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Economic Issues in the Fisheries Sector of Tonga

A thesis

submitted in fulfilment

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by

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Abstract

There are certain characteristics of island economies that are considered hindrances to their 'development'. For example, island economies often lack the economies of scale necessary for enhanced economic development and are too remotely located from the world's major international financial and trading centres to fully exploit the marketing and trading opportunities that are available. However, for island economies in the South Pacific, the sea also offers great opportunities for sustained economic development. The relative abundance and accessibility of fisheries resources means that if these resources are properly managed and exploited, island economies have much potential for social and economic development. At the same time, the sea provides a significant means of basic livelihood for many rural communities in these Island countries. A major and enduring challenge is therefore to ensure that island economies in the South Pacific utilise their sea resources for social and economic development without jeopardising their communities' basic livelihoods.

This thesis, using a combination of quantitative and qualitative methodologies, focuses on the island economy of Tonga, examining a range of economic issues in its fisheries sector both at the national level (focusing on the fisheries export) and local level (focusing on the domestic fisheries). It begins with a discussion of fish exports, including an analysis of the return to fisher-people in Tonga from fish exported to Tonga's major overseas fish markets. Included in the analysis of Tonga's fish exports are two important variables: the size of the local fish operations in Tonga, and the types of fish exported overseas. Secondly, as fish are also caught for domestic consumption, economic development issues facing Tonga's domestic fisheries are assessed. Only four per cent of Tongan households earn income from fishing activities. However, the overall contribution of subsistence fisheries in Tonga is estimated at more than T\$12million per year. For low income earners, there is a high value associated with self-caught fish, with domestic fishing serving a critical safety net for those at the lower end of the socio-economic ladder. Even so, although fish is an important component of household diet in Tonga, an analysis of Pacific Islands New Zealand Migration Survey (PINZMS) data indicates that the consumption of fish is related to the age,

education, household size and income of the head of the household, with fish being more likely to be part of the family diet where the head of the household is older and more highly educated.

The assessment of domestic fisheries includes a case study of the mangrove-dependent rural island community of Pangaimotu in Vava'u, where the fisheries have traditionally been the main source of livelihood. It is argued, with reference to the application of an inter-sectoral economic model, that economic development activities in Pangaimotu need to take account of the critical relationship between mangroves and fisheries resources. The symbiotic relationship between mangroves and fisheries is, however, an issue that is easily overlooked by economic development planners. What the analysis (which compares fishing, tourism and forestry) reveals is that although the best management option appears to be to increase the number of fisheries workers, an increase in tourism, despite its potentially negative impact on fish harvest, would provide an incentive for the community, leading to increased income and, therefore, improved infrastructure and social development.

Highlighted by this research project as a whole is the impact on the fisheries sector in Tonga not only of events happening in the Pacific region, but also of global events, especially those involving fisheries, such as the growing importance of the global fish trade, and the increasing importance of aquaculture in ensuring sustainability. For small island communities for whom fish is an important part of the staple diet, the challenge is to find a solution to the potential conflict between increased economic development activities and sustainable resource utilisation.

Notes

Note on publications

A number of papers have been produced from this thesis. The papers are as follows:

Refereed Journal Articles

- “Efficient remittance services for development in the Pacific” *Asia-Pacific Development Journal* 14(2): (2007). With John Gibson, Geua Boe-Gibson, and David McKenzie.
- “How cost elastic are remittances? Estimates from Tongan migrants in New Zealand” *Pacific Economic Bulletin* 21(1): 112-128 (2006). With John Gibson and David McKenzie.

Refereed Posters

- “Natural Experiment Evidence on Whether Selection Bias Overstates the Gains from Migration” Presented at the 26th Conference of the International Association of Agricultural Economists, Gold Coast, August 12-18, 2006 (with John Gibson, David McKenzie, and Steven Stillman).

Conference Papers

- “Migration and Remittances in the Pacific”, BRCSS New Settlers Research Network National Conference, Auckland University, New Zealand, February 2007.
- “Expectations about Continuing to Remit and Returning Home”, *Pacific Transnationalism: Tracing ties to the homeland*, La Trobe University, Melbourne, Australia, November 2006.
- “An inter-sectoral economic model for optimal sustainable mangrove use in the small island economy of Tonga”, NZARES Annual Conference, Nelson, New Zealand, August 2006.
- “An examination of issues on the Fisheries Sector in small island economy: the case of fish export from Tonga”, NZARES Annual Conference, Blenheim, New Zealand, June 2004.
- “Descriptive Study of the Fisheries Sector in Tonga”, Waikato Management School Student Research Conference, October 2002

Note on chapter seven

Chapter seven is the result of a joint work with my chief supervisor, Dr Steven Lim

Dedication

This thesis is dedicated to my beloved brother and mentor, Rev'd Tui ki Ha'anai Pongi, who was called to rest during the course of this journey. *Toka ā 'i he fiemalie!*

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List of Abbreviations

ADB	Asian development Bank
CTS	Custom Tariffs Schedule
EEZ	Economic Exclusive Zone
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
NRBT	National Reserve Bank of Tonga
NZ	New Zealand
PAC	Pacific Access Category
PICs	Pacific Island Countries
PICTs	Pacific Island Countries Territories
PINZMS	Pacific Island New Zealand Migrant Survey
SOFIA	State of World Fisheries and Aquaculture
SPC	South Pacific Community
TDB	Tonga Development Bank
UNCED	United Nations Conference on Environment and Development
UNCLO	United Nations Convention Law of the Seas
USA	United States of America
USP	University of the South Pacific
WTO	World Trade Organisation

Chapter 1

Fisheries and small island economies

1.1 Introduction

For many island economies in the south Pacific, fisheries provide an invaluable resource base. The Pacific Ocean offers Pacific island countries, many of whose communities depend on fish for their basic livelihood, bountiful resources that can be exploited for social and economic development.

In Tonga, an island economy in the south Pacific region, fisheries are an important resource for economic development for the country as a whole through foreign exchange earnings. At another level – domestically – fishing remains an important source of livelihood for many rural people and communities, especially those living in the outer islands outside of the main island of Tongatapu. As indicated in *Chapter 5*, domestic fishing is of great significance to Tonga, not only because it provides an important part of the basic diet and protein requirement for rural communities, but also because it is an important resource base for community development. In one particular island community, Pangaimotu in Vava‘u, the dilemmas facing the community are how much economic development activity involving fisheries they should embrace (given the need to ensure the sustainability of the resource), and to what extent they should engage in tourism (given the fact that it could put pressure on the community’s inshore fisheries resources) (see *Chapters 6 and 7*). Any decision to reclaim areas for tourism development will inevitably put pressure on an important part of the ecosystem, that is, mangrove swamps, but mangrove swamps provide the main breeding grounds of inshore fish, and a nursery and habitat for them. It is therefore important that the community should be well informed about the potential consequences, so far as fishing is concerned, of clearing mangrove swamps to provide for tourists.

This thesis sets out to provide a better understanding of economic issues relating to fishing and fisheries in Tonga by looking at both of the main sectors, the export sector (*Chapter 4*) and the domestic sector (*Chapters 5 - 8*). The export sector,

known also as national level, which is associated with offshore or deep sea fishing, mainly involves large commercial fishing companies although there are also a number of small-scale fishing operators. Their major concern is to catch fish for sale: many of the fish caught in Tonga are exported to fish markets overseas. The domestic fishing sector is associated primarily with inshore fisheries which are largely non-commercial, providing a secure source of food to help maintain the basic livelihood of semi-subsistence rural island villagers and communities.

So far as the export sector is concerned, this thesis sets out to examine the critical relationship between resource utilisation and the social and economic development of the country as a whole. So far as the domestic sector is concerned, the aim is to explore the interaction between fishing and other development activities such as tourism. Thus, for example, the development of tourism in a rural area may have an impact on one natural resource, mangroves, and this, in turn, may have an impact on the sustainability of another natural resource, fish. It is important that there should be a better understanding of such interactions since they are fundamental to the social and economic development of Tonga. Thus, any consideration of the Tongan fishing industry, and, in particular, of its sustainability, must take account of the potential impact of other types of development activity.

1.2 Background to the study

Because Tonga is an island economy, the fisheries sector is of special significance. It is for this reason that it is the focus of this study. International trade is important to most countries of the world because there is an uneven endowment of economic resources, and no single country can produce all the goods that its consumers demand. Small island economies, such as Tonga, with very limited economic resources, rely on international trade as a means of fulfilling local consumer demand. Trade has recently re-emerged with renewed significance as an important means of facilitating economic development. The barriers to trade have an impact on the flow of goods between countries. These barriers are considered as obstacles to the financial returns that producers/exporters, in this case, fisher people, receive from trading. These

barriers cause additional marketing costs, and thus reduce export volume. This study attempts to analyse the return that fisher people in Tonga are able to obtain when exporting fish to Tonga's main export markets overseas. In so doing, it sets out also to provide insight into important economic issues relating to the Tonga fisheries export sector as they affect the financial returns fish exporters can expect to receive from their exports. There are two key variables here: the types of fish exported, and the size of the local fish operators.

There is ongoing debate about the ways in which a balance can be achieved between the requirements of the domestic market (as a major source of livelihood) and those of the export market (on which there are ever-increasing demands for growth). While the export of fish is important for Tonga from the standpoint of the country as a whole, domestic fishing is equally important for rural communities who have little access to commercial activities. For this reason, one aspect of this thesis is exploration of the development issues relating to fishing that impact on a particular rural community, that of Pangaimotu in the Tonga outer islands of Vava'u. Here, as in so many other areas of Tonga, the domestic fisheries sector is a subsistence one, providing a basic food requirement that is essential to the community's livelihood. The choice of Pangaimotu for research into the Tonga domestic fisheries sector rests on a number of important considerations. First, Pangaimotu has geographical features and natural resources that provide opportunities for economic activities that are unique in Tonga. Second, the region is considered to be reasonably well preserved, with the mangrove ecosystem playing an important role in the livelihood of the community. A major dilemma facing the island community of Pangaimotu is how it is to manage a particular natural resource, namely mangroves, in a sustainable way at the same time as engaging in economic development activities, such as tourism, fisheries and forestry, which, although they have the potential to contribute significantly to social and economic well-being, can impact in a negative way on mangroves. Thus, for example, the forestry sector uses mangroves for producing dye which is then used for *tapa* making.

This study attempts to help clarify issues relating to resource use and sustainability in the wider context of a small island economy through the

exploration of a particular rural community whose aspirations in relation to social and economic development need to be balanced against the importance of protecting the basic livelihood of the community in the long term by ensuring sustainability of a basic food resource, fish. In the case of Pangaimotu, the three different economic activities undertaken by the community – namely tourism, fisheries and forestry – provide the basis for the conceptualisation and design of an inter-sectoral economic model (see *Chapters 6 and 7*). This model is used to examine the relationships between the economic activities of fisheries and tourism in order to demonstrate how these activities could be managed in a way that would allow the community to engage in money making activities without compromising their future food security and basic livelihood (see *Chapter 5*). Thus, the economic model is used as a tool to help ensure that the community is informed of the optimal choice of economic development activities and made aware of the potential implications, so far as the welfare of the community is concerned, of failing to manage different economic development activities appropriately.

1.3 Objectives of the study

In Tonga, fish exports have gained prominence at the national level, particularly in terms of foreign exchange and international trade issues. Development planning in Tonga highlights the importance of the fisheries sector, placing fisheries among those industries which demonstrate the highest growth potential for Tonga's social and economic development policies (Tonga Government 1996). At the domestic fisheries level, however, as the case of Pangaimotu demonstrates, the debate is over economic development versus food security. By looking at fisheries from both a local and a national perspective, this study hopes to provide a timely contribution to the ongoing global debate of resource management and sustainable development.

The broad conceptual framework of this thesis recognises the need to develop a wide picture, hence the importance of looking at the economic issues of fisheries from a global, regional (Pacific Island countries) and local perspective. Fish is the largest single source of animal protein, and some small island states depend on fish almost exclusively. World fisheries production and the fish trade generally

have continued to grow rapidly over the last decade. At the same time, the growing importance of China and its accession to the World Trade Organization (WTO) has implications for the Pacific region and also for Tonga fisheries.

As the fish trade makes an ever-increasing contribution to the Tongan economy, the challenge Tonga faces is that of ensuring that resource utilisation continues to be sustainable. Tonga's population and economic growth are putting enormous additional pressures on inland and marine fishery resources, which at the same time are important contributors to food security and providers of a social safety net. The recently established trade relationship between Tonga and China will clearly be assessed in the near future since Tonga became a full member of the WTO in July 2007. For a country whose main source of revenue comes from indirect taxes, the implications of lowering tariff in order to meet the requirements of the WTO are yet to be fully realised.

Within the context of this thesis, the Tonga fisheries sector is divided up into two broad areas, also described here as sectors. This division represents a recognition of the fact that the economic issues relating to different fishery sectors in Tonga are different. Associated with each sector are different problems and obstacles. For one sector, the Tonga exports fisheries sector, the issues are primarily national in focus. For the other sector, the domestic fisheries sector, the issues are primarily local in focus.

At the national level, fish exports are the main focus of attention, especially through foreign trade. In formulating the research surrounding exporting, there is a need to understand the different cost structures relating to fish exports from Tonga to its main fish markets overseas. The net return that fisher people receive depends on the type of fish exported (e.g., tuna as opposed to bottom fish such as snapper or grouper). Other important variables which affect financial returns on fish exports overseas are the size of the local fishing operator and the size of the vessel or vessels used. Thus, for example, different cost structures apply in the case of tuna long-line fishing and bottom fishing, and smaller-scale individual operators have different marketing costs from those of larger operators.

At the local level, that of the domestic fisheries sector, the major issue is the sustainability of fisheries as a major food resource for the livelihood of rural and non-commercial dwellers. The assumption made in the thesis is that the livelihoods of these people are at stake when other forms of development activity, such as tourism, are undertaken without sufficient regard to how they might impact on fisheries resources. In order to explore relationships between different economic activities at a local level, it was necessary to focus on a particular community. The rural community of Pangaimotu was selected as the focus of this section of the thesis, the aims being to attempt to determine the optimal choice of development activity in the community and to analyse the potential impact on the community of a change of the status quo involving the reclamation of more land, including mangrove areas, to allow for additional tourist resorts.

Given the fact that the choices made can have very significant consequences, it is important that governments (Government policy) and communities (community livelihood) should choose wisely in matters of the conservation and use of resources in the context of development activities. If they are to do so, they will require quantifiable data, hence the employment of an inter-sectoral economic model to provide a simulation of Tonga's domestic fisheries sector, one of the few sectors that has significant potential to contribute to the country's economic development hopes and aspirations.

1.4 Context of the study: Tonga overview

To help put Tonga into context and appreciate the importance of fisheries there, a brief overview of Tonga is provided.

1.4.1 Geography

Tonga is an archipelago of about 150 islands, of which only 36 are permanently inhabited. It lies between 15° South and 23° 30' South latitude and 173° West and 177° West longitude. Tonga's fisheries management system has an Economic Exclusive Zone (EEZ) that covers an area of 700,000 square kilometres. This is compared to only 748 square kilometres of Tonga's land mass. The islands fall into three main groups – southern Tongatapu group, central Ha'apai group and northern Vava'u group. The largest island is Tongatapu, with a total land area of 256 square kilometres. The capital is Nuku'alofa. Tongatapu is approximately

1,850 km northeast of Auckland, New Zealand and around 2000 km east of Australia (see Map 1). Tonga has a subtropical climate characterized by a warm period from December to April and a cool period from May to November, with most rainfall occurring during the warm period. Cyclones are more frequent in the Northern Islands, occurring every few years during the rainy season, and can be quite destructive. On average, Tonga has had one tropical cyclone in every four years over the last three decades. The frequency of cyclones affects economic activities in Tonga, not only the tourism activities in the islands but also the fishing activities.

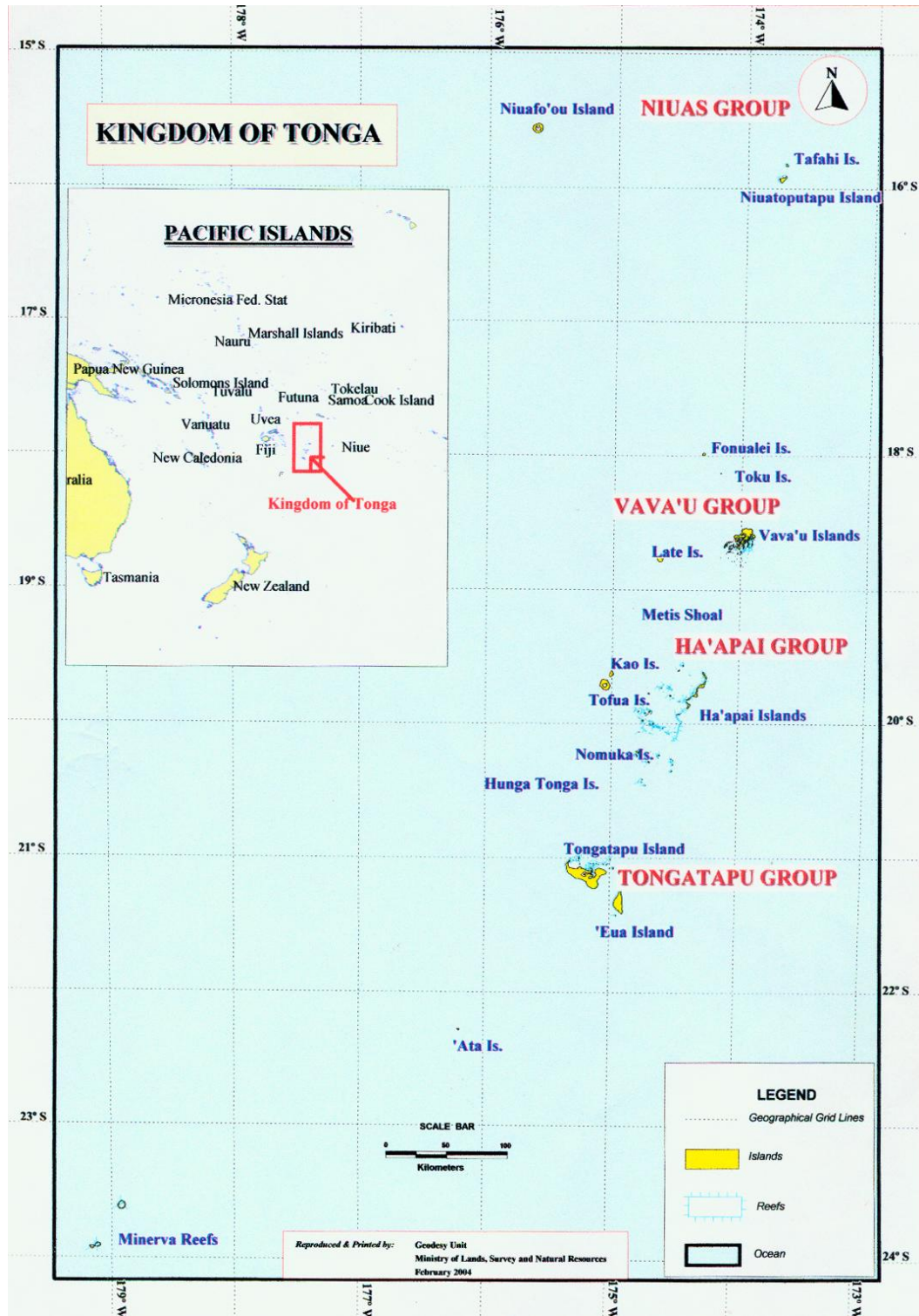
1.4.2 Population and Development

Tonga's population is about 102,000, with an annual population growth of 0.4 per cent. Almost half of its population is made up of children and youth below the age of 20. The unemployment rate was around 13 per cent in 2004 (The World Bank 2006). There is a slowing down of the population growth rate, due largely to emigration mainly to New Zealand, Australia and the United States. While the high rate of emigration has generated a steady stream of remittances, it has also created the paradox of high dependency rates and skill shortages. This is due to the fact that a significant proportion of those who have migrated overseas are from the well educated and productive age group. Migration will also have an impact on the fisheries sector. Thus, the thesis attempts to examine the impact on subsistence fisheries on the nutrient needs of the local population due to external migration (see *Chapter 5*).

There is also significant internal migration in Tonga, particularly from the outer islands to Tongatapu. The 1996 census showed that Tongatapu has registered a net gain of 0.5 per cent, especially in the capital, Nuku'alofa. Vava'u and 'Eua also registered increases of 0.4 and 1.2 per cent, while the populations of Ha'apai and the Niuaus have decreased by 0.9 and 1.5 per cent respectively. As a result, a considerable amount of agricultural land, particularly in the outer islands, is not utilised. These demographic changes have also had an adverse impact on fisheries (discussed in more detail in *Chapters 6 - 8*). In areas of population increase, there has been a rise in demand for residential land. As a result, low-lying coastal areas of mangroves that are ideal for spawning of fish have been cleared and filled with

soil to make way for buildings. Using Pangaimotu as an example, of the impact of tourism development on reclaimed mangrove areas will be discussed later in the thesis.

Map 1: Kingdom of Tonga



1.4.3 The Economy

To put the study into context, it is appropriate to look at the performance of the Tongan economy for the decade 1994–2004. This period has been selected for the following three reasons. First, because the fisheries sector, which is the focus of this study, underwent historic developments during this period, coverage of it will provide useful information on both economic issues and policy issues that affect the fisheries sector in Tonga. Second, for the local community in focus here, Pangaimotu in Vava‘u, this period also saw the establishment of its first tourism development, the Hinakauea Beach Resort. Finally, data are readily available and accessible for the decade from 1994 to 2004.

1.4.3.1 Tonga as a small island economy

As a small island economy, Tonga only has a small population and Gross Domestic Product (GDP). The domestic market is also small, suggesting a limited supply of labour, with fewer firms and thus low domestic competition. The importance of agriculture is very much related to the level of GDP. Tonga has a GDP level below US\$180 million. In fact, Tonga has to rely on agriculture (including fisheries and forestry) for as much as almost forty per cent of the GDP (Food and Agricultural Organisation 2002a).

There are also limited natural resources and the land area available for productive purposes is limited. Because Tonga’s resource base is narrow, fragile and prone to disruption by natural disasters, Tonga is therefore highly dependent on the international trading system, especially in agriculture, including fisheries. In addition, Tonga depends on only a few export commodities for a high proportion of its export earnings (sixty one per cent), making it particularly vulnerable to changes in world markets. The Tongan economy is a net food importer, with food constituting a large share of total imports (Food and Agricultural Organisation 2002).

The interplay of the above-mentioned factors creates specific handicaps for Tonga. Due to the relative size of the Tongan economy, as a small Island, it faces a number of significant challenges in achieving and retaining competitiveness in international markets for agricultural products, including fisheries. Tonga’s small

size and geographic isolation present particular challenges in terms of achieving sufficient economies of scale to enable producers to compete in international markets, and, in many cases, to compete with imported commodities in the domestic market. Scale diseconomies make Tongans dependent on imports for most of their consumption and investment needs as well as on a narrow range of export products, resulting in a high vulnerability to external economic shocks.

In general, the Tongan economy is also dependent on agricultural exports for a significant part of its export earnings. This dependency on agricultural exports has meant that Tonga suffered from a long-run decline in world market prices in real terms and a slow growth in world demand for its major agricultural products. In addition, along with other small island economies, Tonga has found that its agricultural exports are highly reliant on preferential agreements and thus are exposed to risks from multilateral trade liberalization. In general terms, the high dependency on world markets makes the achievement of sustainable agriculture and food security for these small island economies more complex and difficult than for other relatively bigger economies.

1.4.3.2 Tonga's economy: A brief overview

The Tongan economy is based primarily on agriculture, including fisheries and forestry. Manufacturing and tourism are also important contributors although to a lesser extent. Agricultural products comprise over ninety per cent of exports, including fisheries. Tonga's economic base is narrow and vulnerable to external market forces and its reliance on the agricultural sector leaves it susceptible to the impact of adverse weather conditions. As a small island economy, Tonga is subject to seasonal and external factors over which it has little control. The trade deficit continues to grow and there has been a steady depreciation in the value of Tonga's currency – the Pa'anga – over several years (see *section 1.6* for details).

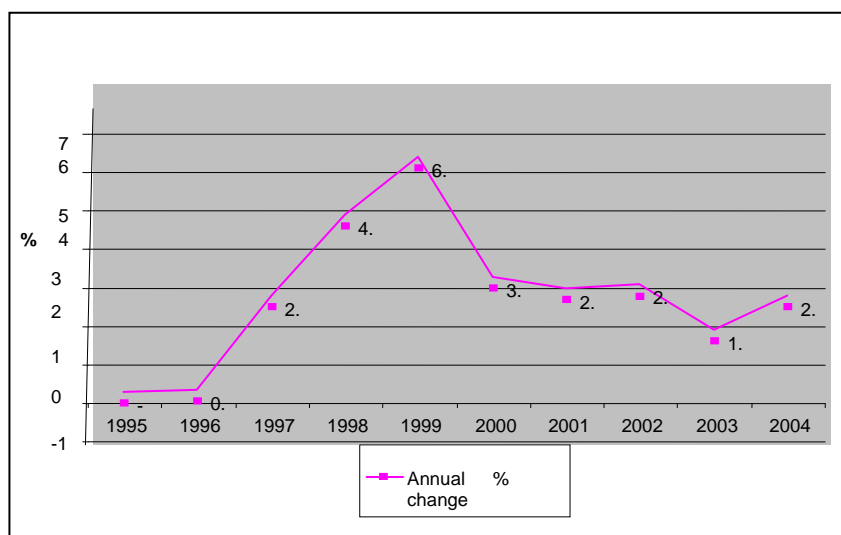
As noted above, the Tongan economy has a narrow export base in agricultural goods. Domestic economic activity is based mainly on the agricultural sector, including fisheries. An estimated seventy per cent of the population derive at least part of their livelihood from the agricultural sector, including fisheries. The Tongan economy is also characterised by a large non-monetary sector and a heavy

dependence on remittances from about half of the country's population who live and work abroad, mainly in the United States, New Zealand and Australia. The trade deficit is usually offset by this large inflow of remittances. A more detailed discussion of the impact of remittances on Tonga's fisheries is provided in *Chapter 5*.

1.4.3.3 Economic growth

The Tongan economy continued to grow since 1996, reaching a high annual growth of 6.1 per cent in 1999. Real GDP growth, however, declined dramatically after that to a low level of 1.6 per cent in 2003, then started to grow again, standing at 2.5 per cent in 2004 (see *Figure 1.1*).

