



Australian Government  
Australian Centre for  
International Agricultural Research

# Project Document

*proposal phase*

Full

*project*

**Strengthening the Fiji Papaya Industry  
through applied research and information  
dissemination**

*project no.*

PC/2008/003

*prepared by*

Dr. Andrew McGregor and Mr. Kyle Stice, Koko Siga (Fiji) Ltd.

*research program  
manager*

Dr Richard Markham

(Please leave this page blank)

## Contents

<b>1</b>	<b>Project outline .....</b>	<b>4</b>
1.1	Funding request .....	4
1.2	Key contacts .....	4
1.3	Project summary .....	6
<b>2</b>	<b>Justification .....</b>	<b>8</b>
2.1	Partner country and Australian research and development issues and priorities .....	8
2.2	Research and/or development strategy and relationship to other ACIAR investments and other donor activities .....	11
<b>3</b>	<b>Objectives .....</b>	<b>14</b>
<b>4</b>	<b>Planned impacts and adoption pathways.....</b>	<b>17</b>
4.1	Scientific impacts .....	17
4.2	Capacity impacts.....	17
4.3	Community impacts.....	18
4.4	Communication and dissemination activities .....	19
<b>5</b>	<b>Operations.....</b>	<b>21</b>
5.1	Methodology .....	21
5.2	Activities and outputs/milestones .....	24
5.3	Project personnel .....	27
5.4	Intellectual property and other regulatory compliance .....	30
5.5	Travel table .....	31
<b>6</b>	<b>Budget .....</b>	<b>34</b>
<b>7</b>	<b>Supporting Documents .....</b>	<b>35</b>
7.1	Appendix A: Intellectual property register .....	35
7.2	Appendix B: Market Prospects for Fiji Papaya .....	37

# 1 Project outline

project number	PC/2008/003
project title	Strengthening the Fiji Papaya Industry through applied research and information dissemination.
ACIAR program area	Horticulture
proposal stage	Full
commissioned organisation	Secretariat of the Pacific Community (SPC)
project type	Large
geographic region(s)	South Pacific & PNG
country(s)	Fiji
project duration	4 years
proposed start date	1 January 2009
proposed finish date	31 December 2012
time to impact	Category 1

## 1.1 Funding request

		Amounts	totals
Year 1 (08/09)	Pay1	\$159,313	\$159,313
Year 2 (09/10)	Pay2	\$ 103,912	\$237,119
	Pay3	\$133,207	
Year 3 (10/11)	Pay4	\$ 104,602	\$214,618
	Pay5	\$ 110,016	
Year 4 (11/12)	Pay6	\$ 90,637	\$169386
	Pay7	\$ 78,749	
Year 4 (12/13)	Pay8	\$ 88,923	\$ 88,923
<b>TOTAL</b>			<b>\$869,357</b>

## 1.2 Key contacts

### *Project leader: Commissioned IARC*

title and name	Dr. John Konam
position	Plant Pathologist
organisation	Secretariat of the Pacific Community
phone	(679) 3370733
fax	(679) 3370733
email	JohnK@spc.int
postal address	SPC PMB, SUVA, FIJI
street address (if different to postal)	

### *Administrative Contact: Commissioned IARC*

title and name	Mr. John Yee Chief
----------------	--------------------

position	Manager, Finance and Administration
organisation	Secretariat of the Pacific Community (SPC)
phone	(679) 3370932
fax	(679) 3370021
email	JohnYC@spc.int
postal address	PMB, Suva, Fiji
street address (if different to postal)	

***Project leader: Collaborating organisation***

title and name	Dr. Andrew McGregor
position	Managing Director
organisation	Koko Siga (Fiji) Ltd.
phone	(679) 3305844
fax	(679) 3305668
email	koko@connect.com.fj
postal address	PO Box 2413, Government Buildings, Suva.
street address (if different to postal)	16 Goodenough St., Suva, Fiji

***Project coordinator: partner country***

title and name	Mr. Sant Kumar
position	General Manager
organisation	Nature's Way Cooperative (Fiji) Ltd
phone	(679) 672-4566
fax	(679) 672-4569
email	nwc@connect.com.fj
postal address	PO Box 9825, Nadi Airport, Fiji
street address (if different to postal)	

***Collaborating scientist: Collaborating organisation***

title and name	Mr. Bob Williams
position	Science Leader, Horticulture and Forestry Science Delivery
organisation	Department of Employment, Economic Development and Innovation
phone	07 40641151
fax	07 40642249
email	Bob.williams@dpi.qld.gov.au
postal address	PO Box 20, South Johnstone QLD 4859
street address (if different to postal)	

***Collaborating scientist: Collaborating organisation***

title and name	Mr. Roger Goebel
position	Consultant Tropical Horticulture Development
organisation	
phone	+ 617 4063 2526
fax	+617 40632526

email	rggoebel@bigpond
postal address	PO Box 153 Mourilyan Queensland Australia 4858
street address (if different to postal)	31 ETTY Bay Road Mourilyan north Queensland Aust.

### **Collaborating scientist: Collaborating organisation**

title and name	Mr. Grant Schule
position	Consultant - Farmer/Exporter
organisation	Kumu Farms
phone	808-567-6480
fax	808-567-6480
email	kumuman@aloha.net
postal address	P.O. BOX 223, KUALAPU'U, HAWAII, 96757
street address (if different to postal)	

## **1.3 Project summary**

Papaya has become Fiji's most important fruit export commodity and offers the prospect of becoming a major industry. Farmers in the Nadroga/Navosa and the Ba provinces are now recognizing the potential papaya provides in household income generation. As a result many new growers are taking up papaya farming. Although there is considerable information on papaya production from around the world this has not been "customised" for use by Fijian farmers, furthermore there has not been any formal research into the issues facing the commercial papaya industry in Fiji. As a result of this lack of sound information with regards to production, harvest and post harvest issues there are serious quality and consistency issues that threaten the long term viability of the Fiji papaya industry.

The proposed project "Strengthening the Fiji Papaya Industry through applied research and information dissemination" is aimed at addressing the immediate needs of the industry as well as establishing the framework to take the industry forward. The project has been developed and will be implemented in close collaboration with the Fiji Papaya industry through Natures Way Cooperative (Fiji) Ltd. The project will draw upon and collaborate with the experiences and expertise of the papaya industries in Australia and Hawaii.

The primary aim of the Project is to substantially increase the contribution of fruit and vegetable exports to livelihoods of rural people in western Viti Levu. The expected outputs of the project include: a three fold increase in exports of papaya; a doubling of persons involved in the papaya industry; a 50% reduction in culled fruit from the farm; an increase in competitiveness of Fiji Papaya on the export market through the use of sea freight.

The Project is expected to generate high economic returns. As a result of the project, in conjunction with the other initiatives to support the development of the Fiji papaya industry, exports are expected to increase from around 600 tonnes in 2008 to reach some 4,000 tonnes annually by the completion of the Project. This is a large increase in production. However, the projected increase is seen as realistic given the keen interest shown in papaya as an alternative income earning opportunity by farmers in recent times. The initial findings of the FACT Project funded market study confirms the availability of remunerative markets to absorb this production increase provided high quality standards are achieved and continuity of supply is maintained.

The projected level of annual exports resulting from the Project, and the other ancillary investments, will generate around \$F7m in export earnings and \$F3.5m in direct farm income. A larger production base will also benefit the local and local tourist markets and

creates opportunities for the development of value added processing industries. The Project provides significant employment opportunities in papaya farming and support industries. An estimated 600 people will be directly involved in field operations. Other stakeholders such as the transport companies, agro processors, airfreight agencies, airlines, quarantine services and exporters are a few of the organizations positively impacted by the project.

The project provides significant employment opportunities in the commercial farms. An estimated 600 people will be directly involved in field operations. Other stakeholders such as the transport companies, airfreight agencies, airlines, quarantine services and exporters are a few of the organizations impacted by the project. Employment creation and up-skilling of the employees will be necessary to meet the challenges and processes associated with increased and consistent exports. Through advocating current best practice, the project does not pose any threats to the environment and is actually significantly environmentally positive.

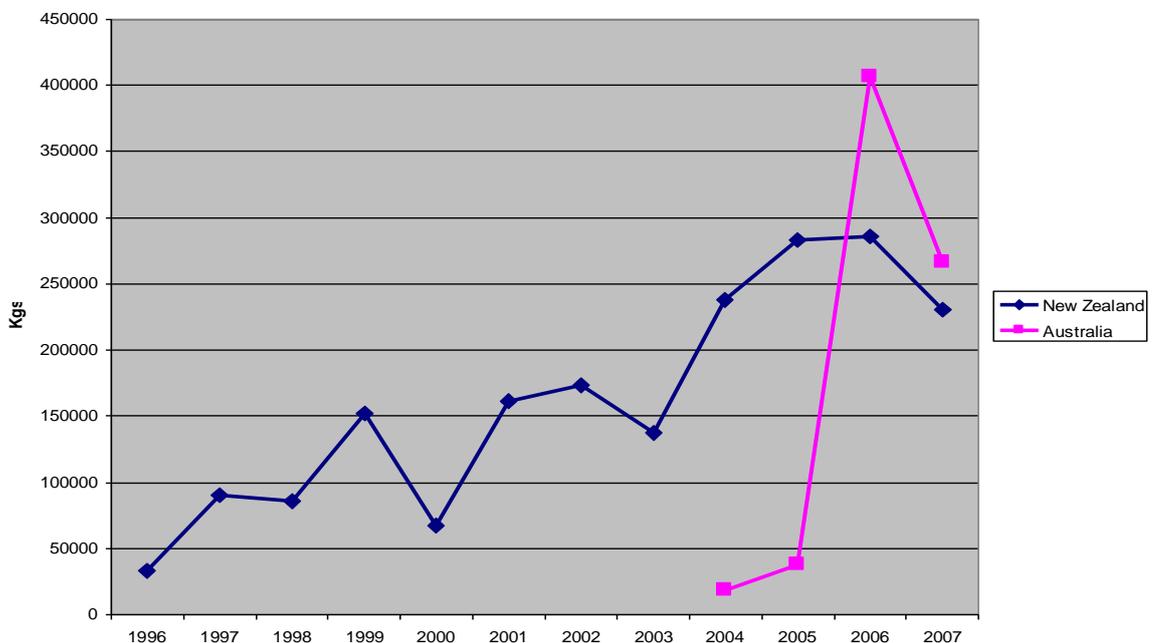
In Australia the papaya industry is undeveloped due to high levels of losses in the supermarket system and inconsistency of product flavour and fruit ripening behaviour. While the industry has invested in Research and Development to improve cultivar performance the need for a supply chain approach to reducing costs and to better meet customer requirements has been identified particularly to improve management of the elite lines. As part of this project consignments for each supply chain and season of activity will be monitored for quality and handling practices and conditions. Results will be reviewed, and analysed to determine areas for improvement. Subsequently improvement plans will be developed and assessed. This will provide resources to solve key research problems in the supply chain and to foster wide uptake of improvements by farmers and other supply chain members. Based on the Australian experience there are good prospects that the supply chain component will deliver short term benefits to farmers in both Fiji and Australia. Benefits will include: stronger chain relationships, a reduction in market losses (10%), lower transaction costs and higher through-put. An assured supply of good quality papaya should contribute to an improvement in the demand for higher quality tropical fruits both domestically and for export.

