SUB-REGIONAL OFFICE FOR THE PACIFIC ISLANDS

Utilisation of the HTFA Facility to Expand the Export of Fresh Fruits and Vegetables from Tonga to New Zealand:

A Value Chain Approach

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For:

The Government of Tonga

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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FAO DISCLAIMER

This study was commissioned under the FAO Regional Programme for Food Security

EXECUTIVE SUMMARY

The primary purpose of this study is to use a value chain approach with a view to supporting the utilisation of the High Temperature Forced Air facility in expanding the export of fresh fruits and vegetables from Tonga to New Zealand.

This study identifies the key chains and interrelated activities starting from the production of the produce along to the market and the ultimate consumers, to allow examination and analysis of the constraints and issues that may hinder the successful utilisation of the HTFA treatment for export, and to provide suggestions as to how to alleviate these constraints and issues.

The report identifies and discusses the role of different enterprises involved in performing the chain activities from Growers' registrations; farm production; inspection and grading; treatment and exporting; transportation of the produce; and in the distinct marketing channels in the export market, to look at ways to improve their performance in an efficient and cost effective way.

The study considers four selected products whose planting and harvest time fits in well with the market demand. For ***eggplant*** supply to the market, Fiji currently produces and supplies 96% of New Zealand's total imports with New Caledonia suppling 4%, while domestic production is very insignificant. The Philippines supplies 74% of total ***papaya*** imports while Fiji supplies 25%. The supply for ***chilli*** and ***breadfruit*** fall short throughout the year. Fiji supplies 99% of total chilli imports and Samoa supplies 96% of total fresh breadfruits imports for 2007/2008. The market demand for the four selected products is there for Tonga to supply through utilisation of the HTFA facility. The risks that are most likely to threaten the production and export include biosecurity issues; the inconsistent supply of the required volume and quality of produce; climate; and transportation costs.

The achievement of better results will come through clearer understanding and performance of their key activities and by developing good linkages and relationships along the chain to ensure more successful results. The investments needed for example in phase planting to ensure consistent supply to the market and to reduce rejection rates through improving the quality will require the identification and strengthening of these key relationships.

A summary of the findings highlights those issues at the conclusion of this study. The study also presents some recommendations for consideration and for further action in order to help achieve success in this export opportunity for Tonga.

ACKNOWLEDGEMENTS

Firstly, I would like to thank the Director of MAFFF, Tonga and his staff for helping with this study specifically with my data collection, organising appointments and meetings. I also thank the Tongatapu farmers for their valuable time to attend meetings, interviews and data collection. Many other individuals, government departments, businesses and organisations local and regional have contributed to this work during the duration of this assignment. They have shared their data and information, ideas, expertise and made significant critique and suggestions along the chain for improvement and expanding the export opportunity of fresh produce for Tonga.

Finally, I would also like to acknowledge the interest and support from FAOSAP Regional Office in funding this study. For without your assistance, this study would not have been possible. You are always being a partner and a bridge to the future… and while you may not think so, we Tongan Growers do have your best interest at our heart.

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OBJECTIVES OF THE STUDY

In March 2009, FAO provided a short but intensive consultative training workshop on value chain approaches. During the workshop, the participants, who included government officials, representatives of grower organisations, and growers, were asked to identify areas where they felt that the application of a value chain approach would assist in the identification of key constraints and associated interventions to alleviate these constraints. One such area concerned the utilisation of the HTFA facility.

With the HTFA soon to come on line, there was some concern that the facility may not be used to full capacity if supply was inconsistent, and that any initiatives to boost local production of priority crops (Papaya, Eggplant, Chilli, Breadfruit, Tomato, Mango) to ensure consistent supply could carry significant risks for chain stakeholders. For example, resulting in a "boom – bust" reaction of producers, where investments in the crops results in supply exceeding HTFA capacity (and/or export demand) resulting in poor returns and subsequent rapid withdrawal from the production of these crops. It was also noted that there was a risk that perceptions are such that producers were reluctant to invest in production of these crops resulting in the plant running at less than capacity.

The value chain approach was used to determine current levels of activities and associated incentives for production of a consistent supply in four selected chains (Papaya, Eggplant, Chilli, Breadfruit) could be used to shed light on these concerns and to ensure that strategies are put in place to mitigate against the risks outlined above.

The above objectives were subsequently refined by the consultant to identify the following key activities and questions to be addressed by this study.

1) To identify key and most important activities that need to be systematically prioritised and performed to expand and/or open up fresh produce export to New Zealand by utilising the HTFA treatment facility.

2) To identify key activities needed to ensure consistent high yield and quality produce that may give a better return to growers and other stakeholders.

3) To examine the main production season for the selected crops and identify the best time for this window market opportunity and map out how to adjust production to fit in well with this opportunity.

4) To determine how reduced rate of rejection as well as improved quality and volume of the market supply can be achieved

5) To find out how many growers involved, target acres to plant now, and for phase planting

6) To investigate who will be organising, order, stock and sell the required agricultural inputs for production of the selected fresh fruits and vegetables for export?

7) Who should be responsible to deliver the produce from production site to the packing shed for inspection and to HTFA treatment facility?

8) Who are the exporter(s) responsible for exporting of the produce to New Zealand?

9) What is the most cost effective type of freight to use for transporting of our fresh produce export to the market?

10) Who will be managing the HTFA facility and how is the produce treat?

11) Who are the importers, wholesalers and distributors for our produce?

12) To ensure commitment from MAFFF Research and Extension technical experts' in supporting farmers in providing training and technical information for production.

13) To ensure that growers willing to involve in planting of fresh fruits and vegetables for export to New Zealand must be registered with Tonga's MAFFF and to comply with the terms, conditions and procedures of the Work Plan (BQA).

1. BACKGROUND

1.1 INTRODUCTION

The economic contribution of the primary and agricultural sector to Tonga's economy is still significant. However, the actual export of primary and agricultural produce, especially fresh fruits and vegetables, from Tonga to overseas markets has declined dramatically over the past few decades. In particular, the export of squash to Japan, fresh produce to New Zealand market, and to other overseas markets has declined rapidly.

The introduction of the HTFA facility in 1996 gave hope not only to the farmers/growers but to the country and the economy as a whole. The facility was co-funded through grant from USAID and New Zealand Aid (NZAID). The initial idea and plan for this initiative was to use the facility to resolve the Quarantine restriction on export of fresh produce due to fruit fly issues and to open up a new export pathway for fresh produce for the Tongan farmers.

The aim of the High Temperature Forced Air Treatment Facility (HTFA) is to treat Tongan export produce that is subject to parasitism by fruit flies. The same type of facility has been installed in Fiji where a farmers' cooperative is successfully running two HTFA facilities for export of fresh produce.

The Tonga HTFA was originally set up as the 'Export Produce Treatment Services Limited' with a Board of Directors comprising the Prime Minister and Minister of Agriculture, Forestry and Fisheries (as Chair) and representatives from farmers' organisations, exporters of agricultural produce, farm businesses representatives, Tonga Development Bank, and the Director of MAFFF and Head of MAFFF Quarantine.

The company started off very well with papaya and eggplants being exported to New Zealand. However, due to frequent natural disasters, inadequate management of production, and finance and marketing problems, the company closed in 2000, and MAFFF took over the operation and management of the facility.

The Tongan Government has offered the management and operation of the HTFA facility to the private sector but no interest has been expressed due to the following reasons:

- Growers' lack of confidence in the HTFA due to their past experiences with the machine. In their view it is risky for the private sector to take over ownership until the HTFA 'proves itself';
- The costs of operating and maintaining the HTFA including uncertainty about the actual costs of running the machine. MAFFF do not have reliable figures on the operating costs but will be building up a profile through the planned trials;

- There is no proper system in place to co-ordinate the growers and their production to ensure a consistent supply to market is achieved, hence there is no certainty of market arrangement and returns until a trial export is delivered and assessed.

Given the above, Tonga MAFFF continues to operate and manage the HTFA in the absence of interest from private sector.

However, Tonga has an advantage of current access to export seven fruit fly host commodities Mango (Mangifera indica), Papaya (Carica papaya), Tomato (Lycopersicon esculentum) Avocado (Persica americana), Breadfruit (Artocarpus altilis), Chilli (Capsicum frutescens), Eggplant (Solanum melongena), to New Zealand utilizing the HTFA facility at the airport.

MAF BNZ and Tonga MAFFF have agreed on the protocol for the importation of fruit fly host produce using the HTFA treatment. Registered farms and Tonga MAFFF must comply with this protocol to ensure the current phytosanitary requirements of MAFBNZ are met, specifically for regulated fruit fly quarantine pests.

The study revealed a lack of confidence in the HTFA unit. Growers, exporters, past operators and others who have had association with the HTFA unit claimed past experiences with the HTFA facility and problems that ranged from product being burnt, through to the machine being inoperable when produce arrived for treatment prior to export. This led to exporters being unable to export their produces, to considerable amounts of money lost, and have to sell their produce on the local market.

By comparison, exactly the same type of HTFA unit (twin chamber) was installed in Fiji in 1995 (approximately the same time as in Tonga). Fiji started off exporting 40 tonnes in their first year (1996), increasing to 1200 tonnes in 2006, despite repeated political and economic instability.

1.2 STUDY DESIGN.

The designing and framework of this study has been determined by the objective and TOR (Annex 10) to adopt the value chain approach to support the HTFA facility to expand the export opportunity of fresh fruits and vegetables for Tonga.

Mappings 1 to 3 are used to define the targeted value chains, identify the main activities from production to consumers, identify different enterprises involved in those activities, and identify the distinct market channels to ultimate consumers.

The study draws heavily on the BQA between Tonga and New Zealand, with exerts from the document examined throughout the report.

The mapping helps us to identify and understand the links between the key roles and activities along the chain. That is, from the registration of growers, selection of farm site, suppliers of production inputs, actual production of the fresh produce upto the markets and consumers. Basically, (a) to understand the value-adding sequences of transformations that occur within their process, from suppliers to their customers; and (b) to provide a framework to understand the fundamental problem-solving, data-gathering and analysis, and communication tools.

Three maps are developed:

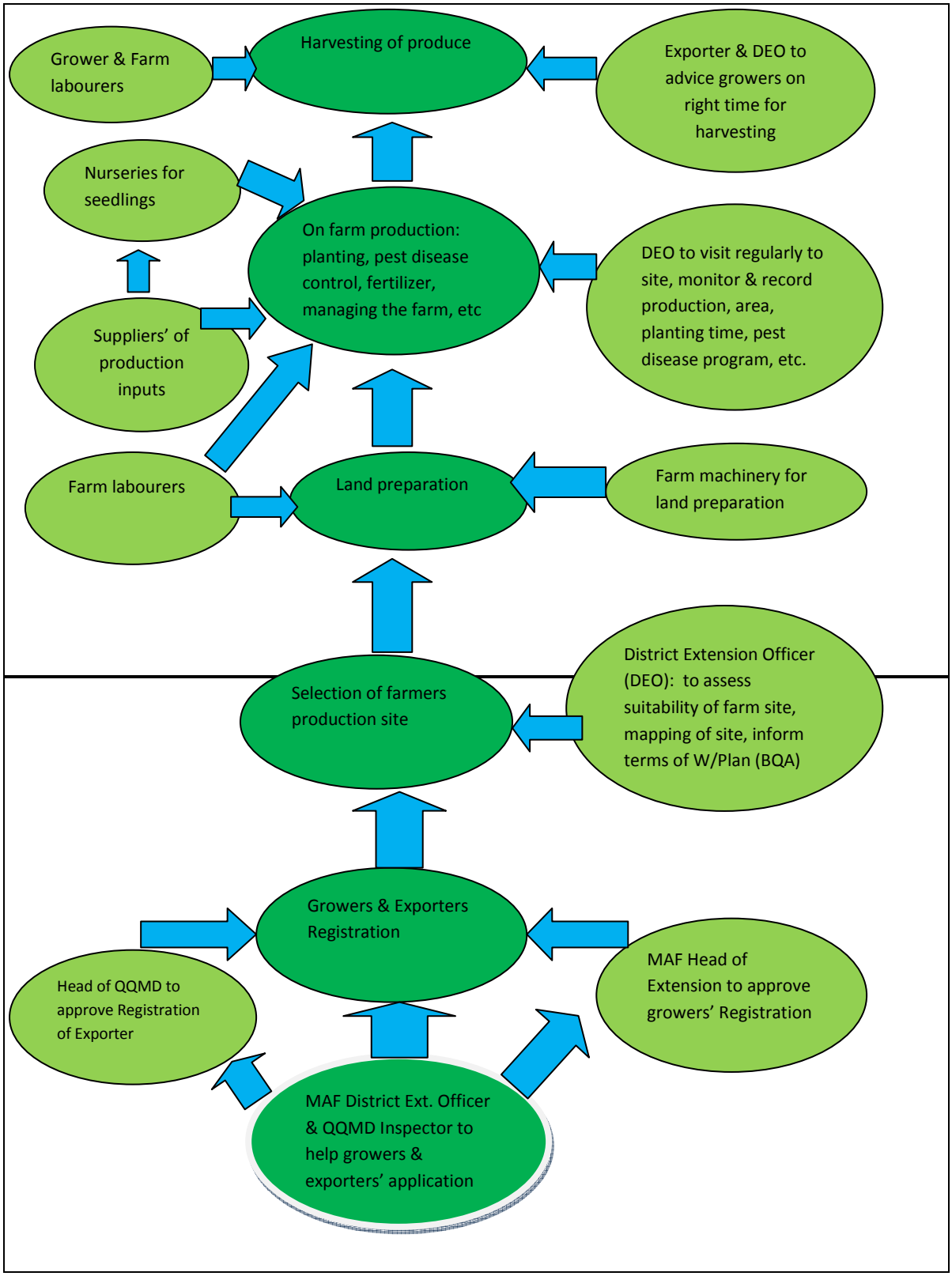
(1) Grower registration to harvest

(2) Exporting activities

(3) Marketing channels in the export market

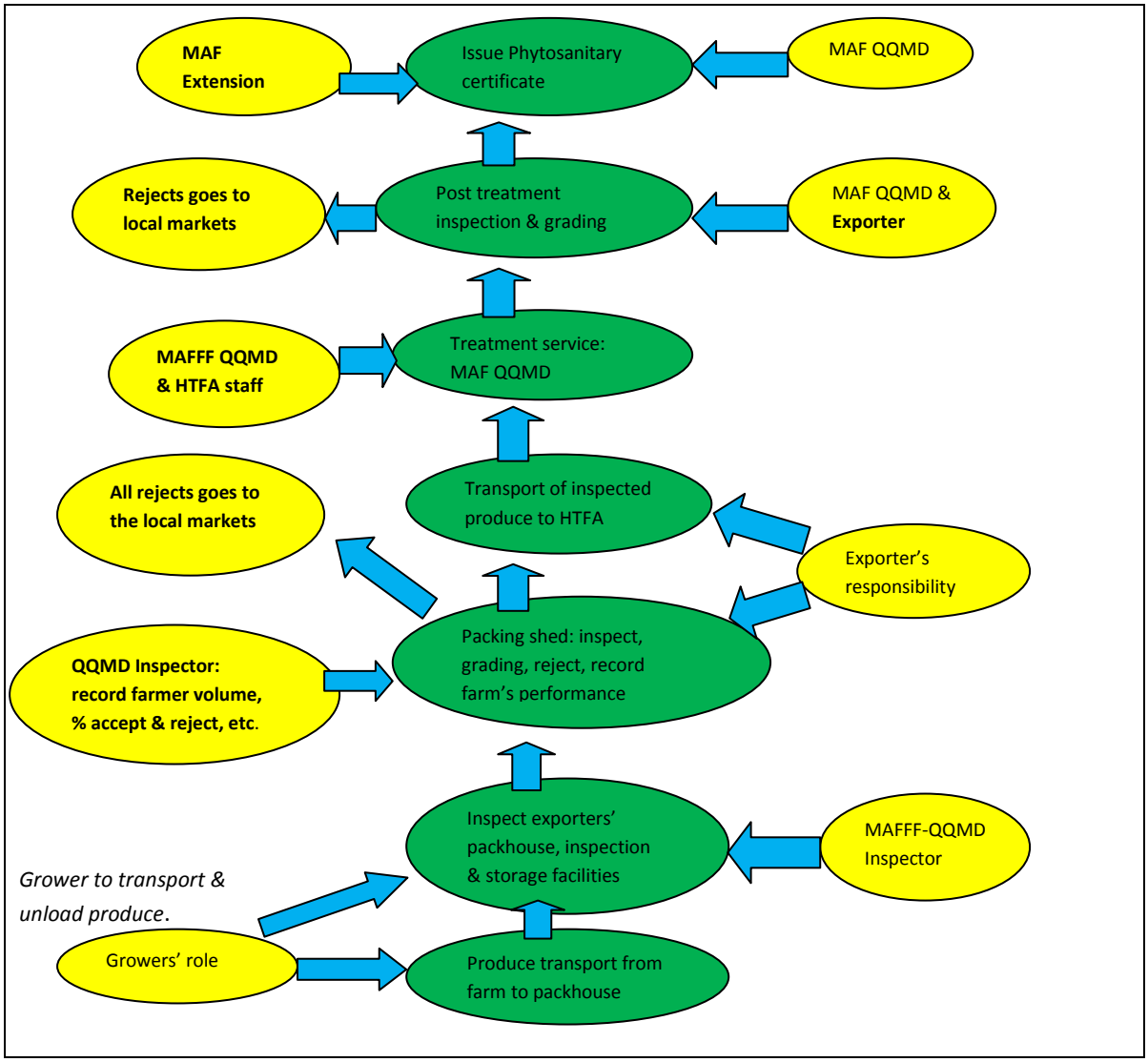
The first chain of activities (Refer Map 1) start with Growers registration, selection of farm site, land preparation, the farm production, field control, managing the farm upto harvesting. The Suppliers of production inputs and raw materials activities (such as seeds, fertilizers, and agri-chemicals) are included in this chain. It also include on-farm production activities such as: planting time, farm acreages per grower, farming procedures and field control up to harvesting.

Mapping 1: Growers Registration, Farm Production, Field control to Harvesting.



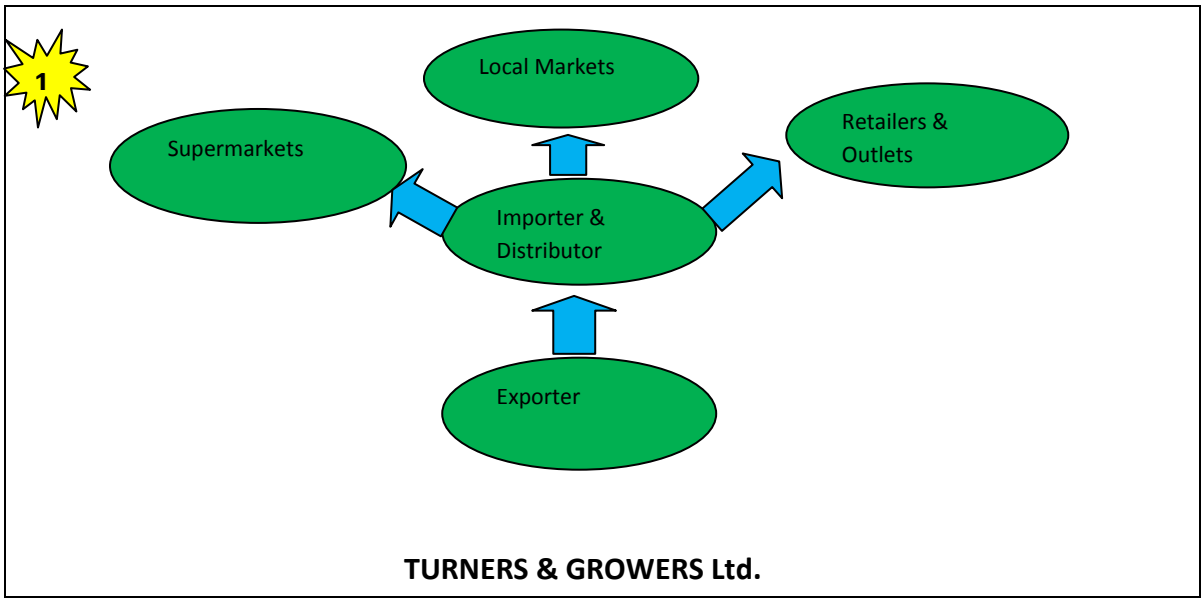
The second chain of activities as in Mapping 2 look at the postharvest to pre-export activities which involve key fundamental processes from the farmers production site to exporters' inspection and packing shed activities, HTFA treatment service, post treatment activities to issue of phytosanitary certificate and exporting.