Figure 1.1: Real GDP



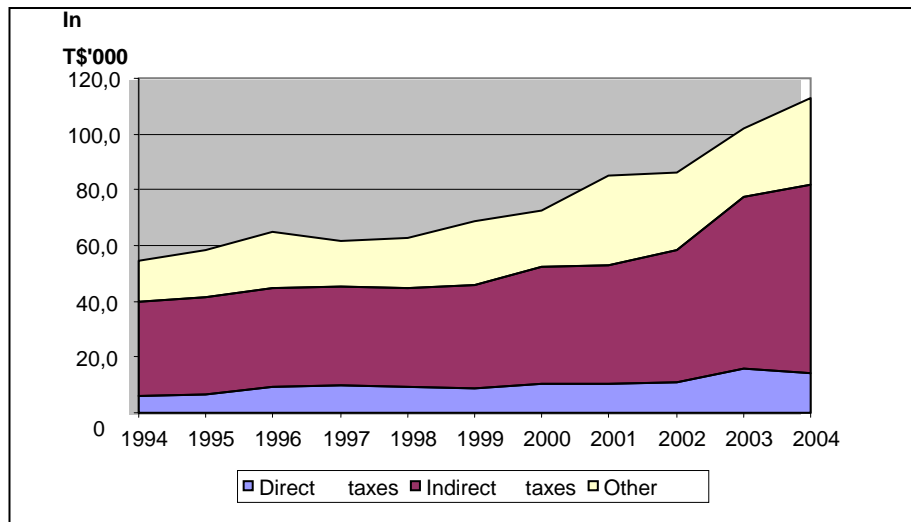
Source: National Reserve Bank of Tonga

In terms of Tonga's primary sector, which includes agriculture, forestry and fishery, a growth of -3.0 per cent was experienced in 2005 compared to -3.3 per cent in 2004. This decline shows the non-performance of most agricultural commodities, including lower international prices and a reduced quantity or production in the squash industry, as the major export commodity from Tonga.

1.4.3.4 Sources of Revenue

The main sources of government revenue for Tonga continue to be in the form of taxes on international trade. The importance of revenue collection from tariffs and duties through external trade is a major contribution to Tonga's economy (see *Figure 1.2*).

Figure 1.2: Sources of current revenue



Source: Statistics Department, Tonga

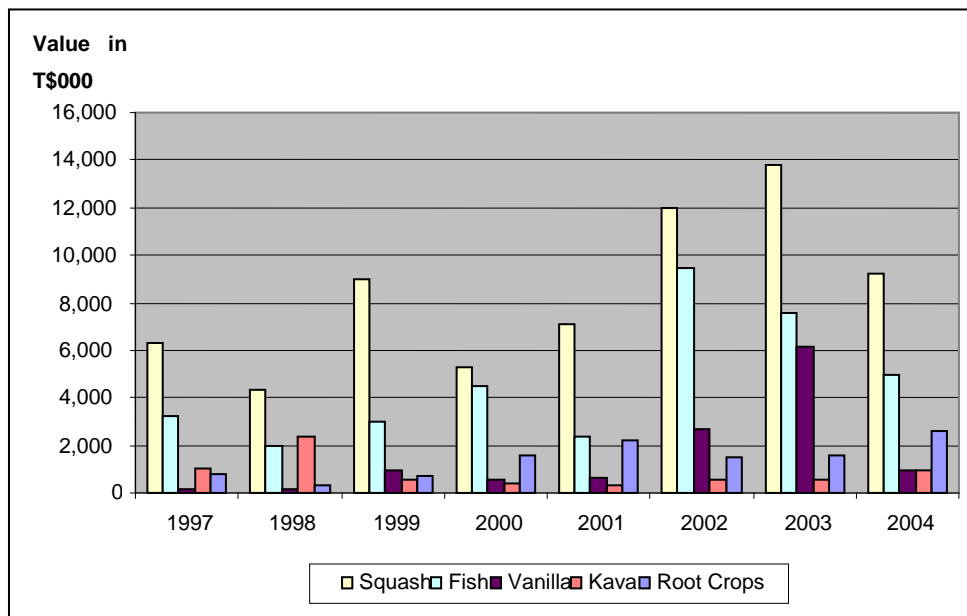
This heavy reliance of government revenue from tariffs and duties on international trade will pose serious implications for the government's bottom line since Tonga became a member of the WTO in July 2007. The terms of Tonga's membership to the WTO place certain restrictions on the level of duty that will be imposed on imports, and there are also requirements for Tonga not to discriminate against imported goods from other member nations. The 'final bound rates', which are restricted to only fifteen or twenty per cent, are the rates that may be applied to imports from other member countries of the WTO. Tonga currently levies import duties at up to forty five per cent (vehicle) on general goods, and rates of around thirty per cent on excise goods. Since Tonga joins the WTO, the maximum rates applied to imports are set at twenty per cent, with any non-excise goods that are currently dutied at higher levels having a twenty per cent rate instead. The import

tariff rates applying to excise goods are set to a rate of ‘free’¹ and dealt with instead by a new excise tax applying to alcoholic beverages, tobacco and petroleum fuels. Clearly, there is going to be a significant revenue impact from the adoption of the WTO Customs Tariff Schedule (CTS), which must somehow be compensated for by other forms of indirect taxes. The CTS rates consistent with Tonga’s WTO accession application came into effect from 1st August 2006.

1.4.3.5 Exports

Agriculture remains the main export sector, with squash pumpkin exports to Japan forming the main agricultural activity. Fisheries had been the second most important export commodity for Tonga since 1993. Vanilla, kava and root-crops are the main export earners (see *Figure 1.3*). Tonga's main export markets are Japan and the United States, which took nearly 80 per cent of exports in 2003. The other important export markets are New Zealand and Australia. Geographic isolation and a narrow resource base restrict the scope for export diversification and import substitution.

Figure 1.3: Local Export Commodities



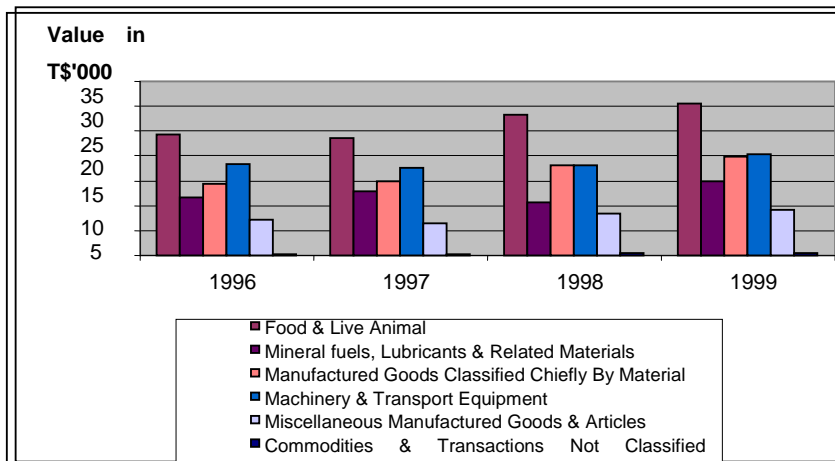
Source: Statistics Department, Tonga

¹ ‘Free’ is ‘zero rate’, which while practically the same as an exemption, has an effect of indicating the goods are dutiable but at a zero rate, which is below the ceiling rate.

1.4.3.6 Imports

Tonga, as a small island economy, inevitably has a high dependency on imports. Tonga imports a high proportion of its foodstuffs, mainly from New Zealand. The other main imports are machinery and transport equipment, manufactured goods and fuels and chemicals (see *Figure 1.4*). Tonga's main import destinations are New Zealand (37.1 per cent); Fiji (24.3 per cent); Australia (9.1 per cent); China (8.9 per cent) and USA (6.3 per cent). From Tonga's point of view, if it was possible to reduce dependency on imports, especially on foodstuff, then fisheries is a likely import substitution good. An increase in tuna by-catch will lead to an overall fall in the price of fish, thus making it more affordable for consumers and therefore reducing dependence on imported fatty meat and tinned food.

Figure 1.4: Import Commodities

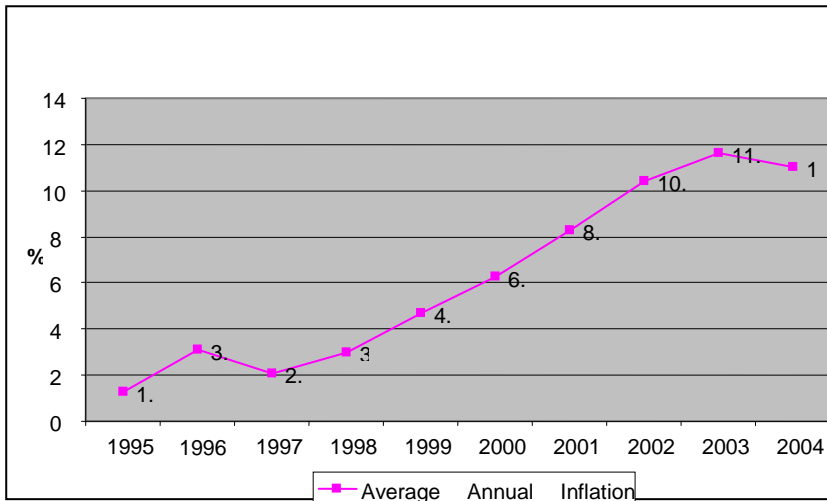


Source: Statistics Department, Tonga

1.5 Inflation

Tonga has suffered from double digit inflation in recent years due in part to the appreciating currencies of its main trading partners (see *Figure 1.5*). The average annual inflation rate continued to grow following the low level of 2.1 per cent in 1997. It has continued to grow from single into double digits in 2002, peaking at 11.6 per cent in 2003 before easing out in 2004 (see *Figure 1.5*). The general increase in price of local goods will have implications on the performance of the fisheries sector.

Figure 1.5: Average Inflation Rate (%)

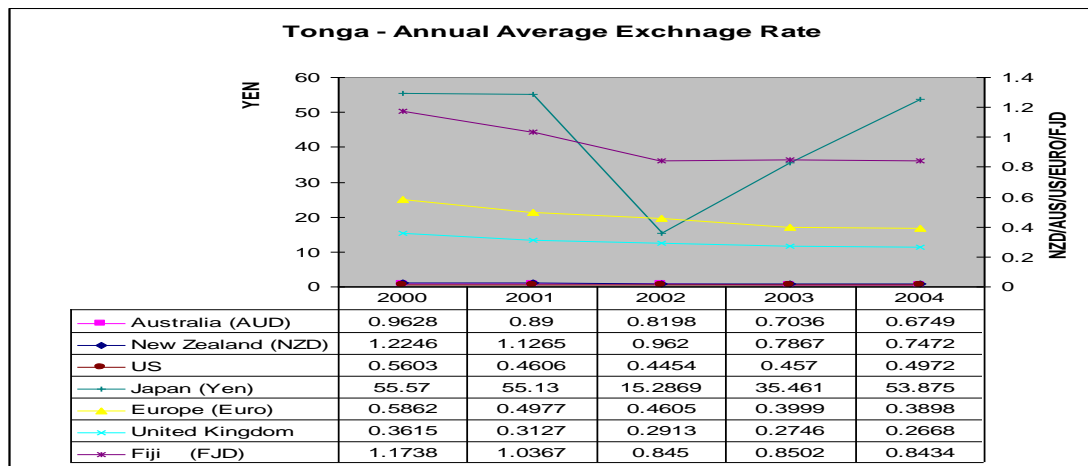


Source: Statistics Department, Tonga

1.6 Exchange rates

Tonga’s economy remains vulnerable to external shocks. The trade deficit continues to grow and has seen a steady depreciation in the value of Tonga’s currency – the Pa’anga – over several years (see *Figure 1.6*). In 2004/05, the Pa’anga depreciated against the AUS, NZ, US, EURO and FJ dollars. In contrast, the pa’anga appreciated against the Japanese Yen. The inflation rate and exchange rates no doubt have an impact not only on the domestic prices of fish but also on the financial return exporters expect to receive from their trading partners overseas.

Figure 1.6: Exchange Rate



Source: National Reserve Bank of Tonga

1.7 Government objectives and policies

The predominant development objective of the Tonga Government Development Plan has been to achieve a sustainable rate of economic growth conducive to higher and more equitable distribution of incomes (Tonga Government Central Planning Department 1996). The basic thrust of the Government's economic policies was to diversify the economic base in order to break the reliance on a narrow range of crops, thus creating additional employment opportunities and fostering private sector development. The Development Plan highlights the importance of the fisheries sector in its development strategies, and places fisheries among sectors demonstrating the highest growth potential for Tonga's economic development.

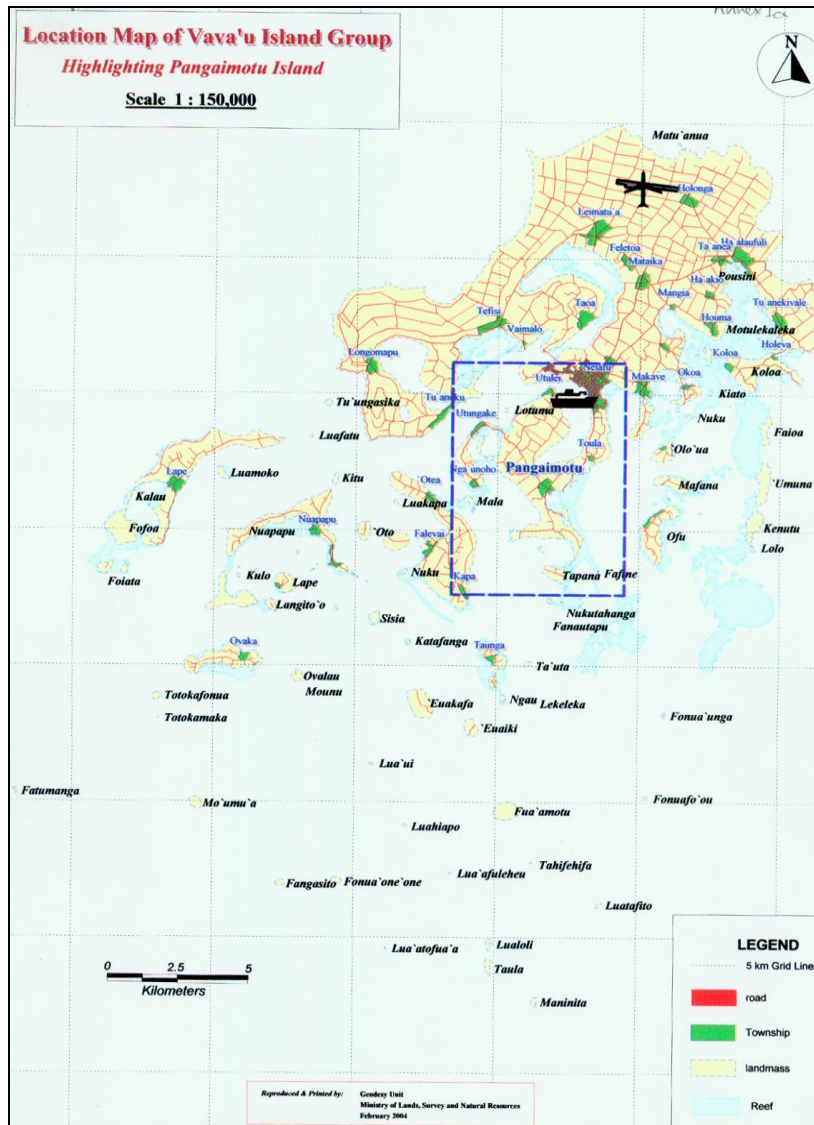
1.8 Land tenure and agricultural system

In Tonga, all land belongs to the Crown and is administered by the Minister of Lands as the King's representative. The King grants land to nobles in the form of estates, where the nobles in turn are supposed to distribute land to the commoners. Land, however, cannot be alienated but it can be leased. The Land Act of 1882 established the right of every Tongan male who is sixteen years and older to a town allotment and a tax allotment. Each adult male was allocated three ha of farm land and a town plot and became liable to pay a poll tax. Almost two-thirds of the land is thus allocated, although not all of it is put to productive use. The expectation, however, is that every person could thus meet the subsistence needs of his or her family, and this arrangement over the years has helped to constrain wage increases in Tonga. With population growth and the resultant demand on agricultural land for residential purposes, however, many adult males are now unable to own land. Many of the traditional 8.25-acre tax allotments are being sub-divided into smaller units as a means of fulfilling land demand. It is estimated that over the past five years, about 200 acres of farmland have been given up for residential and other purposes. This increased usage of land for residential purposes, especially if along coastal zones, will affect the fisheries sector as mangrove areas that used to be breeding ground for fish has been cleared for residential development.

1.9 Area of study: Pangaimotu, Vava'u.

Vava'u is the second largest island in Tonga. It is located 18.36 South latitude and 173.58 East longitude. It is a raised coral island, and consists of one large island and as many as 40 smaller islands. Only 21 of the islands are inhabited. Neiafu is the urban capital of Vava'u and is the second largest town in Tonga (see map 2). The population of Vava'u is around 20,000. Vava'u has a total land area of 103.6 square kilometres. Neiafu is Tonga's main centre for yacht charters and one of the world's yachting capitals for diving and game fishing. It is also one of the best places in the world to go whale watching, as whales arrive yearly to breed in the warm waters around Vava'u. Neiafu's beautiful coastline, sheltered waterways, secluded anchorages and steady trade winds are major attractions for tourists visiting Tonga in their yachts.

Map 2: Vava'u Island



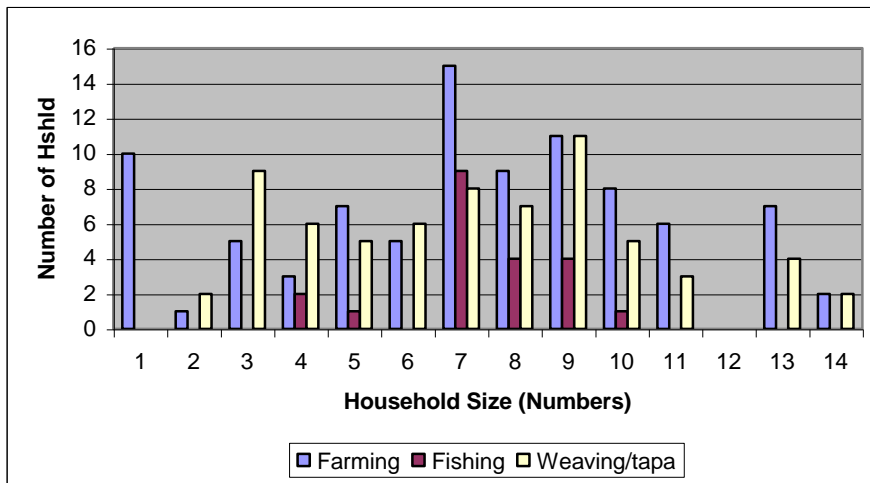
Pangaimotu is located near the main island of Vava'u. It is the second largest island in the Vava'u group. Pangaimotu lies latitude $18^{\circ} 40'$ S and longitude 174° West. It is a raised coral island and has a land area of 9.2 square kilometres and a shoreline of 23.7 kilometres (Franklin 2003) (see map 3).

Map 3: Pangaimotu -Vava'u Island



There are 689 people living in Pangaimotu, comprising 95 households (Tonga Government Census 2001) altogether, living primarily on subsistence fishery and agricultural activities, with an increasing share of the local economy coming from tourism. *Figure 1.7* suggests that an estimated eighty four per cent of households are engaged in fishing and farming. Fishermen are mostly artisan fishermen. Women constitute forty eight per cent of the total population of Pangaimotu and their main contribution to economic activity is weaving as highlighted in *Figure 1.7*. More than seventy one per cent of households have a household size of five members or more (see *Figure 1.7*).

Figure 1.7: Pangaimotu Household Economic Activity



Source: Statistics Department - Census Report

1.9.1 Pangaimotu community utilisation of its mangrove ecosystem

There are three main economic activities taking place in Pangaimotu that have a direct impact on the community's mangrove ecosystem. These are fishing, forestry and tourism development. The most commonly harvested fish products are fish and shellfish. For forestry, local residents use the bark of the mangrove plant for dye for *tapa* making. This ecosystem is also of interest for tourism development, which led to the establishment of Hinakauea Beach Resort in 1994. A detailed analysis of these activities in *Chapters 6 to 8* sheds more light on how best the community should utilise its mangrove ecosystem. The analysis, based on the inter-sectoral economic model, should also enable the community to assess the costs and benefits of these different development activities.

1.10 Research issues, outcomes and methodology

This research project revolves around the following basic issues and questions regarding fisheries in Tonga.

Firstly, what are the current economic issues facing the fisheries sector in Tonga? In other words, what are the global and regional issues facing the fisheries sector and what implications do these global and regional issues pose for the fisheries sector in Tonga? The second issue, relating to fisheries at the national level, is Tonga's fisheries export sector. The key questions include the following:

- How can fisher people maximise the benefit (net return) from fish exports?
- How do returns to fisher people differ by type of fish exported and the size of the operators?
- Which export market offers the best return for fisher people?

Exploration of Tonga's fisheries export sector relates in particular to how marketing costs affect the financial returns that fisher people received. The research approach employed at the national level sets out and tests several export scenarios and market destinations to see how the type of fish exported and the size of the local fisheries operators moderated the income received from fish exports.

The third key issue, regarding domestic fisheries in Tonga, relates the livelihood and sustainability of rural island communities to the economic issues affecting fisheries. From the point of view of a fisheries-dependent community, the key issues are based around the following basic questions:

- How would the rural/outer island community's diet and protein needs be affected by increased economic activity other than fishing?
- What are the potential impacts of migration on Tonga's fisheries sector?
- On the issue of sustainable fisheries, what are the potential implications for the rural community?

- How would the community respond to a type of economic development that would provide job opportunities for them versus relying on fisheries resources?
- How would the community respond to the commercialisation of fish – from subsistence to fishing for export markets?

As indicated earlier, by taking the community of Pangaimotu as the case study, the research focuses on how the community might decide on the optimal use of its natural resources for the benefit of the community as a whole and in a sustainable way. In other words, what are the best returns to the community by engaging in and managing three different economic activities, namely, tourism development, fisheries and forestry?

1.11 Significance of the thesis

This thesis sets out to highlight and reinforce a number of important issues regarding economic development and resource utilisation in Tonga. This study hopes also to contribute towards assessing economic issues that affect small island economies in general. Its focus on fisheries in Tonga provides a backdrop against which the more general issue of the way in which a single economic activity, fishing, may assume a different significance in the context of different island economies. Thus, at a national level, fisheries in Tonga have great significance in relation to foreign exchange and international trade issues that affect the country as a whole, whereas at the local and domestic fisheries level, as the case in Pangaimotu demonstrates, the critical issue relates to economic development versus food security and sustainable utilisation of resources. Because different levels of fishery activity are highlighted in different parts of this research project, it has the potential to provide a timely contribution to the ongoing debate worldwide of resource management and sustainable development. The Tonga Development Plan highlights the importance of fishery, placing it among those sectors demonstrating the highest growth potential for Tonga's economic development. This thesis hopes to make a useful contribution to that national aspiration of increasing revenue from fisheries.

Much existing trade literature takes a wide-angle rather than narrow angle view, tending to focus on trade overall and barriers to overall trade rather than on particular sectors such as fisheries, and the problems these sectors face. Thus, it is hoped that this study will usefully address one aspect of the gap in sectoral studies in the international trade literature. Furthermore, since much of the literature on fisheries focuses on resource management and legislation, there is a need for research that involves looking more closely at the interaction between marketing opportunities and support for barriers to trade, such as the way in which subsidisation has contributed to the current conservation crisis in global fisheries. Studies such as this are therefore in sharp contrast to those earlier studies that have focused on production. The involvement of such institutions as the Food and Agricultural Organisation highlights the significance of this shift in focus. Lessons learnt about Tonga may be relevant to other small island economies, especially those in the Pacific Islands region.

An increasing dilemma faced by decision-makers is how to balance fish exports against domestic demand and food security. This is the core economic issues facing the fisheries sector in Tonga. The downturn in the fishing industry in Tonga that has taken place during the course of this study has led fish exporters to explore all possible opportunities for meeting overseas demands. The government has attempted to assist the industry by providing a fuel subsidy. However, it has been argued that subsidisation will lead to over-exploitation of fish resources. There was also concern that over-exploitation will not only affect domestic demand, but also the food security of rural communities in Tonga, especially in the outer islands. There is evidence that while ocean resources have been dwindling, global demand for seafood has been steadily rising. This growing demand has intensified fishing efforts and so put even greater pressures on available fish stocks. The concept of sustainable development as fish stocks are depleting is one that is by no means limited to small island economies. It is now an issue of major significance within the international fish trade as a whole.

1.12 Outline of the thesis

In addition to this introductory chapter, there are further eight chapters as follows:

Chapter 2 provides a more detailed outline and explanation of the approach and methods employed in the study. Here, issues of validity and reliability are addressed in relation to the combination of qualitative and quantitative approaches adopted.

In *Chapter 3*, the literature review, based on a conceptual framework that moves from global through regional to local, is intended to provide an appropriate background to the study of Tonga fisheries. In situating fisheries in Tonga against both global and regional backdrops, allowance is made for the possibility of framing economic issues in relation to Tonga fisheries in such a way that they resonate with other small island economies world wide.

Chapter 4 reports on an examination of economic issues relating to national fisheries, that is, the focus is on the Tonga international fish export trade, and, in particular, the return to fisher-people from major fish markets overseas. Issues relating to the costs of production and marketing of fish exports from Tonga, as moderated by the types of fish exported and the size of the local fishing operator, are also discussed.

Chapter 5 provides an examination of issues facing Tonga's domestic fisheries. Here, attention focuses on the likely impact on subsistence fisheries and the livelihood of the local community of Tongan migration overseas. A comprehension survey is used in relation to the impact on the fisheries sector (and on those who remain in Tonga) of migration to New Zealand. This is considered to be a particularly important issue in view of the fact that remittances constitute almost forty per cent of Tonga's GDP.

In *Chapter 6*, the focus on Tonga's domestic fisheries continues, the emphasis here being on the dilemma facing the mangrove fisheries-dependent community of Pangaimotu, especially regarding the impact that tourism development is likely to have on its mangrove resources, and, in turn, on the community's fisheries, fish having traditionally provided the primary means of sustenance and livelihood for the community. The major assumption underlying this examination is a conventional view of sustainable development, that is, that too much economic

development activity in one particular industry may have a negative impact on other industries. The analyses in *Chapter 6*, supported by the results provided in *Chapters 7* and *8*, offer the possibility of a more nuanced interpretation of the concept of sustainable development.

In *Chapter 7*, an inter-sectoral economic model, which employs a differential equation approach, is used to determine various relationships between two of the main economic development activities within the community of Pangaimotu; namely tourism and fisheries. The results indicate that it is possible for the same community to engage in both tourism and fisheries activities so long as a range of important considerations is taken into account.

Chapter 8 involves the application of a simulation model which is designed to elaborate upon the discussions and issues highlighted in *Chapter 6*. The model is used to demonstrate the impact on fisheries resources in Pangaimotu of the development of tourism beyond a certain limit. What is demonstrated here is not only the importance to small island communities of sustainable exploitation and use of natural resources, but also the need for a more nuanced interpretation of the concept of sustainable development than is often available. Since an increase in the price of fish exports might encourage domestic fishers to switch from subsistence to commercial fisheries, three different scenarios are discussed in relation to allocation of labour to different economic activities within the Pangaimotu community.