## 2 Justification

### 2.1 Partner country and Australian research and development issues and priorities

Fiji is currently facing an economic catastrophe with the demise of its sugar industry due to the phasing out of preferential access to the EU sugar market. The predicament faced by Fiji's farmers has been accentuated by the political crisis that engulfed Fiji in December 2006. Diversification of export and livelihood opportunities is urgently required if a major calamity is to be avoided. The growing papaya industry provides one of the most promising diversification avenues for many small farmers who have access to suitable land.

Papaya Exports from Fiji 1996 - 2007



Papaya has become Fiji's most important fruit export commodity and offers the prospect of becoming a major industry. The growth in papaya exports since high temperature forced air (HTFA) treatment began in 1996 is shown in the figure above.

A very thorough analysis of the needs of the horticulture industries in Fiji was undertaken in preparation of the Asian Development Bank's Alternative Livelihoods Project (ALP). The ALP was approved by ADB – however has not been implemented due to internal political problems. A number of the key ALP recommendations have been taken up in various forms thanks to the initiative taken by NWC. In the case of papaya many of the key issues such as treatment capacity and market access have already been undertaken. AusAID are expected to undertake a major effort into Pacific Islands market access through the Pacific Regional Market Access Program (PRAMA) which is programmed for implementation in the 2010 FY. Similarly supply chain analysis and current market prospects are being addressed by two other proposed projects:

- FAO-NWC farmer-market linkage project will commence in 2009. This project is designed to upgrade the capacity within NWC to support the industry in its effort to increase the supply of papaya sourced from small farmers, reduce the current demand–supply gap and improve the farmer –market linkages.

- The EU–Funded Facilitating Agricultural Commodity Trade Project (FACT) will support a market study for Fiji papaya. The aim of this support is to provide the industry with the most up to date market information for Fiji and Pacific papaya to Pacific Rim markets.

In this total integrated picture, the ACIAR project will play a key role in focusing in on the agronomic and postharvest issues. Furthermore it is anticipated that the coordination provided under the ACIAR project will allow for greater harmonisation of all the activities of the other actors involved.

Fiji is well placed to become a substantial papaya producer, based on a number of factors, including:

- Favourable soils and climate<sup>1</sup>
- Favourable pest and disease status.<sup>2</sup>
- A functioning commercial quarantine treatment<sup>3</sup>
- Strong export and local market demand for (appendix 1)

The Fiji papaya industry is currently comprised of:

- 9 exporters
- 11 larger papaya farmers (producing more than 1 tonne a week)
- Some 100 small farmers
- 1 industry owned and operated quarantine treatment facility (Natures Way Cooperative)

Exports of 'Fiji Red' papaya are currently to New Zealand, Australia, and Japan. It is likely that these exports will soon include the United States. The domestic market is also important. The projected overall demand for Fiji papaya is summarised in Table 1. Over the next few years papaya exports are expected to exceed 1,000 tonnes and reach 1,800 tonnes over 5–years. Local (including tourism) demand for papaya is expected to be around 1,600 tonnes in the next 2-3 years and to exceed 2,500 tonnes over 5 –years. Within 5-years the overall demand for Fiji papaya is estimated at around 4, 500 tonnes. Such an industry would provide direct livelihoods for 300 to 400 farm households.

---

<sup>1</sup> *The river valleys of Western Viti Levu offer excellent growing conditions for Hawaiian solo “sunrise” variety papaya. A true type Hawaiian solo “sunrise” papaya consistently produces fruit that combines exceptional sweetness and flavour (high o brix-10%-12%), strong red coloured flesh, with good size characteristics (400 to 600 gm) and good keeping qualities. The meeting of this potential, however, requires the use of good quality planting material, and the application of the correct package of practices, with a particular emphasis on irrigation and plant nutrition.*

<sup>2</sup> *The most notable papaya disease that is absent from is papaya ring spot virus (PRV). PRV decimated the Hawaii papaya industry. Some industry recovery has only been possible through the introduction of genetically modified (GM) papaya that is resistant to PRV. The PRV resistant varieties are considered inferior to the Hawaiian solo “sunrise” papaya and do not have access to remunerative markets. Papaya is regarded as a host to the Pacific Fruit Fly (*Bactrocera passiflorae*). Hence the need to use quarantine treatment for papaya exported from Fiji to Australia and New Zealand. However, there are no records of *B. passiflorae* infesting fruit at the colour break to half ripe stage that papaya is exported from Fiji at. As a consequence fruit flies are not a production pest for papaya in Fiji. This contrasts to the situation for papaya in Hawaii and Australia where fruit flies cause major damages to papaya unless costly on-farm control measures are taken.*

<sup>3</sup> *Through HTFA (high temperature forced air) a well established quarantine treatment for papaya that is accepted by Australia and New Zealand has been established and market access to the United States is being sought. Fiji, with a quarantine treatment that does not use chemicals or irradiation, has the opportunity to develop remunerative organic markets.*

Meeting this demand depends on Fiji farmers being able to produce sufficient volumes of high quality red flesh fruit.

**Table 1: Estimated overall demand for fresh papaya**

Market	2-3 years (tonnes)	5 years (tonnes)
<u>Export</u>		
NZ	600	1,000
Australia	300	500
Japan	120	200
United States		100
Sub-total	1,020	1,800
<u>Local</u>		
Tourist	800	1,500
Non - tourist	800	1,200
Sub-total	1,600	2,700
<b>Total</b>	<b>2,620</b>	<b>4,500</b>

It is anticipated that through the introduction and selection of a few new varieties that are very similar to the solo sunrise from Hawaii but might have some other desirable characteristics (better yields, better shelf-life, better phytophthora resistance etc.) the 'Fiji Red' brand will be enhanced. It is also anticipated that the introduction of the Waimanalo and similar phytophthora resistant varieties will spread out the production base of the industry and make it less vulnerable to natural disasters as well as provide livelihoods from papaya outside of the current commercial production areas. Early indications are that there is significant market demand for fruit of the Waimanalo variety which is yellow fleshed and slightly larger than Sunrise solo. This will be confirmed upon completion of the EU-FACT Papaya Market Study.

The need to improve and maintain high quality fruit production and to achieve consistent supply is vital for papaya farmers and exporters to realise the full market potential. In order to achieve this, papaya growing needs to be based on best practice production, harvest, and post harvest methods. The development and adoption of best practice production will enable the industry to be competitive on international markets and to expand exports. Growers need ready access to accurate and easy to understand information on the requirements for the profitable production of high quality fruit.

The proposed project is aimed at developing this package of best practices for the various sectors of the papaya industry as well as addressing major production and quality issues (e.g. hard lumps in fruit, fruit speckle and irregular fruit set) through literature review, stakeholder consultations in Fiji and abroad and through carefully designed field trials.

The proposed project is in line with the ACIAR Annual Operating Plan priority (for the Pacific):

Subprogram 1: Improving incomes through more productive farming systems:-

- facilitating adoption of earlier research on pest, weed and disease management.
- integration of existing knowledge into information packages

Subprogram 3: Biosecurity and pest and disease management:-

- Development and adoption of integrated crop management packages (including pest, weed and disease control)

The Program is also in line with current government of Australia (GOA) policies and priorities which stress that generating shared and sustainable economic growth is the single most important objective for the Asia-Pacific Region over the next 10 years. Major emphasis is placed on the central role of economic growth in reducing poverty; and on the need to strengthen support for private sector-led development as a key driver of economic growth. The AusAID Rural Development strategy has recently been reinvigorated and is expected to support rural enterprise development in a manner that seeks to use markets

to ensure investment and benefits are sustainable. Possible areas of focus include: business development and management; value-chain enhancement for selected high-value commodities; formation and management of producer organisations; application of agricultural technologies and techniques; and market information services. The proposed ACIAR papaya project is fully consistent with this rural development strategy.

In Australia the papaya industry is also undeveloped due to high levels of losses in the supermarket system and inconsistency of product flavour and fruit ripening behaviour. While the industry has invested in research and development to improve cultivar performance, the need for a supply chain approach for reducing costs and to better meet customer requirements has been identified particularly to improve management of new elite lines.

---

## **2.2 Research and/or development strategy and relationship to other ACIAR investments and other donor activities**

The strategy for strengthening the Fiji Papaya industry through applied research and information dissemination is to link up directly with the industry and address very specific problems and needs. This direct link to the Fiji Papaya Industry in this case is through Natures Way Cooperative (Fiji) Ltd. (NWC).

The research strategies to be adopted can be broadly classed into 4 categories, these are:

1. Stakeholder consultation and field visits: Interview stakeholders throughout the value chain to finalise the most specific needs of the industry. Examine the industries in Australia and Hawaii to see what lessons can be learned.
2. Literature review: Prepare a clear background of the Fiji papaya industry as well as analyse where the potential lies for growing this industry and what are the constraints to achieving this potential.
3. Using the available literature resources and technical advisory board; design specific research applications. A key objective is to involve stakeholders as well members of the Fiji Research community in the entire process from identification of the problem to design of the experiment to implementation, collecting data, drawing conclusions and disseminating the information. It is a process we are trying to develop within the industry to identify needs and bring resources in to meet these needs.
4. Applied research: Implement research activities; these will likely include;
  - Field trials to evaluate different production practices under different cropping systems (conventional, organic, fully mechanised, small-holder etc.) The aim will be to determine the most effective and economic set of production practices to produce high quality fruit for the specific market demands. The production practices likely to be investigated include; land preparation techniques, fertilizer rates, weed control techniques, fruit thinning, harvesting techniques etc. There are several commercial farms that have been identified to host the field trials from each of the two main agro-ecological zones of Fiji.
  - Evaluation of the most effective and economic set of post harvest practices to deliver high quality fruit for the specific market demands. This research will likely be carried out on demonstration farms, lead farmers properties, exporters packing houses and at NWC treatment facility.
  - Trials of sea freight shipments of papaya to determine the optimum supply chain requirements for this mode of export.

- Evaluation of the most effective and economic set of practices to address key fruit quality issues that have been identified as constraints to the supply of export quality fruit. Nutritional issues and fungal diseases will likely be the key priorities of this work. Activities will be carried out in the lab (MAPI Research, Taiwan Technical Mission, SPC), on farm and in the packhouse.
5. Information dissemination: Research will be carried out in collaborative trials on grower's properties. These collaborative trials will be used as part of the dissemination strategy. As experiments are completed results will be released to the industry. Culmination of all work will be in the production of a papaya manual with supporting posters to be launched at the Papaya Industry Conference. A series of workshops and mentoring sessions using the manual will follow.