Mapping 2: Exporters' Activities, HFTA Service to Phyto. Certificate Issuance

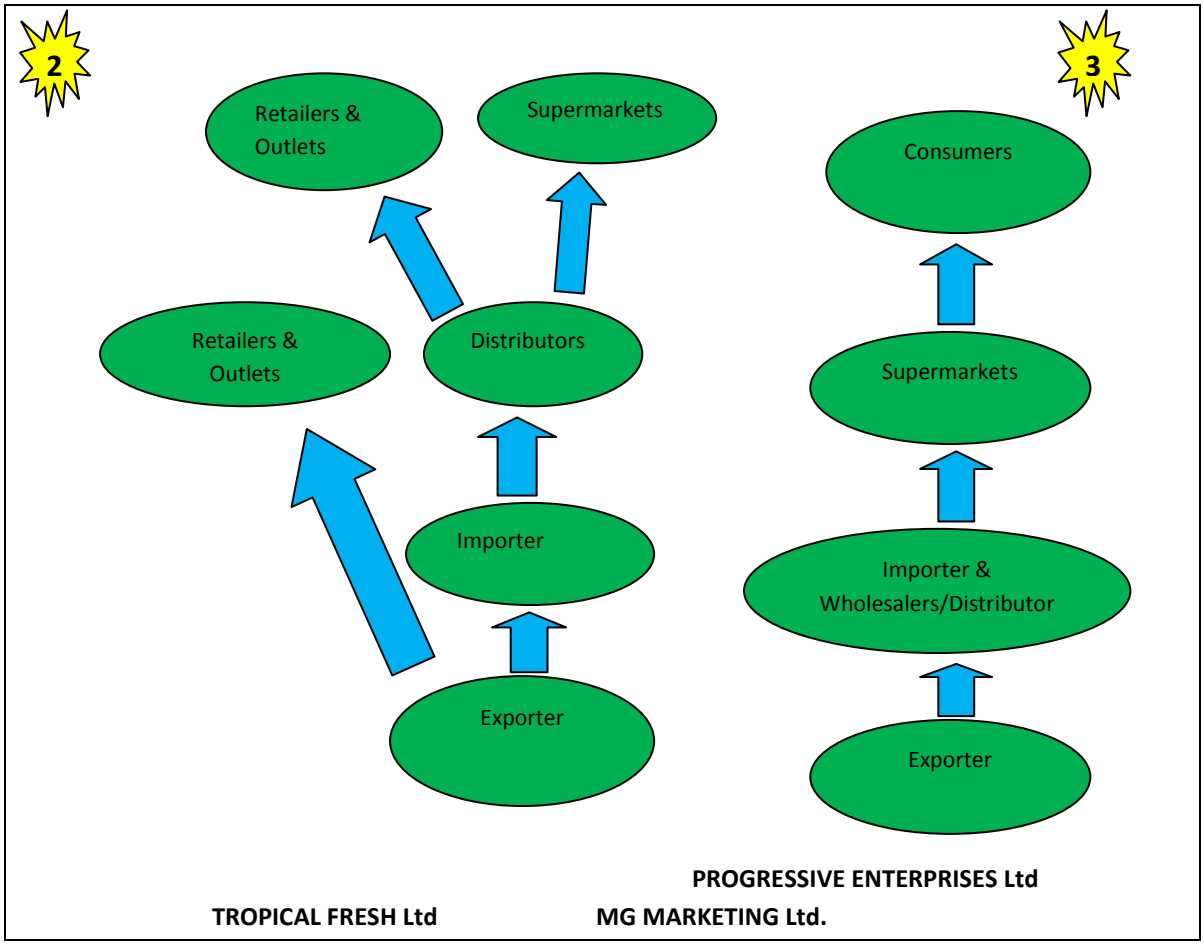


The next chain component involves activities on 'Marketing and Sales' of the selected products in the export destination. The marketing channels have different pathways to reach consumers.This chain involves activities associated with getting buyers to purchase the produce including the selection of marketing channels, advertisements, market promotion, selling, pricing, retail management, etc. Three distinct marketing channels are depicted in Mapping 3.

Mapping 3: Distinct Marketing Channels to Consumers



TURNERS & GROWERS Ltd.



PROGRESSIVE ENTERPRISES Ltd

TROPICAL FRESH Ltd **MG MARKETING Ltd.**

2. DATA COLLECTION & ANALYSIS.

2.1 INTRODUCTION

Existing sources of data and analyses relevant to this study include:

- Previous internal reports on HTFA operation
- MAFFF's Annual reports
- Published reports from MAFFF's Research, Extension and Quarantine
- Department of Statistics data on export trade
- Regional publication and reports on the subject matter
- Any electronic databases and internet, etc.

After reviewing of the available data and information within MAFFF, growers' groups, exporters, Statistics department, etc for this assignment, it was determined that that there is limited data available along the chain. Given the lack of relevant original and secondary data for this study, on aspects such as resource inputs and prices; production data, machinery cost, and yields; exports data, transport costs, warehousing, packaging and order fulfilment; and markets information, it was decided that the best option was to undertake a field investigation to collect relevant data and information, especially from the chain operators.

2.2 DATA COLLECTION

The methodology used in acquiring the original data from the suppliers to grower's production activities, up to the marketing chain used a combination of data collection methods such as diaries, interviews, observation, and questionnaires (refer to the sample Questionnaires in Appendix 2).

While the size of population of suppliers of production inputs is very small, the population for farmers involved in vegetables and fresh fruits production required sample selection. The samples included only growers from the Western District, Central District, and Eastern District of Tongatapu Island that involved in the exports of the selected produce.

3. GROWERS REGISTRATION & AGRICULTURAL PRODUCTION

3.1 INTRODUCTION

The process of growers registration up to farm production are shown in value chain Mapping 1, which identifies all main activities involved from the registration of growers involve in planting of fresh fruits and vegetables for export to harvesting. Other chain activities will be identified and discuss in the following sections of the report.

The agricultural production processes involves a sequence of activities starting from the registration of growers; selection of sites; land preparation; developing nurseries; planting of seedlings, weeds, pests and diseases control, to harvesting. Each activity requires proper planning of production process and management; timing for each activity; managing the plot and yields; harvesting; recording costs and income; and so forth.

3.2 REGISTRATION OF GROWERS

The Work Plan (refer Appendix 3) in the Bilateral Quarantine Agreement (BQA) between New Zealand MAFBNZ and Tonga MAFFF requires all growers who intend to produce fruit fly host commodities for export to New Zealand to register with MAFFF Tonga. Only those registered growers will be covered by the Work Plan. The process to register the grower is reproduced in Box 1.

Box 1 – Grower registration process.

- The grower(s) with the assistant of MAFFF District Extension Officer (DOE) to complete the application form (Form G1) for the production of fruit fly host commodities for export to New Zealand.

- The DOE will inform the grower(s) about the terms and conditions of the Work Plan (WP) as well as procedures for export of fruit fly host produce to New Zealand.

- The grower must identify the actual site where he intends to grow the fruit fly hosts commodities. This site must be approved first by MAFFF Head of Extension (HOE).

- The DEO must ensure that after notifying the terms, conditions, and procedures for export as per WP, the grower must understand before signing Form G2. This is an agreement between the grower and Tonga MAFFF to comply with all the terms and conditions of the WP.

- The grower must understand that the registration is just for one calendar year.

- Following completion and signing of application form (Form G1) and agreement form (Form G2), the grower will submit the application to the HOE to approve and register the grower indicating registration number for each respective commodity.

- The HOE will inform the outcome of the growers' application (Form G3) to be an official registered grower to start planting fruit fly host commodities for export.

Source: BQA

3.2.1 Growers & Growers Organisations/Exporter.

It is very important to understand the relationship between individual growers and existing growers' organisations who might be involved in the export of fresh produce. Each grower's organisation registers their growers in numbers, district, what type of fresh produce they are going to plant, and size of the farm. They need to form a contract with growers including: compliance with the WP, what to plant, must follow production procedures relating to quantity and volume of quality supply to inspect, treat and export. To this effect, exporters should register and develop a contract with their growers in numbers and the type of crop to plant with their weekly or monthly supply, etc.

One of the Growers organisations, the 'Growers Federation of Tonga Ltd' has decided to be an Exporter for their registered growers. The Growers Federation need to process their application and be registered with the MAFFF QQMD to approve to export fruit-fly host commodities to New Zealand. Another organisation, the Growers District Council has also registered growers to plant fruit-fly host commodities (papaya, eggplant, chilli, etc) to export to New Zealand but has not yet decided whether to be an Exporter for their growers or not. To be accepted as an exporter of fruit-fly host commodities to New Zealand they must process their application to register with MAFFF QQMD.

The exact number of exporter(s) and farmers to be involved in planting and exporting of fruit-fly host commodities to export to New Zealand had not yet confirmed as of July 2009. However, about twenty (20) growers are registered and involved in planting for the export trial and one Exporter (Growers Federation of Tonga Ltd) will export the trial shipment.

By way of comparison, the numbers of exporters with their growers in Fiji who actually export fresh produce including fruit-fly host commodities to New Zealand, according to the Natures way Cooperatives' (Fiji) Ltd report , are as follows.

Table 1. Number of Exporters and Farmers

Eggplant	Papaya	Mango	Breadfruit
6 exporters 90 farmers			
	6 exporters 82 Farmers		
		2 exporters 39 Farmers	
			2 exporters 15 Farmers

Source: Natures Way Cooperatives (Fiji) Ltd

3.3 SELECTION OF PRODUCTION SITE

In selection of the production site the grower(s) must identify the actual site to the DEO to inspect first and report to the HOE to approve or not approve. The site must be approved and registered first. This process must be done first prior to completion and submission of growers' application for registration.

Box 2: Guidelines on site selection.

The decision for the site will be at the discretion of MAFFF HOE based on DEO report also taking into account such factor as the proximity of any farm who is planting fruit fly host commodities.

The site will not be registered if it is deemed unsuitable or causes doubt with the ability of the grower to fulfil the requirements of the work plan. But if that doubt is cleared and satisfy, the site can be re-registered.

The DEO will map the registered site for production and monitor regularly as production starts for the whole duration of production.

Source: BQA

3.4 LAND PREPARATION

Preparing land for planting different crops required different times and stages. Land preparation for planting Root crops is different from preparation for planting fruit trees and vegetables. The field investigation and survey, revealed the importance of giving enough time for the land preparation especially for planting vegetables.

Seventy percent of the sampled farmers, 80% of who are classified as family farms, 20% as commercial allow at least one (1) month for their land preparation (***i.e. first cut the site using slasher, then 1st disc plough- after 2 weeks, then 2nd disc plough, after another 2 weeks then harrow, and then ridge according to spacing, before planting)***, others allow more time for the land preparation.

It was noted that the key issue is to have enough time to prepare farm sites as the three selected crops have different spacing and it requires different machinery setting. The availability of agricultural machinery for land preparation is not a problem as almost every village has agricultural machinery (tractors with appropriate equipment) and the hourly rate for the machinery service is reasonable for growers to pay.

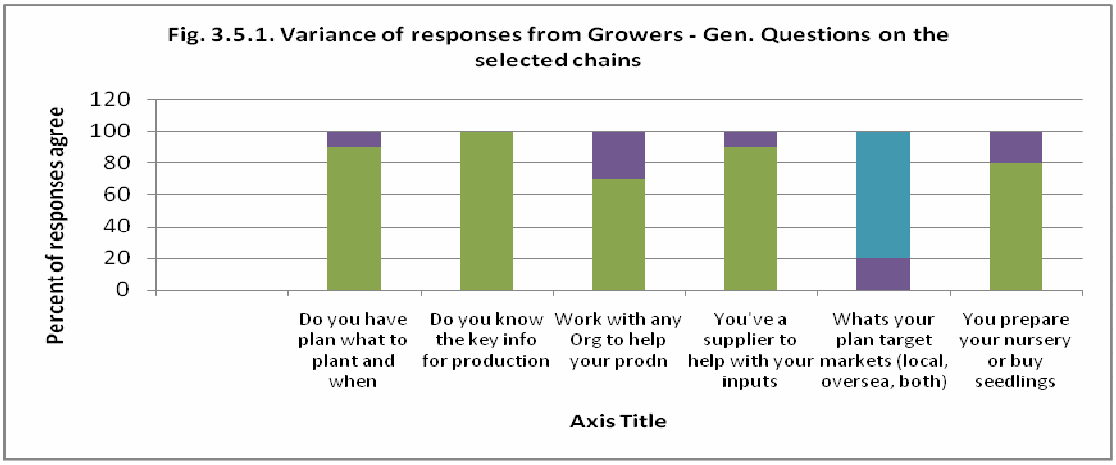
Responses to the question regarding priority requirement (land, labour, finance) for the production, 100 % of farmers said finance is the most needed factor of production. Thirty percent of farmers use only family labour, whilst 70% use a combination of family and hired labour. The availability of farm land is increasing because thousand of acres that were engaged in banana and squash pumpkin production are now available, such that land and labour are not seen as constraints to increased production.

3.5 SUPPLIERS OF AGRICULTURAL INPUTS

To determine the importance and mechanisms for accessing inputs, growers were asked a series of questions, responses to which are reported below

Variance of responses from Growers - General Questions.

1. Do you have plan what to plant and when 90% say 'Yes' 10% say 'N0'
2. Do you know the key info for production 100% say 'Yes' 0% say 'No'
3. Work with any Org to help your production 70% say 'Yes' 30% say 'No'
4. You've a supplier to help with your inputs 90% say 'Yes' 10% say 'No'
5. What is your plan target markets (local, oversea, both) 20% overseas 80% both
6. You prepare your nursery or buy seedlings 80% say 'Yes' 20% say 'No'



The responses show that 90% have identified a supplier(s) to provide their inputs However, when asked about options of developing their own nursery or buy seedlings, the majority (about 80%) indicated a preference for developing their own nursery.

There are only five companies or suppliers of agricultural inputs currently in active operation in Tongatapu. The decline of squash export to Japan and fresh fruits like banana and watermelons to New Zealand contributed to closure of a few other companies. Most of these companies were 'Suppliers of inputs' to, as well as 'Exporter' for, their own registered growers. They supply inputs to their growers and the cost of inputs is on credit and deducted from proceeds of their export.

These companies were also involved in planting for many years on a larger scale, they hired labourers, invested in assets, bought their own farm machineries, and used their own inputs from their stock. The end results were not very convincing to growers due to an over-supply and flooding of this window-market resulting in low and marginal income payment to growers as well as losses to others. Most of the current 'Suppliers' have learned a lot of lessons from previous experiences.

The five suppliers of agricultural inputs currently in operation are:

Fua 'oe Fonua Ltd.

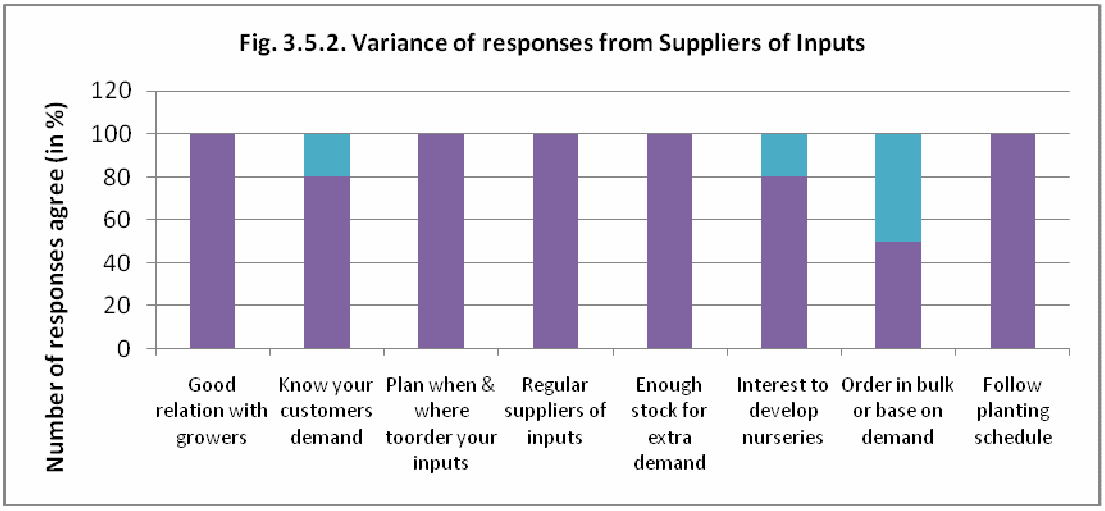
FIMCO (Friendly Island Marketing Co-operative)

JH Nako Holdings

Nishi Trading Co Ltd

Tinopai Farm

The information collected from interview/meeting suggested that all suppliers have a good relationship with the growers and realised the importance of developing a good relationship with the growers. However, only 80% of suppliers know what their customers' demand regarding inputs, e.g. type of pesticides and chemicals for controlling various virus diseases and fruit flies. All suppliers said that they know where and when to order the inputs because they know the season and planting time for the selected produce and all have regular suppliers overseas and developed good relationship. As regards stock, all suppliers confirmed that they have enough stock to cater for demand. In contrast to the views of the growers, 80% said that they are interested in developing nurseries and selling seedling at lower cost.



The most important point revealed during the interviews is that all of the suppliers are willing to start working with growers, MAFFF Quarantine, Research and Extension divisions to find out what to order, when, volume of the inputs required, and prices. All of the local suppliers have their own overseas Suppliers and partners with which they have good relationship. The issue regarding the stock and inventory to cater for any urgent demand, they all agreed to have enough stock to cater for that. They also indicate of the flexibility to place an urgent order if a specific supply is not available in stock. These issues are reflected in Box 3

Box 3: Key issues and activities for the 'Suppliers' of inputs & raw materials

- To work closely with all the associated stakeholders to prepare an Operational Plan and to confirm the timing of production for the selected produce, variety of seeds, total acreage to plant, volumes of required inputs, requirement for phase planting, and price.
- To confirm with the Exporter(s) and Importers of the right variety or varieties of the selected produce to order, as demanded by the market.
- To confirm with MAFFF Research about the information on fertiliser (both for organic and non-organic), the agri-chemicals for control of pests and diseases, etc.
- To know the right time for ordering of agricultural inputs for the selected produce, and timing for preparation of nurseries.
- To ensure that they have enough stock for urgent demand by the customers and growers.
- To keep reviewing their Business plan on key demands as per agreed timeline, and ensure to update and accommodate any changes.
- To ensure that their schedule and delivery of agricultural inputs to the growers will be on time and regard as priority in their plan for the year.
- Lastly but not the least is to develop good relationship both business-to-customer and business-to-business, that is, from one chain to the next chain.

Other important issues were also discussed in regards to service delivery as customers often have a general requirements to be provided by the 'Supplier' or 'Provider' of agricultural inputs:

i. High level of quality: As customer's standpoint, quality is among the first requirement. Evidence suggests that quality is the primary requirement.
ii. A high degree of flexibility: Customers admire suppliers ability to react easily to shifting requirements and irregular arrival patterns.
iii. High levels of service: Subjective measures of customer service include humanity in service delivery; objective measures include having a required item in stock to cater for urgent demand.
iv. Low costs: External customers like growers are price conscious.
v. Quick response (speed): Customers and growers want delay-free service and quick to response to changing requirements. The 'Suppliers' should aims to satisfy by shortening cycle times and quickly introducing attractive new goods and services.
vi. Little or no variability: Customers expect consistency; the idea is zero deviation from targeted or expected results.

3.6 DEVELOPING NURSERIES

The MAFFF Research prepared nurseries for the trial export to the New Zealand market. The growers involved in this trial export programme were selected by Growers Federation and Growers Council from their registered growers as per the work plan. The seedlings will be supplied from the Research Division of MAFFF at no cost to the growers. For the papaya production, the total target acreage is 20 acres or more. For eggplants and chillies, the total target acreage for each of the selected produce will be 5 acres or more.

To ensure the success of the future production and export it is up to each Grower's Organisation to organise their inputs for their own registered growers and according to their production plan and phase planting. Because the cost of seeds is very expensive for growers to afford, some of the 'Suppliers' of inputs indicate interest on developing nurseries and sell to growers at a very cheap and affordable price. Another option is for 'Suppliers' to obtain more information on the availability of seedlings at lower prices especially where it will create differentiation advantage.

Nurseries at Research Division of MAFFF for Trial export.

3.7 ON FARM PRODUCTION.

3.7.1 PLANTING TIME.

Towards the end of the field work in Tonga, MAFFF Extension Services and SPC were finalising the updating the 'Growers Leaflets for Papaya, Eggplants, Chilli, and other vegetables and fruits' for distribution to growers (Refer Appendix 4). These leaflets are very important as they provide all the required information for each crop starting from 'selecting the piece of land, land preparation; varieties for export markets; nursery; planting time; fertilisation, types, timing for fertilising and volume; pests and diseases, agri-chemicals to control, spraying time and how to mix those chemicals; harvesting; etc.