Chapter 9 concludes the thesis, providing a summary of salient issues and findings, and drawing attention to the significance of the ways in which *Chapters 5* to *8* demonstrate, on the basis of empirical study and quantitative analysis, the value of adopting a more nuanced interpretation of the concept of sustainable development.

Chapter 2

Research Methodology

2.1 Introduction

The ‘search for truth’ entails one’s concern to come to grips with the surrounding environment and to understand the nature of the phenomena it presents to the senses. The means by which people set out to achieve this may be classified into three broad categories: *experience*, *reasoning* and *research* (Mouly 1978:6). Though classified into three distinct categories, each category is far from being independent and mutually exclusive. Instead, they must be seen as complementary and overlapping features that can provide solutions to complex modern problems, such as those dilemmas faced by small island economies in the Pacific. In this thesis, all three means of searching for truth have a role to play.

To come to terms with the problems of every-day living, we are heavily dependent on our *experiences*. Experience helps us explain and understand what is going on around us. Hence the authority and value of experience in any search for truth should not be underestimated. However, while experience helps explain what is going on, that in itself is often not enough, and so *reasoning*, inductive, deductive or both, comes into play. Where experience and reasoning are not enough, *research* becomes critical because, as Kerlinger (1986:10) observes, it provides for the systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among natural phenomena and, therefore, can help us to understand *why* things happen. In this thesis, experience, logic and research, applied within the context of what is known as ‘the Pacific Research Paradigm’, all have a role to play in the search for better understanding of Tongan fisheries.

In the following sections, a discussion of the Pacific Research Paradigm (*section 2.2*), a paradigm which informs the research methodology used in the study, is followed by an introduction to the research types (qualitative and quantitative) and research methods, including the data collection methods and the tools used for

data analysis (*section 2.3*), along with, as recommended by Bouma (1996), the rationale for their selection and use. I then provide a historical outline of the events that took place during the course of the four different fieldwork trips that were undertaken and the manner in which the research work as a whole was conducted (*section 2.4.2*), ending with a summary (*section 2.5*).

2.2 Combining Positivism and the Pacific research paradigm

Underlying, and fundamental to the research reported here are both the philosophy of knowledge that has come to be designated as ‘positivist’, that is, a philosophy that is based on “tested and systematised experience rather than (so-called) undisciplined speculation” (Mercer and Powell 1972:5), and the Pacific research paradigm (Tertiary Education Commission 2003), according to which research conducted on Pacific island issues should be informed by and imbued with the continuum of Pacific worldviews, knowledge, practices and values.

Within the context of the Pacific research paradigm, research processes and practices should be conducted in accordance with the ethical standards, including responsiveness and reciprocity, of Pacific peoples, and the research should be conceptualised in a way that is consistent with their needs, expectations and aspirations. This research project was designed with the needs and aspirations of Pacific peoples in mind. The issues addressed are topical ones which relate both to a specific community within Tonga and to the wider Tongan community. It is hoped that the findings will not only have a demonstrable and positive impact on the ability of the community of Pangaimotu to make informed decisions regarding development activities, particularly as they relate to the fishing industry and the sustainability of the domestic fishing resource, but also on the decision-making framework within which the Tonga fisheries industry more generally operates. Ultimately, because the methodologies employed have the potential to be adapted for use in other contexts, it is hoped that the research might also have some positive impact on other Pacific communities, particularly in relation to the fisheries sector. To the extent that it does this, the researcher will not only be the initiator of the project but also one of its beneficiaries.

There is also a broader perspective from which the research can be seen to be located within the Pacific research paradigm. Its methodology is designed in such a way as to recognise and validate relationships between the researcher and the 'researched', to reduce the distance between them by involving Pacific people directly in the research and providing a forum in which their voices can be heard. This is an important aspect of the responsiveness and reciprocity that characterise research conducted within the Pacific research paradigm. It is hoped, therefore, that the research will contribute not only to the Pacific knowledge base in the area of island fisheries but also to growth in understanding of Pacific cultures, experiences and world views.

2.3 Research Methodologies

The broad methodological framework of the thesis is based on a combination of positivist principles and the Pacific research paradigm, the specific nature of the study necessitating the use of both quantitative and qualitative methods of data collection. As Roundtree and Laing (1996) observe, quantitative and qualitative research methodologies operate from fundamentally different epistemologies and deliver very different information. It is therefore important that researchers have some understanding of the applications and limitations of both (Miles and Huberman 1994:5), since there are certain types of research projects which can benefit from the application of both. In the context of this research project, the use of both quantitative and qualitative methods is intended to increase the robustness of the data. Because I use both quantitative and qualitative research methods in this thesis, a brief outline of both types of methodology is in order.

2.3.1 Quantitative Research

Quantitative research is viewed as the traditional, positivist, experimental, or empiricist type of research which is statistical in nature and is designed to give a numerical result, emphasizing the measurement and analysis of causal relationships between variables, not the processes between variables as such. As Creswell (1994) observes, quantitative research may focus on an area previously studied by other researchers, an area in which a body of literature already exists, one in which there are also known variables and existing theories. Quantitative

research emphasizes the measurement and analysis of causal relationships between variables, not the processes between variables as such.

According to Denscombe (Denscombe 1998:177), the major attraction of quantitative research is that it carries with it an aura of scientific respectability. Because quantitative research uses numbers, and because the findings can be presented in the form of graphs and tables, quantitative research conveys a sense of solid, objectivity (Denscombe, 1998:177). In this thesis, the demonstration of causal relationships between identifiable and measurable variables plays a critical role, and quantitative forms of presentation, such graphs and tables, are used to present some of the research findings.

2.3.2 Qualitative Research

Perhaps one of the key differences between quantitative and qualitative research is that in the former a great deal of effort goes into the preparation of questionnaires, the setting up of equipment and experiments and the selection of groups or variables for purposes of comparison (Bouma 1996:176).

Qualitative research is difficult to define clearly because it has no theory, or paradigm, that is distinctively its own. Rather, it is an inductive, descriptive and explanatory method that crosscuts disciplines, fields, and subject matter (Denzin and Lincoln 1994). Although qualitative research is a field of inquiry in its own right, it is nevertheless exploratory in nature, the variables often being unknown while the context is very important. Basically, qualitative research is interpretive in nature and practice, and therefore has no single methodology (Creswell 1994). Banister et al. (1994) have noted that the nature of qualitative research is to attempt to capture the sense that lies within, that which structures what we say about what we do. Thus, qualitative research involves exploration, elaboration and systematization of the significance of an identified phenomenon and the illuminative representation of the meaning of a delimited issue or problem. It uses humans-as-instruments in identifying problems or defining a situation (Maykut and Morehouse 1994).

As Cohen and Manion et al. (2000) observe, qualitative research is non-empirical but is nevertheless extremely useful in collecting, classifying, categorising, synthesizing, evaluating and interpreting raw data. In the case of this research project, a number of qualitative research methodologies, including surveys (interviews and questionnaires), case studies, and participant observation, are used in the collection of data. In view of the fact that the research reported here is underpinned by the Pacific research paradigm, I believe that it is particularly important that qualitative research methods should be used to highlight the value of understanding and appreciating differences in cultural, economic and environmental components of the human society that is examined (Babbie 1998:297)

A case study approach was found here to be best suited to closely investigating Tonga's fisheries at the micro level – the domestic fisheries sector; while the survey method was found to be best suited to better understanding and explaining Tonga's fisheries at the macro level – the fisheries export sector. One qualitative research method used extensively in this study is the interview, these interviews often involving, in a way that is consistent with the Pacific research paradigm, extended dialogue. Pacific communities in general, (in this case the Tongan community in particular), are oral societies, and so interview and extended dialogue are particularly appropriate.

2.3.3 Talanoa

At an immediate and more specific and personal level, much data was collected through *talanoa*², a qualitative methodology that is conducted mainly through dialogue and conversation. *Talanoa* is a framework or methodology that emerges from within Tonga's own cultural and social context. As a method of research based on the Pacific research paradigm, *talanoa* is also a Tongan approach to data collection which is also widely used by Pacific researchers today. In this study,

² Talanoa has been used widely in the Pacific to settle political disputes. This methodology was used during the Fiji coup in 2000 and again during the political dispute in Tonga in 2006 as foundational principle in dialogue. This talanoa provides an open forum for addressing different perspectives on the issues of disputes in the hope for reconciliation and taking account of and learning from reality of the past to ensure future stability

talanoa is considered a very appropriate and meaningful way of collecting data in the context of a Pacific society such as Tonga in which many customs and much indigenous or traditional knowledge are conveyed through stories, songs, dance and poems. Hence, the use of *talanoa* in collecting data and information which seeks to explain why things happen as they do in a Pacific context.

Talanoa allows for extended dialogue and conversation that leads to better knowledge and mutual understanding between the researcher and the researched. Basically, it allows the researcher to *nofo* or live in the community for a few days or hours, sharing food and thus cementing relationships and enabling the researcher (usually a visitor) to become an accepted member of the community. Invariably, however, the data collected through *talanoa* are insufficient in themselves. What they do is allow the researcher to emerge from the community with added knowledge and insider information that contribute to a more holistic understanding.

As a Tongan researcher, one who believes in the importance of the *talanoa* methodology, the extensive use of quantitative analysis throughout this thesis clearly indicates my own philosophical position. In particular, the use of *talanoa* challenges me to think beyond my own personal biases and extend my understanding. As a Tongan educator, rural dweller and advocate of sustainability and development for the grass-root level, I have very real concerns about any research that impacts on communities that lacks a quantitative dimension. For me, *talanoa* as a research tool provides a bridge from observation to understanding. It allows the experiences, texts and narratives of those for whom the research is most pertinent to contribute to and inform the work in a way that justifies use of the term ‘research participant’ (Wodak 1996). At the same time, the use of quantitative research methods reduces the inevitable dangers of subjectivity.

2.4 Data Collection

In this study, there were different layers and stages of data collection. First, there was the need to understand the current issues and debates on the fisheries sector at the global and regional levels. Global level information was collected mainly from reports on State of World Fisheries and Aquaculture (SOFIA) by the Food and

Agricultural Organisation of the United Nations. At the regional level, it was necessary to collect information on the performance of the fisheries sector in the Pacific, with special emphasis on the tuna fisheries and coastal fisheries. Published reports, available through libraries and regional offices such as the Forum Fisheries Agency, South Pacific Community, Forum Secretariat and the University of the South Pacific Marine Department, were very useful in providing this information.

Second, there was the need to be fully informed on the different players involved in the fisheries sector in Tonga. This entails gaining an understanding of the Tonga fisheries sector in general. In assessing the current situation of the fisheries sector in Tonga, there was a need to explore issues related to fish exports from Tonga to its overseas markets, relating in particular to the financial return fisher people received from the fish exports sector. In the study, focus was treated as being related to Tonga fisheries at the national level. The other level of Tonga fisheries is the domestic fisheries sector, in relation to which an inter-sectoral economic model was designed and used to determine the optimal use of community resources for the benefit of the fisheries dependent community of Pangaimotu in Vava'u.

2.4.1 Methods of Data Collection

In deciding what type of methods to use, I was conscious of the fact that the data had to have two main characteristics. First, they had to be detailed, containing contextual information and including layers of meaning. Second, they must represent lived experiences and present various points of views. These two criteria led to the use of a combination of semi-structured and conversational face-to-face interviews (Miles and Huberman 1994:10). The conversational face-to-face interview approach was described earlier as involving the *talanoa* methodology.

Primary data collected in the course of fieldwork and secondary data were interwoven in the course of the research. Extensive use was made of secondary data in reviewing academic literature on fisheries (mainly obtained from libraries, the internet and published reports) and other types of literature, such as government publications, departmental reports and media sources, which provided

up to date information and opinion on the current policy climate in relation to fisheries. The secondary data were examined in terms of both meaning and representativeness (Kitchin and Tate 2000), and provided useful background to the selection of appropriate research participants. The information obtained from secondary sources also played an important role in my ability to establish rapport with informants (Flowerdew and Martin, 1997). The four periods of fieldwork involved in the study are outlined briefly below.

2.4.2 Fieldwork

Fieldwork is a central component of much academic research. In conducting fieldwork, it is important to be ethically vigilant and to adopt a critical stance towards the data so that the personal politics of the researcher and the power differential between researcher and researched do not pose a threat to the research processes or outcomes (Katz 1994:67). This is something that I took seriously in relation to the professional conduct of the research.

In accordance with the Tonga Government policy for research in Tonga, I began by seeking the approval of the Tonga Government for the proposed fieldwork. The Tonga Cabinet approved my request as outlined in a letter dated 8 September, 2003 (see *Appendix 1*). Appointments were then made to meet government officials and the main exporters of fish in order to begin the ‘*talanoa*’ process. Altogether, I undertook four different fieldwork trips in the course of the study.

2.4.2.1 Fieldwork 1

The first fieldwork trip involved three activities. First, I visited Government Departments to obtain information on the current position of the fisheries sector in Tonga. Second, I visited the main fish exporters to obtain information on the industry’s performance. Finally, I identified mangrove-fisheries dependent communities in order to conduct detailed studies relating to the importance of fisheries at the community level and to identify key issues in the community that would provide further and better understanding of issues relevant to the economics of Tonga’s fisheries sector.

The first field work trip was conducted between 23 November and 13 December, 2003. The main focus of the first visit was to update my knowledge of the current economic situation in Tonga, with specific reference to the fisheries sector. During November 2003, a tuna conference was held in Tonga. This provided much up to date information relevant to the study, including information about fish stocks, prices and other issues relating to the fisheries sector as seen from the perspective of exporters and the Tonga government and regional organisations that provide support to the fisheries sector in the Pacific region. The Ministry of Fisheries, which hosted the conference, was forthcoming in providing information and papers presented during the conference. The fisheries industry in Tonga at the time was at a cross-road, so the conference provided an important opportunity for key stakeholders to deliberate and discuss issues relating to the survival and sustainability of the fisheries industry.

I faxed invitation letters to Government Ministries in Tonga (see *Appendix 2* for copy of the letter) seeking permission to visit and collect information that would be useful for my research. The organisations I visited were the Ministry of Education, the Ministry of Finance, the National Reserve Bank, the Statistics Department, the Ministry of Trade and Commerce, the Ministry of Fisheries, the Tonga Development Bank, the Ministry of Foreign Affairs, and the Ministry of Lands (see *Appendix 3* for report and schedule, and *Appendix 4* for details of information sought from each of these Ministries). Much of the information discussed with the different Government Ministries were included in published reports and documents that were readily available to the public. However, these visits to the different institutions also provided an opportunity to investigate the views of representatives of Government departments and financial institutions on the fisheries sector in Tonga.

During Fieldwork 1, I also faxed invitation letters to fish exporters in Tonga (see *Appendix 5* for a copy of the letter), seeking permission to visit and collect information from them. It was made clear to these fish exporting companies that the information collected in the research was intended to relate to the industry as a whole - no specific reference would be made to a particular company's name or performance, and the information they supplied would not be directly associated

with them by name or organisation in the reporting of the research. This confidentiality assurance was also spelt out in the Consent Form and Information Sheet provided for Participants.

There are only four fish exporters in Tonga and I managed to visit three of them. A semi-structured interview was used as the main method of collecting information from the fish exporters (see *Appendix 3* for report and schedule, and *Appendix 4* for details of information sought from each of these fish exporters). The fish exporters were asked to provide historical data that is also available in the exporters' annual reports and in Trade Statistics reports and Ministry of Fisheries Annual Reports. However, these interviews also provided an opportunity to identify barriers to fish exports from the point of view of the fish exporters themselves and to record any problems they had experienced. Important information regarding costs and revenue, including fish prices in the export markets overseas, were also discussed and recorded. The *talanoa* methodology proved useful in collecting information about such important matters as fish prices and target overseas markets. It also provided an important opportunity to seek the views and perspectives of fisheries exporters on potential changes to the fisheries sector in Tonga when it eventually becomes a member of the World Trade Organisation (WTO).

It was also necessary during Fieldwork 1 to identify mangrove fisheries-dependent communities, thus providing an opportunity to conduct a pilot survey. The intention was to identify the communities in the first Fieldwork visit and then return to collect data from these communities in a second fieldwork visit. Based on information provided by the Tonga Government Ministries and the Tonga Development Bank, I was able to identify and select two communities, Nukuleka-Talafo'ou, from the main island of Tongatapu and Pangaimotu, from the outer island of Vava'u. Also very useful was information provided by the Tonga Statistics Department, especially the report of a household survey carried out by the Tonga Government in an Agriculture Census in 2001. The information contained in the report showed, in particular, the number of households in each of these two communities and the economic activities each community was involved in.

Having identified these two communities, I approached the town officer in each community and, using *talanoa*, requested their permission to return at a later date to collect information from their communities. Before I left Tonga for New Zealand at the end of the first fieldwork visit, I received confirmation that thirty five (35) households in Pangaimotu were willing to participate in the second fieldwork. In Nukuleka-Talafo'ou, the town officer was in the process of collecting the names of fisher-people from his community who were willing to participate in the survey. Also during the Fieldwork 1 visit, I was able to conduct a trial or pilot interview with three families in my village of 'Alaki fonua, the aim being to test out and improve my questionnaire design. The pilot interview exercise was extremely valuable, allowing me to consider the broader institutional arrangements and to begin to map out in more detail my research topic and questions.

2.4.2.2 Fieldwork 2

The aim of the second fieldwork trip was primarily to conduct interviews in the mangrove-fisheries dependent communities identified during the first visit. The interviews were semi-structured (see *Appendices 6* (English) and *7* (Tongan) for copy of the semi-structured interview schedule). These were carried out from 1 February to 21 February, 2004. Initially, the plan was to hold interviews in one mangrove fisheries-dependent community only. However, during the first field visit, I saw the need to include a fisheries-dependent community from the outer islands, outside of Tongatapu. For this reason, the community of Pangaimotu in Vava'u was included, the intention being to enrich and add breadth to the data.

The first three days were spent in Tongatapu in order to finalise the semi-structured interview prompts and print the materials. The time spent on Tongatapu was also used to obtain the list of fisher-people collected by the town officer of Nukuleka-Talafo'ou that had been requested during the first fieldwork visit. Also during the first three days, detailed costing of the traditional dye for *tapa* making (from mangroves) in Tonga was carried out in the Nukuleka-Talafo'ou community.

The next eight days were spent in Pangaimotu in Vava'u where a number of activities were undertaken. These included interviewing members of the thirty-five households identified during the first visit. I also observed the community's activities in its mangrove areas, taking measurements and collecting data. I gathered information on Hinakauea Beach Resort (see *Appendices 8* (English) and *9* (Tongan) for a copy of the semi-structured interview schedule), as an alternative development activity to fishing, and visited the Governor's office in Neiafu to collect relevant maps of the area of Pangaimotu.

I then returned to Tongatapu where the next ten days were spent conducting interviews in Nukuleka-Talafo'ou as well as recording observations, taking measurements and collecting data on the mangrove areas. I was also able to gather information on growing squash as an alternative economic development activity to fishing in Nukuleka-Talafo'ou, and to pay a visit to the Ministry of Lands and Survey to collect relevant maps of the area (see *Appendix 10* for a detailed report of this visit).

Towards the end of the Fieldwork 2 visit, I was informed by key government officials, especially from the Ministries of Fisheries and Finance, that certain aspects of the fisheries sector in Tonga are very much determined by decisions taken by key institutions in the Pacific region, especially those that are based in Fiji. I therefore approached the Tonga Ministry of Foreign Affairs, requesting them to provide a letter of support for me to make a fieldwork trip to Fiji (see *Appendix 11* for a copy of the letter).

2.4.2.3 Fieldwork 3

Fieldwork 3 was carried out in Fiji from the 30 November to 9 December, 2004. The trip to Fiji was necessary because Tonga is a member of some of the key regional organisations based in Suva, Fiji. I faxed invitation letters, including the letter of support provided by the Ministry of Foreign Affairs from Tonga, to the regional organisations in Fiji (see *Appendix 12* for a copy of the letter), seeking permission for the visit and to collect relevant information that would be useful for my research. Having the support of the Tonga Government for the study

facilitated access to data collection and information gathering from these organisations.

While in Fiji, I took the opportunity to collect secondary information available at the regional libraries in Suva at the University of the South Pacific (USP), the Forum Secretariat and the South Pacific Community (SPC). Other persons and organisations I visited included the Director of the Marine Programme of the USP, the Director of the Pacific Centre of Environment and Sustainable Development programme at USP, the Director of the Institute of Pacific Management and Development (USP), the Economics Department (USP), the Trade section of the Forum Secretariat and the Oceanic Fisheries Management Division of the SPC.

The intention of the visit to Fiji was primarily to interview important personnel of organisations related to regional aspects of the fisheries sector. It also provided an opportunity to investigate the views of members of these organisations in relation to Tonga fisheries. I also set out to discover the views of those involved in the regional organisations on the following questions: What changes have occurred in regional fisheries over the past ten years? What are the foreseen possibilities for the future of regional fisheries? In addition to seeking answers to these specific questions, I also sought information on regional policies pertaining to the fisheries sector, and trade statistics for the fisheries sector in the region. The trade statistics for the fisheries sector included published reports on the performance of the fisheries sector in the export markets overseas. The Forum Secretariat has headquarters in Suva (Fiji). However, its trade offices are located in different parts of the world, including Sydney, Auckland, Tokyo and Honolulu. Thus, useful information on fish export market performances in these locations could be collected. Information about potential barriers to trade from the Pacific islands region to these overseas markets was also forthcoming.

2.4.2.4 Fieldwork 4

In 2005, I was invited to be a member of a project whose purpose was to explore aspects of labour migration from the Pacific Islands to New Zealand. I was given the responsibility of overseeing the data collection from Tonga for the project. Some of the questions included in the survey conducted in Tonga were designed

to gather information on household income, including subsistence activities among which fisheries featured. Data were also collected on household diet, fish being one of the items listed. Information on household subsistence consumption and production was also collected, as well as information on household income from fisheries. This particular migration project survey was especially important for me as it provided a springboard for the identification of missing variables in the data collection from the three fieldwork trips previously undertaken.

In connection with my responsibility for the Tongan component of the Pacific Island-New Zealand Migration Survey (PINZMS), I recruited four research assistants to assist me in carrying out this task in Tonga. The survey used face-to-face interviews, and was carried out during the first half of 2005. Initial training with the four research assistants was carried out on the first day of our meeting in Tonga. Included as part of this training was piloting of the survey forms to be used. Research assistants worked in teams of two and I took it in turns to accompany each team during their first few interviews to ensure that data collection was carried out efficiently and effectively. I also checked the survey forms completed by the research assistants at the end of every two days to ensure that there was no missing or incomplete information.

The PINZMS used a sample frame of applicants for the Pacific Access Category (PAC), which provides a special immigration quota for Tongans and a few other Pacific Island country groups to enter New Zealand each year. Because more individuals apply to migrate than there are places available under the quota system, a lottery is used to pick winners amongst the hundreds of applicants. In Tonga, the survey covered 230 households representing four different groups in relation to the PAC migration scheme. The four groups of households were as follows: (i) 37 families of Tongan immigrants in New Zealand who were successful participants in the 2002/03 and 2003/04 PAC lottery ballot rounds. Those who were successful in each of these lottery ballot rounds were given Permanent Residence in New Zealand once a job had been secured for the successful applicant (without having to go through the normal process for the immigration job skills categories); (ii) 55 households of potential migrants who had been successful in the same PAC ballots (2002/03 and 2003/04) but who were

still in Tonga; (iii) 78 households containing unsuccessful participants in the same PAC ballots who were still in Tonga; and (iv) a group of 60 households who were non-applicants to the PAC program.

In summary, the four fieldwork visits undertaken formed part of an inductive process of creating a broad picture of understanding built up from smaller units of intensive and detailed investigative observation. The in-depth interviews provided a way of gaining entry into the life world of various agents within the field encompassed by the research topic (Pickles 1985). Indeed, the main purpose of empirical fieldwork is to examine ‘what is going on here?’ (Bouma 1996:169).

At the end of each fieldwork visit, a letter of thanks was faxed to each of the institutions involved and to individuals within these institutions who had participated in the research (see *Appendix 13* for a copy of this letter for Tonga field work and *Appendix 14* for a copy of this letter for Fiji field work). Individual participants in the study from the fisheries-dependent communities and the PINZMS were given their thank you note with a *koha* at the end of their interviews. The provision of a thank you note and *koha* is an important practise that is embedded within those aspects of the Pacific research paradigm that refer to responsiveness and reciprocity.

2.4.3 Methods

The following methods were used in this research project.

2.4.3.1 Case Study

The case study approach was used in relation to the provision of an in-depth study of a rural community. Denscombe (1997: 31) provides the following justification for a case study approach:

Relationships and processes within social settings tend to be interconnected and interrelated. To understand one thing it is necessary to understand many others and, crucially, how the various parts are linked. The case study approach works well . . . because it offers more chance than the survey approach of going into sufficient detail to unravel the

complexities of a given situation ... In this respect, case studies tend to be holistic rather than deal with isolated factors.

Because this research project aimed to provide further understanding of economic issues relating to the fisheries sector in Tonga, a case study approach that aimed to reveal interconnections and interrelationships in the fisheries sector was considered warranted, particularly one that combined several methods of data collection, thus providing for the enhancement of the quality and importance of the work through triangulation. As Yin (1994) observes:

Every student knows the original derivation of the concept of triangulation: a point in geometric space may be definitively established by specifying the intersections of the three variables. . . . This concept has been borrowed for dealing with social science evidence: The more robust fact may be considered to have been established if three or more sources coincide. This type of triangulation is the most desired pattern for dealing with case study data. . . . An important clue is to ask the same question of different sources of evidence . . . if all sources point to the same answer; you have successfully triangulated your data.

The case study approach and the use of multiple sources of data, as well as the utilisation of both quantitative and qualitative methodologies, promotes both the rigor and testing associated with quantitative research and the descriptive detail and insights that come from qualitative research.

2.4.3.2 Interviewee Sampling

It is important to identify key informants in order to ensure that the information gathered yields rich data. Key informants are people directly affected by or involved in the issues being considered by the researcher (Miles and Huberman, 1994:28). As expert witnesses, key informants can elaborate on the issue of the research topic and speak from direct experience. In this particular study, some of the key informants include fish exporters, fisher people themselves, village/church leaders, and Government and other personnel who are directly involved in the Tonga fisheries sector.

2.4.3.3 Interviews

The interview, as an information-gathering tool, lends itself to being used alongside other methods as a way of supplementing data and adding depth (Denscombe, 1997:112). Before I started the interviews, I deliberated on how the various actors (policy makers at Government level; regional organisations; fish exporters; fisher people from rural communities) who were involved in the Tonga fisheries sector would interpret my research questions. Despite a considerable amount of preparation and background knowledge, I remained concerned about whether I would be asking the right questions and guiding the conversations appropriately. The use of the trial or pilot interview in my own village was intended to ensure that the interview schedule that had been designed was workable and that the time involved in each interview was appropriate. Furthermore, the participants in the pilot interviews provided the names of some key people who might be able to provide useful information for the study. Thus, a 'snowball effect' began, with other interviewees also being forthcoming with contacts and additional information (Miles and Huberman, 1994:29). Having the name of an individual certainly acts as a passport in reaching beyond the gatekeepers of large organisations, or communities for that matter.