The project also builds upon and compliments a number of other ACIAR initiatives, these projects along with their potential link the Fiji papaya project are shown in the table below:

ACIAR Project	Link to PC/2008/003
HORT/2003/071 - Integrated pest management and supply chain improvement for mangoes in the Philippines and Australia	Findings and outcomes of this project will provide valuable information for the pest and disease components of the work to be carried out in Fiji and the supply chain work to be carried out in Australia and Fiji.
PLIA/2005/159 - A constraints analysis of mango supply chain improvement in Pakistan HORT/2005/157 - Optimising mango supply chains for more profitable horticultural agri-enterprises in Pakistan and Australia	This Project will draw on the learnings from this supply chain analysis as it applies to the Fiji and Australian papaya industries. Outcomes of this work will have direct benefits to the Project through the technical and economic analysis provided. The same Australian Research partners involved in HORT/2005/157 will be assisting in the Project.
PHT/1997/161 - Market based analysis of constraints to banana industry development in Indonesia and Australia	These approaches will help in forming R&D processes for analysing constraints to industry development in Fiji and Australia.
ASEM/2000/101 - Improving the efficiency of the agribusiness supply chain and quality management for small agricultural producers in Mindanao"	The approach of ASEM/2000/101 will be very useful to the Project in that it has utilised a supply chain approach to develop options for improving industry improvement and benefit flows to smallholders
HORT/1997/094 - Management of post harvest diseases of sub-tropical and tropical fruit using their natural resistance mechanisms	Reference for research applications.
HORT/2001/049 - Development of PRSV-P resistant papaya genotypes by introgression of genes from wild Carica species	Literature reference and possible link with varieties that may be suitable under Fiji conditions.
HORT/2006/108 - The potential for tropical fruits production in Tonga - A feasibility and constraints analysis HORT/2006/173 - Tongan tropical fruit production - improving genetic diversity and production capacity building	Methodology and lessons learnt will be useful to the team as they assess one sector of the tropical fruit industry in Fiji. Tongan project will likely benefit from the findings of the Project as it relates to papaya production and marketing.
HORT/2007/067 - Improved domestic profitability and export competitiveness of selected fruit value chains in the southern Philippines and Australia	Work provides a very useful resource in establishing the way forward for the Fiji papaya industry. It is likely that the Philippines will also benefit from the development model and research outcomes from the Project.
PHT/1994/045 - Control of ripening in papaya and mango by genetic engineering	Reference for literature review.
HORT/2001/023- Horticultural industry development for market remote communities: Cape York &Samoa	Useful reference for a Pacific example of industry development and successful extension activities.

This ACIAR initiative is a critical component to the overall development programme for the Fiji papaya industry.

A summary table of the various complimentary projects is provided below.

Project	Implementing agency/Funding source	Relationship to ACIAR initiative
Natures Way Cooperative Extension Program	Natures Way Cooperative with support from AusAID	NWC, through its Extension Program, has secured funding from AusAID for a full time field officer for a period of three years. Since the commencement of this program there are now 3 specific projects that are targeting small holder involvement in the papaya industry <sup>4</sup> . Around 6000 people will benefit from these NWC initiatives. ACIAR Papaya Project will enhance and build off the success of these initiatives.
Natures Way Cooperative Expansion Program	Natures Way Cooperative with support from the Fiji Ministry of Trade and Commerce and the AusAID Enterprise Challenge Fund.	NWC has been awarded an AusAID Enterprise Challenge Fund <sup>5</sup> to expand the capacity of the quarantine treatment facility to 4,000 tonnes. Without such an expansion of capacity it would not have been advisable to increase production.
Natures Way Cooperative Market Access Initiative	Natures Way Cooperative with its own resources	In early 2008 NWC acquired the services of a recently retired USDA specialist to initiate the market access process for papaya into the US. Similar actions are proposed for other crops into the Australian and New Zealand markets.
Papaya Market Study for Fiji and the Pacific Islands	Secretariat for the Pacific Community (SPC) with support from the EU-funded Facilitating Agriculture Trade and	This project provides the most up to date information on all export markets for Fiji and Pacific Island papaya. The ACIAR project will be able to align its research issues directly with what is required by the market.

---

<sup>4</sup> Taiwan Technical Mission (TTM) small holder papaya project: The TTM, based in the Sigatoka Valley, have agreed to support the development of papaya growing with the NWC Extension officer providing the link between growers to exporters. The TTM have now imported improved papaya seed to support a three year planting program. Planting commenced in April 2008 with 8.6 ha, 40 farmers. A total of around 400 people including family members, casual labour, middleman etc will benefit. A second phase of the TTM Project is planned that will involve 60 farmers with additional 700 people benefiting.

Green Valley Export/MGM NZ papaya joint venture: This is one of the bigger programmes where the NWC Extension officer will play a significant role in an arrangement to secure more production. The venture is built around sea freighting papaya to New Zealand starting with a 10 tonne reefer container per week, increasing to 60 tonnes per week over a four year period. Over the next year the plan is establish 60 ha of papaya in the Sigatoka Valley. There will be 300 farm households (1,500 people) involved.

NWC Dubalevu papaya planting program: Project proposal for pawpaw production at Dubalevu involving 175 farmers' families over a 3-year period.

<sup>5</sup> This was one of only two successful ECF proposals for the entire Asia Pacific Region

### 3 Objectives

Within the broader development goal of improving the livelihoods of rural people in Viti Levu, based on increased production and improved marketing of fruit and vegetables, the purpose of this project is to strengthen the papaya industry in Fiji and Australia.

This will be achieved through the following objectives and activities:

#### ***Objective 1: Strengthen the capacity of the Fiji papaya industry to plan, conduct and adopt the products of problem-solving research***

Activity 1.1 Establish a standing technical advisory board (TAB) and processes for prioritising and managing research

- identify stakeholders in papaya production and market chain; identify representatives of key stakeholders for R&D management; and establish regular meetings
- establish process for obtaining feedback from activity 2 and other sources of problem identification and, based on this, for planning and resourcing research

Activity 1.2 Establish quality monitoring, traceability and feed-back system to farmers

Activity 1.3 Establish infrastructures for identifying producers' problems and conducting on-farm research

Activity 1.4 Establish mechanisms for effective feedback, adaptation and adoption of innovations

- Compile results from research applications and analyse. With assistance from the TAB, review the results of the research applications and extract the most relevant information for use in information sheets and other extension materials.
- Coordinate papaya extension programme that levers available resources from all partners to effectively disseminate findings.
- Hold regular field days at demonstration farms and encourage lead farmers to model best practice techniques to surrounding farmers.

Activity 1.5 Provide targeted technical support in key areas

- Technical support missions from QDPI specialists in pest and disease management, nutrition management.
- Technical support missions from Hawaii to develop organic systems and improved post harvest handling and quarantine treatment.

#### ***Objective 2: To expand and increase the resilience of the Fiji papaya industry***

Activity 2.1 Identify and evaluate local and export markets and strategies to enhance or sustain the value chain for Fijian papaya to these markets

- Evaluate the market for certified organic papayas and assess the costs and benefits of available organic certification regimes
- Evaluate the possibilities for export of Fiji papaya by sea freight
- Analyse the economics of growing papaya under a variety of different management systems including organic. Prepare farm management budgets based on field trials and lead farmer data collection.
- Design and implement a risk management plan for Papaya ringspot virus (PRV) entering Fiji (including a range of precautions, such as strengthened quarantine legislation and actions, to keep PRV out of Fiji and trialling of suitable resistant varieties - as below).

- Collate nutritional and papaya use material suitable for Fiji consumers to enhance the domestic market for Fijian papaya.

#### Activity 2.2 Identify and evaluate new genetic resources to underpin sustainability

- Import pure 'Solo Sunrise' variety seeds from The University of Hawaii
- In traditional growing regions, evaluate with farmers selected varieties similar to 'Solo sunrise' from Hawaii but with possible other desirable characteristics that could enhance the 'Fiji Red' brand
- In new growing regions, evaluate with farmers selected varieties (e.g. Waimanalo) that perform better in more humid and wet conditions but still have export potential. (It is anticipated that opening new growing regions will broaden the production base of the industry, make it less vulnerable to natural disasters and provide papaya-based livelihoods outside the current commercial production areas).
- Identify and evaluate, at selected sites, cultivars resistant to Papaya ringspot virus
- Collect, identify and evaluate locally available papaya varieties with the aim of determining the most suitable types for home gardens. (Of particular interest will be varieties that are nutrient rich, tolerant to strong winds and adverse soil conditions and easily propagated and cultivated).

#### Activity 2.3 Strengthen the seed system to disseminate high quality planting materials

- Design and implement a programme for maintenance of homogenous papaya seeds through regular and effective monitoring and implementation of technical processes involving collaboration between NWC, seedling suppliers and the Ministry of Agriculture.
- Training, awareness, and competency building to encourage establishment of small enterprises and individual growers producing high quality papaya seeds and a revolving industry fund established for the purchase of high quality papaya seedlings and seeds.

#### Activity 2.4 Improve production systems through participatory, on-farm research

- Conduct field trials at selected sites to determine the most effective and economic set of production practices for the currently preferred and most promising proposed varieties planted at the two different sites. (Trials will analyse both conventional and organic cropping systems. The production practices likely to be investigated include: land preparation, fertilizer rates, weed control techniques, fruit thinning etc.)
- Conduct research to solve production-linked problems identified by the processes set out in Objective 1. Problems already identified for immediate attention include:
  - Minimising the impact of phytophthora fruit/root rot and other fungal diseases on commercial papaya plantings (using pest/disease sampling etc)
  - Controlling problem of hard lumps in the fruit (using soil and foliage analysis to investigate possible nutrient deficiencies etc)
  - Address problem of irregular fruit set in commercial papaya plantings
  - Controlling problem of speckled marks on fruit

#### Activity 2.5 Improve post-harvest handling

- Conduct research to solve post-harvest problems identified by the processes set out in Objective 1. Problems already identified for immediate attention include:
  - Extend shelf life of fruit (e.g. through fruit wax, hormone control, cool chain etc.)
- Conduct research to optimise conditions for export of papaya by sea freight

***Objective 3: To enhance the profitability and competitiveness of the Australian papaya industry by improving the supply chain***

Activity 3.1: Identify and mobilise commercial partners who can champion improvements in papaya chains and where benefits and cost savings are shared by all members of the chain.

Activity 3.2: Identify strategies to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain.

Activity 3.3: Identify post harvest disease issues and implement possible remedial strategies.

Activity 3.4: Trial supply chain interventions with commercial partners to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain.

***Objective 4: To promote the adoption of project outputs in the Fiji papaya industry and elsewhere***

Activity 4.1 Identify potential beneficiaries within papaya industry and beyond (e.g. nascent papaya industries in others PICs, other existing or potential fruit industries in Fiji) and define strategy for reaching them

Activity 4.2 Compile, review and analyse results from field trials and all other research activities.

Activity 4.3 Prepare information dissemination materials and processes to bring research outputs to priority beneficiaries (as identified above) including:

- a 'Fiji Papaya' website that will promote Fiji papaya and make available information on the ACIAR project and other parallel activities.
- information sheets, training manuals and posters.

Activity 4.4 Conduct Papaya Industry Stakeholder Workshops (to share outputs from the Project and develop consensus on 'next steps' for further development of the industry)

Activity 4.5 Conduct Australia-Fiji Papaya Industry Learning Workshops (for exchange of experiences in developing papaya value chains)

Activity 4.6 Conduct briefings and informal workshops to transfer conclusions of project to other potential beneficiaries (Fiji Ministry of Agriculture, Koronivia Research Station, Fiji College of Agriculture etc.)

---

## 4 Planned impacts and adoption pathways

The proposed project is identified as an ACIAR Category 1 Project, with the expected outputs likely to have a significant community impact within 5 years of project conclusion.

