
	Insecticide	1 applications	1.7 L/ha	$ 161.16 /L	$ 273.97	
	Insecticide	2 applications	0.3 L/ha	$ 54.40 /L	$ 32.64	
	Fungicide	2 applications	2.2 kg/ha	$ 12.00 /kg	$ 52.80	
	Fungicide	2 applications	3.0 kg/ha	$ 8.24 /kg	$ 49.44	
	Sunscreen	2 applications	25.0 kg/ha	$ 5.60 /kg	$ 280.00	
Water	Drip Irrigation		4 ML/ha	$ 60.00 /ML	$ 240.00	
Labour	Tractor Driving	1 person	28 hr/ha	$ 25.00 /hr	$ 700.00	
	Lay Mulch/Drip Tape	2 people	1.3 hr/ha	$ 25.00 /hr	$ 65.00	
	Transplanting	3 people	7 hr/ha	$ 18.00 /hr	$ 378.00	
	Harvest	4 people	44 hr/ha	$ 18.00 /hr	$ 3,168.00	
	Wash, Grade & Pack	4 people	750 cartons/ha	$ 0.52 /carton	$ 1,560.00	
Electricity/Gas	Irrigation Pumps		4 ML/ha	$ 36.00 /ML	$ 144.00	
	Packing Shed & Coolroom		44 hr/ha	$ 1.05 /hr	$ 46.20	
Packaging	Package Materials		3000 cartons/ha	$1.60 /carton	$ 4,800.00	
Freight/Transport	Truck	96 cartons/ pallet space	$ 115.00 cost per pallet space	$1.20 /carton	$ 3,593.75	
Other Costs	Levies		0.50%		$ 157.50	
	Agents Commission		15%		$ 4,725.00	
	Plastic Mulch		6000 m/ha	0.10 /m	$ 600.00	
	Drip Tape		6000 m/ha	0.11 /m	$ 660.00	
	Bin Hire	14 days	50 bins/ha	$0.40 /bin	$ 280.00	
			B. Total Operating Costs		**$ 28,807.44**	
			Gross Margin per ha (A-B)		**$ 2,692.57**	
			Gross Margin /ML		**$ 673.14**	

Break-even Price	$9.44 / box	for	3000	cartons/ha
Break-even Yield	2515 cartons / ha @	$10.50	/ carton	

PRODUCT TRADE NAMES

The product trade names in this publication are omitted on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Department of Primary Industries

GROSS MARGIN BUDGET

CAPSICUM 2013

SENSITIVITY ANALYSIS

TABLE 1- Effect of Yield and Price on Gross Margin /ha

YIELD (cartons)	DELIVERED PRICE ($/carton)					
	8.50	9.50	**10.50**	11.50	12.50	13.50
2000	-$6,242	-$4,552	-$2,862	-$1,172	$518	$2,208
2500	-$4,310	-$2,197	-$85	$2,028	$4,140	$6,253
3000	-$2,377	$158	**$2,693**	$5,228	$7,763	$10,298
3500	-$445	$2,512	$5,470	$8,427	$11,385	$14,342
4000	$1,487	$4,867	$8,247	$11,627	$15,007	$18,387

NOTES:

Authors - This budget was prepared by G.Kelly, T.Napier and S.Watts and outlines production for inland NSW.

Area - The Sydney Basin, Central Tablelands, Riverina and Sunraysia are the main growing locations.

Production
- Bell shaped capsicums are the most common type. Green capsicums are commonly marketed.
- Red capsicums return higher prices. All varieties require warm to hot conditions for growth and fruit set.
- Two rows are usually sown on 1.5 to 1.8 m beds with plants spaced about 40 to 50 cm apart.
- Plant populations range from 25,000 to 30,000 plants per hectare.
- Plastic mulch and drip irrigation is common and helps reduce weeds and diseases.
- Water usage is 3 to 4 ML/ha (drip irrigation) and varies with soil, location and season.
- Fertiliser applications provide half of total nutrient requirement and most P requirement pre-planting.
- Micronutrient applications improve crop and fruit quality.
- Blossom-end rot can be a problem if irrigation stress occurs and causes calcium deficiency.
- Capsicum growing practices are similar to tomato and eggplant, however pests and diseases are different.