2.4.3.3.1 Interviews: Government Ministries

As outlined in section 2.4.2.1 invitation letters were faxed to Government Ministries in Tonga, seeking permission to visit and collect information for the study. A semi-structured interview format was used to elicit information from Government officials. So far as the Ministry of Education was concerned, the purpose of contact was to introduce the study and to seek permission for access to research facilities. At the Ministry of Finance, the information that was sought related mainly to government policy on tariffs overall, especially in relation to the identification of major changes in the tariff structure since the conversion to the Harmonised System³, a requirement for application to be a member of the WTO

³ The Harmonized System (HS) is an international commodity classification (six digit) developed under the auspices of the Customs Cooperation Council. The HS is based on a fundamental principle that goods are classified by what they are and not according to their stage of fabrication,

(which Tonga was in the process of doing at the time of the research). At the Ministry of Finance, I set out to identify specific policies in the fisheries sector and to collect data on revenue generated from tariffs and fisheries more specifically.

Information sought from the National Reserve Bank of Tonga (NRBT) concerned macro-data for the country and fisheries as a whole in relation in particular to its contribution to Tonga's GDP and Balance of Payments. The latest information on the movement in the exchange rate for the pa'anga was also collected from the NRBT. This was important as it determines the income that fish exporters from Tonga actually receive through foreign exchange transactions with their overseas markets or buyers.

Interviews with the Tonga Development Bank focused on the cost structure of different commercial fisheries operators, whether small or large. Information was also sought on the revenue that fisher people received from fish sales, including information on the marketing of fish. In terms of the rural communities, costs relating to alternative development activities, such as tourism in Pangaimotu and squash in Nukuleka-Talafo'ou, were also obtained. This was considered important because of the potential impact of these activities on the mangroves in the rural communities and, hence, on Tonga fisheries in general. Before accessing information from the Bank, a declaration of secrecy was signed guaranteeing that information collected would be used strictly for the purpose of the research and nothing else.

The primary aim of the interview conducted at the Statistics Department was to seek information on the latest household surveys and fish trade. At the Ministry of Trade and Commerce, the information I requested related to policies on trade, including the price of fish domestically and at the export markets overseas. Policies on the import/export of fish regarding tariffs and non-tariffs, not only

use, or any other such criteria. Both export and import statistics are classified and published according to the Harmonized Commodity Description and Coding (HS).

from Tonga but also at Tonga fish export markets overseas – NZ, Australia, Japan and USA – were also obtained. At the Ministry of Trade and Commerce, I interviewed the WTO advisor, who provided useful information on the status of Tonga’s accession to the WTO, and the implications for Tonga generally and for the Tonga fisheries industry in particular of that proposed accession. The Ministry of Fisheries was forthcoming in providing information on policies on fisheries – inshore and also off-shore. Additional information was obtained on the fuel subsidy provided by the Tonga government to commercial fish operators, as well as data on fishery license holders. Relevant maps and information on mangroves and land areas in Tonga were also collected.

2.4.3.3.2 Interviews: Fish Exporters

Semi-structured interviews were used to collect data and information from three of the four fish exporters who were operating in Tonga during the time of the field work. Information sought from these fish exporters included historical data on catch, price and performance (also available from the exporters’ annual reports), barriers to fish exports from the point of view of the fish exporters themselves, and information pertaining to problems they had encountered so far. Also sought was basic information on the business operations of these commercial fishing companies. Importantly, the interview schedules also provided an opportunity for the fish exporters to express their views on the potential implications so far as the fishing industry is concerned of Tonga’s application to become a member of the WTO.

2.4.3.3.3 Interviews: Fisheries Dependent Community

Members of two fisheries-dependent communities were interviewed as part of the research project. All the interviewees were first contacted face to face. Telephones are not accessible in these communities, so I had to appear in person and make personal contact before the interview could take place. Once the person had agreed to a suitable interview time, I provided a copy of participants information and consent form (see *Appendix 15*). One important function of the participant information was to confirm in writing the agreed time and place for the interview, as well as provide the participants with a record of my contact details. The formality of the participant information served to reassure the participants of the

credibility of the research and of the fact that any information they provided would be handled in a professional manner. I also made it clear to the potential participants that they could contact me at any time if they had any questions or concerns and informed them of their right to withdraw during the research process. The participant information provides a brief introduction to the research topic, giving the interviewee some indication of what to expect during the actual interview. I believed that this approach would not only reassure interviewees and reduce any anxiety they might have about the project, but also encourage them to start thinking about what they wanted to say in the interview. However, I wanted the interview process to be relatively informal, and for it to be an enjoyable experience for all those involved. A consent form (see *Appendix 15*) was used to gain written approval from the interviewees and to guarantee the confidentiality of the information they were providing

2.4.3.3.1 Pangaimotu

Data collection from the Pangaimotu community was done through the use of semi-structured interviews. Full details of the interviews schedule are provided in English in (see *Appendix 6*) and translated into Tongan (see *Appendix 7*). Qualitative information that assisted in explaining the data was also collected through *talanoa*. This included participating in community activities and living as an accepted member of the community, sharing of meals and providing support for community activities. I took part not only in cooking but also in fishing activities conducted by women (partly to provide meals for construction workers who were present in the community at that time).

In Pangaimotu, the community approach was channelled initially through the church minister of the Free Wesleyan Church. This was done during the first fieldwork visit.

Tonga is generally considered a Christian nation and so the role and status of the church minister carries a lot of respect in the community. The close relationship between the researcher and the Church Minister no doubt led to a higher level of community support for the project than would otherwise have been the case.

The *talanoa* methodology played a crucial role in spreading the news within the community of upcoming activities and who was to be involved. When the church minister was informed of my intentions, he approached the town officer of Pangaimotu for his permission and approval for the purpose of the visit. This proved to be very useful in terms of overall awareness of, and support for the project among community members. It was largely because of the participation of the church minister and the approval and support of the town officer that as many as thirty-five households agreed to participate in the research. When I arrived in the community, I was given the opportunity to share with the Free Wesleyan Church community of Pangaimotu the purpose, intention and schedule of the study. Interviews were then scheduled and data collection initiated. Following each interview, participants were given a note of thanks with a small *koha* as appreciation and recognition of their contribution.

2.4.3.3.2 Nukuleka-Talafo‘ou

Information similar to that given to the community in Pangaimotu was also given to the Nukuleka-Talafo‘ou community. Here, a list of fisher people provided by the town officer was very useful. I contacted these people face to face with the assistance of the town officer’s daughter. She guided me through the village, helping to identify the households’ locations. Again, just as in Pangaimotu, semi-structured interviews supplemented by questionnaires were used. Qualitative information that assisted in explaining the data were also collected through *talanoa*. As in the case of Pangaimotu, each participant was given a note of thanks with a small *me‘a‘ofa (koha)* in appreciation and recognition of their contribution to the research.

2.4.3.3.3 Regional Organisations

A semi-structured interview was used to collect information from the regional organisations in Fiji, a particularly useful approach in view of the fact that most of the published studies on fisheries from the Pacific regions were composed by staff of these organisations. The semi-structured nature of the interviews encouraged the interviewees to discuss issues that they felt were important or troublesome in more detail than might otherwise have been the case. One of the main practical and ethical problems of the in-depth interview is the demands it places on the

participants (Kitchin and Tate, 2000). However, without exception, the interviewees made a large commitment to the study by donating their time and energy willingly and cheerfully.

2.4.3.4 Participant Observation

As part of the research, it was also necessary to carry out some measurements of participation in community activities. In February 2003, during the first fieldwork visit, I took part in two fishing trips in Pangaimotu. I also observed and participated in (along with three other women) the process of obtaining dye from the bark of mangroves for *tapa* making and oversaw the measurement and counting of mangroves suitable for *tapa* making that was being carried out by two of the village boys. In addition, I visited the local fish market at Neiafu (Vava'u) on three occasions, observing how fishermen arrived to sell their catches. I observed at first hand the importance of the sea to the community and the reciprocity that characterises their lives and binds their community together. I participated in the sharing of food with neighbours that takes place on Sundays and observed the way in which the community became involved in the construction of a new hall for the Free Wesleyan Church. In particular, I observed the community's most valuable resource-base, fish, being harvested to feed the construction workers as part of the community's obligation towards the community project.

2.4.3.5 Survey

Denscombe (1998:6) notes that:

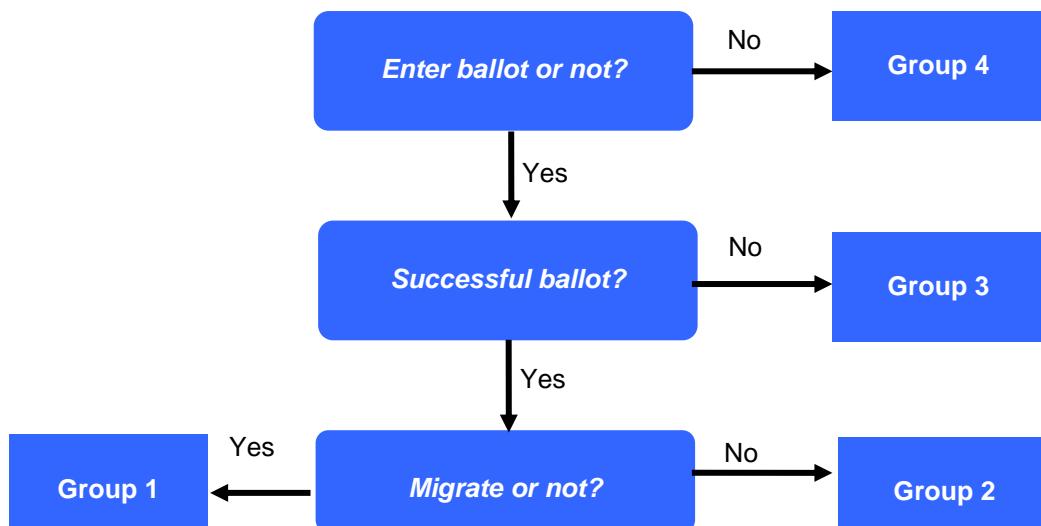
The purpose of surveys is generally to 'bring things up to date' ... [A] Survey usually relates the present state of affairs and involves an attempt to provide a snapshot of how things are at the specific time at which the data are collected

The Pacific Islands New Zealand Migrant Survey (PINZMS) project, to which reference was made earlier, used a survey-based approach designed to measure multiple effects of emigration from Tonga to New Zealand. The sections of the survey considered most relevant to this research project are those dealing with a

twenty-four hour dietary recall, and a seven-day recall of food production and fishing. Since emigration and remittances are key features of the Tongan economy, with over thirty per cent of the Tongan-born population resident overseas and with remittances being equivalent to forty per cent of GDP, it was felt that migration status could be an important influence on fishing behaviour (e.g., remittances may reduce the need to fish, and having absent adults may reduce the ability to fish).

The survey was divided up into four survey samples (see *section 5.2.1* for details). One sample relates to the remaining household members of those successful migrants who have already moved to New Zealand through the PAC scheme. A second sample relates to those successful applicants in the quota for Tonga who still remained in Tonga. A third sample relates to unsuccessful PAC applicants. The fourth sample includes non-applicants who have never participated in this scheme. This last group was selected from the same villages as those who had applied under the PAC quota system. The first round of applicants under the PAC system provided a sample of 65 migrant households in New Zealand, and 230 households in Tonga. The relationship between these samples and the PAC ballot process is illustrated in *Figure 2.1* below.

Figure 2.1: The Immigration Ballot and the Four Household Samples



The coverage of the survey included the following: household demographics, education, labour supply, income, asset ownership and food consumption (based

where possible on the most widely used surveys in New Zealand and the Pacific Islands to enhance comparability). There was also a detailed module on health, containing subjective questions on health status, questions on smoking and alcohol use, self-reports of diabetes and hypertension, and measurement of blood pressure, waist circumference, height and weight of all household members. In addition, there were a number of modules on the migration process, remittance transfers, knowledge and use of the financial system, expectations of future income and of future remittance patterns, and other questions on linkages between immigrants and their families.

2.4.3.5.1 Evidence of Randomization

Table 2.1 examines how random the sample survey is by comparing means of ex-ante characteristics for successful and unsuccessful ballots. The point estimates of the means are similar in magnitude for the two groups and equality of means cannot be rejected for any of the variables. This is as would be expected with the random selection of ballots among applicants to the Pacific Access Category.

Table 2.1: Evidence of Randomisation in PAC samples

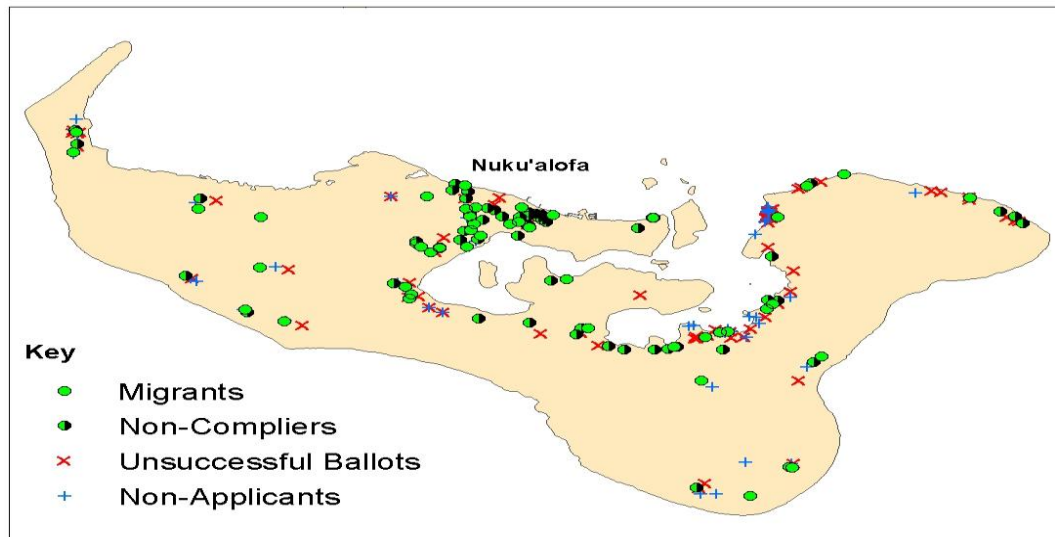
	Sample Means		T-test of equality of means p-value
	Successful Ballots	Unsuccessful Ballots	
Age	33.6	33.7	0.91
Years of schooling	11.9	11.5	0.37
Proportion male	0.55	0.51	0.52
Proportion born on Tongatapu	0.75	0.79	0.54
Proportion who had been to NZ before 2000	0.39	0.35	0.63
Proportion who are married	0.60	0.62	0.77
Height	171.6	169.3	0.16
Income in 2003/before moving	103.7	88.0	0.32
Total Sample Size	120	78	

Source: PINZMS data collected

Valid comparisons of the experimental and non-experimental estimators depend on sampling unsuccessful ballot applicants and non-applicant households from the same areas as the immigrants.

Figure 2.2 shows the results of this strategy according to the spatial distribution of the four samples of households on the main island of Tongatapu (smaller samples were collected on the outer islands and are not illustrated here). From *Figure 2.1*, Group 1 is the Migrants, Group 2 is the Non-Compliers, Group 3 is the Unsuccessful Ballots, and Group 4 is the Non-Applicants.

Figure 2.2: Evidence for spatial matching of the four samples-Tongatapu



Source: PINZMS survey

2.5 Data Analysis

The use of the PINZMS data has provided many interesting stories not only to the fisheries in Tonga but also with unknown variables of subsistence fisheries, see chapter 5 for details. In this context, the software Statistical Package for Social Science (SPSS) has proven to be a useful tool of analysis, as it provides descriptive statistics and also assesses the correlations between identified variables.

2.5.1.1 Export Sector

This part of the study includes a detailed cost analysis of fish production in Tonga for export. It considers both the types of fish exported (bottom fish versus tuna) and also the size of the local fish operators (whether they are small-sized or medium-large-sized operators). The size of operators was determined by the size of their fishing boat, a small-sized operator being categorised as an operator who owned boats of 30 feet, and a medium-large-sized operator being categorised as one who owned boats of 40 feet. The cost of production was calculated as per

metric tonne of fish exported. The CIF price of fish was then determined. The marketing costs associated with measures required by each of the overseas markets where Tonga exports its fish were then closely examined. The financial returns to the fisher people were then determined by comparing the cost of production and the price of fish on sale at each overseas market under a range of assumptions. It was anticipated that the analysis would provide descriptive data, statistical data and other aggregate measures of economic welfare. All these data and analyses are concerned with economic issues relating to fisheries at the national level in Tonga, the fish exported being, in turn, related to international trade.

The main tool employed to assess the issues of fish exports is financial analysis, where costs and benefits of fish exported from Tonga to its main markets overseas were assessed on the basis of net return to fisher people when the fish were exported. The data collected on fish exports came from a published marketing report I was involved with in 1997 (Rohorua et al, 1997), the costs of production and prices being revised specifically for this study in relation to data collected during the first fieldwork visit in February 2003. Updated information on costs of operations was also obtained from the Tonga Development Bank (TDB) loan files and board papers. The exchange rate used in the thesis was that of the last quarter of 2004.

2.5.1.2 Domestic Sector

For Tonga's domestic fisheries sector, the economic inter-sectoral model provided for a very useful micro-economic analysis of activities relating to fisheries. In particular, it focused on different economic development activities taking place at the community level (sometimes in parallel with, sometimes in competition with the utilisation of fisheries resources). The inter-sectoral model assisted in determining how best fisheries resources could be managed in order to maximize benefits for the community as a whole from different economic activities. The data used for the model and analyses of the community economic development activities was restricted only to the community of Pangaimotu. Although data is also available for the community of Nukuleka-Talafo'ou on the main island of Tongatapu, the major purpose of their fishing activity was for sale. My interest in

a detailed study of the community was based, however, on the importance of fisheries in the context of evolving economic development activities of other kinds. The Pangaimotu community in Vava'u was a best fit in relation to this objective and it was for this reason that the community analysis was conducted in relation to that community. Further justification for this decision is provided in *Chapter 7*.

2.5.1.3 Inter-sectoral Economic Model

The inter-sectoral economic model was designed for the purpose of analysing issues relevant to the performance of the domestic fisheries sector. The data and information for the analyses, which focused on Tonga's domestic fisheries, came from the Annual reports of the Ministry of Fisheries and a published survey report on agriculture and livestock in Tonga (Tonga Government, 1997 & 2002). Personal interviews were also carried out with key exporters and staff of the Ministry of Fisheries. The VENSIM PLE software⁴ was used to analyse data in this model.

In the context of the study, the model focused on two broad issues: (i) the impact of tourism activity on the growth of fisheries and (ii) the changes in labour allocation between the two activities – tourism and fisheries.

In the context of Pangaimotu, it is assumed that although fisheries and tourism development can operate alongside each other, mangroves should be reclaimed for tourism development only to an extent that allows for sustainability, something that is of critical importance in view of the fact that mangroves play a significant role as a breeding ground for coastal fisheries and also in view of the fact that fish are a critical food resource for the rural island community. The use of the software VENSIM PLE32 was employed to run a simulation for the allocation of workers between tourism and fisheries so that the relationship between the different

⁴ Refer to *Chapter 7* for a detailed description of the VENSIM PLE software as a tool of analysis for this dynamic model.

economic activities in the community could be demonstrated. For this purpose, empirical data from the small fishing community of Pangaimotu is included.

2.6 Summary

The overall research approach uses both qualitative and quantitative methods and is based on the Pacific research paradigm. It is important that research that involves Pacific island communities should be conducted in a way that is consistent with the lives, needs and aspirations of these communities and because living with, and being accepted by such a community is necessary if there is to be the level of trust that is required for active participation in the research of community members. It is within this context that quantitative data are supplemented by qualitative data collected through *talanoa*; data which complement the modelling-based analyses whose representativeness are confirmed through randomisation regression analysis. This combination is intended to ensure that the conclusions arrived at are as robust as possible. It is also intended to ensure that the voices of key stakeholders in the fisheries sector in Tonga are heard and taken note of.

Chapter 3

Review of Literature on Fisheries

3.1 Introduction

Because fishing is a global industry, it is necessary, in order to fully appreciate Tonga's fisheries, to have a clear understanding of what is happening to fisheries globally. This chapter therefore includes a review of literature on some pertinent aspects of fisheries in the global, regional (Pacific islands) and local (Tonga) context. A historical overview of the main developments in the fisheries sector (3.2) is followed by a discussion of the global contribution of that sector, including global fish utilisation (3.3, 3.4 & 3.5). General discussion of the world fish trade (3.6) is followed by a discussion of the global significance of tuna fishing (3.7). Following an outline of current issues in global fisheries (3.8), there is a discussion of Pacific island fisheries (3.9), a historical overview of fisheries development in the Pacific (3.10), a discussion of Pacific islands fisheries management (3.11) and of issues constraining fisheries development in the Pacific islands (3.12) and in Tonga (3.13). The chapter ends with a summary of the overall content (3.14), and a discussion of its implications for Tonga (3.15).

3.2 Historical overview of global fisheries development

The main debate in the fisheries sector centres on whether or not the apparently boundless fish resources of the ocean could be depleted by fishing. Growth in the human population worldwide has led to an increasing demand for fish products and to the emergence, assisted by a range of technological advances, of a global network of international trade in fish and fish products. The increasing demand for fish products has inevitably led to the development of the concept of fisheries management. As Stephenson and Lane (1995) point out, the concept of fisheries management incorporates science, economics, social and institutional issues. According to Caddy (1999), great progress has been made thus far, with fisheries management at the present time being far more holistic, self-critical and intensive than it was ever before.

Despite the appearance of progress in the area of fisheries management, it remains the case that the status of fishery resources has deteriorated, even though, over the last 100 years or so, it has become increasingly possible to monitor and assess the state of fish stocks and to understand the economic and social forces that underlie ecosystem change. Why is this so? Caddy has suggested that one element of the answer is the fact that managing fisheries is more to do with managing the people involved in fisheries than it is with managing the resources (Caddy 1999:13). Garcia and Granger (Garcia and Grainger 1996) argue that the deterioration in the status of fishery resources is due to poor resource management. In other words, the failure of resource management is not just a question of maintaining fishing mortality within sustainable limits for a series of target species, but recognising the interconnectivity of ecosystems and the so far intractable problem of the management of complex systems (Garcia and Granger 1996). On the basis of his own research, Cochrane (Cochrane 2000) concludes that the primary reasons for the failure of fisheries management can be summarised as: high biological and ecological uncertainty as to resource dynamics, the conflict between social and economic priorities, and the lack of definition or observance of constraints imposed by the limit to production of the resources. He further argues that poorly defined objectives and institutional weaknesses, particularly relating to decision making and co-responsibility, also plays a key part, as does general public ignorance as to the interconnectivity of marine ecosystems (Cochrane 2000). It would seem, therefore, that the widely held (mis)conception that the ocean fisheries resources are boundless, combined with a lack of consensus and accurate understanding about how to properly manage ocean fish resources has led to a critical problem.

3.2.1 Global fisheries development before 1900

Fishing itself is as old as humankind and so is fisheries management. In France, local regulatory boards, known as *prud'homies* ('wise man' of the port) predate the French Revolution. The functions of these bodies included ensuring fair allocation of resources within the local jurisdiction, protecting the territory from outside intrusions, and protection of resources through regulation of fishing gear (Dufour 1996). The *cofradias* of Spain were similar in purpose, and many coastal communities worldwide have systems of taboos, access rights and traditional

practices which effectively protect the status quo. In Japan, during the Tokugawa period from 1603 to 1861, fishing territories were established, and coastal waters were considered to be extensions of the land and thus part of the feudal domain. The feudal lords partitioned the coastal waters and allocated areas of fishing grounds to local fishing communities under the control of the village heads (Kalland 1996). These systems remain largely intact today, although in some countries authority for managing the coastal territories has shifted from village head to fishing cooperatives. Such community approaches to fisheries management were widespread, and McGoodwin (McGoodwin 1990) refers to similar practises in the Philippines, Oceania, the Pacific coast of North America and Mexico. McGoodwin has suggested that the existence of controls itself indicates that the communities knew the value of these resources and the importance of conserving them (McGoodwin 1990:126). This community approach to resource utilization and conservation will be studied in detail with reference to the outer island community of Pangaimotu in Tonga (see *Chapter 5*).

Prior to industrial-scale exploitation, fisheries management, using traditional knowledge and early technology and practices, was largely sustainable even without scientific information about the marine ecosystem. A major challenge to 'traditional' small-scale fishers and their rights was inevitable with the development of a market economy, particularly as fish is an important source of human consumption and sustenance in very many societies. With the development of the market economy, fish became a highly sought after commodity, with corresponding market prices for the commodity providing an incentive to harvest even when local demand was satisfied. New developments, such as large vessels, wider markets and improved storage, processing and transportation of fish meant that the centre of decision making shifted from coastal communities (based on village head or fishing cooperatives) to the business community, banks, cities and central governments. With reference to a case study of the Pangaimotu community, this thesis sets out to unpack the impact of the development of the market economy on traditional small-scale fishers and their rights to their fisheries resources. Associated with this is the fundamental question of the extent to which the community is willing to sacrifice fisheries (a critical aspect of basic livelihood) in order to embrace new developments which involve the use of

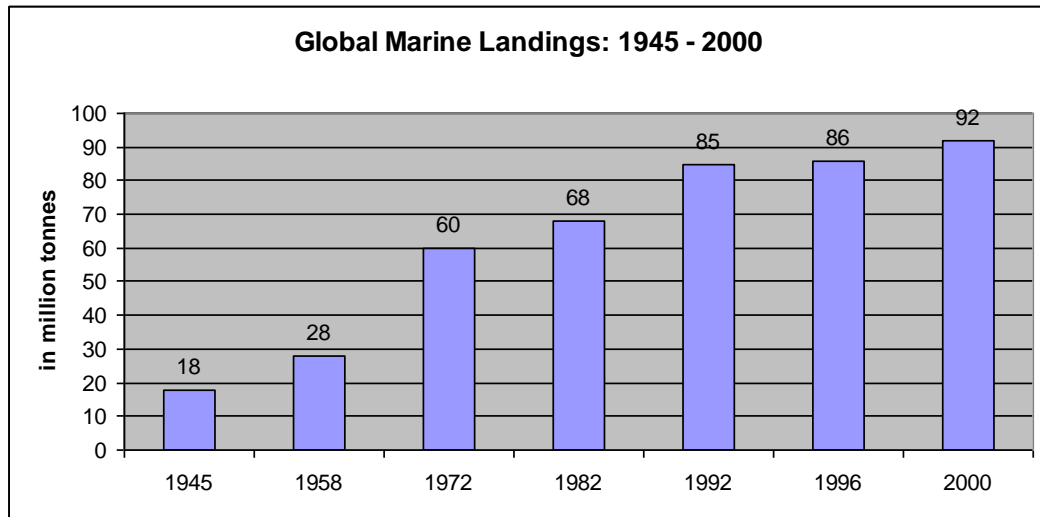
natural resources for other purposes, especially social and economic development activities? In the case of Pangaimotu, tourism offers an alternative economic development activity, so a key question discussed in the thesis is to what extent the community should or could sacrifice mangrove areas to allow for developments such as tourism in view of the fact that fisheries resources, as a fundamental part of the livelihood of the community, must be maintained at an acceptable level.