The expected outputs of the project are:

- A three fold increase in exports of papaya
- An doubling of persons involved in the papaya industry
- A 50% reduction in culled fruit from the farm
- Increase in competitiveness of Fiji Papaya on through the use of sea freight.

---

### 4.1 Scientific impacts

Preliminary literature reviews and stakeholder consultation revealed that many of the production problems that face the Fiji Papaya industry are also experienced in papaya industries in other Pacific islands (Samoa, Tonga, Cook islands, Hawaii), South America, the Caribbean, South East Asia and Australia. It is anticipated that the results of the production trials along with the scientific and economic analysis will provide valuable scientific data that could be utilised well beyond the Fiji Industry. Samoa currently has a very small papaya industry that is seriously constrained by the inability to successfully combat phytophthora. The applied research activities in this project aimed at identifying cost effective chemical and cultural controls for phytophthora will be key to Samoa developing their papaya industry. Similarly the supply chain requirements developed for sea freighting Fiji papaya to New Zealand will benefit Samoa and other Pacific Islands that have very limited air freight capacity.

It is expected that there will be significant scientific outcomes by way of adding to the existing knowledge base of papaya internationally and through scientific publications (e.g. work on irregular fruit set, hard lumps in fruit and fruit speckle). Proposed project coordinator for this ACIAR project, Kyle Stice, has recently been invited to present a paper and chair a session at the Second International Symposium on Papaya to be held in Madurai, India, December 9th -12th 2008. It is anticipated that this type of interaction between Fiji farmers and researchers and the international scientific community will increase as a result of this project.

---

### 4.2 Capacity impacts

Fiji research and extension services are general and diffuse in their nature and as a result Fiji's commercial agricultural industries have suffered and remain small and vulnerable. It is anticipated that the structure and international collaboration associated with this project will improve the capacity within both the private sector and the government for carrying out such industry focused research and information dissemination. As this project is driven by the private sector through NWC there exists a unique opportunity to develop sustainable industry research and extension capability. It is envisaged that this will provide a model for other Pacific islands.

In Australia farmer centred research or action research models used in supply chain management will enhance the capacity of researchers, growers and exporters to manage improvements in the fruit supply chains.

---

## 4.3 Community impacts

### 4.3.1 Economic impacts

The Project is expected to generate high economic returns. As a result of the project, in conjunction with the other initiatives to support the development of the Fiji papaya industry, exports are expected to increase from around 600 tonnes in 2008 to reach some 4,000 tonnes annually by the completion of the Project. This is a large increase in production. However, the projected increase is seen as realistic given the keen interest shown in papaya as an alternative income earning opportunity by farmers in recent times. The initial findings of the FACT Project funded market study confirms the availability of remunerative markets to absorb this production increase provided high quality standards are achieved and continuity of supply is maintained.

The projected level of annual exports resulting from the Project, and the other ancillary investments, will generate around \$F7m in export earnings and \$F3.5m in direct farm income. A larger production base will also benefit the local and local tourist markets and creates opportunities the development of value added processing industries. The Project provides significant employment opportunities in papaya farming and support industries. An estimated 600 people will be directly involved in field operations. Other stakeholders such as the transport companies, agro processors, airfreight agencies, airlines, quarantine services and exporters are a few of the organizations impacted by the project.

Based on the Australian experience with the Better Mangoes Project (to be adapted in adopted QDPI component of the Project), which put the ripening, transport, disease and quality management work into context of real life situations, there are good prospects that the supply chain component will deliver short term benefits to farmers in both the Fiji and Australia. Again based on the Better Mangoes experience, benefits could include: stronger chain relationships, a reduction in market losses (10%), lower transaction costs and higher through-put.

### 4.3.2 Social impacts

The pro poor contribution of expanding Fiji's horticultural exports was recognised by the Enterprise Challenge Fund in allocating NWC one of the first grants awarded in this major new AusAID initiative. The ECF review panel recognised commercial horticulture as an industry that supports the employment of females and therefore an expansion of horticultural exports will create more employment for women<sup>6</sup>. At least half the direct beneficiaries from this Project are expected to be females. The skill levels required for modern commercial horticulture are substantially higher than that of the sugar industry. Thus the quality of employment available for rural women will be substantially enhanced by this Project.

In both the Fiji and Australia the project will have a strong emphasis on grower and supply chain participants to foster increased uptake of better practices and to share the benefits of cost reductions. The primary beneficiaries of this project will be papaya farmers and supply chain participants in both the Fiji and Australia and consumers. Supply chain participants (spray contractors, wholesalers, exporters, transporters, retailers) will also benefit from improvements in supply efficiency/logistics.

---

<sup>6</sup> *Females in Fiji represent only 31% of those regarded as "Economically Active", as evidenced in Dr. Wadan Narsey's 2007 publication "Gender Issues in Employment, Underemployment and Incomes in Fiji". Furthermore the women who are economically active are far more vulnerable to poverty than the males, Narsey states, "Using a conservative \$60 per week as a standard for the incidence of poverty for an income-earning individual, the data indicates that Female workers are far more vulnerable to poverty than Males, with 44% earning below the poverty line, in contrast to 32% of Male Economically Active".*

### 4.3.3 Environmental impacts

The project does not pose any threats to the environment and is actually significantly environmentally positive. The current papaya production systems involve minimal pesticide usage and this is expected to continue in the future with an emphasis on safe and correct application of any chemicals that are necessary. The organic production systems that are to be investigated as part of this project are beneficial to the environment.

Improved supply chain management can lead to increased market share and access to a larger number of markets which has the potential to increase the profitability of papaya production enterprises, resulting in an increase in tree plantings.

---

## 4.4 Communication and dissemination activities

The primary communication outputs for the project are collaborative grower trials and a proposed "Handbook for Production of Premium Quality 'Fiji Red' Papaya". This handbook together with supporting posters will provide growers with ready access to accurate and easy to understand information on the requirements for the profitable production of high quality fruit.

Topics and subjects to be covered in the handbook are: The importance of using best planting material; Site selection; Planting and spacing; Fertilizer and fertilizing; Drainage and water management; Irrigation; Pests, diseases and their control; Fruit thinning; Fruit maturity; Harvest and post harvest handling; Handling in the pack house; Selection and grading; Quarantine treatment; Packing for export; Organic papaya production.

The dissemination strategies that will be used to promote adoption of project results include:

- The use of collaborative trials on grower's properties.
- A train the trainer course for private sector representatives, NWC field staff, agriculture extension officers and trainers from tertiary institutes.
- Papaya industry workshop that includes stakeholders all the way along the value chain to launch the handbook and related workshops.
- Component specific training for stakeholders at the different levels of the value chain from production to marketing and all those in the middle.
- Mentoring - within two months of a group receiving training they shall be visited again by the relevant extension staff to ensure the training was well received and implemented.

It is envisaged that a variety of scientific papers will be produced along with the final project report. Such papers will be submitted to specific journals and forums in an attempt to bring to the international spotlight the specific research outputs from the project.

In Australia the project will work with commercial supply chains that have strong motivation and ability to meet customer requirements. Generic (non-commercial confidential) information will be provided directly to other supply chains.

There will be a strong emphasis on the active involvement of growers and others in the export supply chain. Experience in domestic supply chain improvement projects has shown that to achieve change it is crucial to work with growers as partners in an action research paradigm.

The project team will work closely with industry participants at all stages to generate and transfer information that builds knowledge and capacity of supply chains to implement improved practices and systems.

The participatory approach of working with farmers and other chain members to analyse their supply chains, identify, test and implement improvements, and gain knowledge about customer requirements will increase the capacity of supply chains to improve performance.

---

## 5 Operations

---

### 5.1 Methodology

#### ***Objective 1: Strengthen the capacity of the Fiji papaya industry to plan, conduct and adopt the products of problem-solving research***

Activity 1.1 Establish a standing technical advisory board (TAB) and processes for prioritising and managing research

- identify stakeholders in papaya production and market chain; identify representatives of key stakeholders for R&D management; and establish regular meetings. Coordination of all TAB activities will be led by Kyle Stice and Andrew McGregor. Several TAB members have already been identified and appear in this project document, further appointments to the TAB will be made in due course. It is envisaged that at least one representative from the QDPI partners will be part of this TAB.
- establish process for obtaining feedback from activity 2 and other sources of problem identification and, based on this, for planning and resourcing research. TAB will be responsible for setting up this process under the guidance of the Project Leader and Kyle Stice. With a careful analysis of the issues at hand the TAB will decide what activities are best addressed by what partner. In many instances R&D work outside of the scope of the ACIAR project will be delegated to partners such as SPC, the Taiwanese Technical Mission or the Ministry of Agriculture.

Activity 1.2 Establish quality monitoring, traceability and feed-back system to farmers. This system will be set up in conjunction with the NWC Field Service that closely monitors product that enters the treatment facility. The bilateral quarantine agreement currently in place for papaya exports requires coding of all field crates that enter the treatment facility, this coding should trace back directly to a specific farm, on a specific harvest date. This system needs to be enhanced in conjunction with the introduction of industry export standards that are applied to improve the quality and consistency of papaya exports.

Activity 1.3 Establish infrastructures for identifying producers' problems and conducting on-farm research. Extension partners will have regular task of visiting farming areas to document problems faced by stakeholders and receive requests for assistance. TAB will be tasked to evaluate issues and requests and respond by delegating responsibility to the most appropriate partner to address the issue.

Activity 1.4 Establish mechanisms for effective feedback, adaptation and adoption of innovations

- Compile results from research applications and analyse. With assistance from the TAB, review the results of the research applications and extract the most relevant information for use in information sheets and other extension materials.
- Coordinate papaya extension programme that leverages available resources from all partners to effectively disseminate findings.
- Hold regular field days at demonstration farms and encourage lead farmers to model best practice techniques to surrounding farmers.

Activity 1.5 Provide targeted technical support in key areas

- Technical support missions from QDPI specialists in pest and disease management, nutrition management and post harvest handling. It is also envisioned that QDPI will provide technical assistance to the TAB in the design of experiments and establishment of field trials.

- Technical support missions from Hawaii to develop organic systems and improved post harvest handling and quarantine treatment. Farmer/exporter Grant Schule has already been identified to carry out this activity.

**Objective 2: To expand and increase the resilience of the Fiji papaya industry**

Activity 2.1 Identify and evaluate local and export markets and strategies to enhance or sustain the value chain for Fijian papaya to these markets

- Evaluate the market for certified organic papayas and assess the costs and benefits of available organic certification regimes. This analysis will be undertaken by Andrew McGregor and Kyle Stice and will form the basis for the organic production field trials.
- Evaluate the possibilities for export of Fiji papaya by sea freight.
- Analyse the economics of growing papaya under a variety of different management systems including organic. Prepare farm management budgets based on field trials and lead farmer data collection. Coordination of economic analysis and preparation of financial models will be undertaken by Andrew McGregor and Kyle Stice.
- Design and implement a risk management plan for Papaya ringspot virus (PRV) entering Fiji (including a range of precautions, such as strengthened quarantine legislation and actions, to keep PRV out of Fiji and trialling of suitable resistant varieties - as below). Kyle Stice will undertake the coordination of this activity and likely draw on expertise from QDPI to carry out this activity.
- Collate nutritional and papaya use material suitable for Fiji consumers to enhance the domestic market for Fijian papaya. These materials will be prepared in collaboration with supermarket chains and domestic wholesalers. It is envisioned that this activity will work in conjunction with the Ministry of Health initiative to promote a healthy diet by consuming more fruits and vegetables.