Pests, Diseases & Disorders
- Heliothis, thrips and aphids are the main insects.
- Nematodes can infect roots causing plants to wilt and be stunted.
- Tomato spotted wilt virus, mosaic virus, powdery mildew and bacterial fruit rots are diseases which occur in certain conditions. Virus infection is best prevented by maintaining hygiene, weed control and insect control.
- Calcium deficiency causes blossom end rot.
- Scarring on fruit is usually caused by thrips feeding during flowering.

Harvesting - Fruit is ready for harvest 14 to 15 weeks after transplanting.

Packaging - Capsicums are usually marketed in **8 kg cartons**.

Yields
- Average yields of 3,000 cartons per hectare can be expected (varies with plant population and crop health).
- Higher yields are achieved using intensive management options (i.e. plastic mulch and drip irrigation).

Economic
- **This budget is ONLY A GUIDE** and is specific to the regions specified. Costs and income can be altered for changes in crop management or input prices. Farmers should use their own figures.
- The budget uses a format similar to the Method 2 calculator in the VegTool Gross Margin program.
- Average prices for 2012 were used for this budget. Overhead costs or GST are not included.

Trim Reference: INT13/37813

HAL Horticulture Australia

Australian Government
Australian Centre for International Agricultural Research

11.8 Appendix 8: Abbreviations used in this report

BAS Bureau of Agricultural Statistics

BCR Benefit cost ratio

CDO Cagayan de Oro

CSU Charles Sturt University

DPWH Department of Public Works and Highways

E-V Expected mean-variance framework

IPM Integrated Pest Management

LCL Less-than-container load

FCL Full container load

FGDs Focus Group Discussions

FP Farmers practice

GDP Gross domestic product

GM Gross margin

GRDP Gross regional domestic product

IRR Internal rate of return

MICT Mindanao International Container Terminal

NSCB National Statistical Coordination Board

NCR National Capital Region

NSO National Statistics Office

NPV Net present value

PCAARRD Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development

PIDS Philippine Institute for Development Studies

PPA Philippine Ports Authority

PSCC Philippine Standard Commodity Classification

PUV Public utility vehicle

RORO Roll-on Roll-Off

SEARCA Southeast Asian Regional Center for Graduate Study and Research in Agriculture

UPMin University of Philippines, Mindanao

VSU Visayas State University

11.9 Appendix 9: Definition of fruit and vegetable marketing terms in the Philippines

Bodega is an assembly area where farmers coming from different areas drop off their crops for sale and consolidation. [17]

Contract growing is an agreement between farmers and processing and/or marketing firms under forward agreements, usually at predetermined prices for the production and supply of agricultural products (Eaton & Shepherd, 2001 as cited in Digal, 2007).

Disposer is a middleman who finds buyers for farmers and negotiates prices of farmers' produce among different buyers.

Dropper is a market hauler who is in-charge of unloading the products off the truck.

Filer is a market hauler who files the produce on designated areas assigned to wholesalers.

Habal-habal is a motorcycle which carries people and farm products.

Jeepney is the most popular means of transportation in the Philippines, with seating capacity of approximately 20 passengers. Jeepneys often carry produce in sacks on the roof.

Kargador – see *Market hauler*

Laborer is a market hauler who is responsible for transporting the products from the trading post to the designated stall areas of retailers or wholesalers.

Market hauler, also known as *kargador*, provides hauling services for wholesalers and retailers in transporting the products from the trading post to designated stall areas. The activities involved are unloading, filing and loading or transferring of crates manually or with the use of carts.

Middleman is a mediator between farmers and traders, who is responsible in finding suitable buyers and disposing the farmers' products.

Pakyaw is a system of hiring farm workers, wherein the payment is not on a per-day basis but on a task-based payment.

Resiko or *reseko* is a percentage (usually 25% of the total weight, but the % can vary with the product) deducted from the total weight to allow for waste and risk.

Retailer is a trader who sells products to consumers per piece or on a per-kilogram basis.