Early fishery regulations applied in the marine environment tended to reflect the original practices and established rights to cultivation and conservation of fishery resources. Hugo Grotius, for example, argued in favour of the concept that the freedom of the sea is “common to all”, that is, that the seas and oceans are common property: “the sea ... cannot be attached to the possessions of any particular nation” (Caddy & Cochrane 2001:656). The consequence of this ideology, as noted by McGoodwin, was that “indigenous peoples who survived and adapted to the new colonial regimes were acculturated to the ways and mentalities of the conquerors. As a result a wealth of native knowledge about the managing and conserving of natural resources ... was forgotten” (McGoodwin 1990:186).

3.2.2 Global fisheries development since World War 2

The development of fisheries since World War 2 has been dramatic (see *Figure 3.1*). In 1948, the reported global marine catch was 18 million tonnes. By 1996, it had reached 86 million tonnes. This period of expansion, driven by increasing human demand and the technology used to satisfy that demand, has tested fisheries management. Major developments in fisheries during this period were reviewed by Garcia (Garcia 1992) and Garcia & Newton (Garcia and Newton 1994). They divided up the post-war period according to trends in the global marine landings.

Figure 3.1: Global Marine Landings: 1945-2000



Source: Caddy, Review of fisheries management 2001

The period from 1945 to 1958 was considered one of “Construction and Reconstruction”. Global marine landing increased from 18 to 28 million tonnes (Caddy & Cochrane 2001:657). The mandate given to Food and Agriculture Organisation (FAO), founded in 1945, was intended to assist in the reconstruction of European economies, including the fisheries sector. At the UN International Fishing conference and first FAO Technical Committee, the key problems identified as facing the fisheries sector included overcapacity, over fishing and the depletion of resources (Food and Agricultural Organisation 1945).

The period 1959-1972 was one of further expansion of fisheries and an intensification of research in support of fisheries development. Global marine landings increased from 28 million tonnes in 1958 to 60 million tonnes in 1972. Attention was focussed, particularly by countries with extensively developed industrial fleets (principally at that time from Europe, Japan, USA and former communist countries) on support via subsidy schemes. Expanding fishing power was also boosted by technological developments, such as the development of synthetic fibres for improved fishing gear.

The period from 1973 – 1982 was identified by Garcia (1992:658) as a period of “New Economic order and Stock Variability”. Reported global landings increased from 60 to 68 million tonnes. The slowdown in overall increase during this period

was probably influenced by rising fuel prices, although other problems stemming from resource depletion also occurred (Caddy 1999). At the 1973 FAO Technical Conference on fisheries Management and Development, among the important issues discussed were the failure of fisheries management, over capitalisation, subsidies and economic efficiency, as well as problems relating to open access fisheries, and the need for precautionary management. It was in this period that electronics was applied to navigation and fish-finding, and at-sea catch processing and refrigeration systems began to be widely used, greatly increasing fleet efficiency. It was also in this period that the concept of “limited entry”⁵ began to gain wide diffusion (Wilén 1988).

From 1975, some countries unilaterally extended their jurisdiction to 200 miles (from 3 miles initially), a practise which was formalised in 1982 when UNCLOS III⁶ included the provision for an exclusive economic zone (EEZ). This was ratified in 1993 as the Law of the Sea (UNCLOS). Declarations of a 200 mile limit gave countries exclusive control over fisheries in their own EEZ. This was seen as providing the legal framework for countries to manage their fish stocks for their own benefit. The underlying presumption was that this would be achieved in a wise and sustainable way. One of the consequences of this has been the widespread practise in the 1970s of fishing vessel licensing in an attempt to limit the sizes of fleets.

The years from 1983 – 1992 saw another growth spurt, with global landings increasing from 68 to 85 million tonnes. This period was marked by a growing concern for environmental conservation and the sustainability of fisheries resources. Countries were also finding that the establishment of the 200 mile EEZ had not solved their problem (Food and Agriculture Organization 1992), and that, with a few exceptions, there was no noticeable improvement in the general status of the world’s fisheries resources.

Manifestations of growing concerns with environmental issues included a move to prohibit large-scale pelagic driftnet fishing, which places high seas fisheries on

⁵ Limited entry refers to those fisheries where the total number of licences is limited.

⁶ United Nations Conference on Law of the Sea

the UN agenda. In 1992 the UN Conference on Environment and Development (UNCED) led to the adoption of Agenda 21. The implications of Agenda 21 for fisheries management was profound (Caddy and Griffiths 1995), and included a growing emphasis on ecosystem management, the application of the precautionary approach, and the need for participation of all concerned citizens in environmental issues. While very few, if any, of the concepts were new, UNCED gave their implementation renewed impetus and increased authority.

Finally, this period was also marked by an important national event; the collapse of the Canadian Atlantic Northern cod fishery, which closed down in July 1992 after a decline in landings from as high as 800,000 tonnes in 1968 to only 1,700 tonnes (Parsons and Beckett 1994). Fishery scientists, managers and environmental groups around the world were alarmed. This event was particularly significant because the Canadian approach to fisheries assessment and management was seen by many as being the best in the world. If developed and wealthy countries with such intensive and well-developed fisheries managements system could fail, what hope was there for fisheries around the world? This led to a strong impetus towards adopting the precautionary approach to fisheries promoted by FAO.

Garcia (1994:661) has labelled 1993 – 2000 as the period of the “Sustainability Challenge”. It was also a period of consolidation, one in which several global initiatives reflected the beginning of genuine awareness of the importance of the lessons that had been learnt, and one that was marked by the negotiation of new international agreements and laws on fisheries. The most important new international instrument has been the FAO Code of Conduct for Responsible Fisheries (known as Code of Conduct). The Code is voluntary, but it includes provisions that have already been made binding or obligatory in many national legislations. It sets out the principles to be adhered to in all aspects of fishing in order to ensure responsible and sustainable practises.

Another important legal instrument developed during this period of consolidation is the “Agreement for the Implementation of the Provisions of the United Nations on the Law of the Sea Relating to the Conservation and Management of

Straddling Fish Stocks and High Migratory Fish Stocks’ - usually known as the ‘UN Fish Stocks Agreement’. This instrument sets out provisions to ensure the long-term conservation and sustainable use of straddling and highly migratory fish stocks.

Overall, as the twentieth century drew to a close, the international community was well aware of the crisis facing fishery resources and fisheries in general. As such, a number of important international steps towards an improved global management system of fisheries were undertaken. Through the Code of Conduct, international communities are aware of the steps necessary to implement sustainable and responsible fisheries within national EEZs and on the high seas. Through the UN Fish Stocks agreement and UN laws of the Sea (UNCLOS), legal instruments were set in place to enforce, if necessary, responsible high seas fishing. The challenge for the next phase (labelled by Caddy as the period of “Confronting Rights and Responsibilities” (Caddy & Cochrane 2001:662)) is to implement these legal instruments successfully and to translate them into national policy that will benefit stakeholders: skippers, vessel owners, fishing companies, small-scale fishers and their coastal communities. This last phase completes the cycle, taking us back to before industrial fisheries and high seas inter-governmental negotiations when the current framework began. Now we are seeing fisheries issues returning to the national and local arena, with revived emphasis on the rights and responsibilities of individual fishers, their communities and other stakeholders. The idea that fisheries management involves managing fisher peoples rather than just the resources was considered innovative in 1988 (Larkin 1988), but is now axiomatic. In this thesis, an important point of departure is in the analysis not only of the right of the community to their resources (see *Chapters 5 and 6*) but also the importance of ensuring that maximum return is achieved from fisher people’s decision to export fish from Tonga (see *Chapter 4*).

3.2.3 Future prospects in fisheries management

The question of what fisheries management will look like in the next century and beyond is one that we can begin to address only when we have established appropriate frames of reference or paradigms (Caddy 1999). At the most abstract level Charles (Charles 1992) points to three sets of ‘world views’ that are

competing for influence: the conservationist; the rational users of resources; and those who would design a management system around social criteria. The mechanisms proposed can range from privatisation of resources to government intervention or community-based local management (Charles 1992). These approaches will depend on the local political context and the nature of the resource and environment, but in general, community based approaches will tend to be applied more inshore, with some or all management responsibilities for inshore resources being explicitly ceded by national governments to local entities. The challenge for the immediate future is to evaluate the effectiveness of existing management systems, and to develop systems that are both cost-effective and sufficiently robust to withstand the uncertainties inherent in all stages of the fisheries management cycle. It is in the context of issues such as this that Tonga fisheries will be discussed and an evaluation of the effectiveness of the current system provided in relation to simulations of different alternatives at different stages of the fisheries management cycle (see *Chapter 8*).

Having provided a historical overview of global fisheries development, I will now look in more detail at the global performance of the fisheries sector from 1996 to the present time, the period that Caddy has labelled “Confronting Rights and Responsibilities” (Caddy & Cochrane 2001:662). Attention will be paid to the global contribution of the fisheries sector, including fisheries production, employment, fisheries utilisation, and the significant contribution of tuna fisheries in the context of the fish trade.

3.3 Global contribution of the fisheries sector

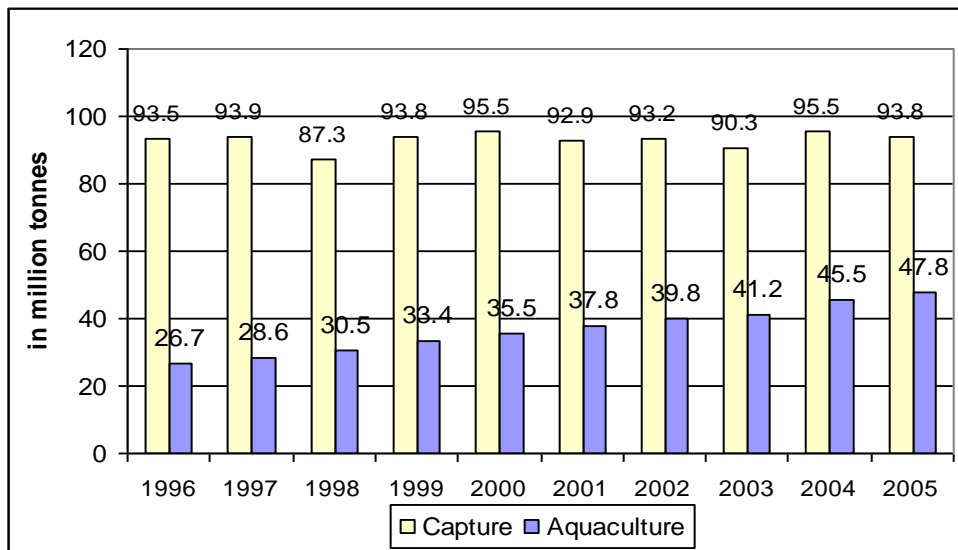
By any measure, fish are among the world’s most important natural resources. Fish supply over 15% of global protein needs as part of total annual trade exceeding US\$55 billion (Ormerod 2003:204). The fishing industry is one of the most highly globalized economic sectors, with the world fish trade growing considerably over the last decades, both in terms of value and volume. This, for example, 38% of all fishery products, valued at US\$58.2 billion was traded internationally in 2002. This was an increase of 41% in volume and 45% in value from the 1992 level. Fishery production activities provided direct employment and revenue to an estimated 35 million people. More than 1 billion people also rely on

fish as an important source of animal protein. About 56 percent of the world's population derive at least 20 percent of their animal protein intake from fish, and some small island states depend on fish almost exclusively (Food and Agriculture Organisation 2006). *Chapter 5* discusses the importance of fish for the diet of the small island state of Tonga.

3.4 World fisheries production

Global production from fisheries (captured and aquaculture) is currently the highest on record and remains very significant for global food security. World fisheries production continued to grow rapidly over the last decade (see *Figure 3.2*) in response to increasing demands due to advanced fishing technologies, growth in aquaculture and the expansion in the areas and species fished (Asian Development Bank 2001). Thus, for example, global fisheries production increased from 120 million tonnes in 1996 to more than 131 million tonnes by the end of 2000 and up further to 142 million tonnes in 2005. Also, while captured fishery is stagnating, aquaculture has continued to expand from just over 26 million tonnes in 1996 to almost 48 million tonnes in 2005 (Food and Agriculture Organisation 2006:3) (see *Figure 3.2*). Increasing production, however, was not enough as some countries' economic decisions gave priority to the export of marine products rather than to the satisfaction of local food requirements (Sann 1998).

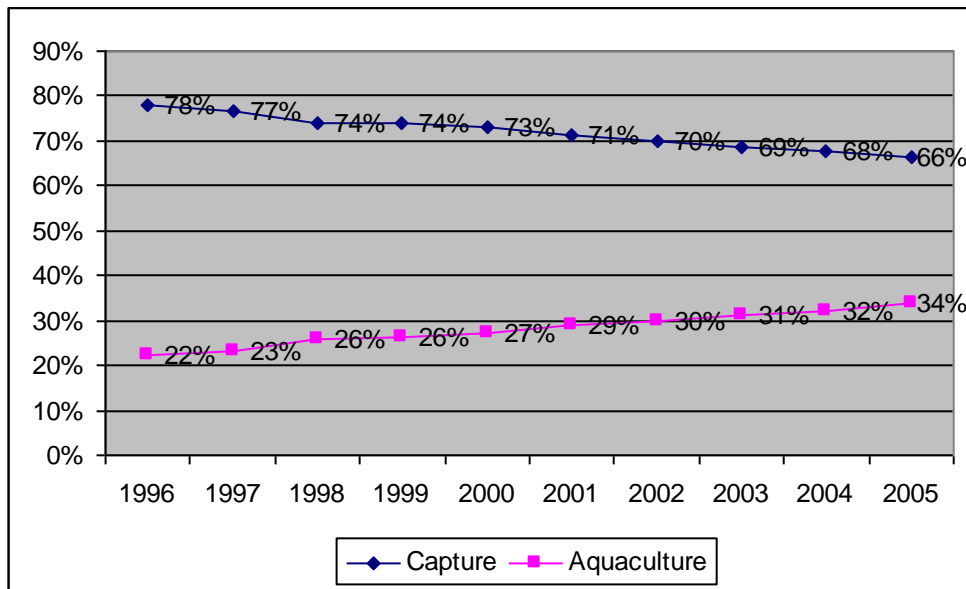
Figure 3.2: Global Fish Production



Source: FAO, *State of World Fisheries and Aquaculture, 2006*

The aquaculture share of the global total fish production increased from 22% in 1996 to almost 34% at the end of 2005 (Figure 3.3). China and other Asian countries are by far the largest producers of aquaculture, accounting for more than 90% of the total volume of aquaculture produced world-wide. China alone contributed over 70% of the Asian aquaculture production. In terms of aquaculture, China is followed by Peru, Japan, the US, Chile, Indonesia, the Russian Federation and India (Food and Agriculture Organisation 2006:5).

Figure 3.3: Share of Global Fish Production



Source: FAO, *State of World Fisheries and Aquaculture, 2006*

3.4 Global fisheries employment

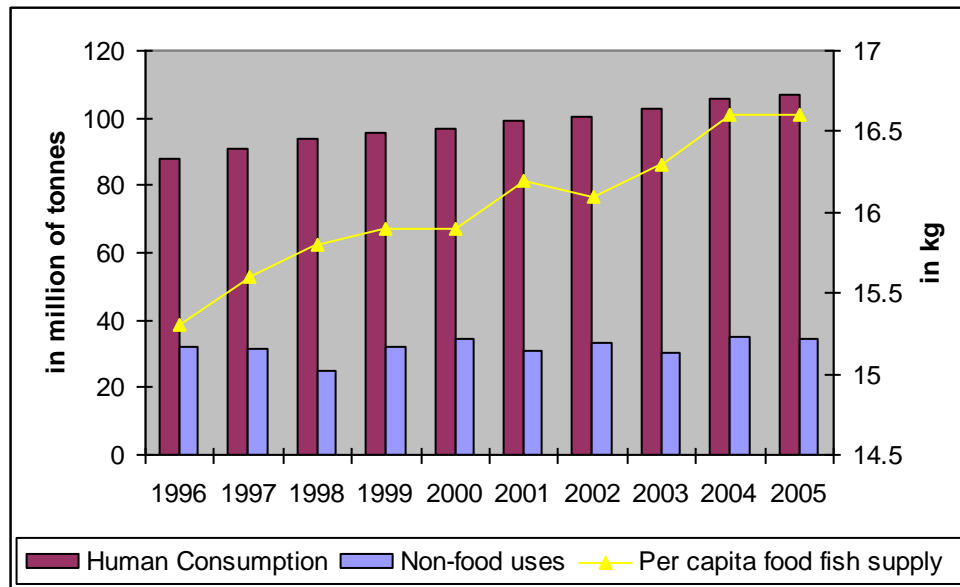
In terms of employment, fisheries provide direct employment and revenue to an estimated 35 million people worldwide. Indeed, at the end of 2002, of the 35 million people worldwide deriving employment and revenue from fisheries, 75% were involved in fishing and 25% in aquaculture. Of the total global fishery employment, Asia accounted for 85% followed by Africa with 7%. Indeed, China alone constituted a third of the world's total fishery employment (Food and Agriculture Organisation 2004:23).

3.5 Global fish utilisation

The global utilisation of fisheries will shed light mainly on issues related to the global food supply. For example, of the estimated 140.5 million tonnes of fish produced in the world in 2004, more than 75% (105.6 million tonnes) was used

for direct human consumption. The remainder was utilized for various non-food products, mostly for reduction to meal and oil. China remains the largest producer, with reported fishery production of 47.5 million tonnes in 2004, providing an estimated food supply of 28.4 kg per capita. Global per capita fish supply increased generally from 15.3 kg in 1996 to 16.6 kg in 2005 (*Figure 3.4*).

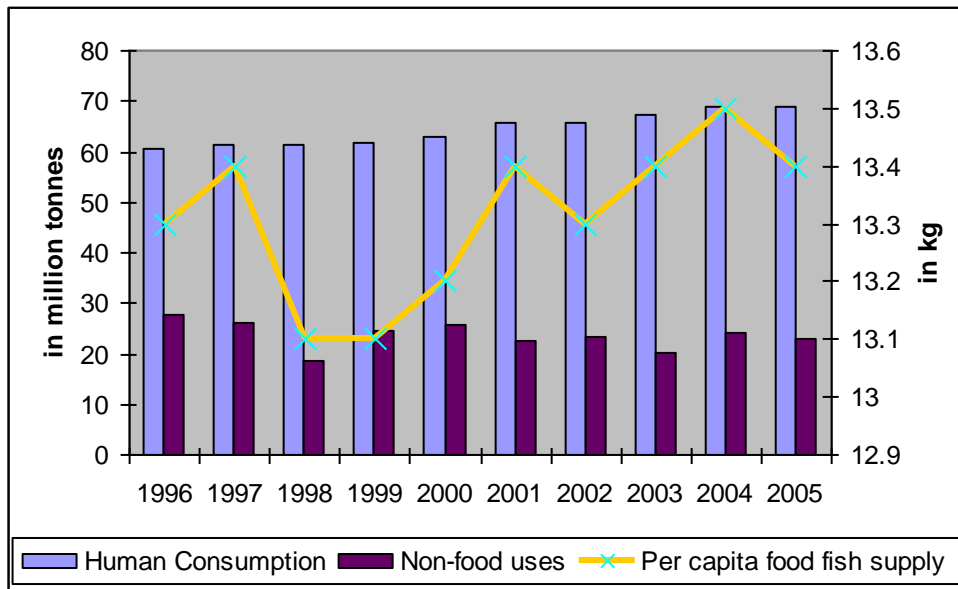
Figure 3.4: Global Fish Utilisation



Source: FAO, *State of World Fisheries and Aquaculture, 2006*

The growth in the global per capita fish supply is largely attributable to China, whose estimated share of world fish production increased from 16% in 1992 to 35% in 2004. Outside of China, the world's population growth outpaced fish food supply, resulting in a decrease in global per capita fish supply from 13.3kg in 1996 to 13.1kg in 1998 and 1999. Although per capita fish supply increased again to 13.4 in 2001, it decreased to 13.3 kg in 2002 and increased again after that and peaked at 13.5kg in 2004 and declined again to 13.4 kg in 2005 (*Figure 3.5*).

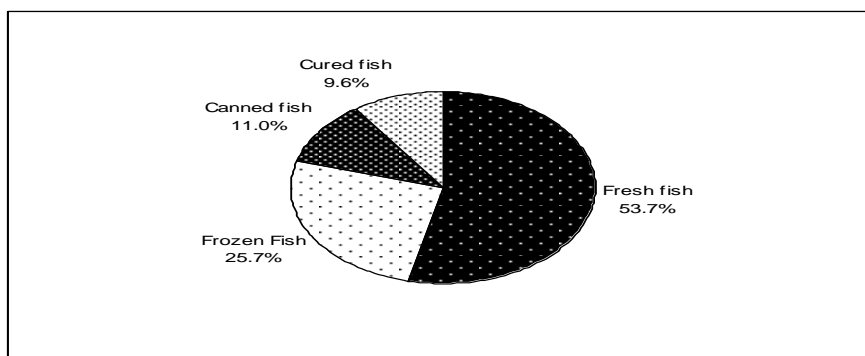
Figure 3.5: Global Utilisation of Fish Excluding China



Source: FAO, *State of World Fisheries and Aquaculture, 2006*

Global per capita fish⁷ consumption has increased over the past four decades, rising from 9.0kg in 1961 to an estimated 16.5 kg in 2003. China has been responsible for most of this increase: its estimated share of world fish production grew from 21 percent in 1994 to 34 percent in 2003, when its per capita fish supply stood at around 25.8kg. (Food and Agriculture Organisation 2006:36) Of more than 96 million tonnes of fish products destined for global human consumption in 2000 (see *Figure 3.6*), fresh fish was the most important (a share of 53.7%), followed by frozen fish (25.7%), canned fish (11.0%), and cured fish (9.6 %) (*Figure 3.6*).

Figure 3.6: Global Fish Consumption in 2000

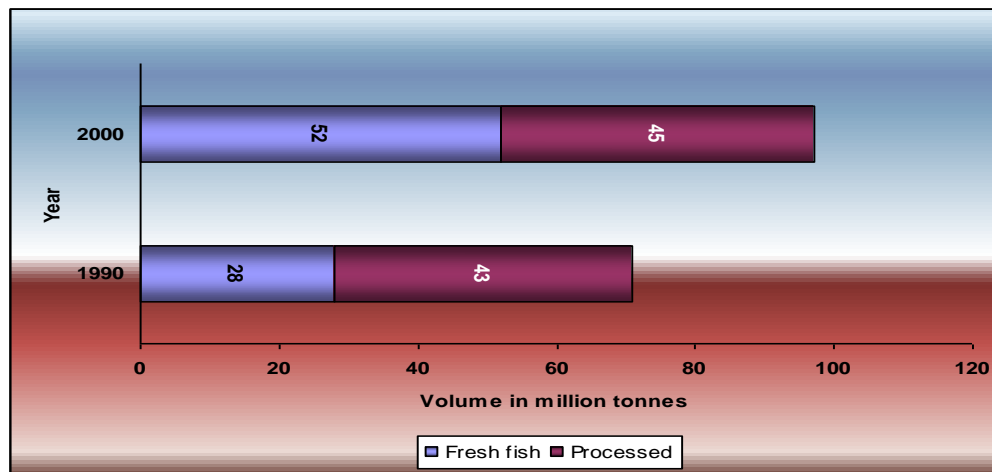


Source: Food and Agriculture Organization, FAOSTAT, 2002

⁷ The term fish indicates fish, crustaceans and mollusks, excluding aquatic mammals and aquatic plants.

The demand for fresh fish has increased, but is partially offset by a lower level of increase in other uses. For example, fresh fish has increased in volume (live weight equivalent) from an estimated 28 million tonnes in 1990 to 52 million tonnes in 2000. Processed fish, however, only increased in volume (live weight equivalent) from 43 million tonnes in 1990 to about 45 million tonnes in 2000 (Figure 3.7).

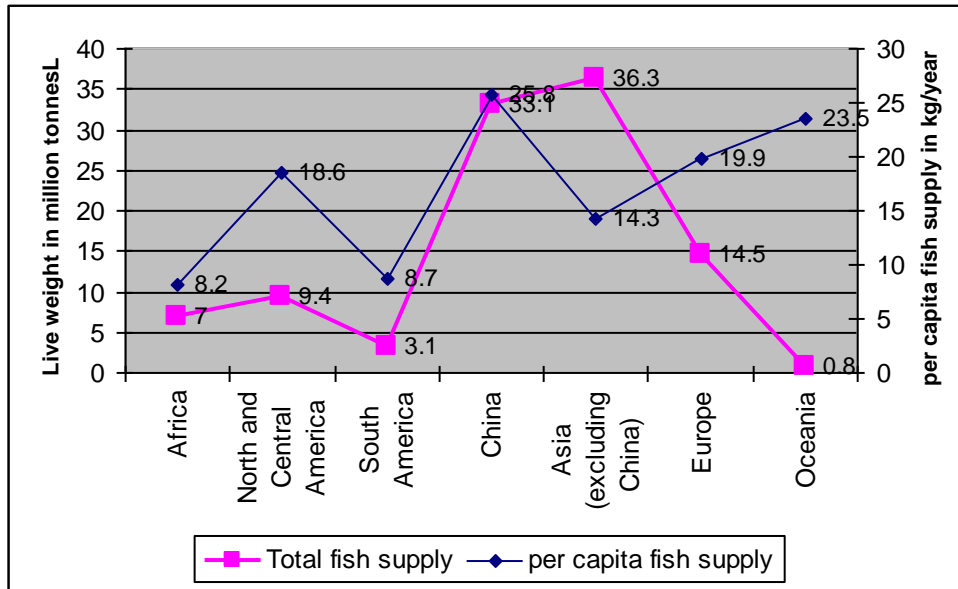
Figure 3.7: Global Fish Demand



Source: Food and Agriculture Organization, FAOSTAT, 2002

The total amount of fish consumed and the species composition of the food supply vary according to region and country, reflecting the different levels of natural availability of aquatic resources in adjacent waters, as well as diverse food traditions, tastes, demands and income levels. For example, Oceania, which includes Tonga, constitutes only 0.8 million tonnes of fish supply, yet the per capita fish supply is at a record high of 23.5 kg per year at the end of 2003, see Figure 3.8. China dominates the per capita fish supply with a record of 25.8 kg per year. However, Asia (excluding China) recorded the highest global fish supply of 36.5 million tonnes, due to its high population, although its per capita fish supply was only 14.3 kg per year, see Figure 3.8.