Activity 2.2 Identify and evaluate new genetic resources to underpin sustainability

- Import pure Hawaiian solo "sunrise" variety seeds from The University of Hawaii. The project will import its own seed for use in field trials and for establishment of nursery development activities.
- In traditional growing regions, evaluate with farmers selected varieties similar to Hawaiian solo "sunrise" from Hawaii but with possible other desirable characteristics that could enhance the 'Fiji Red' brand. Several varieties have already been identified and it will be left up to the TAB to determine the most suitable varieties to be trialled in the two locations.
- In new growing regions, evaluate with farmers selected varieties (e.g. Waimanalo) that perform better in more humid and wet conditions but still have export potential. (It is anticipated that opening new growing regions will broaden the production base of the industry, make it less vulnerable to natural disasters and provide papaya-based livelihoods outside the current commercial production areas). TAB will make all final selections on varieties to be trialled.
- Identify and evaluate, at selected sites, cultivars resistant to Papaya ringspot virus. Varieties will be selected based upon their marketability and suitability to Fijian conditions.
- Collect, identify and evaluate locally available papaya varieties with the aim of determining the most suitable types for home gardens. (Of particular interest will be varieties that are nutrient rich, tolerant to strong winds and adverse soil conditions and easily propagated and cultivated). This activity will be coordinated by Kyle Stice with technical assistance from Roger Goebel.

Activity 2.3 Strengthen the seed system to disseminate high quality planting materials

- Design and implement a programme for maintenance of homogenous papaya seeds through regular and effective monitoring and implementation of technical processes involving collaboration between NWC, seedling suppliers and the Ministry of Agriculture.
- Training, awareness, and competency building to encourage establishment of small enterprises and individual growers producing high quality papaya seeds and a revolving industry fund established for the purchase of high quality papaya seedlings and seeds.

Activity 2.4 Improve production systems through participatory, on-farm research

- Conduct field trials at selected sites to determine the most effective and economic set of production practices for the currently preferred and most promising proposed varieties planted at the two different sites. (Trials will analyse both conventional and organic cropping systems. The production practices likely to be investigated include: land preparation, fertilizer rates, weed control techniques, fruit thinning etc.)
- Conduct research to solve production-linked problems identified by the processes set out in Objective 1. Problems already identified for immediate attention include:
  - Minimising the impact of phytophthora fruit/root rot and other fungal diseases on commercial papaya plantings (using pest/disease sampling etc)
  - Controlling problem of hard lumps in the fruit (using soil and foliage analysis to investigate possible nutrient deficiencies etc)
  - Address problem of irregular fruit set in commercial papaya plantings
  - Controlling problem of speckled marks on fruit

Activity 2.5 Improve post-harvest handling

- Conduct research to solve post-harvest problems identified by the processes set out in Objective 1. Problems already identified for immediate attention include:
  - Extend shelf life of fruit (e.g. through fruit wax, hormone control, cool chain etc.)
- Conduct research to optimise conditions for export of papaya by sea freight

**Objective 3: To enhance the profitability and competitiveness of the Australian papaya industry by improving the supply chain**

Activity 3.1: Identify and mobilise commercial partners who can champion improvements in papaya chains and where benefits and cost savings are shared by all members of the chain.

Activity 3.2: Identify strategies to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain.

Activity 3.3: Identify post harvest disease issues and implement possible remedial strategies.

Activity 3.4: Trial supply chain interventions with commercial partners to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain.

**Objective 4: To promote the adoption of project outputs in the Fiji papaya industry and elsewhere**

Activity 4.1 Identify potential beneficiaries within papaya industry and beyond (e.g. nascent papaya industries in others PICs, other existing or potential fruit industries in Fiji) and define strategy for reaching them

Activity 4.2 Compile, review and analyse results from field trials and all other research activities. This activity will be coordinated by Kyle Stice and Andrew McGregor with constant consultation with the TAB.

Activity 4.3 Prepare information dissemination materials and processes to bring research outputs to priority beneficiaries (as identified above) including:

- a 'Fiji Papaya' website that will promote Fiji papaya and make available information on the ACIAR project and other parallel activities.
- information sheets, training manuals and posters.

Activity 4.4 Conduct Papaya Industry Stakeholder Workshops (to share outputs from the Project and develop consensus on 'next steps' for further development of the industry)

Activity 4.5 Conduct Australia-Fiji Papaya Industry Learning Workshops (for exchange of experiences in developing papaya value chains). Direct project personnel from Fiji and Australia will be involved in these visits.

Activity 4.6 Conduct briefings and informal workshops to transfer conclusions of project to other potential beneficiaries (Fiji Ministry of Agriculture, Koronivia Research Station, Fiji College of Agriculture etc.) These meetings will be an ongoing component of the extension programme. It is also envisioned that through representation of the various agencies in the TAB there will be a constant flow of information from the project to the target beneficiaries.

## 5.2 Activities and outputs/milestones

### ***Objective 1: Strengthen the capacity of the Fiji papaya industry to plan, conduct and adopt the products of problem-solving research***

no.	Activity	outputs/ milestones	due date of output/ milestone	risks / assumptions	applications of outputs
1.1	Establish a standing technical advisory board (TAB) and processes for prioritising and managing research	TAB is established with working mandate and schedule of regular meetings.	Yr 1, m6	TAB members make themselves available and are engaged in the process.	TAB is in place to identify issues and participate in design of research activities.
1.2	Establish quality monitoring, traceability and feedback system to farmers	Traceability and feedback system is in place	Yr 1, m10	Data from NWC, exporters and domestic market is accessible.	Volume and quality data is available to aid in extension activities
1.3	Establish infrastructure for identifying producers' problems and conducting on-farm research	Sustainable system for identifying problems and responding with appropriate research is in place.	Yr 1, m10	Research and extension partners are engaged in this process	An ongoing identification and response to producer issues.
1.4	Establish mechanisms for effective feedback, adaptation and adoption of innovations	Action plan in place with commitment from various extension partners.	Yr 1, m10	Research and extension partners are engaged in this process	

1.5	Provide targeted technical support in key areas	Visits from collaborating scientists in Australia and Hawaii completed	Yr 3, m10	Expertise on specific issues is available to the Project.	Fiji industry has expertise to address specific issues
-----	---	--	-----------	---	--

**Objective 2: To expand and increase the resilience of the Fiji papaya industry**

no.	Activity	outputs/ milestones	due date of output/ milestone	risks / assumptions	applications of outputs
2.1	Identify and evaluate local and export markets and strategies to enhance or sustain the value chain for Fijian papaya to these markets	Desk survey, field visits and stakeholder consultations complete with report detailing way forward for the Fiji industry.	Yr 1, m6	Information is not available.	Strategies can be implemented through the life of the project
2.2	Identify and evaluate new genetic resources to underpin sustainability	New varieties are trialled under different agro-ecological conditions and results of trials are available to all stakeholders (new planting materials are supplied to established nurseries for multiplication and distribution to farmers).	Yr 3, M10	Natural disasters such as cyclones and floods will affect field trials	Papaya industry is expanded beyond traditional growing regions. New planting materials with market demand are available to farmers.
2.3	Strengthen the seed system to disseminate high quality planting materials	Seed collecting and monitoring programme developed, several enterprises established to supply high quality papaya seedlings	Yr 1, m8	Seed line purity is lost	High quality seed and seedlings are produced locally and made available to farmers.
2.4	Improve production systems through participatory, on-farm research	Information sheets released throughout the trials and culminate in a Papaya Manual which covers the set of best practices recommended to the industry.	Yr 2 - Yr 4	Natural disasters such as cyclones and floods will affect field trials	Farmers have ready access to accurate and easy to understand information on the requirements for the profitable production of high quality fruit.
2.5	Improve post-harvest handling	Post harvest research completed and results compiled in information sheets, posters, and manual.	Yr2 – Yr 4	Results from post harvest research are inconclusive	Post harvest handling is improved through application of best practices.

**Objective 3: To enhance the profitability and competitiveness of the Australian papaya industry by improving the supply chain**

no.	Activity	outputs/ milestones	due date of output/ milestone	risks / assumptions	applications of outputs
-----	----------	---------------------	-------------------------------	---------------------	-------------------------

6.1	Identify and mobilise commercial partners who can champion improvements in papaya chains and where benefits and cost savings are shared by all members of the chain	Commercial partners identified and mobilised to champion improvements in tropical fruit supply. Refined methodology acceptable to project partners	Y2 (3-4)	That Australian conditions allow application of the model and strong collaboration established.	Motivated commercial and R&D collaboration with shared methodologies to ensure project success.
6.2	Identify strategies to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain.	Two SCM performance mapped and confirmed; impacts on performance quantified; key informants identified ; improvement opportunities scoped	Y2 (4-6)	That the supply chains being analysed are typical of most supply chains	Results will feed into a process to develop the specific supply chain management approach to be adopted in the study
6.3	Trial supply chain interventions with commercial partners to improve product flows/handling, information systems, supply chain relationships and value adding to all participants in the supply chain	Improvement plans developed by two supply chain groups  Improvement plans refined by supply chain groups  Improvement plans developed by extra supply chain groups	Y2(5)–Y2(8)  Y3(2-12)  Y3-Y4 (5)	That seasonal factors and orchard practices may influence outcomes.  That sufficiently reliable sources of data can be identified	Results will feed into a process to develop the specific supply chain management approach to be adopted.

**Objective 4: To promote the adoption of project outputs in the Fiji papaya industry and elsewhere**

no.	Activity	outputs/ milestones	due date of output/ milestone	risks / assumptions	applications of outputs
4.1	Identify potential beneficiaries within papaya industry and beyond (e.g. nascent papaya industries in others PICs, other existing or potential fruit industries in Fiji) and define strategy for reaching them	Network of beneficiaries is established and action plan for delivering results in conjunction with all partners is developed.	Yr 1 m10	Local and regional partners are willing to join efforts.	Dissemination of Project results will target a wide range of beneficiaries through collaborative efforts.
4.2	Compile, review and analyse results from field trials and all other research activities.	Report of research results and release of information sheets	Yr 3, m4	Results unavailable or trials fail	Industry receives relevant information as it is revealed through project experiments.
4.3	Prepare information dissemination materials and processes to bring research outputs to priority beneficiaries (as identified above).	Drafts of papaya manual and supporting posters	Yr 3, m6	Information is not available or in not in a usable format	Production manual available for use by growers etc

4.4	Conduct Papaya Industry Stakeholder Workshops (to share outputs from the Project and develop consensus on 'next steps' for further development of the industry)	Workshop reports with a summary of comments on draft manual and posters as well as 'next steps'	Yr 3, m10	Workshop cannot be held	Comments of industry stakeholders are incorporated into final draft of manual and posters. Structure for further development of the industry is laid out.
4.5	Conduct Australia-Fiji Papaya Industry Learning Workshops (for exchange of experiences in developing papaya value chains)	Workshops completed and reports produced from both parties	Yr 2, m8	Information from value chain projects on either side is not available.	Exchange of lessons learnt from both parties and application of these lessons to future work.
4.6	Conduct briefings and informal workshops to transfer conclusions of project to other potential beneficiaries (Fiji Ministry of Agriculture, Koronivia Research Station, Fiji College of Agriculture etc.)	Training of trainer's workshop completed. Papaya Industry Conference to launch the handbook and posters completed. Related component specific training and mentoring completed	Yr 2 – Yr 4	Unable to hold any of the described workshops or training sessions	Outputs of project are fully adopted by stakeholders and ongoing mentoring structure is in place.