The above mentioned 'Crop leaflets' should be out by now and available to growers to read and understand these technical information for their production.

The leaflets provide details for fertiliser application per crop, type, volume of application per plant, time of application, etc. are in the leaflets for grower to read and follow. Similarly, with the pest and disease occurrence and control, type of pests and diseases, chemicals to control, how to mix the chemicals and time for spraying. Under the BQA the Tonga MAFFF will supply registered growers with a pest control program designed primarily for fruit fly species and which also control quarantine/injurious/contaminant pests. The work plan also requires a designated DEO to visit the production site regularly in their district to monitor the growers' performance and to comply with the requirements of WP. In the event of non-adherence, the designated DEO will advice HEO to de-register the grower registration.

The recommended planting time as shown on Table 2 for some of the selected crops, together with the recommended spacing, and varieties demanded from the market are also specified, are summarised in Table 2

Table 2: SUMMARY OF SELECTED PRODUCE PLANTING PARAMETERS.

CROP:	PLANTING TIME:	SPACING: ROW TO ROW	SPACING: PLANT TO PLANT	VARIETIES:
1. Eggplant	March – August	5 x 5feet (single row)	2 x 2feet	Black Beauty, Long Purple, Lista de Gandia.
2. Chilli	March – August	7 x 7 feet (double rows)	2 x 2feet	Red Cannayane
3. Papaya	October – April	3 x 3meters	2 x 2meters	Sunrise & Waimanalo

The exact volume of market demand has not yet been confirmed. This will be determined following an assessment of the trial shipment and evaluation of the standard of quality

The inconsistent supply of quality fresh produce to the market is the major threat and risk for this export opportunity, the producers, purchasers/ importers and the profitability of the whole operation will be at risk if the production is fail.

The data collected from survey questionnaire provides information relevant to address the important activities and issues of ensuring consistent high yields and quality that is demanded by market. About 100% of the responses collected from growers said they do have a farm management plan for fertilisation, pest and disease control programme, weeding, etc. Also 80% of the response said they still need some technical support on crop management, specifically on how to achieve high quality yield.

The main focus of the production is to increase the high quality yield produce for export. The concern here is whether we have the capacity to produce high quality yield as demanded by the market. But if all parties work together and follow up with the recommended farm practices, pest & disease control program and other production measures, this export opportunity can grow due to consistency supplying of good quality produce. However, all of this comes down to the important factors: growers, production, quality volume demanded by the market, and lastly is the price and payment option for the growers.

- The volume of supply depends on the volume of market demand. Although importers/distributors are willing to fulfil the market demand but the first step depend on the trial export quality and approval from MAFBNZ.

- The exporters and growers need to know the production and what the required acreage is for the main season first planting time and the phase planting to ensure consistency of supplying of quality produce.
- Exporters need to confirm that they have enough registered growers to involve in the planting and production of the selected produce for export.
- Exporters need to include in their contract and agreement the price and payment time, i.e. payment to be made straight at farm gate or after shipment depart Tonga

3.7.2 RISKS, WEATHER & CLIMATE CHANGE.

Weather and climate changes in recent years are a major threat to agricultural production especially for the fruit trees. It is the most important single factor beyond human control which can affects the scope of farming especially for export. It includes heavy rainfall, chill and cold weather, storms, strong wind, droughts, etc. (Refer to Appendix 5.1 and 5.2).

Low rainfall is needed when fruit trees start flowering, heavy rains and strong winds will affect the pollination season for the fruit trees. Therefore, not only is the total amount of rain is important but its proper distribution is equally essential. It is quite important for the growers and farmers to get regular weather forecast from the Meteorology dept. However, with the weather reports from the Meteorology Dept. the forecast for rainfalls outlook seems normal for the production during the trial export period and there is no drought warning for Tonga and the Pacific islands.

The major risk and threat for the production as revealed by the data collected is suggested as being climate change. 100% of respondents confirmed that climate change is the major threat for the production especially for the papaya and other fruits like breadfruits and mango. All growers stated in the past few years about 50% of the damage to their farms was caused by strong winds and hurricanes which they associated with climate change.

3.7.3 HARVESTING.

All produce for export has a different harvest time especially for the fruit fly host commodities. Some need to be harvested before colour break when they are still in green colour. Some can be harvested at colour break and so on. The right time for harvesting of fruits and vegetables for export should be advice by the exporter and DEO in their district during their regular monitoring visit, or by the Quarantine Inspector as indicated in Box 4.

Box 4 Guidelines on harvesting.

- Their recommendation for harvesting must comply with the terms of BQA. Their advice and recommendation should be adopted by the growers and exporters as it may help to reduce the percentage of rejection and waste.
- The Extension staff and Growers training should clarify of the right time for harvesting (colour break) and transporting of produce to the HTFA treatment facility.
- Harvest should use field pins to collect fruits to reduce fruit damages.
- Transporting of fruits to exporters' inspection and packing shed is a responsibility of the grower to ensure that the fruits are protected from all damages.
- All produce will be loaded and transported in such a manner as to ensure freedom from bruising, cracking and possible pest infestation. Transportation will be direct to the pack house.
- The growers will be responsible for unloading their produce on arrival at the pack house and this must be done in such a manner so as to ensure freedom from bruising and cracking.
- Growers must also provided the required copies of the monitoring sheet to both the Exporter's and to the designated MAF-QQMD Inspector before the commodities can be cleared for grading and inspection.

Source: BQA

3.7.4 GROSS MARGIN ANALYSIS FOR THE SELECTED CROPS.

During the field investigation and data collection, it was noted that secondary data for developing Gross Margins (GM) for vegetables were not updated in terms of yields, costs of production for labour, machinery, prices of inputs, local market prices, etc. The GM for the selected commodities was revised during the fieldwork and data collection.

The analyses (attached as Annex 6.1-6.3) reflect the fact that there is significant variation in yield and in producer price for the four products. A sensitivity analysis was conducted using both parameters as reported below. For example, the average yields for Papaya were reported as 6000kg/acre by 10% of growers, 7000kg/acre by 30% of growers, 8000kg/acre by 50% of growers and 9000kg/acre by the remaining 10%. The reasons behind this were given as being due to a combination of poor farm management and weather condition.

Table 3: Proportion of growers reporting Average Annual Total Yields & Av Export Yields/acre for Papaya

	6,000KG	7,000KG	8,000KG	9,000KG
Total ave. yield papaya	10	20	55	15
Ave. market yield Papaya	10	30	50	10

Table 4. Proportion of growers reporting average Total Yields & Av Export Yields/acre for Eggplants.

	3,000KG	3,500KG	4,000KG	4,500KG
Total average yield.	40	50	10	0
Average Export yield	35	55	5	0

For eggplants, the majority of growers (50%) responded that they produce up to 3,500 kg for the total 12 month period whereas 40 percent produce up to 3,000kg and only 10 percent produce up to 4,000kg.

Table 5 .Proportion of Growers reporting Average Total Yields & Av Export Yields/acre for Chillies

	2,000KG	2,500KG	3,000KG	3,500KG
Total Ave. yield	10	40	50	0
Ave. Market. yield	13	40	47	0

For Chilli growers, about 10 percent of responses received indicate producing up to total 2,000kg in a 12 months period, 40 percent said they produced up to 2,500kg, and 50 percent said they produced up to 3,000kg for 12 months duration. Their average market yield varies as most respondents did not know by how much percent (%) of their total yields loss or rejected.

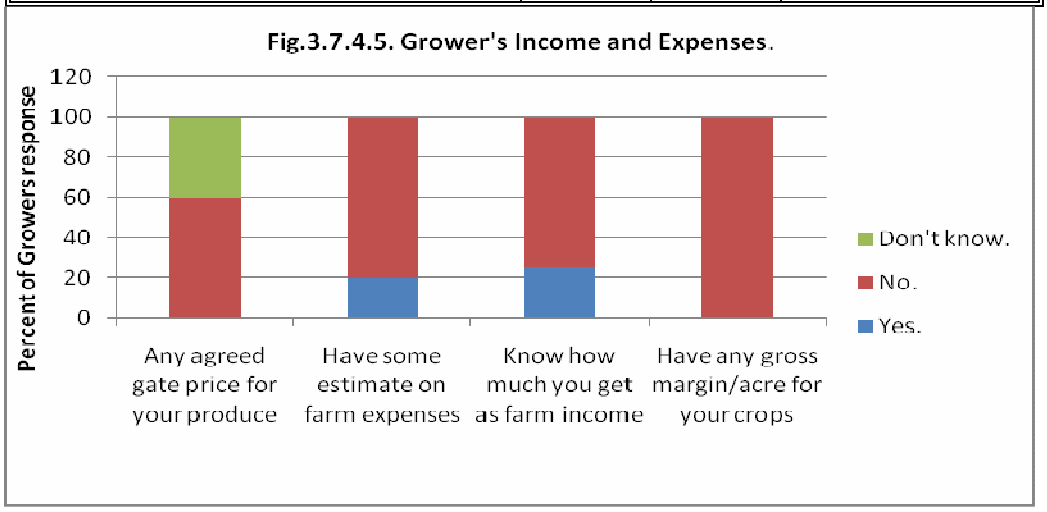
The prices received by growers also varied, although to a lesser extent. For Papaya, the majority (90%) reported a price of T$2.00/kg. For Eggplant, 80% reported a price of T$5.00 and for Chilli, 95% reported a price of T$15.00/kg. For breadfruit, the price was reported as T$1.00/kg by 70% and T$2.00/kg by 30% of respondents

The average local market prices (Refer Appendix 7 and 8) for the selected produce were cross checked and found to be similar to the prices collected from the survey questionnaire.

The survey data was also used in an an attempt to update production costs. However, as reflected in the questionairre responses below, the lack of record keeping casts doubt on the accuracy of this data.

Table 6 Grower's Income and expenses

	YES.	NO.	DON'T KNOW.
Any agreed gate price for your produce	0	60	40
Have some estimate on farm expenses	20	80	0
Know how much you get as farm income	25	75	0
Have any gross margin/acre for your crops	0	100	0



The local average total yields and market yields were based on old data and responses from the survey questionnaires. Unfortunately, there are gaps on various data and information, no data available from previous trials' records to update the production parameters, total and marketable yields, the required total labour hours, etc. Other variables information like input costs, labour costs and local prices, etc was not collected to revised the GM.

There is therefore a need for further data collection on relevant information to update the GM for these and other crops (Refer Appendix.6.1- 6.5).

The analysis is reported for three of the products (Papaya, Eggplant and Chilli). The key assumed parameters and derived margins are reported in the following table. Since breadfruit (and mango trees) are not planted in more typical farming system, no actual data are typically collected and/or recorded for breadfruits for the preparation of a gross margins. The data collected in the survey were based primarily on information from discussion with elderly people. The suggested economic life for both breadfruit and mango trees spread over forty-five years (45 yrs) period. The annual yields were also calculated based on our experience and discussion with the elderly people in villages.

Table 7. Summary of Gross Margin for Eggplant, Chilli, and Papaya/Acre.

Description:	Eggplant:	Chilli:	Papaya:
Average Total Yield	3,655 kg	20,310 bags	28,080 kg
Average Market Yield	3,290 kg	16,248 bags	26,520 kg
Average Local Market Price (in T$)	3.00/kg	0.70 /bags	0.70/unit
Total Gross Income (T$)	9,868.	11,374.	18,564.
Total Variable Costs (T$)	1,080.	1,554.	1,282.
Total Labour Costs (T$)	1,168.	1,604.	4,872.
Margin after Variable Cost (T$)	8,788.	9,819.	17,281.
Return to Variable Cost (T$)	8.14	6.32	13.47
Margin after Labour Cost (T$)	7,621.	8,215.	12,409.
Return per Labour Cost (T$)	39.15	30.72	15.28

NB: GM calculation for Papaya assumes a 4 year growing rotation. Undiscounted value reported above

This GM analysis for the three selected crops was prepared quantifying all cash inflows and outflows starting from productions to the local markets (Refer Appendix.6.1-6.5).

- The Margin after Labour cost indicates a high return. It also suggests a very positive growth if this programme will go ahead, provided full farm production management procedures are carried.
- The Margin after Labour cost for eggplants is T$7,621 and Chilli is T$8,215. But for Papaya the accumulated undiscounted income for 4 years is T$12,409. While the discounted proceeds or stream of incomes calculated to obtain the net present value (NPV) of Papaya for 4 years is T$10,399. The returns to variable costs and returns per labour costs for all the three crops are very positive.

As examples of the sensitivity of returns to labour to changes in yield and/or price, the results of the sensitivity analyses for eggplant and chilli are presented below. Both show changes in the GM after labour costs for 50% increments in price and 30% increments in yield.

Table 8. Sensitivity analysis on Eggplant Gross Margin (inc. labour costs) T$/acre

		Yield (*kg/ac*)		
		2,300	3,290	4,276
Price (T$/kg)	1.50	1,202	2,686	4,167
	3.00	4,652	**7,621**	10,581
	4.50	8,102	12,555	16,996

Table 9. Sensitivity analysis on Chilli Gross Margin (inc. labour costs) T$/acre

		Yield (bags/ac)		
		11,374	16,248	21,122
Price *(T$/bag*)	0.35	822	2,528	4,234
	0.70	4,803	**8,215**	11,627
	1.05	8,783	13,902	19,020

It is clear that a higher price premium (as maybe expected for the export of quality produce) significantly increases the returns to labour. On the downside, a significant increase in supply to the domestic market (for example, if exports are not profitable and increased supplies come on to the local market) could push the producer price down from current levels, significantly reducing the returns to labour.

The analysis refers only to the producer level and is of course highly contingent upon a market for the export commodities. It was unfortunate that a more comprehensive financial and economic analysis that included the HTFA operation was not undertaken as this would have allowed an estimate of the overall incremental benefit and present value of future income stream for the potential export opportunity.

However, resources did not permit the collection of data and information collection for on fixed and variable costs for HTFA operation, nor was it possible to make reasonable assumptions related to the structure and management of the HTFA facility.

3.8 DOMESTIC MARKETS

As noted above, following of an increase in production of the selected products the domestic market price could be increase, if an increase in exports reduces supply to the domestic market, or decrease, if an increase in production is not entirely exported and supplies instead flood the domestic market.

The Talamahu Market is the main market in Nuku'alofa. The current domestic Market survey data has limitations, because the actual market survey is normally carried out only once a week, i.e. Friday morning (Refer Appendix 7 & 8) and only at Talamahu market. Other local market outlets on village roads side are not recorded or included in the weekly market survey. Additionally, data on domestic supplies of fresh fruits and vegetables to other domestic markets such as supermarkets, hotels, motels, and restaurants are not available .This explains some of the inconsistency between the market survey and the growers survey in this study.

An analysis of the potential domestic market effects is critically important in planning for the use of the HTFA facility, but would require a significant investment in improved data collection.

3.9 KEY CONSTRAINTS & ISSUES TO ADDRESS AT THE GROWER LEVEL

The key constraints and issues identified in regards to the activities on Mapping 1: Growers registration, selection of site, land preparation, on-farm production to harvesting, that may cause threat to the treatment plant and need to be resolved include:

1) ***Understanding terms & conditions of the Work plan (BQA).***

i. It is very important for all growers intending to plant the fruit-fly host produce for export to register with Tonga MAFFF Extension Division first. Without registration, they cannot be allowed to export as stated by the Work plan.

ii. Extension Division (ED) needs to train and explain to registered growers and those want to be involved, the terms and conditions of the work plan (BQA).

iii. The District Extension Officer (DEO) must inform the growers about de-registration of the production site and the reasons behind as per Work plan (WP).

2) ***Price of production inputs.***

The prices of production inputs especially for the papaya seeds is very expensive for growers to afford. Searching for other sources of good quality seeds at reasonable price is vital for lowering the production costs.

3) ***Farm production issues.***

On Farm production issues are critical for this export opportunity, especially:

- activities associated with the recommended practices of production, i.e. prior to planting, actual planting, managing the farm (field control measures), to harvesting.
- monitoring of all the activities to ensure it adheres to the WP and to ensure that the production is well under control.
- ensuring that the phase planting programme is schedule to produce consistent supply to meet market demand.
- recording and updating all production data (total & export yields/acre, production costs, prices and income).

4) ***Training & Support Services to growers.***

Close collaboration between MAFFF Research, Extension, QQMD Divisions and the growers to assist in training and dissemination of production information to

alleviate issues, threats and risks regarding production and to help improve the results is important.

5) ***Growers organisations' registered growers & production plan.***
Each Growers Organisation should ensure that their growers are registered with their organisation and there should be a contract and an agreement between them to sign on number of growers registered to plant eggplant, papaya, chilli, and breadfruits specifying their acreage and projected volume of supply .

6) **Data & Information gaps.**
Analysis related to the production of the selected produce for export faces huge data and information gaps starting from production parameters, information on production procedures, data on total yields and market yields, production costs, prices, and income. During the trial production period, those data gaps should be recorded and efforts made to continue to update data during main production season.

4. EXPORTER, HTFA FACILITY & PHYTOSANITARY CERTIFICATION

4.1 INTRODUCTION

A second component of the fresh fruity and vegetables chain map relates to exporter activities. The main activities under this value chain mapping are specifically focus on associated activities required to get the packing facility inspected; produce to be checked; delivery of produce to the HTFA facility for treatment, etc (Refer Value Chain Map 2). The key actions include: checking the exporters' inspection and grading facility; HTFA treatment activities; responsibility for inspection and grading of produce; secured fruit fly free warehouse for packing and labelling; organising the transportation for delivery of produce to the market; etc.

There are only a few stakeholders that are directly involved in this network and process of activities.

The aim of this section of the study is to examine various options open to these operators to see how the fresh produce can be processed along the chain to the importers and wholesalers. Improvements in these processes will help to improve the farmer's return as well as create a more competitive advantage for Tonga's exports.

4.2 EXPORTERS REGISTRATION & PACKING SHED FACILITY.

The Work Plan (BQA) procedures for registration of exporters to export fruit fly host commodities from Tonga to New Zealand must follow and comply with the WP as specified in Box 5.

Box 5 Exporter registration

- Any exporter intending to export any fruit fly host commodities to New Zealand must be registered with MAFFF Tonga.

- The registration and de-registration of exporters is the responsibility of the Director of MAFFF who has designated the Head of Quarantine and Quality Management Division (QQMD) to carry out this task.

- The exporter must apply for registration completing application Form No. E.1.

- The exporter must also sign the Exporter Agreement Form No. E.2. this is assurance of his agreement to adhere to the terms of the Work Plan.

- The designated QQMD Officer will assist the exporters in filling out the application Form No. E.1 assess the suitability of facilities for inspection, packaging, and storage and to ensure that the application has the following documents:

  Valid export license from the Ministry of Labour, Commerce and Industries
  MAFFF-Export Application Form No. E.1
  MAFFF-Export Agreement Form No. E.2

Source: BQA

INSPECTION OF EXPORTERS' PACKING SHED & FACILITY.

In addition there is a requirement for the exporters' facilities to be expected, as specified in Box 6

Box 6 Packing shed inspection

- The designated QQMD Officer will inspect the exporter's facilities. The minimum requirements for registration will be:
  - Suitable building and facilities for grading, inspection, packing and storage of commodities.
  - Building should have concrete floor, sound roof and adequate ventilation.
  - Building should have adequate light and lighting for grading and inspection
  - Building should have adequate water supply.

- The documents must be submitted to the MAFFF Head of Quarantine and Quality Management Division for consideration.

- The Head of Quarantine and Quality Management Division shall register approved exporters' in writing (Form No.E.3) indicating the exporter's registration number and the list of commodities and the Work Plan pathways they are approved to export under. The registration is valid up to the end of the calendar year.

- Registered exporters will accept only quality fruit for export to New Zealand from registered growers. No adherence to this will result in immediate deregistration.

- The Head of Quarantine and Quality Management Division may de-register any exporter's if they do not comply with the term of the Work Plan and Procedures.

Source: BQA

INSPECTION & GRADING OF PRODUCE ACTIVITY AT EXPORTER'S PACKING SHED

Once the inspection of the facility is complete and confirmed to comply with the WP, the designated QQMD officer will assist the exporter to complete the application for approval. Once the application process is complete and register, the facility is ready to use for inspection and grading of the produce as per terms of WP which are summarised in Box 7.