Figure 3.8: Global Fish Supply: 2003



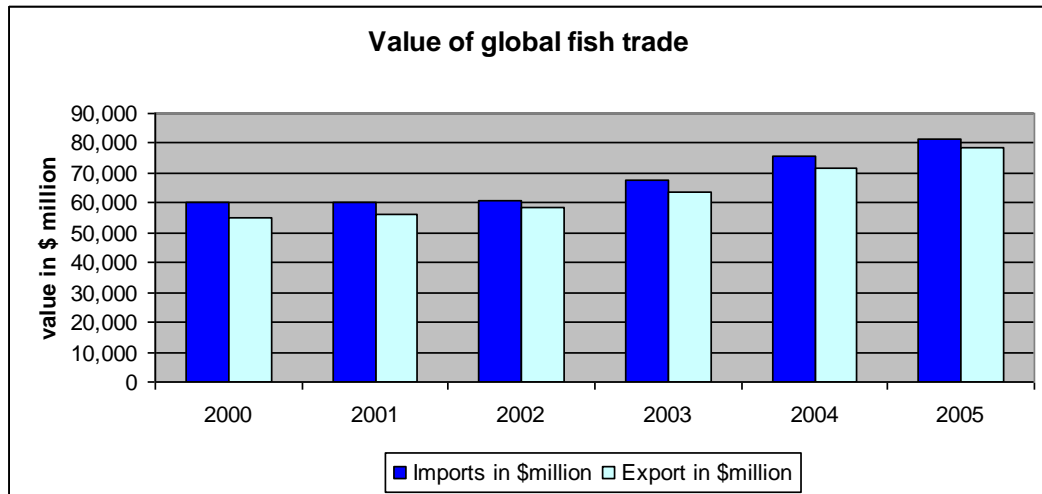
Source: Food and Agriculture Organization, 2006

3.6 World fish trade

Fish is the most highly traded food product in the world market. In 1994, fish trade volume accounted for 41% of world food trade, compared to only 4% for rice and 22% for wheat. In 2004, total world trade in fish and fishery products reached a record value of US\$71.5 billion (export value), representing almost 30 percent growth relative to 2000 (see *Figure 3.9*). In real terms (adjusted for inflation) exports of fish and fishery products increased by 17.3 percent during the period 2000-04. In terms of quantity, exports in live-weight equivalent terms in 2004 accounted for 38 percent of total fisheries (including aquaculture) production, confirming again fish as one of the most highly traded food and feed commodities (Food and Agriculture Organisation 2006:41). Fish is also the largest single source of animal protein in the world, and the fastest growing food commodity in international trade (The World Bank 1996).

In terms of import value, total world trade of fish and fish products reached a new record of more than US\$75.4 billion (import value) in 2004, representing almost 26 percent growth relative to 2000 (see *Figure 3.9*).

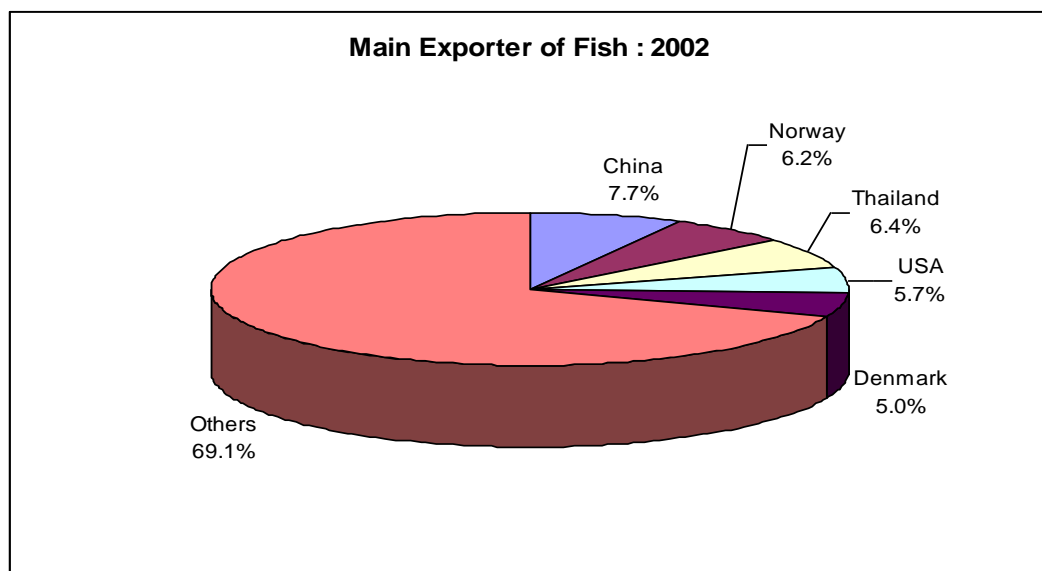
Figure 3.9: Global Value of Fish Trade



Source: Food and Agriculture Organization, FAOSTAT, 2006

Thailand was the main exporter of fish and fish products from 1993 to 2001. However, in 2002, China for the first time became the world's main exporter of fish and fish products, followed by Thailand. Other main exporters of fish were Norway, USA and Denmark. (see *Figure 3.10*). Norway, which used to be ranked second in the world, reported lower export values. These were partly caused by lower salmon prices but also by the low value of the euro – which is the currency of the main trading area for Norwegian fish.

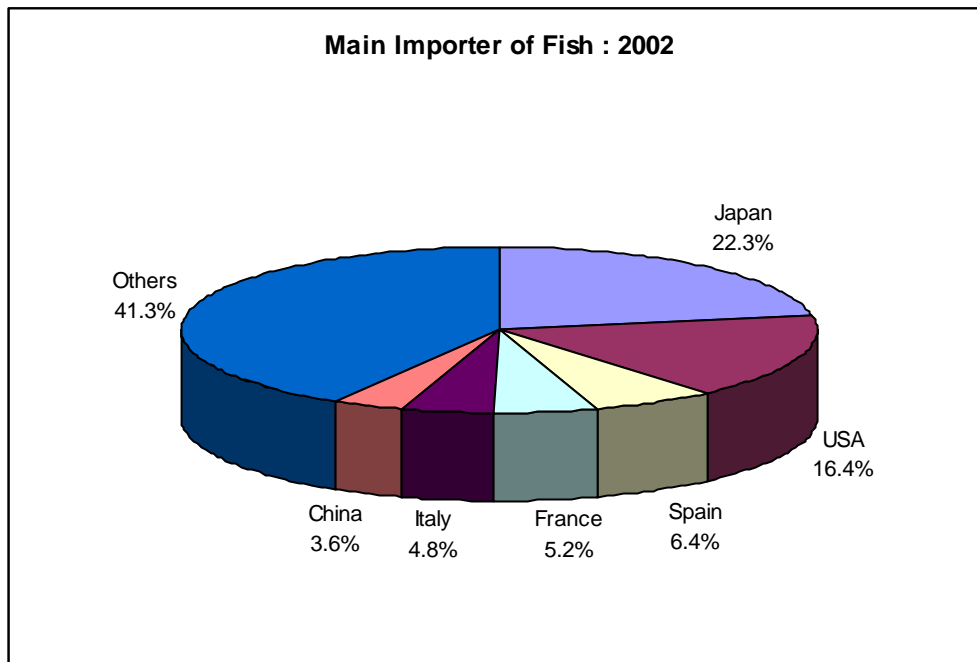
Figure 3.10: Main Exporters of Fish: 2002



Source: Food and Agriculture Organization, FAOSTAT, 2004

Developed countries accounted for more than 80 percent of the value of total fishery product imports. In 2002 Japan was again the largest importer of fishery products, accounting for some 22 percent of the global total; its fishery imports accounted for four percent of its total merchandise trade. The United States, as well as being the world's fourth largest exporting country, was the second largest fishery products importer. Spain, France, Italy and China were the other main importers of fish in 2002 (see *Figure 3.11*). Imports grew in the United States in 2000, mainly owing to an expansion in shrimp imports (Food and Agricultural Organisation 2002:43).

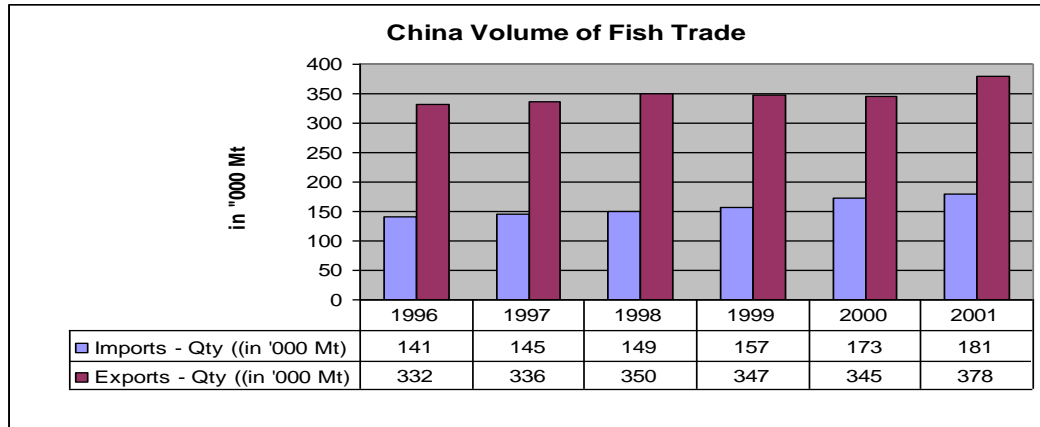
Figure 3.11: Main Exporters of Fish: 2002



Source: Food and Agriculture Organization, FAOSTAT, 2004

Since the early 1990s, China has experienced remarkable increase in its fishery exports, with fish export volume increasing by almost 14% from 1996 to 2001, compared to a 28% increase in the volume of fish imports. In 2001, China continued to experience a sharp increase in its fish export performance, reaching 0.378 million metric tonnes – a major growth of 14 percent from 1996 (see *Figure 3.12*). These increases are mainly linked to growth in the fish processing industry.

Figure 3.12: China – Volume of Fish Trade

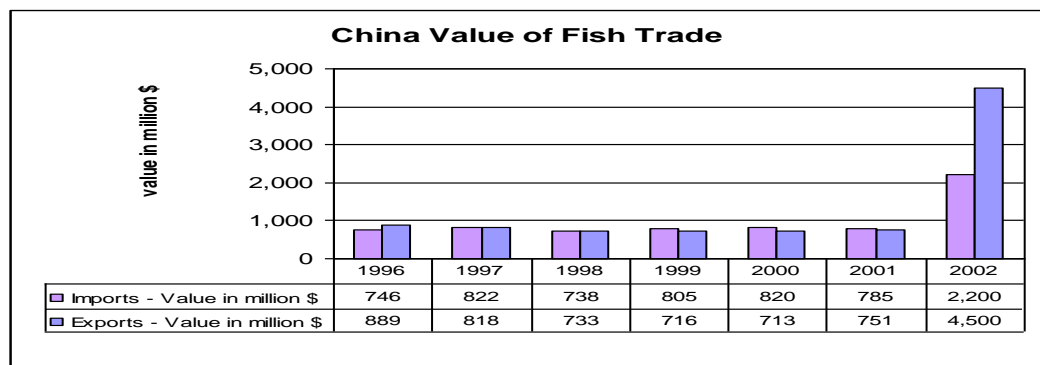


Source: Food and Agriculture Organization, FAOSTAT, 2004

Chinese imports of fish and fish products also increased significantly from US\$746 million in 1996 to US\$2,200 million in 2002 (see *Figure 3.13*), making China the world’s eighth largest fish importer. With its accession to the WTO in late 2001, China had to commit itself to lowering its import duties, which decreased from an average import tariff as high as 15.3% in 2001 to 11% in 2003 and 10.4% in 2004.

Since 2002, China has been the world’s main exporter, and in 2004 its fish export valued at US\$6.6 billion following remarkable average annual growth of 12 percent in the period 1992-2004 (see *Figure 3.13*). In addition to exports from domestic production, China also reprocesses imported raw material for export, creating a strong value-addition to the process.

Figure 3.13: China Value of Fish Trade



Source: Food and Agriculture Organization, FAOSTAT, 2004

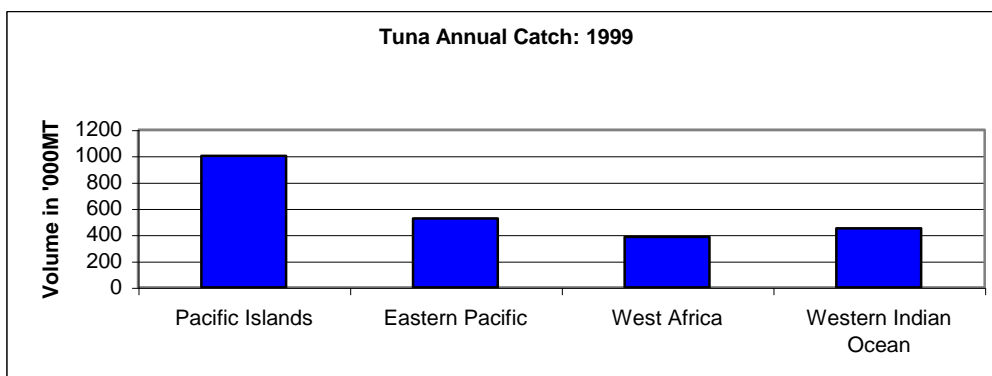
In value terms, shrimp continues to be the main fish commodity traded, accounting for 16.5% of the total value of internationally traded fish products in 2004. The other main group of exported species were ground fish (10.7%), tuna (8.7%) and salmon (8.5%) (Food and Agriculture Organisation 2004:47). Tonga's fish trade (export sector) will be discussed in line with the above trends and performance of world fish trade in *Chapter 4*.

Due to the high perishability of fish, more than 90 percent of internationally traded fish in 2002, is in processed form. However, recent improvements in logistics and technology have enabled fresh and live fish trade. Exports in frozen fish have also increased over the last decade (World Resources 1996:51). Overall, there is a trend in both developed and developing countries to focus less on producing raw fish for processing and more on high-value live fish, or value-added processed products (Lindsay, V 2005:10)

3.7 Global significance of the tuna fishing

Tuna catch (albacore, bigeye, skipjack and yellow fin) averaged 3.6 million Mt per year. The Pacific Islands are the main tuna fishing area (1 million Mt/year), followed by the Eastern Pacific (0.5million Mt), West Africa, and the West Indian Ocean (Joseph 2000:4), (see *Figure 3.14*). The total catches of tuna and tuna like species exceeded six million tonnes for the first time in 2002. This constituted 11% of the total value of fish landings for consumption.

Figure 3.14: Tuna Annual Catch: 1999



Source: Joseph, *World Tuna Production, 2000*

Thailand continues to be the main exporter of canned tuna to the United States market but lower exports were experienced in 2001. The Philippines remained in

second position. The use of tuna loins by Italian canners continues to expand. Loins as raw material now account for about 70 percent of the total Italian canned tuna production

Having outlined and discussed the global context of the fisheries sector, I move on in the next section to highlight some of the current issues that emerge from the global fisheries sector discussed above.

3.8 Current issues in global fisheries

Emerging out of the above historical overview in which fisheries were viewed globally are a number of important issues. These include: the international fish trade and trade liberalization; the importance of fisheries to the diet of small island communities, the pressure on fisheries resources; issues of sustainability; the growing importance of aquaculture and of mangroves. These issues are discussed further below.

3.8.1 International fish trade

The current debate on liberalizing the international fish trade through market access and the elimination of trade barriers is one that is of critical importance given the continued dominance of the fisheries industry in food trade. There is a growing concern that small island economies may not be able to cope with the process of trade liberalization: there is growing evidence that the production, processing and marketing of many commodities, including fish, are increasingly being controlled by multinational corporations. In addition, many small island economies are facing a dilemma in terms of whether to export fish or to focus on meeting the demands of the domestic market. There is evidence to suggest that while ocean resources have been dwindling, the global demand for seafood has been steadily rising. This growing demand for ocean resources has intensified fishing efforts and so put even greater pressures on the available fish stocks. As fish stocks worldwide are being depleted, the concept of sustainable development, discussed later (3.8.4), has also become an increasingly major issue in fish trade (Food and Agriculture Organisation 2004:61). In this context, *Chapter 4* of the thesis discusses the returns to fisher people in Tonga of fish exports.

3.8.2 Fish as an important nutrient

More than 100 countries have a coastline with coral reefs. At least tens of millions of people depend on coral reefs for part of their livelihood or for part of their protein intake (Salvat 1992:12). Jennings and Polunin calculated that one square kilometre of actively growing reef could support over 300 people if no other protein sources are available (Jennings and Polunin 1997:48). It is clear therefore that fisheries provide the dietary need of millions of people worldwide. *Chapter 5* discusses in detail the impact on the Tongan community, and on the Tongan fisheries industry more specifically, of issues of Pacific migration, particularly labour migration from Tonga to New Zealand. In this context, a major focus is on fish as a domestic food resource.

3.8.3 Pressure on fisheries resources

Debate about sustainability of fish resources focuses on evidence that there is pressure on fisheries resources due to over-fishing and the depletion of fish stocks. According to Jackson et al., the pressure on natural resources has been identified as the major cause of the recent collapse of the coastal ecosystems (Jackson, Kirby et al. 2001:635). Data from the FAO points to a real global concern. It suggests that 47% of fish stocks are already exploited to their maximum sustainable limits, while 18% are reported as being over-exploited and 10% are depleted (Food and Agriculture Organisation 2002:23). The underlying causes of over-fishing are attributed to a number of factors. These include economic, social and political factors as well as scientific ones. Economic factors that are responsible for putting pressure on natural resources include a highly mechanized approach to fishing which provides both the means and the incentive to over-fish. For example, large capital investment in boats and gear require a payback, which in turn creates the incentive to maximise fishing efforts leading to a 'race to fish'. Social and political factors include the shortfall in the fishing industry which results in the provision of various forms of subsidy to fishing companies. These subsidies are intended to stimulate economic activities which in turn create employment. However, these subsidies are ultimately counterproductive as they undermine the sustainability of the resource. In the fishing industry, subsidies are not only provided for fishing activities but also for ship builders. From the scientific viewpoint, the complexity of ecological systems and the practical limits

to gathering comprehensive data on the ecological systems means that there is a continuing degree of uncertainty in relation to stocks assessment (Nixon 1997).

Over-fishing has also altered the ecological balance in some areas and commercially valuable species have been exhausted. Deforestation, industrial pollution, agricultural run off and urban development are some critical aspects that have contributed to the degradation of fish habitat and hence reduced productivity in fishing. Much of the most important and productive coastal habitats, consisting of estuaries, mangroves, wetlands and coral reefs, have also already been damaged or destroyed by modern economic development activities (Mabey and Nixon 1997). This issue will be discussed in more detail in *Chapters 6 and 8*.

3.8.4 Sustainable fisheries

As indicated above, continued over-fishing and environmental destruction of fish habitats endanger fish stocks. The implications of this are huge. They include weakening the long-term economic viability of the fishing industry and a gradual undermining of the stability of coastal communities. Ultimately, over-fishing and environmental destruction threaten the contribution of fishing to global food supply. The FAO has projected that without a large increase in aquaculture production there will be the real potential for a substantial shortfall of fish and fisheries products by 2010 (FAO Fisheries Report 1995: 43). What should be done? At the most basic level, over-fishing must be stopped and fish habitats protected. An FAO report suggested that limiting fisheries efforts will lead to a potential solution. (FAO Fisheries Report 1995: 43). A substantial reduction in the world's commercial fishing is required if sustainable harvest levels are to be achieved. The fishing industry currently has twice the capacity needed to harvest the subsistence production of the ocean (Safina 1995:48). The issue of sustainability requires that in order to maintain the integrity of coral reefs as ecosystems, certain interventions are essential. These interventions must include such initiatives as the establishment of marine reserves, exercising control over fish harvests, and enhancing the natural productivity of fish stocks through such activities as reef restoration (Yap 1999).

The reality has been that fisheries have rarely been 'sustainable'. Rather, fishing has led to serial depletions, long masked by improved technology, geographic expansion and exploitation of previously spurned species lower in the food web. With global fishing catches declining since the late 1980s, a continuation of present trends will lead to supply shortfall, for which aquaculture cannot be expected to compensate. Reducing fishing capacity to appropriate levels will require major reductions of subsidies. A possible solution would be to zone the oceans into un-fished marine reserves and areas with limited levels of fishing. Such efforts and initiatives would allow for sustainable fisheries that are based on resources embedded in functional, diverse ecosystems. Simulation models in *Chapter 8* attempt to shed more light on this.

3.8.5 Aquaculture

Since 1989, the decline in marine capture fisheries has been largely offset by increased aquaculture production – policy makers and fisheries managers often see aquaculture as an alternative to capture fisheries as it has the potential to take pressure off wild stocks and also provide economic development opportunities and employment. Aquaculture is often lauded as a potential solution to fishery problems because it allows the economic and efficient production of fish protein, and because production can occur over a wide range of climates. Global production of farmed fish and shellfish has more than doubled in the past 15 years. Although many people believe that such growth relieves pressure on ocean fisheries, the opposite is true for some types of aquaculture. Aquaculture brings its own range of difficulties. Although aquaculture currently delivers a net addition to world fish production, negative environmental effects arise through habitat modifications for installations, the collection of seed-stock, and local adverse changes in water quality (Naylor, Goldburg et.al. 2000:1016). For example, farming carnivorous species requires large inputs of wild fish for feed. Some aquaculture systems also reduce wild fish supplies through habitat modification, wild seed-stock collection and other ecological impacts. On balance, global aquaculture production still adds to world fish supplies. However, if the growing aquaculture industry is to sustain its contribution to world fish supplies, it must reduce wild fish inputs in feed and adopt more ecologically sound management practices.

3.8.6 Importance of mangroves for global fisheries

Mangroves occupy an estimated 15 million hectares globally and line one quarter of the world's tropical coastlines (World Resource Institute, 1996). Mangroves serve as nursery areas and habitats for commercially valuable shrimp and prawns, and for locally consumed fish species and mangrove crabs. Through the export of nutrients to coastal ecosystems, they also support offshore fisheries. Mangrove forests play a critical role in the ecology and economics of tropical coastline communities, yet they have been grossly undervalued – and hence overexploited – in most regions of the world where they are found. About a half of the world's mangroves have already been destroyed or severely degraded by human activities such as logging, road construction, drainage operations, hydroelectricity development, and/or conversion to agriculture or aquaculture (World Resource Institute 1996). While the importance of forested wetlands, terrestrial and marine ecosystems have become widely recognised in several industrialized countries where policies to mitigate such destruction are now in place, mangroves continue to be destroyed in many developing countries. As such, continued damage to mangrove ecosystems has important implications for productivity as well as equity, since a disproportionately large share of the world's poor live in coastal villages of the developing world (Naylor, Goldberg at al. 2000:1020).

Direct use of resources, such as mangrove forests and fisheries, plays a more fundamental role in the daily existence of poor people throughout the developing world. Given the task of well defined property rights for resources in many poor regions, the conjecture is that perceptions of resource value are important in determining the evolution of both informal and formal institutions that govern resource use and depletion over time (Dasgupta and Maler 1991). Therefore, for most islands in the Pacific, access to mangroves traditionally has been open and free, and there are no restrictions or fees for fishing in mangrove forests. *Chapter 7* of this thesis discusses the important role that mangrove forests play in a local community in the outer islands of Tonga.

Having discussed the global fisheries context and some of the major issues surrounding global fisheries, I now consider fisheries at the regional Pacific level.

3.9 Pacific Islands fisheries

The Pacific islands are a diverse group of countries with a total population of around 8.5 million people, of whom around 66 per cent occupy one country, Papua New Guinea. The total land area amounts to around 550,947 square km (South Pacific Community 2004), with over 83 per cent of the land located in Papua New Guinea. In contrast, the total area of ocean under the jurisdiction of Pacific Island Countries and Territories (PICTs) amounts to over 29 million square km. The high ratio of ocean area to land area (roughly 53:1) highlights the importance of the ocean to PICTs. Pacific Islands countries share some common characteristics. For example, nearly all of these countries have relatively small populations and therefore also have a limited domestic market. Most of the countries of the Pacific rely on their agricultural and fisheries and other natural resources for food, employment and exports. There is only limited manufacturing in most of the countries and nearly all depend on imports for most of their product inputs and consumer products. The introduction of the 200-miles Economic Exclusive Zone (EEZ) where Pacific Island Countries (PICs) extended control over fishing grounds to 200 nautical miles out from their coastlines in the 1970s, was a dramatic development for the island countries of the South Pacific. The significance of the Pacific island countries Economic Exclusive Zone (EEZ) is indicated by the fact that the combined area of these zones covers 30.57 million square km, contributing to at least 30 percent of the world's tuna harvest each year. However, at present 90 percent of the region's total tuna catches are taken by distant-water fishing fleets from Japan, the US, South Korea and Taiwan. In this regard, a suggestion has been made that in order for PICs to increase the benefits derived from the exploitation of their tuna resources, each Pacific island country should select its own development strategy to effectively utilize the tuna resource (Scharmann 1991).

3.10 Historical overview of fisheries development in the Pacific

Pacific Islanders have traditionally harvested marine resources for their dietary needs, with inshore resources targeted in most cases. In Polynesia, the tuna resource has also been targeted traditionally by fishermen, who used poles with pearl shell lures from paddling or sailing outrigger canoes. Paddling canoes have also been used traditionally in Polynesian countries to catch flying fish at night

with light attraction (burning coconut fronds) and a scoop net. Traditional fishermen in the Pacific were very skilled, and the methods they used had evolved over generations. Their methods were developed for specific fishing situations, and in some cases, species (Chapman 2004:5).

From about the 1960s, the availability of modern fishing gears, aluminium dinghies and outboard motors started to erode traditional fishing methods. Using this modern equipment, more people also became involved in fishing. Some of the 'new' fishermen did not have the knowledge of traditional fishing techniques, so they were also open to learning fishing methods, both traditional and modern, that were being used elsewhere in the region.

In the 1960s and 1970s, many Pacific Island countries and territories started looking at developing their marine resources commercially. Initial focus was on harvesting inshore resources, such as trochus for export and reef fish to sell locally. This was followed by the harvesting of near shore resources, such as deep-water snapper and tuna, which in many cases had not been fished for traditionally. However, in order for this to happen, the fishermen and fisheries administrators in most PICTs needed guidance and training in the gear~~s~~ and fishing techniques needed. Training programmes were implemented in many PICTS in the 1980s for the harvesting of deep-water snapper. Fish markets and ice machines were installed in support of this development in both urban and rural areas. Fish aggregating device (FAD) programmes were also set up in many countries to assist local fishermen catch tuna using small-scale fishing methods. Mid-water fishing techniques for the larger, deeper-swimming tuna that aggregated around FADs were also introduced around the region.