## 5.3 Project personnel

### 5.3.1 List of participants involved in the project

#### *Commissioned agent and collaborating organisations*

Name	Sex (M/F)	Agency and Position	Discipline and Role in Project	Time input (%)	Funding
Dr. John Konam	M	SPC - Plant Pathologist	Plant pathologist - Project Leader	15%	SPC
Dr. Andrew McGregor	M	Koko Siga (Fiji) Ltd - Managing Director	Economist - Project Leader	15%	ACIAR
Kyle Stice	M	Koko Siga (Fiji) Ltd - Project Coordinator	Horticulturalist - Activity Leader	35%	ACIAR
John Yee Chief	M	SPC - Manager, Finance and Administration	Finance and administration - Finance manager	10%	SPC
Sant Kumar	M	Natures Way Cooperative (Fiji) Ltd - General Manager	Agronomy/extension - Project coordinator	15%	NWC
NWC Field Officer		Natures Way Cooperative (Fiji) Ltd - Field Officer	Agronomy/extension - Project coordinator	25%	NWC
Grant Schule	M	Kumu Farms - Owner/Manager	Farmer/exporter - Collaborating scientist	5%	ACIAR
Roger Goebel	M	Consultant	Tropical Fruit expert - Collaborating scientist	5%	ACIAR
Bob Williams	M	NQ DEEDI Science Leader, Horticulture and Forestry Science Delivery	Research/ Extension - Collaborating scientist	10%	ACIAR

Terry Campbell	M	DEEDI Principal Extension Horticulturist	Supply Chain Specialist	10%	DEEDI
Lynton Vawdrey	M	DEEDI Plant Pathologist	Plant pathologist	5%	DEEDI
Pat O'Farrell	M	DEEDI Horticulturist	Production specialist	5%	DEEDI
Stewart Lindsay	M	DEEDI Horticulturist	Production/Extension specialist	5%	DEEDI
Robert Henriod	M	DEEDI Postharvest Physiologist	Fruit physiologist	10%	DEEDI
Losalini Toganivalu	F	MAPI Plant Protection - Senior Research Officer	Research - Collaborating scientist	10%	MAPI
Dr Charles Eaton	M	Consultant	Small Holder Management specialist - Collaborating scientist/Technical Advisor Board	10%	ACIAR
Graeme Thorpe/ Barry Ladwig	M	Produce Specialty Ltd - Directors	Farmer/exporter - Technical Advisory Board	10%	PSL
Dr. Mary Taylor	F	SPC - Regional Germplasm Centre Adviser	Plant breeding - Technical Advisory Board	5%	SPC
Saten Reddy	M	Southern Development Company (SDC) - Manager Sigatoka Operations	Horticulturist - Technical Advisory Board	10%	SDC
Mant Kumar	M	Southern Development Company (SDC) - Manager Sigatoka Operations	Farmer/exporter - Technical Advisory Board	10%	SDC

### 5.3.2 Description of the comparative advantage of the institutions involved

SPC - SPC's vision for the region is that of a secure and prosperous Pacific Community, whose people are healthy and manage their resources in an economically, environmentally and socially sustainable way. SPC's organizational vision is that of a highly professional and dynamic bilingual organization, working in partnership with other international and regional organizations and donor partners to best serve their island members. SPC programmes benefit 22 Pacific Island countries and territories. The 26 members of the Pacific Community include these island countries and territories, plus the four remaining founding countries: Australia, France, New Zealand and USA. Dr John Konam is SPC's Plant Pathologist and has recently served as Project Leader for another ACIAR project "A scoping study on the potential for increasing the value of Pacific Island cocoa industries in Solomon Is, Vanuatu, Fiji & Samoa."

Koko Siga (Fiji) Ltd (KSL). - Koko Siga is a Fiji based consulting firm that specialises in Pacific island rural development. Andrew McGregor is the Managing Director of KSL and holds a PhD from Cornell University. He is an agribusiness expert who specializes in small and micro businesses in horticulture and agriculture. Dr McGregor has long experience with the Fiji and Hawaii papaya industries. Kyle Stice is KSL's tropical horticulture specialist and holds a Fruit Science degree from the University of California. He has several years experience working with tropical fruit production and research in Fiji and the Pacific islands. KSL, in collaboration with SPC, recently completed an ACIAR project "Developing the ornamentals industry in the Pacific: an opportunity for income generation" and are in the process of completing with SPC an ACIAR "A scoping study on the potential for substantially increasing the value of Pacific island cocoa industries: Solomon Is, Vanuatu, Fiji & Samoa"

NWC - Natures Way Cooperative (Fiji) Ltd. (NWC) was formed in 1995 to undertake mandatory quarantine treatment on behalf of Fiji's fruit export industry. The company has over 120 shareholders, made up of growers and exporters. The vast majority of NWC shareholders are small farmers, who without the services provided by NWC would not have access to export markets. Over the last decade NWC has grown from a small business handling just 30 tonnes of papaya to a thriving agribusiness treating 1,200 tonnes of fruit (papaya, mango, eggplant and breadfruit) annually for export.

Sant Kumar is NWC's General Manager. He was formerly Director of Extension for the Fiji Ministry of Agriculture and managed the Sigatoka Valley Project. Sant Kumar is now a leading supplier of papaya seedlings.

DEEDI - Department of Employment, Economic Development and Innovation, Horticulture and Forestry Science (DEEDI) is using innovative, world-class science to develop and apply new technologies that contribute to better food and fibre products, better production practices and better quality of life for all Queenslanders. DEEDI has worked on a number of ACIAR projects in the development of research based activities and extension. DEEDI works in close collaboration with the papaya industry in North Queensland and will serve a good facilitator for the flow of information between the Fiji papaya Industry and the Australian papaya industry.

### **5.3.3 Summary details of the role of each participant involved**

Dr. John Konam - As Project Leader Konam will provide general administrative oversight to the project and will be responsible for compiling and submitting required reporting. As a plant pathologist Konam will provide expertise and guidance to the development and implementation of the disease research components of the project.

Andrew McGregor - As Project Leader McGregor will provide oversight to the project. McGregor will provide expertise and guidance to all components of the project.

Kyle Stice - As Activity Leader Stice will have the responsibility of coordinating and implementing all components of the project. Stice be the liaison person between all participants in the project and will work closely with both Project Leaders.

John Yee Chief - As the Administrative Contact and Finance Manager at SPC John will be responsible for receiving, dispersing, and accounting for all project funds.

Sant Kumar - As Project Coordinator Kumar will be the direct link with the industry. Kumar and the NWC Field Officer will assist in the planning and implementation of field trials and stakeholder meetings.

Grant Schule - As Collaborating Scientist Schule will provide the project with expertise related to papaya production and exporting from Hawaii. Schule will also provide guidance and expertise in the development of appropriate field trials for organic papaya production in Fiji. Schule will coordinate and host the project teams' visit to Hawaii.

Roger Goebel - As Collaborating Scientist Goebel will provide the project with guidance and support in the development of appropriate research activities as well production guidelines. Goebel will be the link between the Fiji and Australia papaya industry members and will help coordinate and host the project teams' visit to Australia.

Bob Williams - As Collaborating Scientist Williams will work directly with the project leaders and technical advisory board in the implementation of the various components. Williams will be in a position to assign appropriate technical expertise from the DEEDI as the need arises. Williams will also serve as the teams host counterpart during visits to Australia.

Terrence Campbell, Principal Extension Horticulturist, DEEDI, Bundaberg, Australia has over 20 years experience in helping improve horticulture systems. His knowledge and experience covers both pre- and postharvest practices and he has worked extensively with the mango industry. Terry was project leader for the successful Australian mango

industry funded domestic supply chain project. He is currently the project leader of Component 1 of the Philippines ACAIR project HORT/2007/067-01. He will provide technical advise in the supply chain component and in development of extension strategies.

Lynton Vawdrey, Senior Research Scientist (Plant Pathologist), DEEDI, Centre for Wet Tropics Agriculture, South Johnstone, Queensland, Australia, has been involved in plant pathology research for over 30 years and in the last 10 years has focussed on the cultural and chemical control of Phytophthora-related diseases of papaya and durian and the management of leaf diseases of bananas in far northern Queensland. He is currently the Component leader of the Philippine ACIAR project HORT/2007/067-03. He will provide technical advise on fungal disease of papaya.

Stewart Lindsay, Senior Horticulturist, DEEDI Centre for Wet Tropics Agriculture, South Johnstone, Queensland, Australia, has 19 years experience in horticultural production systems with the NQ banana industry since 1993 on projects in integrated pest management, fruit harvest and handling systems, crop forecasting, root and soil health, EMS and sustainable farming systems.

Patrick O'Farrell, Senior Experimentalist with DEEDI, Mareeba in north Queensland, has worked in horticulture research for over 35 years, mainly in banana coffee, cashew and macadamia plant improvement, nutrition and crop management. Since 2002, Pat has led the macadamia 'abnormal vertical growth' project that has described the significance of the disorder in the Australian industry, geographic distribution, symptoms, spatial characteristics, and the effects of remedial treatments. He is currently the agronomy leader of the papaya component of the Philippine ACIAR project HORT/2007/067-03.

Losalini Toganivalu - As Collaborating Scientist Toganivalu will work closely with the project leaders and technical advisory board to establish appropriate research activities and monitor outputs of these activities. Toganivalu will be providing the main link between the project and the Fiji Ministry of Agriculture and Primary Industries.

Dr Charles Eaton - As Collaborating Scientist Eaton will work closely with the technical advisory board to develop appropriate research activities and help monitor outputs of these activities. Eaton, widely regarded as the father of the Fiji papaya industry, will also provide good agronomic and extension advice to the team with relation to papaya production and post harvest handling.

Graeme Thorpe/ Barry Ladwig - As members of the Technical Advisory board Thorpe and Ladwig will provide the team with direct industry representation and expertise on papaya production and marketing in Fiji.

Dr. Mary Taylor - As a member of the Technical Advisory Board Taylor will provide the team with advice on the most appropriate research activities and particular expertise on variety selection and maintenance of homogenous seed.

Mant Kumar - As a member of the Technical Advisory board Kumar will provide the team with direct industry representation and expertise on papaya production and marketing in Fiji.

---

## 5.4 Intellectual property and other regulatory compliance

The results of this project are intended to improve the livelihoods of Fiji's papaya stakeholders. The information will also be made available to other Pacific Island countries and other interested international partners.

Any new papaya varieties that may result from this project will be made available to all interested farmers in Fiji and can be made available to any other interested farmers/breeders abroad upon proper approval from ACIAR and other relevant authorities.