Box 7: Inspection of packing shed activities

- The transport of produce from the production site straight to the packing shed is the responsibility of the grower. The grower must ensure that produce must be protected from bruising and damages that may cause rejection.
- Unloading the produce on arrival at the packing shed is also the responsibility of the grower. He must provide two (2) copies of the monitoring sheets to give each to the exporter and QQMD Inspector before they can clear for inspection and grading.
- It is the responsibility of the exporter to carry out the full initial inspection and grading of the commodities at the packing shed.
- The Exporter's Graders will inspect every individual fruit (100%) for the presence of fruit fly egg, larvae and pupae (and the signs of such presence including; bruising soft spots, cracks, skin punctures, insect infestation etc.) and reject such produce for export to New Zealand.
- Infestation by other actionable pests will also result in the rejection of such produce for export to New Zealand.
- All traces of soil will be removed.
- All grading and packing will be carried out in a packing shed registered by Tonga MAFFF.

Source: BQA

The inspection and grading of the fresh produce (breadfruit, papaya, eggplant and chilli) by the exporter are very important as the Quarantine officer will check the graded produce before issuing a transfer docket to allow transport of the produce to the HTFA facility. Unfortunately, data from the previous export trial were not available to allow an analysis of the percentage of rejection.

Various reports and information from other countries indicate that the rates of rejections at the treatment facility are very high (i.e. papaya 6% of 9 tons, eggplant 8% of 15 tons, etc) due to factors including lack of quality seeds available for planting, poor field control measures, poor harvesting and post-harvest handling, poor quality control inspection prior treatment, problems during transportation, etc.

To continue improving the export volume, stakeholders such as growers, exporters, MAFFF Extension Division, QQMD, etc must all work together to resolve the issue of high rate of rejection. The potential utilisation of the HTFA treatment facility to expand and open new fresh commodity pathway to the market, has however created awareness among key stakeholders of the importance of good crop management and post-harvest handling when producing for the export market. The potential for new export pathways for eggplant, pawpaw, chilli and breadfruit has resulted in the production of the production leaflets referenced in Section 3. More training and materials need to be developed for growers, exporters, and quarantine and extension officers. This will definitely resulted in economic gains from increase production, reduced rejections and increased volumes of exportable produce. .

4.3 HTFA FACILITY TREATMENT SERVICE.

After the initial inspection and grading of the fruit-fly commodities at the exporters' packing shed and facility, the inspected produce must be transported to the HTFA facility for treatment and final inspection and grading.

As per the BQA, the exporter is responsible for the transportation of the inspected commodity from the packhouse to the MAFFF post treatment center, either at the Queen Salote Wharf or the Fua'amotu Airport. The commodities must be transported under cover with an insect proof screen.

The procedure for the treatment of fruit fly host commodities must be according to the prescribed treatment procedures in the BQA as specified in the following box:

Box 8: Procedure for treatment of fruit fly host commodities.

All commodities for export, received at the Tonga MAFFF treatment centre or Exporter Produced Shed, will be held under insect-proof screen cover while awaiting treatment (e.g. HTFA treatment & fumigation).

After treatment, the exporters' grader will carry a post- treatment inspection and grading of the produce; reject any produce that has bruises, damage or any sign of infestation from packing.

The Tonga MAF QQMD inspector after checking the post-treatment process and packing will place a "***a passed quarantine***" sticker on cartons/bins which have been cleared for export.

The Phytosanitary certificate will then be issued by the designated Tonga MAF QQMD inspector after the **"PASSED QUARANTINE"** seal is placed.

Cartons/bins can either be placed in an insect proof container or covered with an insect proof screen (NB. Ventilation holes will be covered with mesh not greater than 1.6mm)

After cartons/bins are loaded into the container (e.g. watermelon) a quarantine seal will be placed on the door.

Tonga MAF QQMD will ensure that the commodity is covered with insect proof screen when transporting from Treatment/Produce shed to the airport/port of discharge.

The Tonga MAF-QQMD officers at the airport/port of discharge will check the Phytosanitary certificate and will ensure security of the commodity until it is loaded into the aircraft/vessel.

Tonga MAF QQMD Inspectors will record the following data for each grower line.

i) Product
ii) Inspection date
iii) Grower and site(s) identification
iv) Inspector
v) Exporter
vi) Monitoring sheet numbers
vii) Number of units inspected
viii) Number of units rejected from each grower and site
ix) Total of export carton/bins
x) Pest identifications
xi) Reasons for rejections
xii) Reference to treatment records
xiii) Reference to Phytosanitary certificate

The above information will be recorded in a Book of Produce Record by Tonga MAFFF-QQMD and it will be required for auditing purpose by NZ MAF at any time.

A Senior Officer of the Extension Division will be designated as Work Plan Coordinator that shall be responsible to the Head of the Extension Division. His duties will include:

Co-ordinate and ensure work plan procedures are being followed by District Extension Officers growers and exporters.

Documentation and storage of records pertaining to the Work Plan

Liaise and establish linkage between Extension, Quarantine, Research, Growers and Exporters on matters pertaining to the Work Plan.

Source: BQA

The treatment schedules and temperature specified (Refer BQA work Plan) approved that fruit temperature raised from ambient to 47.2oC and then held for a minimum of 20 minutes for Avocado (Persica americana); Breadfruit (Artocarpus altilis); Chilli (Capsicum frtutescens); Eggplant (Solanum melongena); Mango (Mangifera indica); Tomato (Lycopersicon esculentum) and Papaya (Carica papaya).

Inspected Papaya at bin ready for treatment.

HTFA treatment Chamber.

4.4 MANAGEMENT OF THE HTFA FACILITY.

As mentioned in the background, the EPTSL was closed down in 2000, and the HTFA facility is now managed by the Tonga MAFFF. The decision for the model and type of management structure and body that will manage and oversee the running of the HTFA facility is yet to be made. The preference from donors clearly stated an Independent body from private sector to manage and operate the HTFA facility.

With the current position of the HTFA Treatment facility in Tonga, the feeling as discussed with farmers, exporters and government, indicates that people still have mixed opinions. Some support the idea of an independent body like the structure of the old 'Tonga Produce Board'. Another opinion from groups including Banks, business people, and commercial farmers is to establish a clear business structure model such as an 'Incorporate Company Limited'. That is, an independent body with preference shares and with clear amount of share capital to be stated in both memorandum and article of association. The shareholders should represent the associated stakeholders' and include both public and proprietary members who have the rights to select the Directors as governance body to oversee the whole operation.

Fiji's HTFA facilities are currently managed and operated by Nature's Way Cooperative Ltd. It is a successful model in the Pacific compared to other machine operators from other Pacific Islands, and is worthy of further examination. Unfortunately, the scope of this study did not allowed a

site visit to the Fiji's HTFA however some of the information on its successful operation was made available for the study.

The choice of the model and management structure to manage the HTFA facility will definitely have an impact on the success of this export opportunity through utilisation of HTFA treatment facility. The independent body must have a clear vision, mission and objective, be financially viable and independent to operate its service without relying on government or donors for financial assistance to support its operation. Therefore, the choice of the right model and structure is critical not only for the whole operation but for future development and expansion of the export opportunities for Tonga.

It is important for this export pathway opportunity to ensure that the machine will be operating more efficiently with no problem. The farmers, exporters, market, and consumers will all be disappointed if any problems happen with the HTFA machine that stop the export. To avoid this from happening, management of the HTFA facility needs to develop a plan on how they will operate the machine for treatment. What time and when they need the machine to be checked and tested. Who will do the checking, testing, and recertify the machine. Who will organise the spare parts for the machine and other facilities as well as doing any repair services.

In addition, the management should consider organising a standby power system like generator(s) for the treatment plant because of various power cuts due to strong wind, irregular power cut due to maintenance or power line work, etc. This issue will possibly affect the treatment facility as well as the cooling system for the inspected fresh produce ready to export.

4.5 OTHER POST-HARVEST & QUARANTINE FACILITIES.

The Director of MAFFF has confirmed the planned construction and building of new Post-harvest and Quarantine facilities in Nuku'alofa and Vava'u. These new facilities includes, building a new office, pack-house, fumigation chambers, blast freezer, cooling rooms. The new quarantine post-harvest facilities will help to reduce pests reinfestation and improved quality of fresh produces for exports.

The Director also confirmed a plan to obtain another smaller HTFA machine to cater for vegetables and smaller produce like chilli and courgettes. The government's new infrastructure development and investment plan clearly indicates their commitment and support for the sector and growers' contribution to the whole economy of Tonga.

Because this is an important investment and major economic development for Tonga's primary sector export and trade, Tonga MAFF Quarantine needs capacity strengthening.

In Tonga a designated QQMD officer as Protocol Officer will liaise with the DEO in monitoring the pathway for all fruit-fly host commodities to produce and export to New Zealand. A summary of

the export Pathway for papaya export pathway also provides key information for other fruit-fly produce to export to New Zealand.

Box 9 - Papaya (Carica papaya) Export Pathway.

1. Farmers' Registration

- Registration Declaration signed by farmer
- Farmer and farm (site) registered and map of farm submitted

2. Field Control Measures

- All husbandry inputs done accordingly to recommended (agreed) practice
- Pests and disease control programme, etc

3. Harvest

- Papaya harvested from only registered sites
- Harvest at colour break
- Field bins used to collect fruits to reduce fruit damage

4. Exporter/Packhouse

- Licensing and Packhouse Inspection
- Daily records kept for papaya supplied
- Packing house sorters sort and grade papaya for exports
- Inspection and grading done on grower lines
- Quarantine officer inspects graded papaya and issues a transfer docket (slip)
- Papaya transferred to quarantine treatment centre in field bins

5. Quarantine Treatment

- Graded papaya as per transfer docket is subjected to High Temperature Forced Air (HTFA) treatment.
- Treatment: 47.2 C for 20 minutes
- Treated papaya is packed and labeled
- Packed papaya is stored in a secure and insect proof facility at HTFA plant
- Product security is import to prevent contamination of treated product

6. Phytosanitary Certification

- Phytosanitary certificate is issue for each consignment exported (to NZ) attesting the product has been produced under this protocol
- Treatment printout is attached to the PC (but not essential)

7. Arrival Inspection and Clearance

- Documents accompanying the consignment is checked
- 600 unit sample inspection is done by NZ-MAF quarantine

• Consignment is cleared, subjected to further treatment or rejected (re-consigned or destroyed)

8. Quality Assurance

• Audit of export pathway – conducted regularly by Ministry and audit records are kept

9. Compliance and Monitoring

• On farm production – farms must comply with all phytosanitary inputs required under the protocol

• Export packhouse – will not accept papaya from unregistered farms, subject to MAFF audit and can be suspended or de-registered for non-compliance

• MAFF – regulatory authority and provides audit and phytosanitary advisory and inspection service

Source: BQA

5. MARKETING & DISTRIBUTION CHANNELS TO CONSUMERS.

5.1 INTRODUCTION.

The third component of the value chain mapping (Refer Mapping 3) focused on how the selected fresh produce be delivered along the distinct marketing and distribution channels to consumer.

5.2 TRANSPORTATION OF PRODUCE TO MARKETING CHANNELS.

With the geographical isolation of Pacific Island nations from the big markets, transport cost is a major significant issue for exporters. Transporting products, especially the fresh product, is an important issue as it will determine the competitiveness of this export opportunity in the New Zealand markets. An assessment of alternative options is important as it will affect the quality of the produce because of time involve reaching the market, and this will have a direct effect on the presentation and shelf life of the produce and hence returns to chain stakeholders.

During the field investigation and data collection, Shipping Lines were visited to discuss the normal shipping routes, schedules, freight cost, and any other options that fit well with the export of fresh fruits and vegetables to New Zealand. Discussions were focused on the direct route from and to Auckland as the destination.

The current situation with the airfreight is that only one flight a week using a large aircraft (AirNZ Boeing 767-300) leaving Auckland on Tuesday and returning on Thursday from Los Angeles (LA) via Samoa, Tonga, then Auckland. Other airlines including Air New Zealand, Pacific Blue,

Polynesian Blue, and Air Pacific are using smaller Boeing 737 aircraft with limited space for cargo. The major problem is the fact that passenger's cargoes are the first priority. Secondly, the freight cost is higher than the sea-freight. If the airfreight option is considered then exporters should start to negotiate and make a deal with the Air New Zealand for a more stable price, regular and agreed space and weight weekly.

The other freight option for transport and delivery of produce is sea-freight. It is suggested that shipping freight is the best long-term option to be considered as it will reduce the transport cost per unit. However, there are potential trade-offs with the length of shipping time and consequent reductions in quality and shelf-life.

Table 10: Freight Cost for Air Freight & Sea Freight of fresh produce.

Type of Freight:	Rate:	Volumetric Measures:
Airfreight	T$2.50-$3.00/upto 100kg	Cubic volume
Sea Freight	T$4,000.	20' Container

There are two potential options:

The normal shipping route departs Auckland for Nukualofa, Vavau, Pagopago and Apia before returning to Auckland. It is scheduled every 14 days and the time from Apia direct to Auckland is 6 to 7 days.

A second option is available where the ship can return from Apia to Nukualofa on the return route to Auckland if more than 5 containers are available. This will take between 4 – 5 days to Auckland, a significant reduction in shipping time. Additionally, the freight cost for returning back and pick more than 5 extra containers will be cheaper than the normal route. Additionally, the fruits and vegetables are still fresh, the quality is there, and their shelf-life will certainly be longer.

In contrast, transporting of fresh produce from the Philippines, Thailand and Asian countries takes between 10 to 12 days to reach Auckland.

5.3 INSPECTION OF PRODUCE ON ARRIVAL IN NEW ZEALAND.

MAF Biosecurity New Zealand will check the accompanying documentation on arrival to confirm that it reconciles with the actual consignment. MAF BNZ requires, with 95% confidence, that not more than 0.5% of the units (for capsicums, a unit is one fruit) in a consignment are infested with visually detectable quarantine pests. To achieve this, the New Zealand Ministry of Agriculture and Forestry will sample and inspect 600 units with an acceptance level of zero infested units (or equivalent), from the (homogeneous) lot.

5.4 DISTINCT MARKETING CHANNELS.

When fresh produce gets clearance from New Zealand MAFBNZ, the importer and distribution channels can pick up the consignment for delivery to the wholesalers for storage and distribution to outlets.

In the value chain mapping (Mapping 3), three distinct marketing channels were identified. All the three distinct channels are relevant for the export of fresh fruits and vegetables from Tonga.

5.4.1 TURNERS & GROWERS Ltd.

The first distinct marketing channel is the channel adopted by Turners & Growers Ltd (Refer Market Mapping 1) which is one of the biggest importer and distributor of fresh produces to their outlets such as the supermarkets, medium retailers (Fresh direct Ltd, Foodstuffs Auckland Ltd, etc), small dairies, and other outlets.

Turners & Growers also has an auction house which they promote wholesale sales through auction of fresh produce both overseas and local supplies for the local markets, food processors, Dairies, people who operate stalls on flea markets, and even individual consumers. They are also involved in exporting fresh produce overseas.

Turners & Growers operates and negotiates with suppliers and requires that all imports must comply with the New Zealand requirements on the BQA before they consider negotiation.

The information regarding the volume demanded and supplying schedule, the quality standard of the produce, the agreed price or wholesale price offer, and the timing of market entry for the supplies, etc is discussed and negotiated with the supplier and exporter.

The supplies available from local production and the supplies provided by imports are presented below on the Produce Calendar in Table 11.

The Produce Calendar (Refer Table 11) provides useful information not only on domestic production and supplies for the market but also to reorganise our production and utilise the HTFA treatment plant to match up with this export opportunity to the markets. The selected produce included in the above produce calendar also indicates the opportunity where the domestic supply runs short or relies on imports to meet the market demand.

TABLE 11: PRODUCE MARKET CALENDAR

PRODUCE;	JAN – MAR	APR – JUNE	JUL – SEPT	OCT - DEC
Bananas				
Beans				
Breadfruits				
Capsicum				
Chillies				
Coconut				
Courgettes				
Eggplant				
Ginger				
Mango				
Papaya				
Pineapple				
Rockmelon				
Sweetcorn				
Taro				
Tomato				
Watermelon				

Plentiful supply ***Short supply*** ***Imported***

5.4.2 TROPICAL FRESH Ltd (TFL).

The Distinct marketing channel Map 2 depicts the channel that is adopted by the Tropical Fresh Ltd (Market Map 2). They are the major importers, and distributors of the Pacifica fresh produce. They deliver their supplies to their outlets through out New Zealand. TFLtd started importing fresh ethnic produce to New Zealand since 1995. It continues to increase and expand imports of ethnic produce from the Pacific. Their supplies of ethnic produce mostly come from Fiji, Samoa, Solomon Islands, and Vanuatu. Other non-ethnic produces and supplies are supplied locally, Asian countries, and Australia. Their customers include major supermarkets like 'Pak n Save', 'New World', Green Groceries, Four Square, Gilmours, and corner stores.

Table 12. Fresh, Frozen & Dry Produce import by TFL. From Pacific.

Produce:	Fresh:		Frozen:
	Fruits:	Vegetables:	Root Crops:
Breadfruits			
Beans			
Banana			
Cassava			
Chilli			
Dry Coconut			

Eggplant			
Ginger			
Giant Taro			
Mango			
Papaya			
Pink Taro			
White Taro			
Yam			

Fresh & Frozen Produce demanded

The supplies of the ethnic produce especially from the Pacific countries are inconsistent and rarely fulfil their demand especially for fresh fruits and vegetables.

The Tropical Fresh Ltd like Turners & Growers must ensure that all imports must adhere to the terms and conditions specified under the BQA. The requirement to be a Suppliers of TFLtd, there are terms and conditions to understand and accept before any contract can be drawn.

5.4.3 PROGRESSIVE ENTERPRISES Ltd (PEL) & MG MARKETING Ltd (MGML).

The last distinct marketing channel to discuss is the channel that is operated by the two biggest marketing operators. That is, the Progressive Enterprises Ltd and MG Marketing Ltd (Refer Market Mapping 3). The Progressive Enterprises Ltd owns more than 150+ big Supermarkets (Foodtown, Woolworths, Countdown, Super Value, and Fresh Choice) across country. Similarly, with the MG Marketing Ltd they have their own distribution channels and outlets.

This channel is direct and straight forward pathway from the exporter to the importer and distributor to their 150+ supermarkets across country and to the customers. As indicated during the Trade mission they were interested to receive samples from the trial export of fresh produce shipment from Tonga. They both expressed their interest in chillies, courgettes, eggplant, pink taro other fresh produce such as papaya, breadfruits, watermelons, and frozen root crops and are open for further discussion. In Table 10 for Produce Calendar, all the fresh produce like chilli, eggplant, courgettes, papaya, breadfruits, watermelons, pink taro, frozen root crops, etc are clearly shown either they are short supply or rely on imports to fulfil the market demand.

During the follow up meeting with them, they are still keen to receive the trial shipment to see and assess the quality standard of the produce when it arrives in New Zealand before any further discussion.

TABLE.13. FRESH FRUITS & VEGIES AND FROZEN ROOT CROPS IMPORT by PEL & MGML.

Produce:	Fresh:		Frozen:
	Progressive Enterprise. Ltd.	MG Marketing Ltd	
Breadfruit			
Courgettes			
Eggplant			
Chilli			
Papaya			
Watermelon			
Pink & White Taro			
Yams			

Fresh or frozen Produce demanded

The above supplies are mostly imported from overseas suppliers including Pacific countries as indicated in Tables 14 and 15. However, the supplies are often inconsistent and inadequate to meet the market demand.

Table. 14 Total Papaya Imports to NZ from all countries.

Country:	Jan - Dec 2006			Jan - Dec 2007			Jan - Dec 2008		
	Qty (kg)	CIF. (NZ$)	VFD. (NZ$)	Qty. (kg)	CIF. (NZ$)	VFD. (NZ$)	Qty (kg)	CIF. (NZ$)	VFD. (NZ$)
Australia	3,488	13,138	9,541	8,498	27,483	21,751	864	2,442	2,262
Cook Is	93,364	223,909	110,428	42,891	150,391	96,158	9,239	37,642	22,853
Fiji	279,849	814,773	519,559	206,208	625,025	415,224	224,792	700,718	424,844
NZ	1,400	5,611	4,142	0	0	0	0	0	0
Philippines	508,674	1,152,346	1,067,529	557,221	1,222,116	1,139,359	656,639	1,734,142	1,614,033
Samoa	5,382	29,940	20,928	0	0	0	434	1,334	638
Taiwan	0	0	0	0	0	0	434	1,334	638
Thailand	82,047	206,443	197,770	59,406	176,367	170,218	0	0	0
All Countries	968,822	2,416,220	1,908,969	874,224	2,201,382	1,842,710	892,008	2,476,412	2,064,746

Source: Statistics New Zealand. (CIF – Cost insurance and freight; VFD – Value for Duty, i.e. the value of imports before insurance and freight costs are added).