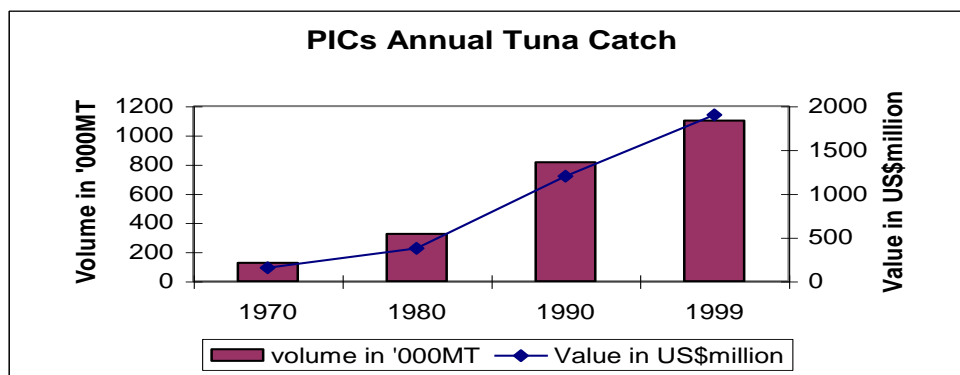
In the late 1980s and early 1990s, domestic fisheries development changed dramatically, with some PICTs looking to commercially harvest the tuna resource using tuna long-lining techniques. Private sector entrepreneurs could see the potential of the tuna long-line industry, based on the foreign fishing activities in the region and the prices paid for high-quality fresh tuna in export markets such as Japan and Hawaii. Tuna long-line development occurred in many PICTs through

the 1990s and early 2000s, and remains the main focus of near shore domestic fisheries development today.

3.10.1 Pacific Islands tuna resources

The Pacific tuna fish are an important global food resource and the economies of many Pacific Island countries (PICs) rely heavily on tuna industries. The Pacific Islands are the world's main tuna fishing area at 1 million metric tonne per year (Joseph 2000). Pacific Islands Tuna catch is on an increasing trend both in value and volume (see *Figure 3.15*). Although almost one million metric tonne of the Pacific Islands tuna are caught annually, only some 40% are handled by Pacific Islanders themselves. The South Pacific is the most productive region in terms of tuna harvest due mainly to its abundant skipjack resource, and contributes some 40% of the total tuna supplied for canning. The region also supplies a substantial proportion of Japan's sashimi market. South Pacific tuna is worth some US\$1.5 billion and the economic future of many Pacific islands is dependent upon the conservation of the region's tuna stocks. It has been suggested that a practical alternative to the direct control of tuna catches, while other methods are being researched, is area closures (Hunt 1997). It has been argued that governance by PICs is the key to improving the sustainability and profitability of tuna industries in the region (Barclay and Cartwright 2006).

Figure 3.15: Pacific Islands Tuna Catch



Source: *Forum Fisheries Agency Annual Report, 2002*

With access agreements in place, many PICTs looked at ways to develop their domestic tuna fishing capabilities, so that they could harvest a larger portion of the region's tuna resource themselves. In many countries, the tuna resource is the only natural resource they have to harvest to generate economic wealth, create

employment, and provide an ongoing protein source for the local population. Several approaches were taken, as governments looked at both small-scale and medium-scale tuna fishery development. FAD programmes were developed in some countries to support small-scale tuna fishery development (Gillett in press). Some countries focused more on developing medium-scale tuna long-lining, with both public and private sector participation. Development of the domestic tuna fishing capacity continues to be the main focus of most PICTs today, with some countries looking at the processing sector as well as the harvesting sector.

According to a Forum Fisheries Agency report (FFA 2002), there are three types of fishing vessels operating in the Pacific Islands region. The purse seiners account for 75% of the catch, followed by long-liners, and pole and line. Most of these purse seiners are from Japan (34.8%), followed by Taiwan (23.8%) and Korea (17.9%) respectively. Only 3% of these tuna vessels are from Pacific Island countries. About 60% of the region's tuna catch are exported to canneries and 30% to the sashimi market in Japan (Petersen 2002). The value of tuna catches accounts for 11% of the region's GDP (Kildow, Kite-Powell et al. 2000). Relative to total exports, tuna value makes up almost half of the annual exports from the Pacific Islands region.

The total revenue from fisheries has been significant for many countries, accounting for up to 50% of the national budget in some cases. In most PICs, however, there is growing demand for fish in the domestic market and it is difficult to cope with this by exploiting the coastal/near-shore fisheries alone. This is due to resource limitations and the artisanal nature of most of the fisheries. The major strength of most of the PICs is the relatively large, potentially resource rich sea areas with exclusive economic rights, the extent of which may be as high as 3.5 square kilometres in some cases (refer to *Chapter 5* for details).

3.10.2 Pacific Islands coastal fisheries resources

As the majority of the Pacific islands are atolls and small islands surrounded by coral reefs, the principal target of near-shore fisheries in the region is fauna associated with coral reefs and lagoons. The total coastal fisheries production is 100,000 tonne per year (worth US\$262 million). About 80% of this production is

from subsistence fishing (Dalzell, Adams et al. 1996). For many of the people in the Pacific, fish is the stable source of protein. Fisheries in the coastal zone have traditionally been the target of subsistence activity and provide a major portion of the diet. Even with increasing urbanisation and the shift in preference to more imported western goods, fresh fish and invertebrates caught in coastal waters continue to be a significant item in the diet of many Pacific islanders.

Most coastal fisheries in the South Pacific are characterised by small scale artisanal fishing methods whereby fishing takes place from the shore or in shallow waters without the use of fishing vessels. Where fishing vessels are used they are generally small. They are either non-powered canoes or canoe and dinghy powered by an outboard motor and, to a lesser extent, by sail. Large vessels of 8-20m in length are often powered by an inboard diesel engine which is used for commercial fishing for demersal species beyond the reef slope, and for catching tuna in the open ocean.

3.11 Pacific Islands fisheries management

The Pacific island countries are home to the world's largest and most valuable tuna. Despite this, the Pacific island countries have found it tremendously difficult to capture significant economic rents from the resource. It is argued that poor economic policy is partly responsible for this. Poor policies are preventing the implementation of strong, cost-effective institutions for the governance of the tuna fishery which, coupled with strong institutions for broad social and economic governance, are required for development of the industry (Petersen 2002:316).

Community-based fisheries management is being widely promoted as an alternative to centralized systems based on the familiar bio-economic models that have manifestly failed to prevent a near catastrophic overexploitation of fish stocks worldwide. The Pacific islands region contains the world's greatest concentration of still-functioning traditional community-based systems for managing coastal-marine fisheries and other resources. However, complex problems relating to the reconciliation of customary and statutory legal systems continue to remain a major issue (Ruddle 1998:105).

Although customary marine tenure (CMT) systems for management of local marine resources occur throughout the world, compared with other models of fisheries management they remain relatively unknown. The Pacific Island Basin is especially rich in CMT systems, which play key roles in the overall social, economic, and cultural life of societies. An example from the Solomon Islands has been used to examine the organizational principles and potentials of CMT systems to provide sustainable yields and equitable access to resources, their resilience to external pressures, and mechanisms for ensuring local autonomy in resource control (Ruddle, Hviding et al. 1992).

One of the most hotly debated issues of fisheries policy in the Pacific is whether or not public funds should be used to finance commercial tuna fishing ventures. Many commentators from within the region argue for public investment in the industry to stimulate domestication. However, an alternative policy is where tuna fishing revenues are invested offshore through a trust fund, rather than re-invested in domestic commercial fishing activity, such as Kiribati has done. Trust fund earnings could then be used to stimulate and support private sector initiatives and alternative economic activities. As has been demonstrated in the case of Kiribati, offshore investment through a trust fund can be successful in generating substantial revenues. In comparison, most Kiribati government corporations, including a state-owned fishing enterprise, have performed poorly (Pretes and Petersen 2004).

3.12 Issues constraining fisheries development in the Pacific Islands

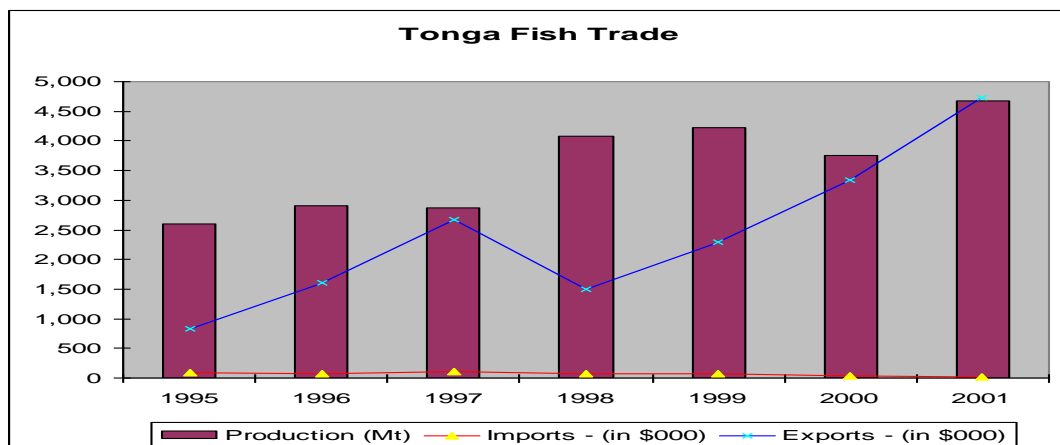
One of the major constraints on fisheries development in the Pacific Islands is transport. High transport costs to overseas markets due to the remoteness of PICs means that air shipment is limited to certain high value products such as sashimi tuna, fresh tuna, tuna loins and high priced reef fish species. There is limited airfreight capacity due in part to the small number of airlines operating in the Pacific island countries. Furthermore, limited downstream processing of fish products due to the small size of domestic markets is compounded by relatively high production costs. High fuel and labour costs also result in island countries themselves becoming dependent on food imports including canned fish from overseas.

Another major constraint on fisheries development in the Pacific islands is limited access to overseas markets due to heavy price competition in international markets as well as specific technical/quality requirements imposed by some target markets. Along with that, threats to the long-term sustainability of fishery resources mean that in spite of the rapid expansion of fleets operating in the region, catches and landings have remained relatively static in recent years. Depleting tuna resources and the deployment of super-purse seiners in the Pacific islands region raise serious concerns about the potential long-term viability of fisheries in the region. In terms of addressing the long-term viability of fisheries in the region, one way forward might be for island governments to declare waters adjacent to PICs as a whale sanctuary. Also, to help meet the growing domestic demand for fish, and to cut down on heavy imports of meat and meat products, it would be prudent for PICs to focus on expanding/upgrading their domestic fleets so that they can fish in deeper waters and consider diverting by-catches from off-shore fleets to sell in the domestic markets.

3.13 Tonga fisheries

Tonga's fish production has continued to follow the global trend over the last decade. Fish exports from Tonga grew to a record level in 2001 due mainly to the expansion of the tuna fishery (see *Figure 3.16*). *Chapters 4 to 8* provide more detail about Tonga's fisheries.

Figure 3.16: Tonga Fish Trade



3.14 Summary

The literature discussed above not only focuses on problems but also on potential solutions. Some of the reasons for the deterioration in the overall status of fisheries resources were identified as poor resource management, high biological and ecological uncertainty as to resource dynamics, the conflict between social and economic priorities, and the lack of observance of resource use limitations. It would seem that the (mis)conception that the ocean fisheries resources are boundless is compounded by lack of detailed understanding of how to properly manage ocean fish resources.

The historical overview of the development of the fisheries sector highlights the significant contribution made by fisheries globally, regionally (the Pacific region) and locally (Tonga). World fish trade has continued to grow considerably over the last few decades, not only in terms of value but also in terms of the volume traded. More than 1 billion people worldwide rely on fish as an important source of animal protein, with about 56 percent of the world's population deriving at least 20 percent of their animal protein intake from fish and some small island states depending on fish almost exclusively.

Over the last decade, world fisheries production has continued to grow rapidly in response to the increasing consumer demand for fish products and as a result of the use of advanced fishing technology, growth in aquaculture, and the expansion in areas and species fished. Fish production is mainly for direct human consumption, with China remaining by far the largest producer of aquaculture. Because fish is a highly perishable commodity, more than 90% of internationally traded fish products are in the form of processed food (frozen, canned or cured).

In global terms, fish is the most highly traded food product in the world market. In international terms, fish is also the largest single source of animal protein and the fastest growing food commodity. China's accession to the WTO in late 2001 has meant a lowering of its import duties, something that has important implications on fish trade worldwide. In terms of import value alone, the total world trade of fish and fish products reached a new record of more than US\$61 billion in 2002. The EU, Japan and the US imported about 82% of this total. Japan was the single

largest importer, accounting for 22% of all imports. In value terms, too, shrimp continued to be the main fish commodity traded worldwide, accounting for 18% of the total value of internationally traded fish products in 2002.

Important issues have emerged in relation to the expansion of the fisheries industry, issues relating to harvesting, production, consumption and trade. Emerging issues include the importance of fisheries to the diet of small island communities; debate about the pressures on fisheries resources and sustainable fisheries; the growing importance of aquaculture; and the importance of mangroves for global fisheries. What are the implications of all of this for Tonga as an island nation which is fishery dependent?

3.15 Conclusion: Implications for Tonga

The international community was well aware of the crisis facing fishery resources and fisheries in general at the end of the twentieth century. A number of important international steps towards an improved global management system of fisheries were undertaken. Tonga has responded positively to these steps and is a signatory to the legal framework set out mainly by FAO with regard to the laws of the sea.

The global fish trade continues to grow, as does the contribution of the fish trade to the Tongan economy. The challenge Tonga faces is the need to balance economic development activities and sustainable resource utilisation. Tonga's population and economic growth are putting enormous additional pressures on inland and marine fishery resources, which are important contributors to food security and providers of a social safety net. The impact of the recently established trade relationship between Tonga and China will be fully assessed since Tonga has finally become a full member of the WTO in July 2007. For a country whose main source of revenue comes from indirect taxes, the implications of lowering tariff in order to meet the requirements of the WTO are yet to be fully realised.

Tonga will also need to be able to formulate a response to current 'world views' that are competing to influence the future direction of the fisheries sector. These world views include the conservationist; the rational users of resources; and those

who would design a management system around social criteria. The mechanisms proposed and approaches to be taken will depend on the local political context and the nature of the resource and environment. The challenge, therefore, for small islands such as Tonga is to evaluate the effectiveness (including the cost-effectiveness) of existing management systems, and to develop systems that are both cost-effective and sufficiently robust to withstand the uncertainties inherent in all stages of the fisheries management cycle. All of the issues discussed above are further elaborated in this thesis, which also provides an evaluation of the effectiveness of Tonga fisheries.

Chapter 4

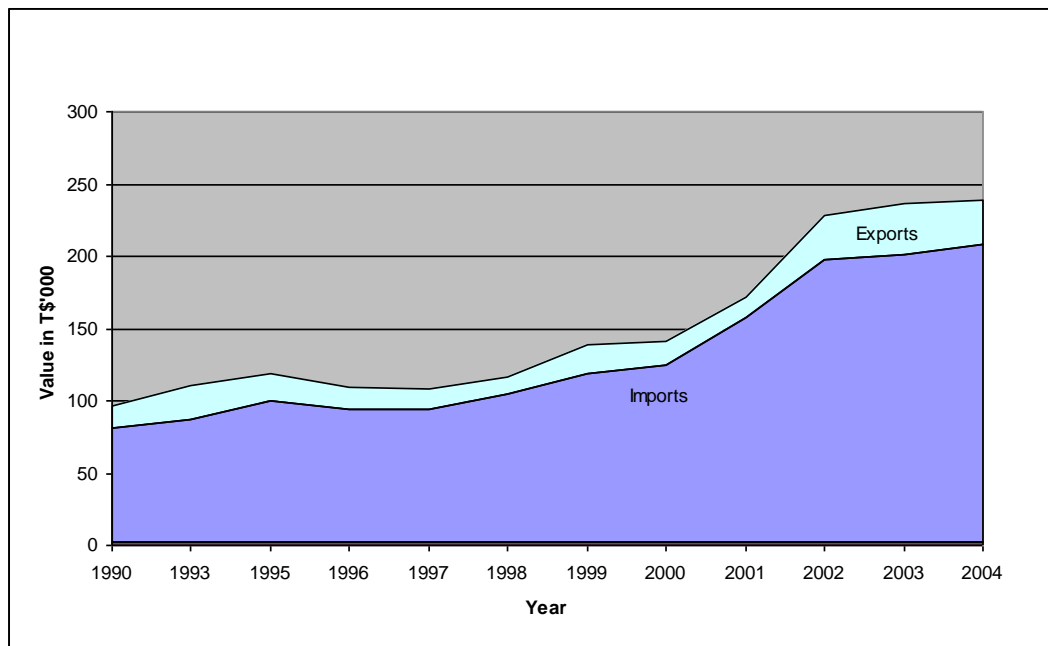
Economic Issues in Tonga Fisheries: The Export Sector

4.1 Introduction

This chapter examines the relevant economic issues in the Tonga fisheries export sector, the focus being on the financial return that fisher people receive when they export their fish overseas. The financial returns to fisher people are moderated by the type of fish exported (whether bottom fish or tuna) and also by the size of the operators. For instance, small fish operators have a different cost structure from medium and large size operators.

Tonga has faced a chronic trade deficit over the past decade. The external current account deficit increased from an average of 6.3% of GDP in 1999 to 8.1% in 2000 (Asian Development Bank 2002). *Figure 4.1* shows the external current account position of Tonga for the period 1990 – 2004.

Figure 4.1: Tonga Current Account: 1990 – 2004



Source: National Reserve Bank of Tonga

In its response to the problem of increasing trade deficit, the Tonga Government put forward a Development plan which aimed to achieve sustainable economic

growth with special emphasis on enhancing the export sector (Tonga Government 2006). The fisheries sector was identified as one of the sectors demonstrating the highest growth potential.

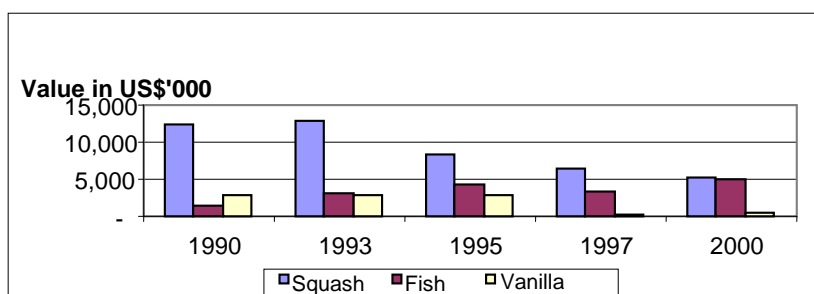
4.2 Tonga's fisheries sector

Fishing has always been an important subsistence activity in Tonga, having played an important role for Tonga in traditional food production. However, commercial fishing for local and export markets remained under developed until the early 1980s, when budgetary assistance to the Fisheries Division was strengthened and specific sectoral initiatives were undertaken by the government to exploit pelagic harvests and accelerate private small-scale investment.

4.2.1 Significance of the fisheries sector to Tonga

Fisheries are of special importance to small island states like Tonga. The industry grew steadily throughout the period 1990–2000 to become an important source of foreign exchange earnings. In 1993, fisheries exports become the second largest foreign exchange earner after squash, exceeding vanilla for the first time as shown in *Figure 4.2*. The decline in foreign exchange earnings from fish in 1997 was partly due to the rapid decline in sea cucumber stocks, such as sandfish (*nga'ito*), white teat fish (*huhuvahu*) and black teat fish (*mokohunu*). The decline in sea cucumber stocks saw the Government, through the advice of the Ministry of Fisheries, impose a ten year moratorium on its harvest. The moratorium impacted on fish exports, considering that sea cucumber was an important export commodity to the East Asian markets.

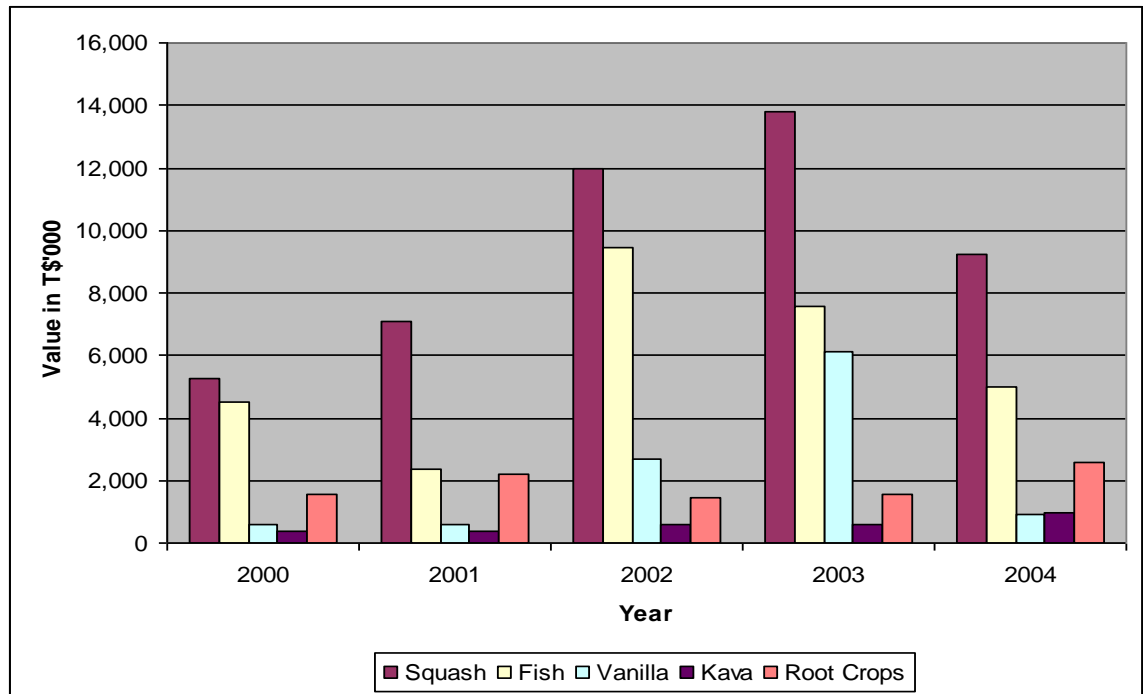
Figure 4.2: Tonga-Local Export Commodities: 1990 -2000



Source: Asian Development Bank Database

Foreign exchange earnings from fish declined during the years 2000 and 2001 but then increased in 2002, reaching a record level of more than T\$9.4 million (see *Figure 4.3*). This is the highest level of foreign exchange earnings ever recorded for Tonga from fisheries. The record was due mainly to the rapid expansion of tuna fishery exports, which accounted for more than 82 percent of the total value of the commercial fish catch in 2002. Kava and root crops also increased their share of Tonga's local export commodities from 2002–2004, see *Figure 4.3*.

Figure 4.3: Tonga-Local Export Commodities: 2000-2004

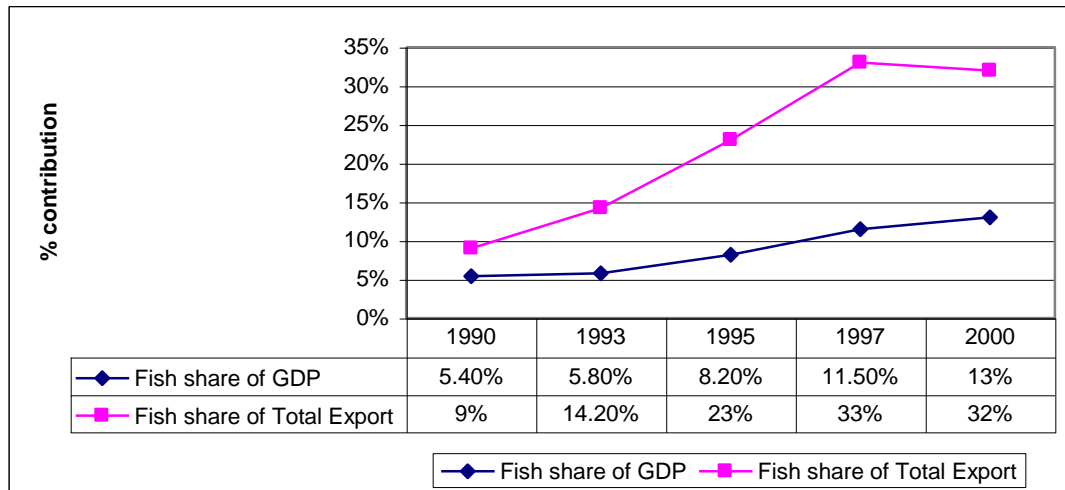


Source: Statistics Department, Foreign Trade Report

4.2.2 Contribution to the Economy

Since the late 1980s, the fisheries sector has become increasingly important in generating foreign exchange earnings for Tonga and also in contributing to Tonga's Gross Domestic Product (GDP). The fisheries sector's share of foreign exchange earnings increased from 9% in 1990 to more than 33% in 1999. Similarly, the fisheries share of GDP increased from 5% to 13% as shown in *Figure 4.4*. Much of the growth is the result of a substantial increase in tuna long-lining which was achieved in recent years.

Figure 4.4: Fish contribution



Source: National Reserve Bank of Tonga

4.2.3 Social benefits

Besides making a direct financial contribution to the Tongan economy, the fisheries sector also provides social benefits through employment and nutrition. During the mid-1990s, there were 2,300 registered fishermen in the country with about 16% of the households in Tonga engaged in some form of commercial fishing (Tonga Government 1995). This number increased to more than 5,000 households (32.6%) at the end of 2000 (Tonga Government 2002). Generally Tonga’s population suffers from obesity and nutritional problems. These problems have been identified by the Ministry of Health as being associated with a fatty diet of imported animal products. The opportunity to increase the availability of the by-catch from fishing, especially with the expansion of tuna long-lining, means that the market price of fish is expected to decline. Cheaper fish products would be more affordable to consumers and serve also as possible substitutes for imported meat products. If the consumption of fish and other marine products could partially replace consumption of imported meat by-products, this would have a positive impact on Tonga’s public health.

4.2.4 Fisheries legislation

The basic and most important legislation affecting Tongan fisheries is the Fisheries Act 1989. The Act declares that all territorial seas and internal waters are the property of the Crown. Every Tongan has the right to fish in these waters

and there are no traditional fishing rights that give villages, clans or individuals exclusive rights to fish in certain areas.

4.2.5 Fisheries resources

Three percent of the total area of the Pacific EEZ belongs to Tonga. However, Tongan fishermen take only about 0.3% of the total fish catch in the region. In 2001, the commercial catch of fish was the highest recorded in the history of Tonga. The total value recorded was in excess of T\$12 million (see *Table 4.1*). This was due mainly to the rapid expansion of tuna exports. Commercial fish exports, in fact, were made up mostly of tuna and bottom-fish.