Viajero is a middleman who travels across different farm areas and market locations to gather vegetable products and sell them at designated market channels.

Wholesaler acts as intermediary trader between farmers and retailers. For tomato, the locals identified *Tagalog buyers* as wholesalers coming from Luzon while *CDO wholesalers* were those coming from Mindanao.

Reference

Digal, L.N. (2007). *Agricultural Contracts in Mindanao: The Case of Banana and Pineapple*. Philippine Institute of Development Studies Discussion Paper Series No. 2007-04. Retrieved May 3, 2013, from http://dirp4.pids.gov.ph/ris/dps/pidsdps0724.pdf

[17] This list prepared by School of Management, University of the Philippines in Mindanao

11.10 Documents and spreadsheets from economic and policy component on ACIAR's archive Meridio.

The following documents and spreadsheets are on the ACIAR archive Meridio: See folder -"Economic and Policy files and spreadsheets from Philippines Fruit and Vegetable program 2008-12 (HORT 2007 / 066 and 067).

Bulayog, S.B. and Preciados, L.S. (2009b). Region VIII Cabintan, Leyte Vegetables Enterprise Budgets. Available on ACIAR Archive website, Meridio

Bulayog, S.B. and Preciados, L.S. (2009c). Gross margins, Leyte, Mindanao and Philippines Vegetables Enterprise Budgets. Available on ACIAR Archive website, Meridio

Domingo (2013). Gross margins for eleven vegetable crops in Mindanao. Unpublished spreadsheet. Available on ACIAR Archive website, Meridio

McDougall, S., and Orr, L. (2011). Benchmarking vegetable IPM Adoption: Business case for adoption of integrated pest management (IPM) in lettuce. Part of report for National Vegetable IPM Coordination project (VG09191). Available on ACIAR Archive website, Meridio

Orr, L., and McDougall, S. (2011). Benchmarking vegetable IPM Adoption: Cost-benefit analysis of IPM Adoption by NSW lettuce growers. Part of report for National Vegetable IPM Coordination project (VG09191). Available on ACIAR Archive website, Meridio

Orr, L. M. (2009). Australian (NSW) vegetable gross margin budgets for selected ten vegetables, Internal NSW DPI Report. Available on ACIAR Archive website, Meridio

Orr, L. M. (2010a). Benefit cost analysis of a multi target approach to fruitspotting bug management. Available on ACIAR Archive website, Meridio

Orr, L., and Al-Khawaldeh (2010). Assessing the benefits from improved environmental controls in greenhouse vegetable production in NSW. Internal report NSW DPI. Available on ACIAR Archive website, Meridio

Orr, L., and McClintock, A., (2009). The fruit and vegetable industry Southern Philippines 2000-2009, Key statistics. Available on ACIAR Archive website, Meridio

12 Attachments

These reports are also available from the authors

12.1 Report Domingo *et al*. 2013.'Vegetable production and farmers' profile in the Southern Philippines'

12.2 Report: 'Welfare impact simulator for evaluating research: a manual for users'. Briones, R. and Galang, I.M.

12.3 Report: 'Welfare impact simulator for evaluating research (Spreadsheet version). PIDS WISER spreadsheet'. Briones, R. and Galang, I.M.

12.4 Report: 'Assessment of prospective impact of fruits and vegetables research at the industry level in the Philippines: The case of the ACIAR-PCAARRD horticulture project'. Briones, R. and Galang, I.M.

12.5 Report: 'Strengthening markets of high value fruits and vegetables in Mindanao: the case of transport and shipping service improvement'. Llanto, G.M., Sombilla, M.A., Quilloy, K.P., and Quimba, F.M.A.

12.6 Report: 'Evaluation of workshop on economic analysis techniques for the evaluation of farm fruit and vegetable systems'

12.7 Report 'An economic assessment of the contribution of trellising to the economic resilience of Far North Queensland fruit tree crops'

12.8 Report 'An economic assessment of better Phytophthora control in papaya through better fallow management'

12.9 Report 'Economic assessment of cocoa production- Far North Queensland'