Table 14 shows Philippines and Fiji are the major suppliers of papaya to New Zealand all in quantity, CIF, and VFD value over the past three (3) years. Both countries produce and export 99% (Fiji export 25% while Philippines export 74%) of total papaya supplies to the New Zealand market. Despite the big volume they produce and export, a Naturesway Cooperatives (Fiji) Ltd report on 'Improving market services for Fiji Fruit & Vegetable export' shows that the overall achievement on market demand and supply, for eggplant they achieved only 66%, papaya they achieved only 47%, mango they achieved 66%, and breadfruit they achieved 0%.

Table. 15: Total Eggplant Imports to NZ from all countries.

Country:	Jan - Dec 2006			Jan - Dec 2007			Jan - Dec 2008		
	Qty (kg)	**CIF. (NZ$)**	**VFD. (NZ$)**	**Qty. (kg)**	**CIF. (NZ$)**	**VFD. (NZ$)**	**Qty (kg)**	**CIF. (NZ$)**	**VFD. (NZ$)**
Australia	800	6,177	5,148	0	0	0	0	0	0
Fiji	441,201	1,060,680	642,107	461,043	1,214,773	773,042	383,615	1,108,023	723,309
Japan	250	2,984	2,872	0	0	0	60	501	483
New Caledonia	4,263	18,978	9,069	5,587	25,021	14,853	15,211	63,886	32,617
New Zealand	2,146	5,572	3,066	0	0	0	0	0	0
All countries	**448,031**	**1,088,557**	**657,239**	**466,673**	**1,240,068**	**788,044**	**398,979**	**1,173,121**	**757,041**

Source: Statistics New Zealand.

Table. 16: Summary of Total Breadfruits & Chilli imported to New Zealand (2007/2008)

Produce:	Quantity of Total Imported: In (MT)	Major Suppliers:
Breadfruit	**35**	**Samoa (98%) Tonga (1.1)**
Chilli	**68**	**Fiji (99.4%), Cook Is (0.4%)**

Source: MAFBNZ QuanCargo.

Tables 14 to 16 show all the main competitors as well as their volume of export for the four (4) selected products. The Produce Calendar (Table 11) together with the imports figures shown on Table 14 - 16 certainly help in Tonga's production planning on timing, type of fresh produce to plant and export. However, further information on the timing of market entry for each of the above products from the competitors is also needed as an input to the production plan.

The average prices for the selected produce at most retail outlets are shown at Table 17. The major reasons why the fresh produce prices varied is because most or all are imported.

Table 17. Retail Outlet's prices for the selected produce.

Produce:	Long purple. NZ$	Black beauty & Lista de Gandia. NZ$	Red Cannayne. NZ$	Sunrise. NZ$	Waimanalo. NZ$	Breadfruit. NZ$
Eggplant	6.00-7.00/kg	5.00-6.00/each				
Chilli			4.0-6.0/bag			
Papaya				6.0–7.00 each	5.00-7.00 each	
Breadfruit						6.00-7.00 each

6. CONCLUSIONS AND SUMMARY OF FINDINGS.

Typically, the aim of taking a Value Chain Approach is to facilitate analysis and understanding of all major constraints such as to identify where improvements in performance and competitiveness from the production to the market and consumers can be made.

For this study different Mappings were developed (Refer Mapping 1 – 3 & Appendix 1) to help identify and link key chains and interrelated activities from the initial idea of utilising the HTFA facility to production and along the chain to the market.

Map 1 starts with the process of registration of growers to allow to plant and export fruit-fly host commodities to New Zealand.

The roles and activities for those farm enterprises that are involved includes the registration of growers, selection of production site, on farm production, supplying inputs, planting, and field control up to harvesting. There are issues and constraints identified on each key activity along the chain that need to be resolved. However, it is very important for those enterprises such as Growers organisations and their farmers; MAFFF Extension Div; Research and MAFFF Quarantine to work closely to discuss and consult on various issue and constraints to see how to address it. Each activity identified has a procedure to follow as per BQA starting from the registration to the market.

Most of the prices for the production inputs have been increase rapidly such as papaya seeds and it's a major cost contribution to production. Suppliers need to search through their overseas suppliers for reasonable quality low cost inputs.

The production activities are vital and key for the long-term securing of the market opportunity. Because there is a real concern that the HTFA facility may not be used to full capacity, a

production plan on the field activities needs to be developed outlining the key objectives and key targets to implement, monitor, and ensure it is achieved. For example at initial planting (and phase planting) how many growers to involve, number of acres to plant, field control methods, expected yield to supply per week, month, and year. The objective is to ensure that production will provide consistently supply to meet the market demand.

In addition, key vital activities associated with the recommended practices of production, i.e. prior to planting, actual planting, field control measures to harvesting, all need to be implemented effectively. The monitoring of these activities to ensure it adheres to the work plan is vital to ensure that the production is well under control. Both Exporter and Extension Officer need to train the growers on the right time for harvesting as per WP. Exporter, growers and Extension training and dissemination of information is vital to alleviate the issues, threats and risks regarding production to harvesting.

During the field investigation and data collection, the issue of data availability was identified as a major problem. It is important that all production data should be collected, recorded, save and updated regularly especially the technical information, (i.e. spacing, inputs applied, yields/acre, production costs, prices, and income). In addition, the relevant export data including the total yields, percentage of rejection and cause, export yields, percent of fulfilment of market demand transportation costs, etc. Also the operation costs for the HTFA treatment service needs to be determined.

The growers' organisations (Growers Federation; Growers Council; etc), exporters, MAFFF Extension officers, and Quarantine staff need to work together with the farmers to ensure that: production and yields increase, plan on phase planting to implement every 6 months to ensure consistent supply, reduce percent of rejection, improve quality standard, and improve percent of market demand fulfilment. Here there is a need for capacity strengthening in all segments of activities. In addition, every stakeholder needs to record their performance data/ information from their inter-related activities.

Although limited by data availability, the gross margin analyses indicate that the products can be profitably exported, but that returns are critically dependent upon the final price and yield obtained.

There was also concern and need from farmers to pay them at farm gate or as soon as the shipment leaves Tonga. This is an incentive for the farmers' production to ensure consistent managing their farm and supplying their produce for export.

Under Mapping 2, the export related activities were considered. The current status of the HTFA treatment machine is working well during this trial test run. The recertification and audit of the machine is expected to be done soon. Because the managing and overseeing the HTFA machine is still with Tonga MAFFF, it is important for government to decide soon who will manage and

oversee the operation of the facility. There are a few options of business model and structure suggested to consider in their decision for the appropriate independent body to manage and run the HTFA operation.

Improvement of the capability and capacity of relevant staff that will work directly with stakeholders in this programme is crucial. Firstly, is the capacity strengthening of the Quarantine officers through training to obtain the skills and experiences especially in monitoring the compliances requirement according to MAFBNZ agreement. Secondly, is the capacity strengthening of Extension officers through trainings to achieve knowledge and skills in farm production. Thirdly, is the issue of having a smaller chamber HTFA machine to cater for small vegetables such as chilli, tomatoes, eggplant (long purple). Lastly, is to ensure that the current HTFA machine is well maintained to avoid any major technical break down as this will affect the level of export.

The means for transporting and delivering the export produce to the market is another major cost contribution factor that may cause low return to the organisation and farmers and it contributes to a competitive disadvantage. The Airfreight option is a very costly option for the fresh produce export from Tonga. Despite its importance for produce freshness and shelf life which is enhanced by speedier passage through the supply chain, the cost factor will play a major effect.

The other option is the shipping freight, where it is suggested that this may be the option most suitable for the future when full production is on as it requires five or more extra containers (20') for each time the ship return back.

Exporters need to follow up and keep dialogue with both airlines and shipping lines on what is best for the export. The exporters need to keep communicate with the market (wholesalers/importers) on order fulfillment in terms of timing; supply volume demanded; required quality standard; projected future market demand; what will be the purchase price; and other market information and data on what needs to improve.

A third component of the mapping involves the marketing channels in New Zealand. The marketing interrelated activities including wholesalers, importers, and the distribution channels up to the consumer are vital to the whole fresh fruits export opportunities for Tonga. The three distinct marketing channels as shown on market mapping each expressed of their interest to receive export trial consignments to assess the quality of the fresh produce. As shown in the Produce calendar, the supply for several fresh produce and frozen produce are available all year round but the most important key factor is the quality of the produce available to sell in the market.

The future of this export opportunity through the utilisation of the HTFA facility depends on how effectively each chain component is performing its key activities. Improvements can be achieved through clear understanding of their key roles and the importance of developing good relationships along the chain. It is through these activities that each enterprise has an opportunity to generate a superior value while at the same time secure the position of our supply to the market.

7. RECOMMENDATIONS.

Based on the results of the analysis using the value chain approach for utilising the HTFA facility to expand export opportunity of fresh produce to the market, our field investigation, information and data collection, we conclude and recommend the following activities for consideration and for further action:

I. **Availability of Data & Information**: A key difficulty in both analysing the constraints and potential solutions along the chain, and facing stakeholders in planning chain activities, is the lack and huge data and information gaps starting from key production data and costs; Horticulture research trials data including production parameters, yields, phase planting, etc; Extension Divisions' data and information on production procedures; local markets and export trade data; collect variable data regularly to update Gross margin analysis; as well as data/information from the Quarantine including HTFA operation and treatment costs. It is very important to establish a Centralised Database at MAFFF Head Office to collate all relevant production data, trade data/info from all MAFFFs' Divisions, analyse, update and save at the Central Database.

II. **Growers Registration**: A mechanism should be established whereby the Extension Division and Growers Organisations Exporter can explain clearly to the growers the purpose of registration process since they must understand the requirement to complete the application forms and must adhere to terms and conditions of the work plan as discussed.

III. **Production inputs**: The prices of agricultural inputs are increasing rapidly and affecting the overall production costs. Suppliers of agricultural inputs need to search for more information on quality low cost inputs especially for quality papaya seeds from various sources including the University of Hawaii.

IV. **On Farm Production & development**: Each growers' organisation and exporters needs to register their growers and develop a production plan/program with a strategy on each export crop production specifying key activities such as production and promotion; establishing a target planting acreages per

grower/produce for export; establishing field control measures (e.g. fruit-fly spray and crop protection); and specify clearly the market supply with required yields per week, month, and year. It is also suggested that a phase planting programme be established to ensure consistent market supply, a proposed schedule for treatment of their produce with the HTFA machine be submitted to the HFTA management body to avoid congestion.

V. **Training & dissemination of information**: MAFFF Research division should help farmers through training, developing production materials and dissemination of scientific information especially on production and any problems like seed purity, time for fertiliser applications, pests and diseases occurrences and intercept. Both Extension and Quarantine officers should help farmers through training to reduce the percentage of crops rejection and waste; controlling pests and diseases; and compliance with the BQA.

VI. **Capacity strengthening**: The capacity of Extension officers should be strengthened through training to help growers with monitoring their production, improvement of yields, quality through adoption of good farming practice, and dissemination of production information such as production leaflets and trainings. Also to strengthen the capacity of the Quarantine officers in terms of improving their skills and experience to improve their performance in monitoring the biosecurity tasks right from production to treatment and to ensure all export activities must comply with the export requirement and BQA agreement.

VII. **Independent Body to manage HTFA Facility**: The choice of the model and management structure to manage the HTFA facility will definitely have a direct impact on the success or failure of this export opportunity through utilisation of the HTFA treatment facility. The establishment of an independent body should be financially viable and independent to operate its service without relying on government for financial support of the operation, apart from the initial working capital outlay. Therefore, the choice of the right model and structure is critical not only for the whole operation but for future development and expansion of export opportunities for Tonga.

VIII. **Study on Fiji's HTFA facility**: In relation to point VII, as government has not yet established a company or independent body to manage and oversee the HTFA facility, it is recommend that a comprehensive study on the Nature's Way Cooperative (Fiji) Ltd is undertaken, focussing on their business model, management structure and how they operate. This will be relevant and useful for government's decision on the right model to adopt.

IX. **Exporter's responsibility**: All exporters need to register to export fresh fruit-fly produce to New Zealand. They need to comply with Work Plan also to negotiate with importers/wholesalers in regards to advance ordering system, the volume of supply, timing of market entry, required quality standard, and purchase price. They need to continue negotiate with the transport agents (Airlines and Shipping Lines) regarding shipping schedule, available spacing and freight cost, and the important to keep communicate with the market on ways to improve.

X. **Develop payment option**: The exporters involved in exporting of fresh fruit-fly host commodities should consider and decide a system where they will be able to pay their growers at farm gate or after the shipment leaves Tonga. This is an incentive that will ensure continued commitments from their growers for the production also to eliminate the concern on inconsistency of supply to the market.

XI. **Important Linkages**: In securing the market and marketing channels and securing the trust of the growers are two different chains in this export program. Both parties (growers and exporters) must secure agreement in a form of contract and understanding the need in order to function effectively and efficiently for the long-run. The issue of production without securing a market or vice-versa poses threats and risks to production and export. The two different activities must be coordinated and understood to secure the linkage and developing the trust and good relationship are the key.

XII. **Quality Assurance & TQM**: Growers, MAFFF extension staff, QQMD, Exporter must ensure that quality aspect of all fresh produce for export reaches the required quality standard of the market and should be able to hold and present in the shelves for at least 5 days. Therefore M&E of adoption practices and continuous improvement program for Extension staff and growers involve in production and farm management need to understand the recommended practices. MAFFF Extension and Exporters should develop its own total quality management system in line with the fresh produce export program with detail procedures standardise to govern the quality production and handling.

XIII. **Future Development**: More consultation needs to be done between stakeholders including: government, farmers, exporters, and relevant stakeholders to assess and evaluate performance, discuss issue(s) and ways to resolve, and how to improve performance for a better result. Through regular consultation process we

may be able to make good constructive decisions to improve and shape our competitive advantage against rivalry; our economy; our future; and our life.

XIV. **The new commodity pathway approach**: has create awareness amongst farmers, exporters, government, businesses, and, market about the importance of crop management and post-harvest handling when producing for the export market with the obligations under the BQA. Discussion on future option for new export opportunity like the semi-process pathway for fruit-fly host commodities to overseas market is an option that may help to resolve issues on biosecurity, issues on fresh produce quality, high transportation costs, etc. Benefit from this new pathway includes additional economic gain from increases in commodity exports.

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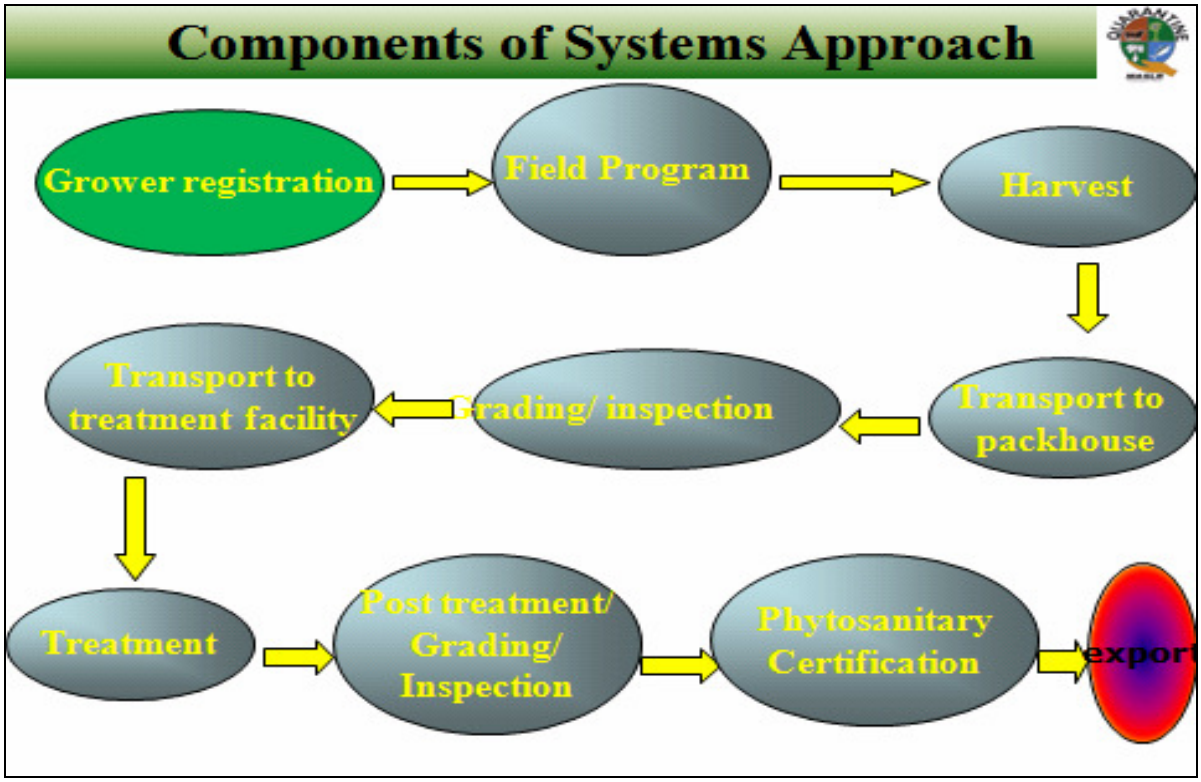
APPENDIX. 1: Mapping of Major Components of Systems Approach.



APPENDIX. 2.1 Suppliers of Production Inputs Questionnaire.

1.1 SUPPLIERS of RAW MATERIALS & PRODUCTION INPUTS.

a) Suppliers and Farmers relation:

- Who are your current key people & customers?
  Old ☐ New ☐ Both ☐

- Does the business work closely with farmers regarding how they operate, specifically with their input demands, volume, and time, etc?
  Yes ☐ No ☐
- Do you know your customers/farmers well and have good relationship with them? Yes ☐ No ☐

b) Scheduling of orders for production inputs and Stock

- Do you have regular suppliers of your production inputs?
  Yes ☐ No ☐

- If you decide to involve with this HTFA export project, do you know your likely new customers, their required production inputs, the planting time, etc.
  Yes ☐ No ☐

- What will be your plan when & where you're placing orders for those inputs, the volume, price, etc?
  Current Supplier ☐ Search new Supplier ☐

- What is your normal schedule & time for ordering those agricultural inputs?
  < One month ☐ > One month ☐

- Do you consider the possibility of seasonal recurring planting?
  Yes ☐ No ☐
- Do you normally have stock in place to accommodate any urgent and unplanned demand?
  Yes ☐ No ☐

- How flexible is the business to accommodate unplanned orders? Are you able to make impromptu express orders?
  Yes ☐ No ☐

- Do you normally have enough stock for other agricultural inputs demanded by growers? Yes ☐ No ☐
- With the papaya seedlings and breadfruit planting materials, are you interested in developing nurseries with different varieties?
  Yes ☐ No ☐

- Did you have some survey or data/information collected from your customers regarding any particular information or any feedback on volume, seed variety, timing of their orders, pricing, etc?
  Yes ☐ No ☐

- Does the business follow farmers' planting schedule, season, or by any other indicators?
  Yes ☐ No ☐

APPENDIX.2.2. Growers Questionnare

2.1 GROWERS

a) Pre-Cultivation periods

- How do you plan & decide for what crops to plant and when?
  Base on income return. ☐ Base on family needs. ☐
- What sort of information you need for your production plan?
  Finance ☐ Land ☐ Other ☐
- Do you work closely with any organisations to guide you with what to plant, when, why, and how to do it?
  Yes ☐ No ☐
- What is your plan and target market(s)?
  Local Markets: Overseas Markets: Local & Overseas Markets:
  ☐ ☐ ☐
- Do you have a supplier of inputs to work with?
  Yes No
- Do you prepare your own nurseries or purchase seedlings from a commercial nursery?
  Yes No
- Do you have the knowledge and expertise in preparing your own nurseries?
  Yes No

b) Farm Management

- Is your farm a family farm or commercial?
  Family Commercial
- What time do you need for your land preparation?
  <One month >one month
- What do you needs to be ascertained before planting? (Land? Labour? Finances? Resources?)

- Do you have any program or plan when it comes to managing your own farm? (fertilisation, disease & pest-control, weeding, etc)
  Yes No

- Do you use family labour or hire labourers or both?
  Family Lab Hire Lab. Both

- How do you know that your plots are well managed to produce higher yield?
  Yields. Growth. Other

- Do you need some technical assistance and advice on crop management?
  Yes No

c) Yields and Production

- What is your average (in %) total yield/acre?
  Papaya: Eggplants: Chilli: breadfruits:

- What is your average marketable yield/acre?
  Papaya: Eggplants: Chilli: Breadfruits:

- What is the local price per kg/produce?
  Papaya: Eggplants: Chilli: Breadfruits:

- Is there any agreed gate price or exportable price per kg for your different produce?
  Yes. No.