## 5.5 Travel table

### *PART A: SPC*

<b>trip no.</b>	<b>person or position</b>	<b>estimated date of travel</b>	<b>from / to</b>	<b>Purpose</b>	<b>duration (days)</b>
3	John Konam	January 2010	Fiji/Australia	Networking and exchange with Australia Industry	10
6	John Konam	January 2011	Fiji/Australia	Follow up with Australia industry, presentation of preliminary results	10
9	John Konam	November 2012	Fiji/ Australia	Final inputs and wrap up presentations	5

### *PART B: Koko Siga*

<b>trip no.</b>	<b>person or position</b>	<b>estimated date of travel</b>	<b>from / to</b>	<b>Purpose</b>	<b>duration (days)</b>
2	Kyle Stice	April 2009	Fiji/Hawaii	Survey of Hawaii Industry	10
3	Kyle Stice	January 2010	Fiji/Australia	Networking and exchange with Australia Industry	10
6	Kyle Stice	January 2011	Fiji/Australia	Follow up with Australia industry, presentation of preliminary results	10
9	Kyle Stice	November 2012	Fiji/ Australia	Final inputs and wrap up presentations	5

### *PART C: Natures Way Cooperative*

<b>trip no.</b>	<b>person or position</b>	<b>estimated date of travel</b>	<b>from / to</b>	<b>Purpose</b>	<b>duration (days)</b>
2	Sant Kumar or Field Officer	April 2009	Fiji/Hawaii	Survey of Hawaii Industry	10
3	Sant Kumar or Field Officer	January 2010	Fiji/Australia	Networking and exchange with Australia Industry	10
6	Sant Kumar or Field Officer	January 2011	Fiji/Australia	Follow up with Australia industry, presentation of preliminary results	10
9	Sant Kumar or Field Officer	November 2012	Fiji/ Australia	Final inputs and wrap up presentations	5

### *PART D: Collaborating scientists*

<b>trip no.</b>	<b>person or position</b>	<b>estimated date of travel</b>	<b>from / to</b>	<b>purpose</b>	<b>duration (days)</b>
1	Roger Goebel	February 2009	Australia/Fiji	Preliminary visit and introduction to Fiji Industry	8
4	Grant Schule	March 2010	Hawaii/Fiji	Follow up with Fiji Industry and research activities	8
5	Roger Goebel	September 2010	Australia/Fiji	Follow up with Fiji Industry and research activities	8

7	Grant Schule	March 2011	Hawaii/Fiji	Follow up with Fiji Industry and research activities	8
8	Roger Goebel	October 2011	Australia/Fiji	Follow up with Fiji Industry and research activities	8
9	Grant Schule	November 2012	Hawaii/Fiji/Australia	Final inputs and wrap up presentations	10
9	Losalini Toganivalu	November 2012	Fiji/ Australia	Final inputs and wrap up presentations	5

***PART E: DEEDI***

<b>trip no.</b>	<b>person or position</b>	<b>estimated date of travel</b>	<b>from / to</b>	<b>purpose</b>	<b>duration (days)</b>
1	Terry Campbell	March 2009	Bundaberg/ Cairns/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	4
2	Terry Campbell	July 2009	Bundaberg/ Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	4
3	S. Lindsay	July 2009	Cairns/Brisbane /Sydney/ Cairns	Project planning and co-ordination/Australia supply chain activities	8
4	Terry Campbell	February 2010	Bundaberg/ Cairns/Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	3
5	Henriod	February 10	Cairns/Brisbane /Sydney/ Cairns	Project planning and co-ordination/Australia supply chain activities	4
6	Terry Campbell	July 2010	Bundaberg/ Cairns/Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	3
7	S. Lindsay	July 10	Cairns/Brisbane /Sydney/ Brisbane/Cairns	Project planning and co-ordination/Australia supply chain activities	8
8	Terry Campbell	February 2011	Bundaberg/ Cairns/Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	3
9	PO	February 2011	Cairns/Brisbane /Sydney/ Cairns	Project planning and co-ordination/Australia supply chain activities	4
10	Terry Campbell	July 2011	Bundaberg/ Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	4
11	Terry Campbell	February 2012	Bundaberg/ Sydney/ Bundaberg	Project planning and co-ordination/Australia supply chain activities	4
12	Terry Campbell	March 2009	Bundaberg/ Fiji	Preliminary visit and introduction to Fiji Industry	6
13	Lynton Vawdrey	March 2009	Cairns/Fiji	Preliminary visit and introduction to Fiji Industry	6

14	Pat O'Farrell	September 2009	Cairns/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
15	S Lindsay	March 2010	Cairns/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
16	Lynton Vawdrey	September 2010	Cairns/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
17	Pat O'Farrell	March 2011	Australia/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
18	Terry Campbell	September 2011	Bundaberg/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
19	S. Lindsay	March 2012	Cairns/Fiji	Follow up with Fiji Industry and research activities - Technical advisory services as required	6
20	Lynton Vawdrey	September 2012	Cairns/Fiji	Final inputs and participation in papaya industry workshop	6
21	Terry Campbell	September 2012	Bundaberg/Fiji	Final inputs and participation in papaya industry workshop	6

---

## **6 Budget**

See attached budget proforma spreadsheet

## 7 Supporting Documents

Documents attached:

- Letters of support - Sant Kumar (NWC), Dr. John Konam (SPC), Dr. Andrew McGregor (Koko Siga), Bob Williams (DEEDI), Grant Schule.
- Curricula vitae - Dr. Andrew McGregor, Kyle Stice, Sant Kumar, Roger Goebel, Grant Schule, Dr John Konom

### 7.1 Appendix A: Intellectual property register

Inquiries concerning completion of this form should be directed to [contracts@aciar.gov.au](mailto:contracts@aciar.gov.au)

#### 7.1.1 Administrative details

Project ID	PC/2008/003
Project Title	Strengthening the Fiji Papaya Industry through applied research and information dissemination
Assessment provider	
If not Australian Project Leader, provide title	Mr. Kyle Stice
Date of assessment	1 December 2008

#### 7.1.2 Categories of intellectual property and brief description

##### *Plant or animal germplasm exchange*

Does the project involve:	Yes	No
provision of germplasm by Australia to a partner country?		No
provision of germplasm from a partner country to Australia?		No
provision of germplasm from or to an IARC or another organisation and a project participant?		No
use of germplasm from a third party		No
material subject to plant breeders/variety rights in Australia or another country?		No

If yes to any of the above, for each applicable country provide brief details of the material to be exchanged:

- If the germplasm exchange can be finalised before the project commencement, provide a Materials Transfer Agreement.
- If the specific germplasm to be exchanged cannot be identified until after project commencement, indicate the type of material likely to be exchanged.

Country	Details of plant or animal germplasm exchange

**Proprietary materials, techniques and information**

Does the project involve provision (from one party to another) of:	Yes	No
research materials or reagents (e.g. enzymes, molecular markers, promoters)?		No
proprietary techniques or procedures?		No
proprietary computer software?		No

**Other agreements**

Is any aspect of the project work subject to, or dependent upon:	Yes	No
other materials-transfer agreements entered into by any project participant?		No
confidentiality agreements entered into by any project participant?		no

**7.1.3 Foreground, background and third party Intellectual Property**

This includes, but is not limited to patents held or applied for in Australia and/or in partner countries and/or in third countries. For example, Foreground IP includes any new germplasm, reagents (such as vectors, probes, antibodies, vaccines) or software that will be developed by the project.

**Foreground IP (IP that is expected to be developed during the project)**

Ownership of or rights to Foreground IP other than as detailed in the ACIAR Standard Conditions must be approved by ACIAR.

	Yes	No
Is it expected that there will be Foreground IP?		No

**Background IP (IP that is necessary for the success of the project but that has already been created and is owned by parties to the project)**

Any agreements in place regarding Background IP should be provided to ACIAR prior to project commencement.

	Yes	No
Is it there Background IP?		No
If "yes",		
are there any restrictions on the project's ability to use the Background IP?		
would there be any restriction on ACIAR or the overseas collaborator claiming their rights to IP for the project based on the Background IP (refer ACIAR Standard Conditions)?		

**Third Party IP (IP that is owned by or licensed from other parties)**

Agreements governing the use of third party IP can be related to research materials, research equipment or machinery, techniques or processes, software, information and databases.

	Yes	No
Is there any relevant Third Party IP that is essential to the project?		No
If 'yes', would there be any restriction on ACIAR claiming its rights to IP for the project (refer ACIAR Standard Conditions)?		

**Other contracts, licences or legal arrangements**

	Yes	No
Are there any other contracts, licences or other legal arrangements that relate to the project?		No

**7.2 Appendix B: Market Prospects for Fiji Papaya****7.2.1 New Zealand**

An extensive study of the New Zealand market was undertaken in 1995 in advance of Fijian and Tongan HTFA facilities being established. The study concluded “that papaya sales in New Zealand of 1,000 tonnes at remunerative prices would seem to be readily achievable provided there was continuity of supply and good quality fruit”. Since that time the Cook Islands supply has substantially declined. However, Fiji’s marketing experience indicates that it will take much longer to obtain broad market acceptance of smaller red fleshed “sunrise” papaya than was originally envisaged. Yet, a number of factors have emerged that favour continued growth in Fiji’s papaya sales to New Zealand. These are:

The steady growth in demand. The New Zealand papaya market has developed steadily since the early 1970s. Interest in the fruit has developed through hotels and restaurants and papaya is now sold through supermarkets throughout most of New Zealand. The Sunrise variety is gradually gaining acceptance on market particularly by the Asian population. It is encouraging to note that Food Town supermarket chain is now selling Fiji papaya for the first time and Fijian papaya is also prominent in the eight Fruit World shops in Auckland. However, a more concerted promotional effort is required to expand this market.

The demise of the Cook Islands papaya industry. The Cook Islands led the way in the development of the papaya market in New Zealand. At its peak in 1986, 555 tonnes were exported from the Cook Islands. Since then, these exports have been in decline. By 2001 papaya exports from the Cook Islands had almost ceased, with noni replacing papaya on most farms. There have been further set backs with the discovery of Queensland fruit fly and cyclones.

Lack of competition from other suppliers. Fiji now virtually faces no competition on the New Zealand market for papaya and this is expected to remain the situation for the foreseeable future. The Cook Islands, despite some recent replanting, is unlikely to ever return to its former glory. Tonga is not regarded as a serious threat. Tonga’s government operated HTFA facility has remained largely idle. Samoa now has a small semi-commercial HTFA unit. Samoa has good production conditions, but does not yet have a papaya industry. Furthermore Samoa has no container carrying aircraft flying to New Zealand. Early 2006 saw the arrival of Philippines papaya into the New Zealand market. Unless quality is maintained and costs reduced through sea freighting Philippines does pose a long term threat to the Fiji industry.

The commencement of sea freight shipments to New Zealand. In the later part of 2006, Fiji largest papaya exporter plans to commence sea freight exports of papaya to New Zealand. This will substantially reduce transportation costs and increase the competitiveness of Fijian papaya.

Since 2003 the average annual growth rate in papaya exports to New Zealand have been around 60%. Exports to New Zealand will exceed 1,000 tonnes within 5 years, if a 20% annual growth rate can be achieved.