- Do you have some estimate of the farm expenses?
  Yes. No.

- Do you receive good return from your farm income?
  Yes. No.

- Does your gross margin/acre for other produce gives good return?
  Yes. No.

d) Barriers/risks experienced

- What are some setbacks or barriers that you foresee during land preparation, actual planting, during cultivation periods, or during harvesting?
  Weather. Finance. Other.

- How do you deal with these difficulties?. Can you resolve it?
  Yes. No.

- Is the climate change and current weather patterns is a threat and risk for the production? Yes . No.
- How much damage (in %) did climate change and weather had affected your fresh fruits, veggies and other produce? How are you going to deal with it?
  < 50% > 50%

- Any other risks that you growers could face or anticipate?
  Yes . No.

e) Growers-Exporter Relations

- Do you think exporting of your fresh fruits and veggies should be done thru one exporter or more exporters and why?
  One exporter. More exporters.

- How do you choose the exporter to work with?

- Do you have good relationship with your exporter and how that relationship maintained?
  Yes . No.

- Do you want to have a contract or an agreement with your exporter?
  Yes. No.

- What are the conditions of the contract or agreement do you want to include?
  Transparent. Other.

- What sort of pricing and payment system do you prefer?
  Gate price & after shipment. High after market sales.

- Do you prefer payment after delivery or wait for an agreed period with the exporter?

  After delivery. Wait for agreed time.

APPENDIX.2.3. Exporter Questionnaire

a) Exporter-Grower relations

- Who are your registered growers that you service?
  Own growers. own plus anyone.

- How many and from what district?
  Don't know. All districts. Other.

- Do you have any contract or agreement with them?
  Yes. No.
- What are the conditions?

- How are your relationships with your growers like?
  Excellence. Good. Nor Good.

o Does your grower have any influence with the pricing system? If yes. What level of involvement do growers have?
  Yes. No.

b) Pricing, Estimates and Payments

- How are your prices set and determined?

- What is the estimated gross income per acre for the growers?

- How are your growers paid?

- Is there any agreed payment time and/or have a plan on the agreed payment time?

c) Exporter- Market Relations.

- Have you established and start negotiating with any Importer and Marketing agents?
  Yes. No.
- What kind of produce, volume that you plan to export and on what time?

- Have you agreed or discussed any likely price/kg per produce?
  Yes. No.

d) General Questions

- How are the produce exported? What are the chosen delivery channels and why? Any other channel?

- Do you have any relations with other exporters? Do they have any influence on how the prices are set and managed?

  Yes. No.

- What is competition like with other exporters?

- Do you have good relations with the HTFA facility operator? If not, why?

- Any barriers or risks with that relation?

e) Future Outlook

- Any suggestions on how things can be improved, if need to be? Any specific areas of concern?

- How is the exporting delivery channel at the moment?

- Any future proposals? Between air-freight and sea-freight what is the most cost-effective choice?

- What will be the chosen channel in the long run?

- What other markets would you consider and wishes to explore and export to?

APPENDIX.3.1: The Tonga Ministry of Agriculture Food & Forestry Work Plan For The Export of Fruit Fly Host Commodities.

Procedures for Registration of Growers to Export Fruit Fly Host Commodities from Tonga to New Zealand.

1. The registration and re-registration growers is the responsibility of the Director of MAF who has designate the MAF Head of Extension Division to carry out this task
2. All registration of growers must be done for each commodity before planting
3. The duration of the registration is valid only to the end of the calendar year.
4. The growers must apply for registration to MAF Head of Extension, using the prescribed From No. G1.
5. A designated District Extension Officer will assist growers in filling out the application Form, visit and assess suitability of site, description and mapping of the growing sites and inform the growers of the terms of the Work Plan.
6. The growers must sign Agreement Form No. G2 and submit it together with the application Form No. G1 form to the MAF-Head of Extension Division for consideration.
7. The MAF-Head of Extension Division shall register approved grower in writing, indicating the growers registration number for each respective commodity.
8. During the production season, the designated extension officer will visit the growers fields several times and record activities in the monitoring sheet, e.g. planting date, area, spray programme, fertilizer rates etc.
9. During production season, the designated District Extension Officer will monitor the grower's adherence to the requirements of the Work Plan. In the event of non adherence, the designated Extension Officer will advice the MAF Head of Extension Division who has the authority to de-register the grower. The grower can be re-registered if the Work Plan conditions can be met again.

Form No. G.1

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD GROWERS APPLICATION FORM FOR THE PRODUCTION FRUIT FLY HOST COMMODITIES FOR THE EXPORT FROM TONGA TO NEW ZEALAND.

To:
MAF Head of Extension
P.O. Box 14
Nuku'alofa
Name of Application: _____Date: _____
Address: _____
Location of production Area:_____
I herewith apply for registration to produce the following fruit fly host commodities for export to New Zealand.
Type(s) of crop: Acreage: Expected Export Yield:
_____ _____ _____
_____ _____ _____
_____ _____ _____
Total _____ _____
Expected time of planting _____
Expected time of harvest: _____
Name of Exporter: _____
Signature of Application: _____
Description and map showing the location growing sites:

For official use only:
Date of first site inspection: _____ Date of Approval:_____
Remarks: _____

Farmers Registration No. _____Site Code No: _____

_____ (Signature)
_____ (PRINT NAME)
Name of Extension Officer

…….
HEAD OF EXTENSION DIVISION

Form No. G.2

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD
GROWER'S AGREEMENT TO COMPLY WITH THE WORK PLANS TO EXPORT FRUIT FLY HOST COMMODITIES FROM TONGA TO NEW ZEALAND

I,_____ of _____ Understand and agree to adhere to the terms of the Work Plans and Procedures for the exportation of Fruit Fly host commodities from Tonga to New Zealand.

Date: _____ Signature: _____

Name of Applicant: _____

Form No G.3

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD
GROWER'S REGISTRATION FOR THE PRODUCTION OF FRUIT FLY HOST COMMODITIES FOR EXPORT FROM TONGA TO NEW ZEALAND

Date: _____

Dear _____

I would like to inform you that your application has been approved. You are now officially registered to grow the following Fruit Fly host commodities for the export to New Zealand:
Your registration number is GR No. _____

Your Site Code No. is _____
Location of Production Area _____
This registration is valid from _____ until the end of the calendar year 20_____

You are required to apply every year for renewal of this registration.
You are expected to adhere to the terms of the Work Plans. Non adherence to these conditions may lead to your de-registration.

Yours Sincerely,
MAF Head of Extension Division

APPENDIX. 3.2: Procedures for Registration of Exporters to Export Fruit Fly Host Commodities from Tonga to New Zealand

All exporters intending to export Fruit Fly Host commodities to New Zealand must be registered by MAF Tonga.

1. The registration and de-registration of exporters is the responsibility of the Director of MAF who has designated the Head of Quarantine and Quality Management Division to carry out this task.

2. The exporter must apply for registration using application Form No. E.1.

3. The exporter must also sign the Exporter Agreement Form No. E.2. this is assurance of his agreement to adhere to the terms of the Work Plan.

4. The designated QQMD Officer will assist the exporters in filling out the application Form No. E.1 assess the suitability of facilities for inspection, packaging, and storage and to ensure that the application has the following documents:

   i. Valid export license from the Ministry of Labour, Commerce and Industries
   ii. MAF-Export Application Form No. E.1
   iii. MAF-Export Agreement Form No. E.2

5. The designated QQMD Officer will inspect the exporter's facilities. The minimum requirements for registration will be:

   - Suitable building and facilities for grading, inspection, packing and storage of commodities.
   - Building should have concrete floor, sound roof and adequate ventilation.
   - Building should have adequate light and lighting for grading and inspection
   - Building should have adequate water supply.

6. The documents must be submitted to the Head of Quarantine and Quality Management Division for consideration.

7. The Head of Quarantine and Quality Management Division shall register approved exporter's in writing (refer from Form No.E.3) indicating the exporter's registration number and the list of commodities and the Work Plan pathways they are approved to export under. The registration is valid up to the end of the calendar year.

8. Registered exporters will accept only quality fruit for export to New Zealand from registered growers. No adherence to this will result in immediate deregistration.

9. The Head of Quarantine and Quality Management Division may de-register any exporter's if they do not comply with the term of the Work Plan and Procedures.

10. These procedures will be used for both Work Plans A and D.

Form No. E.1

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD EXPORTER'S APPLICATION FORM FOR THE EXPORTATION OF FRUIT FLY HOST COMMITIES FROM TONGA TO NEW ZEALAND

MAF Head of Quarantine and Quality Management Division
P.O. Box 14
Nuku'alofa.
Name of Applicant:_____Date_____
Address: _____
_____
Location of Packing/Storage/Inspection Facilities _____
_____

I herewith apply for registration to export the following fruit fly host commodities to New Zealand.

Type (s) of crop _____
_____
_____
Expected time to export_____

Market in New Zealand _____
(give all necessary details of the market establishment in New Zealand)

Signature of Applicant
For official use only

Date of visit to the Export's Premises _____Date of Approval_____
Exporter's Reg. No. _____
Remarks_____
_____

_____ (Signature)
_____ (PRINT NAME)
Name of QQMD Inspector.

……..
HEAD OF QUARANTINE & QUALITY MANAGEMENT DIVISION

Form No. E.2

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD EXPORTER'S AGREEMENT TO COMPLY WITH THE WORK PLANS TO EXPORT FRUIT FLY HOST COMMODITIES FROM TONGA TO NEW ZEALAND

I, _____on behalf of_____

Understand and agree to adhere to the terms of the Work Plans and Procedures for the export of Fruit Fly host commodities from Tonga to New Zealand.

Date_____ Signature_____

Form No.E.3

TONGA MINISTRY OF AGRICULTURE, FORESTRY AND FOOD EXPORTER'S AND PACKHOUSE'S REGISTRATION FOR THE EXPORT OF FRUIT FLY HOST COMMODITIES FROM TONGA TO NEW ZEALAND

Date _____

Dear_____

I am glad to inform your application has been approved. You are now officially registered to export the following Fruit Fly host commodities from Tonga to New Zealand:

Your Registration number is ER No. _____

Your Packhouse Registration number is PR No. _____

This registration is valid from _____until the end of the calendar year 20____.

You are required to apply every year for renewal of this registration. You are required to apply to adhere to the terms of the Work Plans. Non adherence to these conditions may lead to your deregistration.

Yours Sincerely,

_____

MAF-Head of Quarantine& Quality Management Division.

APPENDIX.3.3: Procedures for Harvest and Inspection of Fruit Fly Host Commodities for Export from Tonga to New Zealand

Work Plan A and D (100% Inspection)

These harvest and inspection procedures apply only to those crops listed in Work Plan A and D.

1. Registered grower will only harvest produce for export to New Zealand that has been grown at a registered site (s) and which has been subject to field control measures described in this workplan. Only sound fruit will be harvested and forwarded to packhouses for grading and packing.

2. All produce will be loaded and transported in such a manner as to ensure freedom from bruising, cracking and possible pest infestation. Transportation will be direct to the packhouse.

3. The growers will be responsible for unloading the produce on arrival at the packhouse and this must be done in such a manner so as to ensure freedom from bruising and cracking.

4. Growers must provided the required copies of the monitoring sheet to both the Exporter's and to the designated MAF-QQMD Inspector before the commodities can be cleared for grading and inspection.
5. It is the responsibility of the exporter to carry out the grading and full initial inspection of the commodities.

- The Exporter's Graders will inspect every individual fruit (100%) for the presence of fruit fly egg, larvae and pupae (and the signs of such presence including; bruising soft spots, cracks, skin punctures, insect infestation etc.) and reject such produce for export to New Zealand.
- Infestation by other actionable pests will also result in the rejection of such produce for export to New Zealand.
- All traces of soil will be removed.

6. All grading and packing will be carried out in a packhouse registered by Tonga MAF.

7. Tonga MAF-QQMD will inspect all units of produce (100%) on a grower lot basis, presented by a registered grower for export to New Zealand. Any unit found to be infested with fruit fly and or other quarantine pests will be rejected for export to New Zealand. Tonga MAF –QQMD will also reject unsound produce or produce in any other condition that may have fruit fly infestation.
8. Grower lots infested with fruit fly are to be rejected from the consignment, the grower suspended and trace back audit carried as per the section 4.5 of the Work Plan.

9. Grower lots passed inspection by Tonga MAF will be packed by Exporter. All cartons/bins will be identified by monitoring sheet number which will be written on each carton/bin. A seal "Passed Quarantine" will also be placed on the carton/bin.

10. After sealing, the carton/bin by Tonga MAF-QQMD Inspector the commodity will be covered with an insect proof screen.

11. The exporter shall be responsible for the transportation of the inspected commodity from the pack house to the MAF post treatment center, either at the Queen Salote Wharf or the Fua'amotu Airport. The commodities must be transported under cover with an insect proof screen.

12. Tonga MAF QQMD Inspectors will record the following for each grower line.

- Product
- Inspection date
- Grower and site(s) identification
- Inspector
- Exporter
- Monitoring sheet numbers
- Number of units inspected
- Number of units rejected from each grower and site
- Total of export carton/bins
- Pest identifications
- Reasons for rejections
- Reference to treatment records
- Reference to Phytosanitary certificate

These will be recorded in the Book of record produce by Tonga MAF-QQMD and it will be required for auditing purpose by NZ MAF at any time.

All cartons/bins will be identified by the monitoring sheet number which will be written on each cartons/bin.

APPENDIX 3.4: Procedure for Post Treatment Security for the Exportation of Fruit Fly Host Commodities from Tonga to New Zealand

Procedures.

1. All fruit fly host commodities must be treated according to the prescribed treatment in the Work Plan.

2. All commodities for export, received at the Tonga MAF or Exporter Produced Shed, will be held under insect-proof screen cover while awaiting treatment (e.g. fumigation).

3. After treatment, the Tonga MAF QQMD inspector will place a "a passed quarantine" sticker on cartons/bins which have been cleared for export.

4. The Phytosanitary certificate will be issued by the designated Tonga MAF QQMD inspector after the "PASSED QUARNTINE" seal is placed.

5. Cartons/bins can either be placed in an insect proof container or covered with an insect proof screen (NB. Ventilation holes will be covered with mesh not greater than 1.6mm)

6. After cartons/bins are loaded into the container (e.g. watermelon) a quarantine seal will be placed on the door.

7. Tonga MAF QQMD will ensure that the commodity is covered with insect proof screen when transporting from Treatment/Produce shed to the airport/port of discharge.

8. If the exporter is transporting the commodity to the Airport, Airport Staff will be informed by Quarantine Staff at the Airport will ensure that the commodity will be under insect proof cover until produce is loaded onto the aircraft

9. The Tonga MAF-QQMD officers at the airport/port of discharge will check the Phytosanitary certificate and will ensure security of the commodity until it is loaded into the aircraft/vessel

10. The grower must obtain two copies of the Monitor Sheet from the designated MAF Extension Officer for submission to the exporter and to MAF QQMD. Produce without a monitoring sheet cannot be accepted for export.

11. A Senior Officer of the Extension Division will be designated as Work Plan Coordinator that shall be responsible to the Head of the Extension Division. His duties will include:

    - Co-ordinate and ensure work plan procedures are being followed by District Extension Officers growers and exporters.
    - Documentation and storage of records pertaining to the Work Plan
    - Liaise and establish linkage between Extension, Quarantine, Research, Growers and Exporters on matters pertaining to the Work Plan.

APPENDIX. 4.1. Eggplant Leaflet.

FOUNGA HO TO ‘O E NGOUE PAINGANI- (Eggplants)

Talateu (Introduction)

‘Oku famili tatau ‘a e paingani mo e ngaahi vesitapolo hange ko e temata, polo mo e pateta. ‘Oku ‘i ai ‘a e kalasi ‘oku fuololoa pe mo fuopotopoto hono fua. ‘Oku lanu kulokula fakapopo’uli, lanu valeti pea ‘uli’uli ‘a e fua ‘o e paingani. Neongo ‘oku ‘ikai fu’u manakoa fefe ‘e he kakai Tonga ‘a e ‘akau ni ka ‘oku ‘i ai hono kaha’u lelei ‘aupito ‘i he maketi tautefito ki Nu’usila.

Taimi to (Planting Time).

Ko e paingani ‘e lava pe ‘o to ha fa’ahinga taimi pe ‘o e ta’u. Ka ko e fa’ahi ta’u lelei taha ko Ma’asi ki ‘Aokosi.

Fa’ahinga ke to (Variety)

Ko e fa’ahinga ‘eni ke to he ‘oku fiema’u ‘e he maketi Nu’usila.

Fa’ahiga ke uta ki Nu’usila (Export variety to New Zealand)	***Lanu***	***Fuo***
Black beauty	Valeti fakapopo’uli	Fuopotopoto
Kalasi ‘oku kau ki he Long Purple	Valeti	Fuololoa

Large fruits,elongated. Eggshaped and pear shape varieties



Teuteu e kelekele (Land Preparation and Spacing)

Palau ke toka malie pea fahi fute ‘e 5.

Teuteu’i e pulopula (Preparation of Nursery)

‘Oku lulu ‘a e tenga’i paingani ‘i he mohenga ‘akau pe fanga ki’i pelesitiki ‘uli’uli kuo fakafonu kelekele pea toki fakalanga ‘o to ‘i he hili ha uike ‘e 4 – 6.

Vaha ‘i hono to (Spacing)

‘Otu ki he ‘otu (fute) (between rows)	*Fu’u ‘akau ki he fu’u ‘akau ‘i he ‘otu (fute) (between plants)*
5’	2’

Fafanga ‘o e kelekele (Fertiliser)

Fa’ahinga ‘o e fafanga	*Lahi ‘o e fafanga ke laku*	*Feitu’u ke laku ai*	*Taimi ke laku ai*
NPK (mo e Te’emoa ka ma’u)	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 7 ‘o e ‘otu pe manga ‘e 3	Laku fakaholo ‘i he loto’i fahi pea toki fio leva mo e kelekele	Uike ‘e 1 kimu’a he to
CAN pe Urea	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 10 ‘o e ‘otu pe manga ‘e 4	Laku fakaholo he tafa’aki pe ‘e 1‘o e ‘otu paingani	Uike 3 pe 4 mei he to
NPK	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 14 ‘o e ‘otu pe manga ‘e 6	Laku fakaholo he tafa’aki pe ‘e 1‘o e ‘otu paingani	Tu’o 1 he mahina
CAN pe Urea	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 16 ‘o e ‘otu manga ‘e 7		Tu’o 1 he mahina

Malu’i mei he ‘Inisekite mo e Mahaki (Pest and Diseases & Control)

Taimi	*Faito’o*	*Hu’i (Sepuni Lahi)*	*’Inisekite/Mahaki*
Uike 2 mei he to	1. Perfekthion 2. Manzate	1 6	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 4	1. Attack 2. Sanomyl	2-3 4	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 6	1.Perfekthion 2. Manzate 3. Agrimec	1 6 1	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau

			Maiti
Hokohoko fana fakauike 2 ‘o fetongitongi ‘a e faito’o ‘i he Uike 4 mo e Uike 6 ‘i ‘olunga kae ‘oua kuo kamata toli			
Uike 2 mei he kamata toli	1. Malathion 2. Copper	3 6-8	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 4	1. Malathion 2. Manzate	3 6	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Hokohoko fana fakauike 2 ‘o fetongitongi ‘a e faito’o Faka Uike 2 mo e Uike 4, kae ‘oua kuo ‘osi e kamata ke toil.			

APPENDIX.4.2. Chilli Leaflet.

FOUNGA HO TO ‘O E NGOUE POLOFIFISI (CHILLI).

Talateu (Introduction)

‘Oku famili tatau ‘a e polofifisi mo e ngaahi vesitapolo hange ko e temata, paingani mo e pateta. Ko e polofifisi ki he uta ‘oku fuolololoa mo foiiki. ‘Oku lanu mata ‘a e fua ‘I he’ne kei mui, pea liliu ‘o melomelo ‘I he’ene motu’a pea lanu kulokula ‘I he’ene momoho. Ko e polo ‘oku sai ‘aupito ‘I hono to ‘I Tonga ni pea ‘oku ‘I ai hono maketi ‘I Nu’usila.

Taimi to (Planting Time).

Ko e polofifisi ‘e lava pe ‘o to ha fa’ahinga taimi pe ‘o e ta’u. Ka ko e fa’ahi ta’u lelei taha ko Ma’asi ki ‘Aokosi.

Fa’ahinga ke to (Variety)

Ko e fa’ahinga ‘eni ke to he ‘oku fiema’u ‘e he maketi Nu’usila.

Fa’ahiga ke uta ki Nu’usila (Variety)	*Lanu(Color)*	*Fuo (shape)*
Red Cannayne	Melomelo ‘o momoho kulokula	Fuolololoa foiiki

Insert: Chili -*Photos in colors*

Teuteu’i e pulopula (Preparation of Nursery)

‘Oku lulu ‘a e tenga’i polofifisi ‘i he mohenga ‘akau pe laulau kuo fakafonu kelekele pea toki fakalanga ‘o to ‘i he hili ha uike ‘e 4 – 6.

Teuteu ‘o e kelekele mo e Vaha (Land Preparation and Spacing)

Palau ke toka malie pea fahi fute ‘e 7. Ko e ‘otu ‘e tu’u ia ‘i he ongo kaufahi ‘o e fo’i fahi ‘a ia ‘o tu’u ‘otu 2. Pea fute ‘e 2 mei he fu’u polo ki he fu’u polo ‘i he ‘otu.

Fafanga ‘o e kelekele (Fertiliser)

Fa’ahinga ‘o e fafanga (Type of Fertilizer)	*Lahi ‘o e fafanga ke laku (Amount of fertilise to apply)*	*Feitu’u ke laku ai (place where to applythe fert.)*	*Taimi ke laku ai (time to apply the fertiliser)*
NPK (mo e Te’emoa ka ma’u)	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 7 ‘o e ‘otu pe manga ‘e 3	Laku fakaholo ‘a e fafanga ‘i he kaufahi.	Kimu’a he to
CAN pe Urea	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 10 ‘o e ‘otu pe manga ‘e 4	Laku fakaholo he tafa’aki pe ‘e 1‘o e ‘otu polofifisi	Uike 3 pe 4 mei he to
NPK	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 14 ‘o e ‘otu pe manga ‘e 6	Laku fakaholo he tafa’aki pe ‘e 1‘o e ‘otu polofifisi	Tu’o 1 he mahina
CAN pe Urea	100 kalami pe faluku lahi ‘e 1 ki he fute ‘e 16 ‘o e ‘otu manga ‘e 7	Laku fakaholo he tafa’aki pe ‘e 1 ‘o e ‘otu polofifisi	Tu’o 1 he mahina

Malu’i mei he ‘Inisekite mo e Mahaki (Pest and Diseases & Control)

Taimi	*Faito’o*	*Hu’i (Sepuni Lahi)*	*’Inisekite/Mahaki*
Uike 2 mei he to	1. Perfekthion 2. Manzate	1 6	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 4	1. Attack 2. Sanomyl	2-3 4	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 6	1.Perfekthion 2. Manzate 3. Agrimec	1 6 1	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau Maiti
Hokohoko fana fakauike 2 ‘o fetongitongi ‘a e faito’o ‘i he Uike 4 mo e Uike 6 ‘i ‘olunga kae ‘oua kuo kamata toli			
Uike 2 mei he kamata toil	1. Malathion 2. Copper	3 6-8	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Uike 4	1. Malathion 2. Manzate	3 6	Kutu, fonu, ‘inisekite kehe Lau enga/ngangana e lau
Hokohoko fana fakauike 2 ‘o fetongitongi ‘a e faito’o Uike 2 ‘o e kamata toli mo e Uike 4 kae ‘oua kuo ‘osi e toli.			

APPENDIX 4.3, PAPAYA

KINGDOM OF TONGA

POTUNGAUE NGOUE MO E
ME ATOKONI, VAO AKAU MO E TOUTAI

Va'a Fekumi mo Fale'i. Telefoni 37-474 / 37-479
Vahe Hifhifo: 41-011 / 886-0241 Vahe loto: 23-614 / 886-0242 Vahe Hahake: 32-488 / 886-0243

Tohi Fakahinohino ki he Ngoue Lesi

Feitu'u mo e 'Ea
'Oku tupu lelei 'a e lesi 'i he feitu'u 'ata kae uu mei he toka'anga matangi. 'Oku 'ikai sai 'ae feitu'u malumalu mo e feitu'u toka'anga vai koe'uhi ko e mahaki mo e pala e aka moe tefito.
Ko e taimi momoko 'oku tuai ai e tupu 'a e fu'u lesi pea holo ai mo e fua.

Fa'ahinga 'o e Lesi ke uta ki muli
Ko e ongo lesi mei Hawaii:
- Ko e Sunrise Solo 'oku fololoa pea foiiki (kalami 'e 400 – 600), pea lanu kulokula mo melie hono kakano.
- Ko e Waimanalo 'oku ki'i folalahi ange (kalami 'e 700 - 1100), kakano lanu engeenga mo melie hono kakano.

Ko e lesi fefine 'o e ongo fa'ahinga ni 'oku fopotopoto hono fua.

Faha'i ta'u To 'o e Lesi
Ko e ongo faha'i ta'u lalahi ki hono to 'o e lesi ko Tisema ki Sanuali mo Me ki Sune. "Oku sai ange to 'i Me 'e nonou ange ai 'a e fu'u lesi pea ma'ulalo hono fua.
'Oku mahina 'e 8 ki he 10 mei hono to pea kamata hono toli 'o meimei ke ta'u 'e 2 ki he 4.

Lulunga 'Akau
Ko e lulu 'o e tenga'i lesi 'e malava pe ke lulu he mohenga ke tupu pea toki fakalanga 'o to pe kono to hangatonu ki he poti. 'I he'ene a'u ki he senitimita 'e 24 'a e ma'olunga 'o e tupu 'a e fu'u pulopula, fakapapau'i 'oku hauhau 'a e kelekele pea toki fakalanga 'o to ki he ngoue'anga.

Vaha hono to
Ke fili he ongo vaha ko 'eni:

Founga to	Vaha 'o e 'otu	Vaha 'o e fu'u lesi	Fu'u lesi ki he 'eka
'Otu taha	fakahili fahi (3.7mita)	1.8 mita	605
'Otu ua	To e fahi 'e 2 pea li'aki e fahi 'e 1	1.8 mita	805

Fafanga 'o e kelekele

Taimi fafanga	Kalasi Fafanga	Lahi e fafanga	Feitu'u ke laku ai
Fafanga 'ulu-aki (uike 2 kimu'a he to)	NPK Te'emoa	200 kalami (faluku 'e 2) 200 kalami (faluku 'e 2)	Keli 'o fio 'i he tu'u'anga 'o e fu'u lesi.
Fafanga ua (uike 4-6 mei he to)	CAN pe Urea	50 kalami	laku takai
Fafanga tauhi (fakahili uike 'e 4-5)	NPK/Urea laku fetongi-tongi	100 kalami	laku takai
Fafanga lau	Thrive	Sepuni lahi 'e 2 pe 3 ki he misini	Fakahu he taimi fana faito'o

Tauhi Ma'ala'ala
'Oku mahu'inga ke tauhi ma'ala'ala 'a e lesi 'aki 'a hono huo pe fana vao.

Pakipaki Huli
Ko e 'ene 'asi pe 'a e huli pea kamata leva hono pakipaki.

Ngoue Lesi Tuifio
Ngoue tuifio 'a e lesi mo ha fa'ahinga ngoue 'oku si'i ange 'i he mahina 'e 6 pea utu pe toli 'o faka'aonga'i.
To 'a e ngoue tuifio 'i he taimi tatau mohono to 'o e lesi. 'Oku

APPENDIX.5.1. Weather Report

Climate Update for Tonga
April 2009 Climate Summary
June to August 2009 Rainfall Outlook

Issued 19th May 2009

April's Climate in Brief.

- *The South Pacific Convergence Zone (SPCZ) shifted in April, with only the eastern end positioned southwest of normal.*
- *Enhanced convection throughout the kingdom during April.*
- *Normal to above normal rainfall is expected for Tonga in the coming months*

Generally normal to above normal rainfall occurred during April throughout the country. La Niña-like conditions have existed in the tropical Pacific in previous months, but most climate models project ENSO neutral conditions for autumn and winter 2009. Rainfall outlook for June to August 2009 is for normal to above normal condition

Table 1: Temperature April 2009

Location	April 2009 Mean Temperature (oC)	Departure from Normal	Comments.
Niuafo'ou Island	27.1	-0.1	Below normal
Niuatoputapu Is.	27.4	+0.3	Above normal
Vava'u Is.	25.0	-1.2	Below normal
Ha'apai Is.	26.6	+0.6	Above normal
Nukualofa	26.1	+0.8	Above normal
Fuaamotu Airport	25.3	+0.3	Above normal

Mean air temperatures were above normal over Niuatoputapu, Ha'apai and Tongatapu and below normal temperature over the rest of the country. The mean temperature for the month was 26.3oC which was 0.5oC cooler than normal but 0.2oC warmer than April 2008.

Daytime maximum temperatures were warmer than normal across the country except for Niuafo'ou and Vava'u which recorded 0.2 and 1.2oC cooler than normal daytime maximum temperature. The overnight minimum temperature was warmer than normal throughout the country except for Vava'u where cooler than normal overnight minimum temperature was recorded. The highest departure from normal daytime maximum temperature was 0.5oC

recorded in Nuku'alofa and also the highest departure from night time minimum temperature which was 1.0oC**.**

Rainfall April 2009.

- The South Pacific Convergence Zone (SPCZ) shifted in April, with only the eastern end positioned southwest of normal. Enhanced convection throughout the kingdom during April.

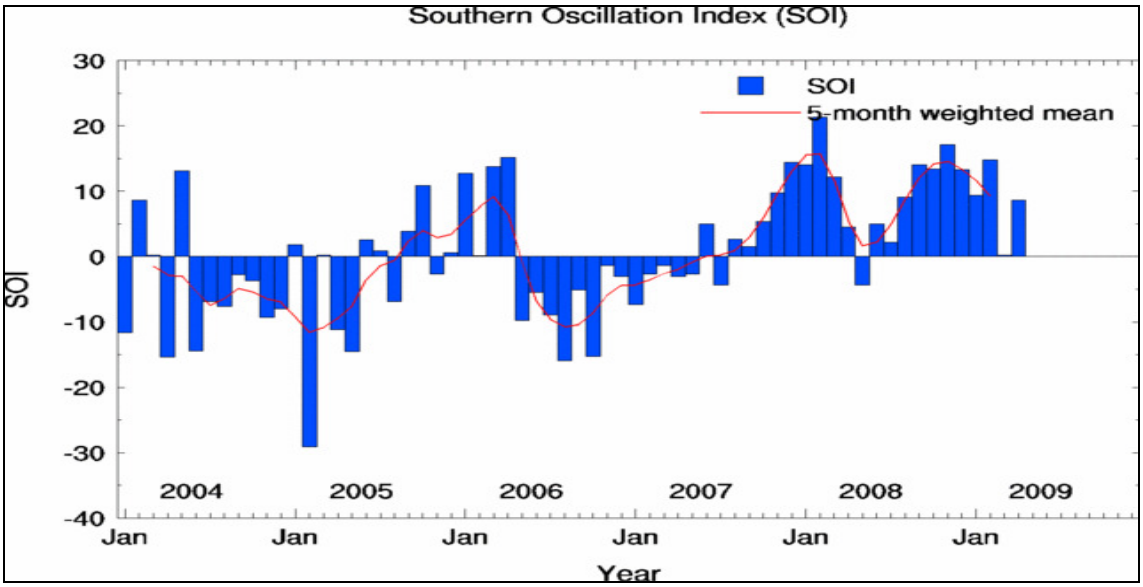
Table 2. Rainfall April 2009.

Station Data period.	**Monthly Total**	**33% tile Rainfall (mm)**	**67% tile Rainfall (mm)**	**Medium Rainfall (mm)**	**Comments**
Niuafoou (1971-2008)	319.9	178.8	291.0	219.0	Above normal
Niuatoputapu (1947-2008)	237.8	161.0	289.0	222.5	Normal
Vava'u (1947-2008)	412.5	178.3	267.0	212.5	Above normal
Ha'apai (1947-2008)	262.0	117.3	228.3	170.5	Above normal
Nuku'alofa (1945-2008)	128.1	104.0	203.0	138.0	Normal
Fuaamotu Airport (980-2008)	249.0	93.7	197.0	159.0	Above normal

Current Conditions.

Drought Status (*Summary analysis*).
There is no drought warning currently in place.

El Niño Southern Oscillation (ENSO) status.
Climate indicators across the equatorial Pacific are currently neutral. Both the equatorial Pacific Ocean surface and sub-surface have continued to warm over the past few weeks, resulting in near average ocean temperatures across most of the tropical Pacific, but slightly warmer than normal sea surface temperatures (SSTs) in the east. Trade winds have weakened further, and are now widely weaker than average. The SOI rose from zero in March to +9 in April, however the current (5 May) 30-day value has fallen slightly to +7 and remains in the neutral range.
Most international coupled climate models predict further warming of Pacific Ocean SSTs, with SSTs remaining in the ENSO-neutral range until at least midwinter.



Seasonal Predictions for Tonga (June-August 2009).

Rainfall Outlook.

The confidence level in the outlook is related to how consistently the Pacific Ocean affects the rainfall in Tonga. Therefore the outlook confidence level for the June to August 2009 period according to climatological historical data shows this effect to be normal to above normal for Tonga. It should also be noted that the skill level of the forecast is low during this time as it is the dry season.

SCOPIC model outlook for the June to August period is for rainfall to be normal to above normal and the skill is low. Other models predict normal condition for the same period.

Table 4. Seasonal Rainfall Outlook for June to August 2009.

Location	Below normal Probability (%)	33% tile Rainfall (mm)	Normal Probability (%)	66% tile Rainfall (mm)	Above normal Probability (mm)
Niuafoou	31	278.7	30	424.0	39
Niuatoputapu	25	239.0	49	369.0	36
Vava;u	21	261.3	38	350.3	41
Ha'apai	31	192.3	30	317.3	39
Tongatapu	24	236.0	34	367.0	43
Fuaamotu airport	23	282.0	31	402.3	46

Note the rainfall values are for the three month period (June—August 2009).

APPENDIX 5.2 Weather Report

Station: Fua'amotu Airport

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	263.0	356.0	164.0	163.0	**720.0**	**17.0**	**72.0**	**157.0**	**90.0**	**116.0**	**21.0**	**112.0**
1998	**13.0**	**45.0**	**329.0**	**36.0**	53.0	76.0	62.0	28.0	96.0	54.0	367.0	391.0
1999	201.0	487.0	103.0	331.0	30.0	146.0	159.0	245.0	153.0	301.0	219.0	217.0
2000	434.0	370.0	413.0	304.0	132.0	68.0	227.0	88.0	78.0	171.0	65.0	229.0
2001	466.0	150.0	222.0	159.0	41.0	155.0	77.0	149.0	92.0	33.0	167.0	157.0
2002	132.0	489.0	285.0	327.0	**84.0**	**47.0**	**235.0**	**121.0**	**199.0**	**27.0**	**102.0**	**68.0**
2003	**413.0**	**30.0**	**321.0**	**78.0**	38.0	16.0	116.0	221.0	76.0	62.0	42.0	135.0
2004	84.0	98.0	253.0	36.0	127.0	211.0	**164.0**	**355.0**	**262.0**	**33.0**	**38.0**	**108.0**
2005	**259.0**	**15.0**	144.0	313.0	158.0	172.0	165.0	133.0	125.0	317.0	179.0	49.0
2006	194.0	153.0	137.0	357.0	34.0	359.0	70.0	90.0	**101.0**	**99.0**	**43.0**	**293.0**
2007	**19.0**	240.0	180.0	287.0	572.0	47.0	228.0	126.0	158.0	130.0	149.0	68.0
2008	303.6	420.0	273.5	92.0	343.5	91.3	96.5	35.1	285.4	41.8	284.5	83.7

Mean Temperature (deg C)

1997	26.3	26.6	26.4	24.3	23	21.8	21.0		20.3	22.5	24.1	25.6
1998	26.7	26.8	25.8	25.6	23.5	23.1	21.6	22.1	22.3	23.4	25.2	26.8
1999	25.9	25.7	26.4	25.6	23.2	21.9	22.1	21.1	22.3	23	24.7	25.0
2000	26.7	26.9	26.6	25.9	24.4	22.8	21.1	21.4	21.6	22.7	24.5	25.1
2001	26.7	26.9	26.6	25.9	24.4	22.8	21.1	21.4	21.6	22.7	24.5	25.1
2002	26.0	26.6	26.8	26.1	24.2	23.3	21.9	21	22	20.3	23.5	25.1
2003	26.3	26.3	25.6	25.5	24.8	22.5	21.3	20.2	21.9	22.2	24.5	26.6
2004	25.8	27.8	27.2	25.8	24.1	23.3	22.4	21.1	21.3	22.8	23.9	21.8
2005	27.6	27.2	27.1	25.9	24.3	21.7	21.3	20.6	22.4	23.7	24.8	25.9
2006	27.4	27.2	27.5	26.9	24.5	22.6	21.2	22.4	22.9	22.9	25.1	25
2007	26.6	26.8	27.1	25.8	24.4	23.2	22.4	22.6	24.5	24.9	25	26.2
2008	26.1	26.7	26.4	26.0	23.3	23.4	21.8	23.1	23.3	23.5	25.1	26.0
2009	26.7	27.1	26.9	25.3								

Any correspondence regarding these data should be directed to fmt_met@met.gov.to .

APPENDIX. 6.1. Gross Margin For Eggplant.

Gross Margin Budget (Local Market)

1 Acre

1. Production parameters

Spacing		Plant density	6,093 pl/ac
Between row	1.0 m	Average price	3.00 T$/kg
Between plant	0.5 m	Weight/pl	0.3 kg
Avg. Yield	3655 kgs	Yield/pl	2
Crop Duration	12 mth	Other Loss	10%
Avg Mktable Yield	3,290 kg	Planting time	March / August

2. Gross Income

	Yield Unit	Price T$/unit	Gross Income T$/acre
Eggplant	3,290 kg	3.00	9,868.50
Total Gross Income			**9,868.50**

3. Variable Costs

Description of Input	Quantity Unit	Price	Variable Cost (T$)
(*seeds*)	0.02 kg	5,607.73	112.15
Ploughing/Slashing	1.5 hour	90.00	135.00
Ploughing	1.5 hour	80.00	120.00
Disk Harrowing	1 hour	80.00	80.00
Chicken manure	400 kg	0.10	40.00
NPK 6:15:6	160 kg	1.20	192.00
Urea	80 kg	0.90	72.00
Manzate 200 80% WP	1 kg	25.00	25.00
Malathion 50% EC	1 litre	45.00	45.00
Agral	1 litre	12.50	12.50
Marketing cost	30%		246.35
Total Variable Costs			**1,080.00**

4. Gross Margin	8,788.50
Return to Variable Costs	8.14

5. Gross Margin Returns to Labour:

	Quantity Unit
Planting	8 hrs
Transplanting	3 hrs
Pruning	17 hrs
Fertilising	12 hrs
Mulching	0 hrs
Watering	25 hrs
Spraying	17 hrs
Weeding	41 hrs
Harvesting	47 hrs
Processing/packing	20 hrs
Selling	3 hrs
Total Labour	**195 hrs**
Total Labour Cost	**1,167.83 T$**
Margin after Labour Cost	**7,620.67 T$**

Return per labour hour.
39.15

6. Gross Margin Sensitivity Analysis

Increment:				Yield (*kg/ac*) 2,300	3,290	4,276
Yield	30%		1.50	1,202	2,686	4,167
Price	50%	Price	3.00	4,652	**7,621**	10,581
		(T$/kg)	4.50	8,102	12,555	16,996

APPENDIX. 6.2. Gross Margin For Chilli.