## 7.2.2 Australia

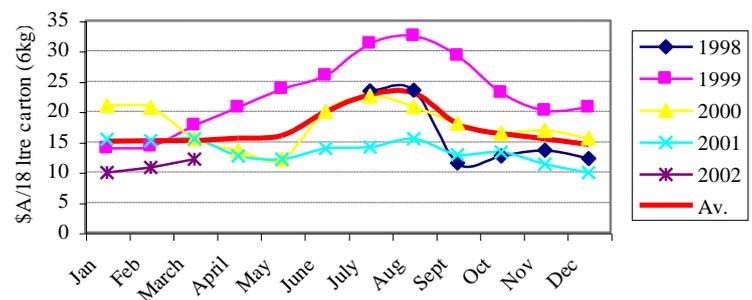
The Australian papaya market is far larger than New Zealand. Some 6,000 tonnes of papaya are sold annually on Sydney's Flemington Markets alone (Sydney Market Reporting Service).

During the 1980s Fiji was a significant exporter of papaya to Australia. The highest exports were achieved in 1987 when 132 tonnes were shipped. By comparison in that year only 25 tonnes went to New Zealand. These exports ceased in 1992 the chemical ethylene dibromide (EDB) was lost as a quarantine treatment. It took 7 years before Fiji's HTFA facility was certified for shipment to Australia. Exports to Australia recommenced in October 2004. In that year 5 tonnes were shipped. In 2005 exports to Australia totalled 38 tonnes. In 2006 there was a substantial increase in exports to Australia, with 123 tonnes shipped up until the end of June. This sharp increase in shipments was a result of devastation caused by cyclone Larry on the North Queensland papaya crop.

During the 12-year absence of Fijian papaya from the Australian market, Australia has made progress in developing its own domestic industry, particularly in North Queensland. Prior to Cyclone Larry there were over 500 hectares of papaya planted in Queensland, spread from south, east, central and northern Queensland<sup>7</sup>. There is also commercial papaya production in northern NSW, Western Australia and the Northern Territory.

However, by and large, Australia has not been particularly successful in growing the popular Hawaiian "Solo" varieties in reasonable proximity to the major southern Australian markets. North Queensland and Northern Territory producers still enjoy transport cost advantages compared with Fiji. Fiji's advantages are in lower labour costs and its ability to produce superior eating quality fruit.

Fig 2: Sydney Flemington Market: Wholesale Solo Papaya Prices



Yellow-fleshed dioecious lines (either female or male trees – no hermaphrodite) dominate Northern NSW and Southern Queensland production. Yellow fleshed "papaw" are still the main papaya sold on Australian markets. "Papaya" is decidedly inferior in terms of flavour. These southern production areas have an unfavourable disease status.

Around half of Queensland's papaya production is sold within the State. Thus, there remains a market for good quality Fijian hermaphrodite papaya in southern markets. The overall level of papaya consumption in Australia is low; approximately 1kg per head per year<sup>8</sup>. Thus, there is good scope for considerable market expansion. The Sydney Market Reporting Service<sup>9</sup> provides price and volume information for the Flemington Wholesale Market, Australia's largest produce market. Price data is provided for a range of papaya types: yellow fleshed papaw (dioecious lines); "Hawaiian Solo" (red fleshed Sunrise

7 Growing papaya: Before you start. Queensland Horticulture Institute, Queensland Department of Primary Industries, DPI note. Patricia Chay-Prove 2000

8 See Chay-Prove in above note.

9 Sydney Market Reporting Service, Stand 30, E Warehouse, Flemington Markets 2129, Mobile 0416 108639: e-mail cqs@accsoft.com.au

types); exotic red flesh types; and culinary. Total market throughput and annual average annual prices for all papaya over the last three years were:

	Annual market throughput - all types (mt)	Average annual price (\$A/kg)
1999	3,535	2.16
2000	3,845	1.84
2001	5,922	1.44

The NWC's Strategic Plan suggests "that the appropriate marketing strategy for redeveloping the Australian market would be initially target the July to September winter window, with superior quality fruit (figure 2). During this period returns in Australia can be expected to be at least as good as those obtained in New Zealand. Once Fijian papaya has established a reputation for quality and reliability it would be in a position to attract the best prices available at other times of the year. Only best quality fruit should be sent to the Australian market".

Three exporters are now shipping to the Australian market. There are two importers of Fiji papaya based in Melbourne and one in Sydney. Most of the papaya goes to Melbourne. It remains to be seen what the demand for Fijian papaya will be once Australian production returns to normal. Indications are that provided Fijian papaya can maintain its unique high quality image, it should be in a position to retain market share.

NWC Strategic Plan notes:

Aggregate figures show a situation of increasing supply and declining price. However, there are large price variations with respect to season, type of papaya and quality. The relevant comparison for an aspiring Fiji exporter is the prices received for "Hawaiian Solo" papaya. Highest prices are received during the winter months (July through September). Prices usually peak in August, which coincides with the lowest supply and the non-availability of local stone fruit. Over the four years (1998 – 2002), the average August wholesale price was \$A23.05/18 liter carton (or \$A3.83/kg). (The highest average August price was \$A32.48/carton or \$A5.41/kg and the lowest \$A15.48/carton or \$A2.58/kg.) The lowest prices are received during December and January. Over the four years the average December wholesale price was \$A14.60/carton (or \$A2.43/kg). (The highest average December price was \$A20.65/carton or \$A3.44/kg and the lowest \$A9.91/carton or \$A1.65/kg.)

At any one time there is a huge variation for the price received for any particular type of papaya. Chart 3 plots the low, high, average and best prices for hermaphrodite solo papaya for the first eleven weeks of 2002. Price variations at any one time are largely a reflection of quality. Fiji's better quality export fruit can certainly match the appearance of the higher price fruit sold at Flemington. The likely superior taste of Fijian papaya could be expected to enhance its position at the top end of the market.

In March 2006, cyclone Larry devastated the main Australian papaya growing areas of Innisfail and Mareeba in far North Queensland. Papaya Australia's representative described the impact of the category five cyclone.

Damage has seen some papaya and papaw trees completely torn from the ground, but in most cases the trees were snapped off above the base by the 290km/ph winds of cyclone Larry. This year's crop would have been worth about \$A18\$ to \$A20 million dollars to the local economy and now it is destroyed. It will take anywhere from 9 to 18 months for us to start to get back to where we were before the cyclone hit. The industry anticipates that

availability of papaya and papaw should be headed back towards normal levels by January 2007.<sup>10</sup>

The cyclone has provided Fiji's exporters with the opportunity for re-entry and exploration of a very important market. If they can now establish a reputation for quality and reliability, annual sales of 500 tonnes would seem achievable over the next 5 years.

### 7.2.3 Japan

According to JETRO statistics, Japan imports around 500 tonnes of papaya per month. In the past Hawaii was the main supplier. In 1990, Hawaii shipped 8,400 tonnes of papaya to Japan (US Census Bureau). Since the arrival of PRV these exports have fallen to less than 2,500 tonnes. Japan does not permit the importation of the genetically modified varieties that have been developed for their PRV resistance. This has created a market opportunity for Fijian papaya. Two Fiji exporters are now shipping to Japan. In 2004, according to Fiji's trade statistics, 71 tonnes of papaya were exported to Japan. Red flesh of Fiji papaya, with its GM free status, has significant niche market opportunities in the Japanese market. At present Japan does not require quarantine treatment of papaya for fruit fly. However, the main exporter Produce Specialities Ltd, chooses to use the HTFA facility as a precautionary measure. It is projected that over the next 5-years papaya exports to Japan will reach around 200 tonnes annually. However, the achievement of this target will depend on the availability of air freight capacity.

### 7.2.4 United States

The west coast United States offers a potential market for high quality Fijian papaya. This market has had been traditionally supplied by Hawaii. However, the Hawaiian industry has been in decline since the establishment of Papaya Ring-spot Virus (PRV) in 1992. In 1990 18,500 tonnes of papaya were shipped out of Hawaii. By 2002 out-shipments had declined to 9,600 tonnes (Hawaii Agricultural Statistics). Disease problems have been compounded by the presence in Hawaii of Oriental fruit fly which is both a serious production and quarantine pest in papaya.

HTFA quarantine treatment technology was originally developed by the USDA for the treatment of Hawaiian papaya for export to the US mainland. Despite this, NWC's facility is not yet certified for the export of papaya to the USDA. Fiji Quarantine has yet to commence the process for entry into the US market. Even in the best of circumstances it will take several years before export approvals to the US will be in place. High airfreight rates are also likely to be a major constraint to exporting fresh produce to the United States. Thus given these circumstances, exporting 50 to 100 tonnes annually of papaya at the end of 5-years is probably a realistic target.

### 7.2.5 Tourism

The tourism sector provides a substantial under supplied market for locally grown produce. The 1996 ADB Agricultural Sector Review identified the linkages with tourism as one of the major factors providing Fiji with a competitive advantage to the production of high value horticultural and floriculture products. To quote the ADB report:

Hawaii provides a model here. The development of Hawaii's large papaya and floriculture export industries was a direct bi-product of the outward freight capacity at reasonable cost created by tourist arrivals into Hawaii. For some high value products, tourism can provide a domestic demand base upon which an industry can be established. Hawaii's macadamia nut industry, the largest in the world, is built around exporting via the "suitcases" of tourists. Supplying hotels is the basis of Hawaii's anthurium, orchid, and other floriculture industries. The Kona coffee industry is based entirely on selling the

ambience of Hawaii to visitors and former visitors. Tourism offers Fiji's diversified agriculture with similar opportunities for flowers and value added packaged products such as spices (p, 12).

While the tourism sector is well short of realising its potential contribution to the agricultural sector, it already buys significant quantities of products such as fruit. A survey conducted by AgTrade in 1998 estimated that 88 tonnes of papaya were sold to the hotels. This was about the same volume that was exported in that year. Since that time sales to the hotel sector have grown steadily. Results of the latest AgTrade survey

Some simple calculations for fruit show the extent that the tourism market is under-supplied. Currently around 500,000 tourists arrive annually and stay an average of 8 days. If the average tourist consumes 3 papayas during their stay this represents a market of some 900 tonnes of papaya. Tourist arrivals are projected to exceed 1 million over the next decade. Thus tourism offers a substantially larger market than those expected from exports, at least for the foreseeable future.

### **7.2.6 Non tourist local market**

Papaya has become increasingly popular fruit amongst local consumers. The fruit is prominent in municipal markets, road side stores and major supermarkets. The weekly standing order for MH supermarkets alone is estimated 5000 Kgs . If the per capita consumption of local population is 0.8 kg per annum, this represents a total market of 800 tonnes. Within 5-years local demand for papaya of 1,500 tonnes would seem a reasonable expectation.

Papaya is now making an important contribution to the health and nutrition of the community. Papaya represents one of the best nutritional deals available per dollar spent. Papaya, like most fruit, is low in calories but rich in dietary fibre, minerals and vitamins. A 100 gm serve of ripe papaya has 39 calories, compared with 92 calories for banana<sup>11</sup>. Papayas contain 16% percent more Vitamin C than oranges and are good source of Vitamin A. Consumption of papaya adds digestion because of its papain content.