1 Acre

1. Production parameters

Spacing	Size	Unit		Size	Unit
Between row	1.5	m (Double rows)	Average price	0.70	T$/bag
Between plant	0.6	m	Avg Yield	500	fruit/pl
Plant density	4,062	pl/ac	Avg weight	0.002	kg
Crop Duration	12	mth	Planting time	*June* -	Oct
Avg yield	4,062	kg	Mktable Yield	16,248	(100 fruits/bag)
			Other Loss	20%	

2. Gross Income

	Yield	Unit	Price	Gross Income
Marketable yield	16,248	bags	0.70	11,373.60
Total Gross Income				**11,373.60**

3. Variable Costs

Description	Quantity	Unit	Price T$	Variable Cost (T$)
Planting Material	10	100g pkt	49.00	490.00
Ploughing/Slashing	1	hr	90.00	90.00
Ploughing	1	hr	80.00	80.00
Disk Harrowing	1	hr	80.00	80.00
Chicken Manure	350	kg	0.08	28.00
NPK 6:15:6	200	kg	2.65	530.00
Manzate 200 80% WP	2	kg	18.00	36.00
Perfekthion 50% EC	0.2	litre	6.65	1.33
Mistblower Operation	3	times	30.00	90.00
Transport to Water	12	trip	5.00	60.00
Maketing cost				69.00
Total Variable Costs				**1,554.33**

4. Gross Margin	9,819.27
Return to Variable Costs	6.32
Equivalent Annuity	
Benefit Cost Ratio	

5. Gross Margin Returns to Labour.

	Quantity	Unit
Planting seedbed	2	hrs
Digging and fertilising	39	hrs
Transplanting	19	hrs
Fertilising	9	hrs
Watering	39	hrs
Spraying	28	hrs
Weeding	56	hrs
Harvesting	17	hrs
Processing/packing	17	hrs
Selling	39	hrs
Total Labour	**267.42**	**hrs**
Total Labour Cost	**1,604.49**	**T$**
Margin after Labour Cost	**8,214.78**	**T$**

Return per labour hour
$30.72

6. Gross Margin Sensitivity Analysis

Increment:
Yield 30%
Price 50%

Price *(T$/bag)*

	Yield (bags/ac)		
	11,374	16,248	21,122
0.35	822	2,528	4,234
0.70	4,803	**8,215**	11,627
1.05	8,783	13,902	19,020

APPENDIX. 6.3. Gross Margin For Papaya

Paw paw - Gross Margin Budget

1 Acre

1.0 Production Parameters

Plant spacing	Size /Unit	Plant density	750pl/ac	Avg. price		
Between row	2.4 *m*	Other Loss	20%	-fruits	*0.70T$*	
Between plant	1.8 *m*	Yield/plant	13kg	-pl/material	*1.00T$*	
Economic Life	5 *yrs*	Planting time	Oct to Apr			
Avg Mktable Yield	7,800 *kg*	Common name.	papaya, pawpaw.			

2.0 Gross Income

					Years	
		0.8	1	1	0.6	
Years	**0**	**1**	**2**	**3**	**4**	**Total**
Yield (kg\ac)		6,240	7,800	7,800	4,680	26,520
Price ($/kg)	0.70	0.70	0.70	0.70	0.70	5.00
Gross Income	0	4,368	5,460	5,460	3,276	18,564

3.0 Establishment Costs

Establishment Costs	Qtn	Unit	Cost/unit	0	1	2	3	4	Total
Clear land	3	hrs	40.00	120.00					120.00
Planting materials	750pl/ac	seedling	1.00	750.00					750.00
Digging holes	750pl/ac	holes	0.30	225.00					225.00
Fertilizing	750pl/ac	holes	0.25	187.50					187.50
Total Establishment Costs				**1,282.50**	**0.00**	**0.00**	**0.00**	**0.00**	**1,282.50**

4.0 Gross Margin	-1,282.50	4,368.00	5,460.00	5,460.00	3,276.00	17,281.50
Gross margin per dollar invested in variable cost	-1.00	0.00	0.00	0.00	0.00	
Return to variable cost	13.47					

5.0 Labour Input

Economic Life *(in years)*				0	1	2	3	4	Total
Tasks *(in hours)*	Quantity.	Unit.	Cost/unit.						
Slashing	2	Hrs	90.00	0	182	182	182	182	728
Mulching	15	Hrs	6.00	0	15	15	15	15	60
Picking	4	Hrs	6.00	0	4	4	4	4	16
Selling	2	Hrs	6.00	0	2	2	2	2	8
Total labour requirement				**0**	**203**	**203**	**203**	**203**	**812**
Total labour cost				**0.00**	**1,218.00**	**1,218.00**	**1,218.00**	**1,218.00**	**4,872.00**
Margin after labour costs				**-1,282.50**	**3,150.00**	**4,242.00**	**4,242.00**	**2,058.00**	**12,409.50**
Total Cost				1,282.50	1,218.00	1,218.00	1,218.00	1,218.00	6,154.50
Cashflow				-1,282.50	3,150.00	4,242.00	4,242.00	2,058.00	12,409.50
Accumulated Cashflow				-1,282.50	1,867.50	6,109.50	10,351.50	12,409.50	29,455.50

ANALYSIS OF INVESTMENT

Opportunity Cost of Capital	7%							
Discount Factor	1.279825			1.00	0.93	0.87	0.82	0.76	
Discount Cashflow				-1,282.50	2,943.93	3,705.13	3,462.74	1,570.04	10,399.33
Net Present Value (NPV)	10,399.33								
Internal Rate of Return (IRR)	128%		**Return per Labour**						
Payback Period	2 yrs		**15.28**						

APPENDIX. 7. Quarterly Report for Talamahu Market Survey (2004 – 2008)

Commodities		2004				2005				2006				2007				2008				2009	
PAWPAW	Quantity (MT	2.95	1.68	1.68	1.76	0.82	1.65	2.64	1.91	1.40	1.33	1.88	2.38	1.50	1.51	2.28	2.28	0.79	0.89	0.94	0.59	0.75	Sept-Jan (Year round)
Piece	Ave.price/CT	2.23	1.66	1.61	1.33	1.56	1.94	1.70	1.77	2.04	2.35	1.68	1.60	1.66	1.84	2.56	1.99	1.42	2.14	1.77	1.71	2.01	
	Ave.price/KG	1.76	1.38	1.23	1.02	1.17	1.61	1.53	1.48	1.57	2.04	2.12	1.51	1.76	1.52	2.07	1.69	1.53	1.87	1.71	1.52	1.46	
MANGO	Quantity (MT	2.08	1.47	0.00	0.46	37.27	0.27	1.88	1.21	0.04	0.11	0.00	0.45	0.83	0.00	0.00	0.30	0.10	0.17	0.11	0.36	0.10	Nov-April (Seasonal)
Heap	Ave.price/CT	2.00	2.00	0.00	2.00	1.93	1.88	2.00	2.00	2.00	2.00	0.00	0.75	1.47	0.50	0.00	1.50	0.50	0.50	0.50	2.22	1.75	
	Ave.price/KG	2.38	1.74	0.00	1.79	0.71	1.18	1.69	1.82	1.81	1.72	0.00	2.08	2.34	0.87	0.00	2.72	1.11	0.83	2.11	2.83	2.94	
BREADFRUIT	Quantity (MT	3.43	8.31	2.42	1.09	1.49	12.58	0.73	1.36	5.93	12.76	0.84	0.81	0.52	3.83	0.00	0.00	1.30	0.41	0.47	0.43	2.19	Year round
Basket	Ave.price/CT	9.06	6.07	9.50	9.83	5.00	6.92	12.00	9.33	8.75	9.58	10.20	11.25	2.33	6.32	0.00	10.00	8.73	5.67	8.92	3.75	6.19	
	Ave.price/KG	0.67	0.32	0.60	0.72	0.43	0.46	0.92	0.63	0.62	0.68	0.80	0.88	0.18	0.45	0.00	0.69	0.66	0.61	0.76	0.70	0.50	
EGGPLANT	Quantity (MT	0.07	0.39	0.09	0.20	0.08	0.54	0.03	0.13	0.02	0.17	0.06	0.14	0.00	0.00	0.17	0.02	0.33	0.11	0.19	0.07	0.41	Year round
Heap	Ave.price/CT	1.94	1.83	1.52	1.57	2.00	2.00	1.75	2.00	2.00	2.01	1.53	1.00	0.00	0.00	1.17	1.25	2.71	3.00	2.50	2.75	3.00	
	Ave.price/KG	2.72	4.47	1.92	1.53	2.50	2.28	2.67	1.89	3.40	4.90	3.75	1.03	0.00	0.00	4.67	4.38	3.51	3.63	4.57	2.95	3.93	
CHILLI	Quantity (MT	0.19	0.32	0.08	0.08	0.08	0.18	0.02	0.05	0.04	0.15	0.08	0.16	0.37	0.12	0.12	0.08	0.19	0.08	0.23	0.03	0.21	Year round
Heap	Ave.price/CT	1.97	1.94	1.96	1.98	2.00	2.00	2.00	1.98	2.00	1.97	1.66	1.83	1.83	2.00	2.00	2.00	2.83	3.00	2.44	2.75	3.00	
	Ave.price/KG	6.05	6.20	8.79	8.77	16.28	11.39	13.28	12.84	15.26	11.61	21.75	9.28	6.45	7.58	10.43	10.79	16.31	15.23	19.42	13.88	13.20	

APPENDIX.8. Summary of Talamahu Market Survey (Five Years 2004 – 2008)

	QUANTITY AND VALUE OF MAJOR CROPS AT TALAMAHU MARKET ONLY FOR 2004 - 1st Qarter 2009.				-	-	
Commodities		**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
							Q1
YAM (Early)	Quantity (MT)	143.41	133.73	98.65	36.54	27.06	8.92
Basket	Ave. Price/Kg	2.66	2.84	3.48	2.69	2.82	2.61
YAM (Late)	Quantity (MT)	43.43	49.10	38.59	8.22	6.45	4
Basket	Ave. Price/Kg	1.02	1.76	1.94	1.56	1.86	1.38
GIANT TARO	Quantity (MT)	16.41	37.37	35.17	13.95	11.56	3.43
Piece	Ave. Price/Kg	1.25	0.96	1.03	0.96	0.74	0.82
TARO TARUA	Quantity (MT)	77.04	82.74	169.63	93.44	95.96	36.79
Basket	Ave. Price/Kg	0.84	0.93	0.93	0.69	0.66	0.82
SWAMP TARO	Quantity (MT)	34.57	47.55	40.33	35.5	53.51	12.28
Bundle	Ave. Price/Kg	1.06	1.37	1.49	1.23	1.1	0.81
SWEET POTATO	Quantity (MT)	148.53	180.11	203.93	72.69	28.63	7.25
Basket	Ave. Price/Kg	0.70	0.93	1.06	0.75	1.06	0.68
CASSAVA	Quantity (MT)	340.19	441.36	287.22	132.39	81.86	16.00
Basket	Ave. Price/Kg	0.31	0.37	0.58	0.49	0.47	0.52
POTATO	Quantity (MT)	2.95	1.06	2.73	1.34	1.74	0.65
Bag	Ave. Price/Kg	2.39	2.28	2.4	2.85	3.03	2.67
BANANA	Quantity (MT)	30.36	39.47	21.46	10.64	8.24	3.5 9
Bunch	Ave. Price/Kg	0.63	0.53	0.77	0.52	0.54	0.44
PLANTAIN	Quantity (MT)	21.15	27.84	20.78	15.12	11.64	4.16
Bunch	Ave. Price/Kg	0.87	1.00	1.33	0.85	1.02	0.90
PATA	Quantity (MT)	9.18	14.97	6.62	2.34	5.25	4.68
Bunch	Ave. Price/Kg	0.87	0.46	0.4	0.56	0.42	0.32
RIPE BANANA	Quantity (MT)	7.64	4.82	5.63	7.32	5.01	2.33

Hand	Ave. Price/Kg	2.48	3.10	3.04	2.72	2.69	1.77
PAWPAW	Quantity (MT)	8.07	7.02	7.00	7.57	3.21	0.75
Piece	Ave. Price/Kg	1.35	1.45	1.81	1.76	1.66	1.46
PINEAPPLE	Quantity (MT)	7.83	5.61	8.87	23.61	15.05	3.11
Piece	Ave. Price/Kg	4.07	4.12	5.06	4.35	5.36	4.20
AVOCADO	Quantity (MT)	0.17	0.42	0.12	0.6	0.67	0.46
Piece	Ave. Price/Kg	2.86	2.08	2.25	4.53	3.24	2.36
ORANGE	Quantity (MT)	6.7	6.53	3.5	5.64	1.01	0.25
Heap	Ave. Price/Kg	1.06	1.25	1.05	1.23	3.02	2.31
LEMON	Quantity (MT)	0.85	0.87	0.41	3.19	0.86	0.26
Heap	Ave. Price/Kg	3.20	3.50	3.41	3.06	6.58	5.00
COLA	Quantity (MT)	3.01	1.29	1.17	3.45	1.15	0.48
Heap	Ave. Price/Kg	1.69	4.16	4.61	2.95	7.08	2.75
MANGO	Quantity (MT)	2.01	40.63	0.15	1.13	0.74	0.1
Heap	Ave. Price/Kg	1.97	1.35	1.87	1.98	1.72	2.94
WATERMELON	Quantity (MT)	264.9	411.01	210.07	444.62	533.17	152.49
Piece	Ave. Price/Kg	1.00	1.04	1.16	1.12	1.07	1.17
BREADFRUIT	Quantity (MT)	15.25	15.16	20.34	4.35	2.61	2.19
Basket	Ave. Price/Kg	0.58	0.61	0.75	0.32	0.68	0.50
TOMATO	Quantity (MT)	44.86	39.21	46.86	25.64	20.56	5.36
Heap	Ave. Price/Kg	2.57	2.94	3.34	3.74	3.62	7.81
BEANS	Quantity (MT)	11.69	9.07	6.25	3.68	2.48	0.64
Heap	Ave. Price/Kg	6.18	5.32	6.1	5.48	7.04	10.79
CAPSICUM	Quantity (MT)	8.87	6.19	17.16	5.06	4.93	1.18
Heap	Ave. Price/Kg	5.74	5.58	6.04	7.86	9.78	12.94
CARROT	Quantity (MT)	17.75	10.99	22.59	8.75	8.15	1.64
Heap	Ave. Price/Kg	3.04	3.85	3.02	3.39	5.03	5.18
ONION (bulb)	Quantity (MT)	5.68	3.24	2.30	1.50	1.47	0.31

Bag	Ave. Price/Kg	2.92	3.03	3.18	3.77	4.43	4.67
ONION (spring)	Quantity (MT)	1.17	0.74	0.45	1.14	1.13	0.16
Bundle	Ave. Price/Kg	9.60	9.92	15.55	10.51	27.54	25.74
LETTUCE	Quantity (MT)	3.76	3.58	9.14	6.87	6.08	1.11
Piece	Ave. Price/Kg	10.59	10.14	8.96	7.92	9.39	26.00
HEAD CABBAGE	Quantity (MT)	38.96	49.12	38.01	22.02	20.63	5.06
Piece	Ave. Price/Kg	2.37	2.71	2.84	3.08	3.37	4.2
CH/CABBAGE	Quantity (MT)	24.36	22.00	12.72	11.9	6.83	0.88
Piece	Ave. Price/Kg	1.93	2.34	1.97	2.39	2.64	6.71
CUCUMBER	Quantity (MT)	15.4	12.74	17.41	16.54	15.92	7.16
Heap	Ave. Price/Kg	1.79	1.80	1.76	1.72	1.38	1.87
PUMPKIN	Quantity (MT)	0.26	0.09	0	0	0	0
Piece	Ave. Price/Kg	1.01	1.24	0	0	0	0
EGGPLANT	Quantity (MT)	0.75	0.78	0.39	0.19	0.70	0.41
Heap	Ave. Price/Kg	2.66	2.34	3.27	2.26	3.67	3.93
ZUCCHINI	Quantity (MT)	0.22	0.13	0.06	0	0	0
Piece	Ave. Price/Kg	2.04	1.61	3.00	0	0	0
LU (taro leaves)	Quantity (MT)	21.44	22.26	18.21	7.86	5.52	1.88
Bundle	Ave. Price/Kg	3.06	3.25	2.8	2.85	2.66	2.78
PELE	Quantity (MT)	17.16	13	8.9	4.28	2.77	1.07
Bundle	Ave. Price/Kg	1.28	1.55	1.58	1.28	1.69	1.23
CORN	Quantity (MT)	0.59	0.58	0.33	0.39	0.67	0.41
Heap	Ave. Price/Kg	1.83	1.97	2.04	2.12	2.88	1.98
GINGER	Quantity (MT)	0.07	0.07	0.14	0.27	0.13	0.04
Heap	Ave. Price/Kg	10.84	13.39	13.82	8.68	13.6	13.04
CHILLI	Quantity (MT)	0.67	0.33	0.43	0.69	0.53	0.21
Heap	Ave. Price/Kg	7.45	13.45	14.48	8.81	16.21	13.2
PEANUT	Quantity (MT)	3.35	1.97	3.95	0.52	0.66	0.27
Bag	Ave. Price/Kg	11.58	12.21	9.35	9.16	12.63	21.95

APPENDIX. 9: Terms of Reference for chain analysis in support of utilization of the HTFA facility in expanding the export of fresh fruits and vegetables from Tonga

I. Background

On the basis of a consultative workshop held in the Kingdom of Tonga on 9th and 10th March 2009, the utilisation of the HTFA facility for initiating exports of selected fresh fruits and vegetables was selected as an issue for further evaluation.

With the HTFA soon to come on line, there is some concern that the facility may not be used to full capacity if supply is inconsistent, and that any initiatives to boost local production of priority crops (Papaya, Eggplant, Chilli, Breadfruit, Tomato, Mango) to ensure consistent supply carry significant risks for chain stakeholders. For example, resulting in a "boom – bust" reaction of producers, where investments in the crops results in supply exceeding HTFA capacity (and/or export demand) resulting in poor returns and subsequent rapid withdrawal from the production of these crops (i.e. oversupply result in flooding the market demand, low return, withdrawal from production). Alternatively there is a risk that perceptions are such that producers are reluctant to invest in production of these crops resulting in the plant running at less than capacity.

It was suggested that a value chain approach to determine current levels of activities and associated incentives for production of a consistent supply in four selected chains (Papaya, Eggplant, Chilli, Breadfruit) could be used to shed light on these concerns and to ensure that strategies are put in place to mitigate against the risks outlined above.

In particular the approach would be used to determine (i) periods over which the crops can be produced and volumes marketed in adequate quantities, (ii) investments required to lengthen seasons, (iii) the risk perception of producers and purchasers and their likely profitability.

The approach would be used to elaborate risk mitigation strategies that could be put in place to encourage appropriate levels of investment in production, harvest, delivery of product to treatment plant, and in the establishment of distribution chains.

II. Terms of Reference for the National Consultant of the Study

Under the technical supervision of the FAO Trade and Markets Division, in close cooperation with FAO Sub-Regional Office, the National Consultant (NC) will, using the attached brief guide on "Using Value Chain Approaches in the Pacific Island Countries":

(i) Refine the objectives of the study and formulate key questions to be addressed by the study.

(ii) Collate existing secondary information (i.e. data on key production, trade and market parameters and information and analysis on the performance of chain activities, market opportunities etc) related to the product in question.

(iii) Map, using the available secondary information, and in close consultation with key national stakeholders, the chain of the selected product by:

a. Delimiting the targeted value chains
b. Identifying the main activities between the start of the production process and sale to the final customer
c. Identifying the distinct marketing channels or final outlets (for example, local market, supermarkets, food processors, importers in destination countries, retailers etc)
d. Identifying the different types of enterprises that carry out each successive function
e. Explaining the relationships (spot market transactions, form of contracts etc) between adjacent enterprises in the chain

(iv) Use the map to:

a. further refine key questions for further analysis and to determine the analytical approach required.
b. identify where available information is not adequate to undertake this analysis

(v) Where secondary information does not exist, suggest appropriate investigation approaches and tools (for example direct observation, focus group interviews, informal discussions, survey questionnaires, etc.) through which to collect the required data.

(vi) Submit a brief interim report to FAO summarising the above activities, including proposed data collection and analytical approaches, together with estimates of associated costs. These will be further agreed and refined in consultation with FAO prior to their implementation.

(vii) Undertake field investigations to collect the required data and information on chain operators and the relationships between them (for example producers, importers, distributors, hotels/restaurants, consumers, exporters).

(viii) Undertake analysis in support of the questions detailed under (iii) with a view to formulating key recommendations on policy and support interventions in line with the objectives of the study.

(ix) Submit a full report (max 7500 words plus annexes) summarising the findings of the mapping and analytical activities, and key recommendations.

III. The timing of the study

(i) A brief report detailing the mapping activities (mapping, question identification, data identification and proposed data collection and analytical approaches) should be submitted to FAO 15 May 2009.

(ii) Data collection, analysis to be undertaken during by the end of May 2009.

(iii) A draft version of the full study to be completed by the Middle of June 2009.

IV. Experience Required

The National Consultant will possess proven experience of production and related marketing issues activities within the agricultural sector. Furthermore, s/he will possess experience in field investigations within the agricultural sector and be capable of independently organizing and monitor the work of local collaborators if necessary. Knowledge of the fresh fruits and vegetables industry would be an advantage, as would as attendance at one of the subregional workshops on implementing commodity chain studies organised under FAO RPFS between April and July 2008.

V. Length of the Assignment

The overall length of the assignment will be **32 working days** distributed between 1 -31 May 2009.

VI. Remuneration

Remuneration: Local consultant rate as agreed with FAO Sub-regional Office in Samoa.

Expenses: Agreed expenses to cover transport and accommodation and miscellaneous items required for field investigations to be determined will be reimbursed against receipts.