Table 4.1: Value of Tonga's commercial fish catch by vessel and type of fish: 2001

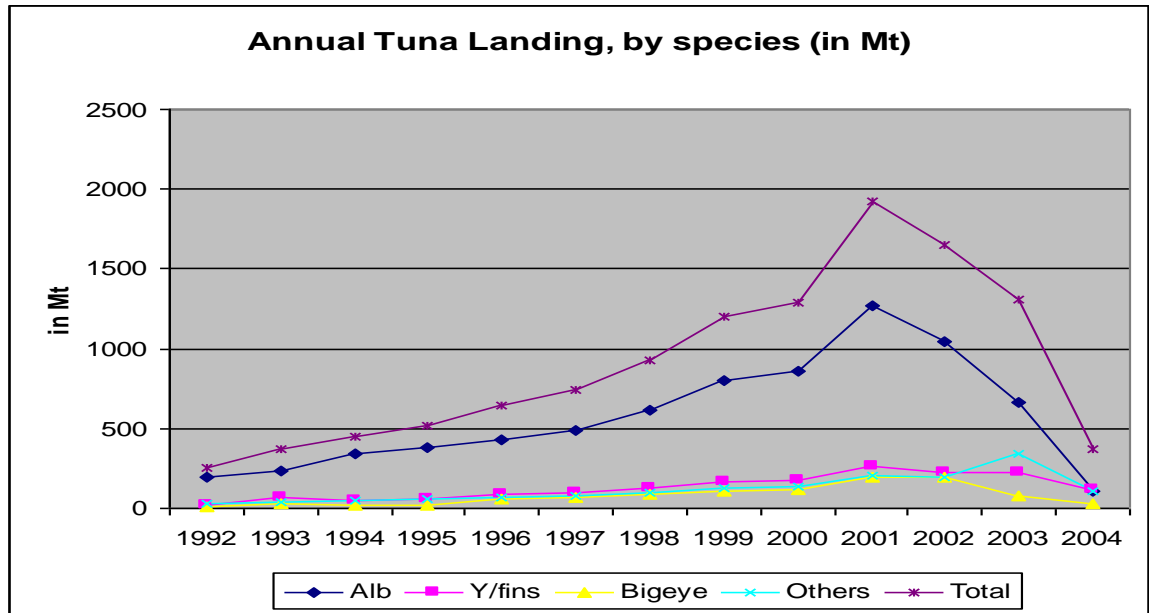
Characteristics	Tuna long line vessels	Bottom fish vessels
Domestic fish (T\$)	1,025,953	366,906
Fish export (T\$)	9,966,444	821,110
Total (T\$)	10,992,397	1,188,016

Source: Ministry of Fisheries Statistics and National Reserve Bank of Tonga

4.2.5.1 Tuna resources

Based on productivity and the relative extent of Tonga's EEZ, the South Pacific Commission (SPC) estimated that for Tonga an annual landing of up to 4,000Mt was sustainable. As noted in *Figure 4.5*, there has been a steady increase in the total tuna landing over the past decade. The highest catch was in 2001, with a total of 1,919Mt. The steady increase was due to the increase in the number of fishing fleets (from 16 in 1999 to 26 at the end of 2001). The decline in 2002 was due to the al-Nino effect on global weather that resulted in low catches.

Figure 4.5: Annual tuna landing in Mt

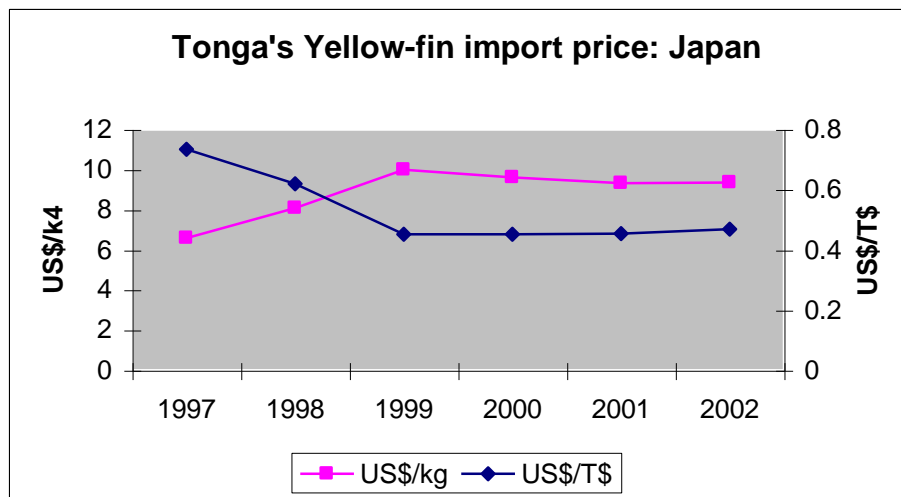


Source: South Pacific Commission, 2005

4.2.5.2 Tuna Prices

The price of yellow-fin Tuna exported from Tonga to Japan has been increasing since 1997 and levelled off at an average of US\$9.30/kg as shown in Figure 4.6.

Figure 4.6: Tonga's Yellow-fin import price: Japan



4.2.5.3 Bottom fish

There is a much longer history and experience in Tonga of bottom fishery than of tuna long-lining. Bottom fishery is dominated by snapper and grouper catches from the slopes of deep seamounts. In 2001, the catch of snapper and grouper increased nearly 18% over 2000. Currently, there are 20 vessels altogether

licensed for bottom fishery. The characteristics of vessels in bottom fishery fall into two distinct groups. One group is made up of larger vessels owned by major exporting companies. These generally exceed 12 metres in length. In contrast, the other group, made up mostly of smaller bottom fishing vessels, tends to be owned by individuals. Many of the smaller vessels were originally built by the UN Boat Building Project that operated in Tonga from 1983 and constructed nearly 50 boats. *Table 4.2* presents average prices received from the export of bottom fish (combined snapper and grouper sales). The information provided in *Table 4.2* indicates a strong movement in the value of bottom fish exports from 1997 to 2001.

Table 4.2: Price of bottom fish exports

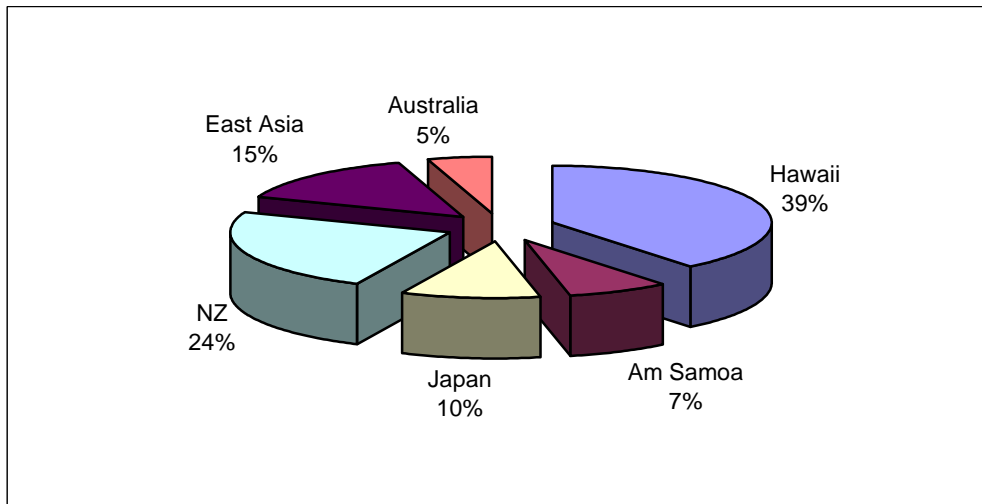
Year	Snapper (%)	Average FOB value (T\$/kg)	Average CIF value (T\$/kg)
1997	88	7.19	9.99
1998	94	9.21	11.82
1999	94	10.42	13.12
2000	85	11.21	14.55
2001	89	12.66	16.46

4.2.6 Fish Export Market

Tonga's main fish export markets are Hawaii, New Zealand, Japan and Australia. Japan imports fish mainly for sashimi, while Hawaii is mainly a market for sashimi and bottom fish. Australia and New Zealand markets are largely associated with Tonga's exports of bottom fish and tuna long-line. The East Asian market is mainly associated with crustaceans and molluscs and American Samoa mainly with tuna for cannery. *Figure 4.7* shows the distribution of fish exports from Tonga in relation to these markets.

Since exports of bottom fish from Tonga are relatively small compared to the overall market demand for snapper and groups, exporting companies in Tonga have tended to supply individual seafood markets or restaurant chains overseas rather than sell their exports through auctions or wholesalers channels.

Figure 4.7: Major Markets for Tonga’s Fish export

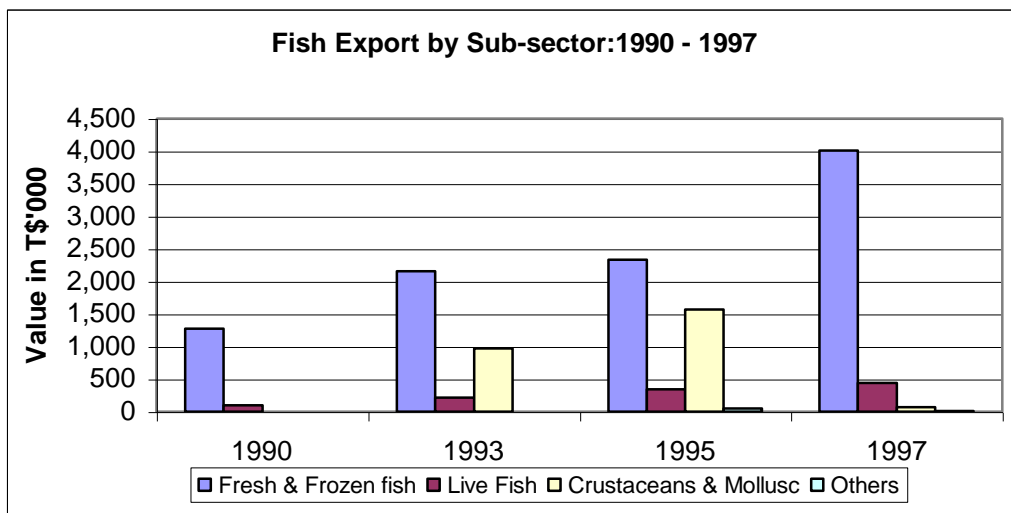


Source: Statistics Department: Foreign Trade Report

4.2.7 Export by sub-sector

The export of fresh and frozen fish dominates the fish export sector. In the mid 1990s, export of crustaceans & molluscs became increasingly important, especially to new markets in East Asian such as Hong Kong, Taiwan and South Korea. However, in 1997, due to the rapid decline in sea cucumber stocks (such as sandfish (*nga'ito*), white teat fish (*huhuvalu*) and black teat fish (*mokohunu*)), the Government took the advice of the Ministry of Fisheries and imposed a ten year moratorium starting in 1998 (see *Figure 4.8*).

Figure 4.8: Fish export by sub-sector: 1990 - 1997



Source: Statistics Department: Foreign Trade Report

4.2.7.1 Export by institutional sector

The export of fish is dominated by the private sector. About 76% of fish exports were from the private sector and the remaining 24% from quasi-government companies (in this case, the Sea Star fishing company).

There are only four major fish and marine exporters in Tonga.

Sea Star fishing Company, established in 1990, in which the Tonga Government is the main shareholder, has three long-line fishing boats that fish for tuna.

‘Alatini Fisheries, established in 1990, exports mainly snapper and high quality fish to Hawaii markets.

Maritime Project Tonga Limited, established in 1980, sells bottom fish such a snapper and grouper as raw fish to Japan. They also assist the newly established long-line fishing company, Capricorn, in packing and marketing their fish to the Japanese sashimi market.

Capricorn Fishing Company, the first long-liner to be established, fishes exclusively for the sashimi-grade tuna associated with the Japanese market.

4.3 Financial returns to fishermen from the main export markets

As indicated in the following sub-sections, analysis of likely financial returns to fisheries from the main export markets indicates the impact of operator size and fish type. For our purposes, those using 40 ft boats are said to be large-medium-sized operators and those using 30 ft boats are said to be small operators.

4.3.1 Production cost of fish exported

The cost of production of fish exported depends not only on the type of fish caught but also by the size of the fishing vessels operators used. In this instance, the data collected for the cost of production of fish exported were obtained through interviewing exporters. Much of the information, however, was also contained in a report this researcher published in 1997 outlining the exports of fish

from Tonga to its main markets (Rohorua 1997). An update of the data from 1997 was collected during the fieldwork conducted by the author in February 2003.

Information from exporters was collected through semi-structured interviews and open-ended questionnaires. Open-ended questionnaires were used to obtain general information about the commercial businesses; semi-structured interviews were used to obtain specific costs and returns. A questionnaire was designed to obtain basic background information on the nature of the company's operation, information on inputs used at different stages of the supply chain and their respective costs; output produced, export quantities and free on board (fob) prices of key products. A financial record from one of the companies was made available to the researcher. As such records were not available from the others, the researcher relied in these cases on information provided orally. The data obtained was validated against information collected from the Tonga Development Bank. Using the results of these interviews and data collected from other sources, the cost of production for the different operators was calculated and used also to assess the financial returns that could be expected from fish exports in different contexts.

The cost of production in the case of medium to large long-line operators was calculated at T\$3.87/kg. For small operators, the cost of production was only T\$3.00/kg. The cost of production for the medium to large bottom fish operators was calculated at T\$5.40/kg, while for small operators the cost of production was only T\$4.10/kg

4.3.2 Marketing cost of fish exported

The marketing cost of fish exported also differed depending on the type of fish exported and the size of the operators. The data collected and presented here are for exports of more than 1,000kg only. Exports of less than 1,000kg have a much more expensive cost structure. Information collected from operators showed that in order to improve their profit margin, the set target for every shipment of fish export has to be greater than 1,000kg.

4.3.2.1 Process and cost of obtaining an export permit

The information presented here was provided by one of the exporters with costs being double checked against the Government Departments concerned and against files and records held at the TDB. So far as the export permit process is concerned, twenty four hour's notice must be given to the Fisheries and Custom Officers prior to any export packing taking place. The Fish exporter must arrange to pick up a fisheries permit (blind copy only) from the Fisheries Department. The blind copy is then taken to the Department of Labour where a certificate granting the right to export will be issued. The export company then has to locate and pick up custom officers and take them to the processing plant where they keep watch over the packing of all the products that are for export. This is to ensure that drugs are not packed with the fish. A fisheries officer must also be present to inspect the entire packaging process. No packing can occur without representatives from each of these two Government departments being present. The fisheries officer is present to ensure quality assurances are met. The charge for the services of the fisheries officer is \$8/hr and for the customs officer, \$3/hr during normal working hours, \$4/hr if packing runs over lunch hour, and \$5/hr outside of normal working hours (including the weekend). Once the fisheries officer has inspected the packing, an export permit is issued and taken back to the Department of Labour, where the exporter has to pay a further \$5 as an export license fee. This is done for every shipment of fish exported. A packing slip is handed to the fisheries officer where a 0.5 percent fish export levy is calculated on an imputed T\$3.50/kg as the export price. The average price of \$3.50/kg is used since the actual fish price will not be known until the fish arrive at the destination. The product is then transported to the airport where a further \$0.70/ctn (up to 0.2 cubic metre volume) or \$1.40/ctn if greater than 0.2 cubic meter volume) as export duty is added.

4.3.3 Financial returns for fish export

The following sub-sections indicate the net return fishers can expect to receive from different export markets. Again, the return is moderated by the size of operators and also by the type of fish exported. The rate of exchange used for these analyses was the average rate for February 2003 (during the first field survey).

4.3.3.1 Bottom fish: Medium to large size operators

The cost of production is estimated at \$5.40 per kg. The marketing costs differ for each market destination. Costs depend partly on packaging requirements in Tonga. However, the main difference in cost is attributable to the cost of air freight. *Table 4.3* provides a detailed analysis of the costs and returns that medium-sized and large-sized fishing operators can expect in relation to the export of bottom fish to overseas markets.

Table 4.3: Financial return to fishers: Bottom fish medium to large operator

For shipment of 1,000kg or more

	Hawaii	Japan	Australia	NZ
Cost of Fish Production				
Per MT	5,400	5,400	5,400	5,400
Per kg	5.40	5.40	5.40	5.40
Export Market Price				
C&F per kg	USD\$8.40	1,000yen	A\$8.00	NZ\$8.00
Exchange rate	0.8293	97.65	1.1114	1.2951
C&F Prices (T\$/kg)	10.13	10.24	7.20	6.18
Marketing Cost/kg				
Airfreight	2.37	4.50	2.55	1.08
Packaging	0.50	0.80	0.50	0.50
Fees/levy	0.10	0.10	0.10	0.10
Total Marketing cost/kg	2.97	5.40	3.15	1.68
Balance after marketing cost				
Price/kg	7.16	4.84	4.05	4.50
Net to fishers				
Per kg	1.76	-0.56	-1.35	-0.90
Per MT	1,760	-560	-1,350	-900

The above results indicate that the export of bottom fish by medium-sized and large-sized operators is profitable only in the case of the Hawaii market where a net financial return of T\$1.76 /kg is likely. All the other markets record a loss, with the Australian market recording the highest loss of T\$1.35/kg. The cost of airfreight to Japan is a major marketing expense since there is no direct flight

from Tonga to Japan. Transshipment usually passes through either New Zealand or Fiji.

4.3.3.2 Bottom fish: Small operators

Here, the cost of production is estimated at \$4.10 per kg. Again, as in the case of the medium-sized and large-sized operators, the marketing costs for each overseas market differ depending on packaging requirements in Tonga and the cost of air freight. *Table 4.4* provides a detailed analysis of the costs and returns that small-sized fishing operators can expect from exporting bottom fish to overseas markets.

Table 4.4: Financial return to fisher people: Bottom fish small operator

For shipment of 1,000kg or more

	Hawaii	Japan	Australia	NZ
Cost of Fish Production				
Per MT	4,100	4,100	4,100	4,100
Per kg	4.10	4.10	4.10	4.10
Export Market Price				
C&F per kg	8.40	1,000yen	8.00	8.00
Exchange rate	0.8293	97.65	1.1114	1.2951
C&F Prices (T\$/kg)	10.13	10.24	7.20	6.18
Marketing Cost/kg				
Airfreight	3.30	6.48	2.55	1.08
Packaging	0.50	0.80	0.50	0.50
Fees/levy	0.10	0.10	0.10	0.10
Total Marketing cost/kg	3.90	7.38	3.15	1.68
Balance after marketing cost				
Price/kg	6.23	2.86	4.05	4.50
Net to fishermen				
Per kg	2.13	-1.24	-0.05	0.40
Per MT	2,130	-1,240	-50	400

The above results indicate that export of bottom fish by small operators is, as in the case of larger operators, most profitable in relation to the Hawaii market, where a net financial return of T\$2.13 /kg can be expected. The New Zealand market records a net return of T\$0.40/kg. The cost of airfreight to Japan again

affected the financial return to fisher people, showing, in this case, a loss of T\$1.24/kg.

4.3.3.3 Tuna long–line fish exports: Medium-sized to large-sized operators

The cost of production in this case is estimated at \$3.87 per kg. The marketing costs differ for each overseas market depending on packaging requirements in Tonga and, in particular, the cost of air freight. *Table 4.5* provides a detailed analysis of the cost and return fisher-people can expect from exporting yellow fin tuna to overseas markets through either a medium-sized or large-sized operation.

Table 4.5: Financial returns to medium-sized to large-sized operators: Tuna long line fishing

For shipment of 1,000kg or more

Long-line Fish- Yellow fin Tuna

	Hawaii	Japan	Australia	NZ
Cost of Fish Production				
Per MT	3,870	3,870	3,870	3,870
Per kg	3.87	3.87	3.87	3.87
Export Market Price				
C&F per kg	5.56	1,100yen	10.00	9.00
Exchange rate	0.8293	97.65	1.1114	1.2951
C&F Prices (T\$/kg)	6.70	11.26	9.00	6.95
Marketing Cost/kg				
Airfreight	2.37	4.50	2.55	1.08
Packaging	0.50	0.80	0.50	0.50
Fees/levy	0.10	0.10	0.10	0.10
Total Marketing cost/kg	2.97	5.40	3.15	1.68
Balance after marketing				
Price/kg	3.74	5.86	5.85	5.27
Net to fishers				
Per kg	-0.13	2.00	1.98	1.40
Per MT	-130	2,000	1,980	1,400

The above results indicate that tuna exported through medium-sized to large sized operations is most profitable in the case of Japan followed by Australia and New

Zealand. The Hawaii market shows a loss of T\$0.13/kg. A net financial return of T\$2.00 /kg is recorded for the Japanese market, T\$1.98/kg for Australia and T\$1.40/kg for New Zealand.

4.3.3.4 Tuna long–line fish exports: Small operators

For the small operator exporting tuna long-line fish, the cost of production is estimated at \$3.00 per kg. Again, as in the case of medium-sized and large-sized operators, the marketing costs differ for each market depending on packaging requirements in Tonga, and, in particular, the cost of air freight. *Table 4.6* provides a detailed analysis of the cost and expected financial return in the case of small-sized operators exporting yellow fin tuna to overseas markets.

Table 4.6: Financial return to fishers: Tuna long line exports (small operators)

For shipment of 1,000kg or more

Long-line: Yellow fin Tuna

	Hawaii	Japan	Australia	NZ
Cost of fish Production				
Per MT	3,000	3,000	3,000	3,000
Per kg	3.00	3.00	3.00	3.00
Export Market Price				
C&F per kg	USD\$5.56	1,100yen	A\$10.00	NZ\$9.00
Exchange rate	0.8293	97.65	1.1114	1.2951
C&F Prices (T\$/kg)	6.70	11.26	9.00	6.95
Marketing Cost/kg				
Airfreight	3.00	5.40	2.32	0.98
Packaging	0.50	0.80	0.50	0.50
Fees/levy	0.10	0.10	0.10	0.10
Total Marketing cost/kg	3.60	6.30	2.92	1.58
Balance after marketing cost				
Price/kg	3.10	4.96	6.08	5.37
Net to fishers				
Per kg	0.10	1.96	3.08	2.37
Per MT	100	1,960	3,080	2,2370

The above results indicate that tuna exported by small operators is profitable for all overseas markets. The highest return is recorded for the Australian market, which shows a return of T\$3.08/kg. New Zealand is the next best market, with a return of T\$2.37/kg. This is followed by T\$1.96/kg for the Japanese market. The Hawaii market recorded the lowest return of only T\$0.10/kg.

4.3.3.5 Summary of results

The financial returns analysis above indicates that Hawaii is a viable market for bottom-fish but not tuna long-line in the case of operators of all sizes. Both the Japanese and Australian markets, on the other hand, fetched good returns for the export of tuna but not bottom fish. The New Zealand market is proven viable for the export of bottom-fish and tuna long-line fish exports for both small-size and medium-large size operators. An exception, however, is bottom fish exports by medium-sized or large-sized operators (see *Table 4.8* for details).

Table 4.8: Summary of financial returns from fish exports (T\$/kg)

For shipment of 1,000kg

Size/type of fish	Hawaii	Japan	Australia	New Zealand
Medium Operators				
Bottom-fish	1.76	(0.56)	(1.35)	(0.90)
Long-line	(0.14)	1.99	1.98	1.40
Small Operators				
Bottom-fish	2.13	(1.24)	(0.05)	0.40
Long-line	0.10	1.96	3.08	2.37

4.3.3.6 Sensitivity Analysis

The return to fisher people is very sensitive to change in the price of fish at the export market and also the movement of the exchange rate of the currency of Tonga's main fish trading partners. An analysis of the change in price is provided in *Table 4.9* and movement in the US\$ and NZ \$ is provided in *Table 4.9*

Table 4.9: Sensitivity Analysis (T\$/kg): An increase in fish export price by 10.7%

For shipment of 1,000kg:

Size/type of fish	Hawaii	Japan	Australia	New Zealand
Medium Operators				
Bottom-fish	2.80	0.53	(0.57)	(0.24)
Long-line	0.58	3.19	2.94	2.43
Small Operators				
Bottom-fish	3.21	(0.14)	0.72	1.06
Long-line	0.82	3.16	4.04	3.11

A change in export price of fish will enable Japan to be a viable market for medium operators' export bottom fish from Tonga. Similarly small operators from Tonga will also be viable when exporting bottom fish to Australia.

Table 4.10: Sensitivity Analysis (T\$/kg): A 33.8% change in US\$/T\$ and a 29.5% change NZ\$/TS

For shipment of 1,000kg:

Size/type of fish	Hawaii Net return	Hawaii Price change	New Zealand Net return	New Zealand Price change
Medium Operators				
Bottom-fish	6.92	15.29	1.68	8.76
Long-line	3.28	10.12	4.31	9.86
Small Operators				
Bottom-fish	7.29	15.29	2.98	8.76
Long-line	3.52	10.12	5.28	9.86

Exchange rate as of 9/4/09 access www.westpac.co.nz

4.4 Conclusions

A number of important economic issues, issues that could present major barriers to Tonga's export fisheries sector, have been identified. The geographical distance between Tonga and its major markets and trading partners is such that the cost of air freight and other forms of transport necessarily work against the competitiveness of the industry. This is not, however, the only problem with

which fisher people involved in exporting have to deal. Lack of air cargo space is a major constraint, as are changing airline schedules/routes and aircraft types. Secondly, government customs and ports and services charges are a significant fiscal disincentive to exporting, especially in the case of bottom fish and tuna long-lining. The fisheries export tax of 0.5% represents a disincentive to exporters as does the cumbersome and costly process that exporters have to go through each time they wish to export a shipment. Another factor that acts as a disincentive to fish exports is a general lack of understanding of important aspects of fishery operations. The fisheries industry differs from the agriculture and tourism industries in that it is not necessarily tied to a fixed location. Tuna stocks are highly mobile and so too are the vessels that hunt them. It is therefore important that those involved in the fish industry should be able to unload their catch, refuel, and re-provision their vessels at ports far from their home base, something for which there is at present inadequate provision. Unless these critical issues are addressed, the fisheries export sector in Tonga is unlikely to realise its full economic potential, or to become an engine for Tonga's economic growth intentions and aspirations.

The sensitivity analysis shows how volatile the fish export market is. Any change in price or exchange rate will have an impact on the net return to fisher-people. This is beyond the control of fisher-people as these movements are determined mainly by global events in which small island nations like Tonga will have no control over. The best solution for Tonga fish export market is to ensure that the quality and marketing cost are kept to a minimum coupled with targeting to maintain a high price for the fish export.

Chapter 5

Economic issues in Tonga fisheries: The domestic sector - Impact on community from changes in subsistence fish catch

5.1 Introduction

Chapter 4 explored issues related to Tonga's export fisheries sector. It highlighted the fact that trade barriers, especially those associated with marketing costs, can have a major impact on a small island economy. A detailed analysis of the financial return that fishers can expect to receive from fish exports was provided and discussed. It was noted that financial returns were affected in a major way by the type of fish exported (bottom fish or tuna), export destination and operator size). The focus of *Chapter 4* was financial returns. Another issue of considerable importance so far as Tongan fisheries are concerned is that of human resources, particularly the location and distribution of people. Emigration and remittances are key features of the Tongan economy, with over thirty per cent of the Tongan born population being resident overseas, and remittances being equivalent to 40 percent of GDP. Therefore, the key question to be addressed in this chapter is the extent to which overseas residency impacts, directly or indirectly, on Tonga's domestic fisheries. Thus, for example, remittances from overseas may reduce the need to fish, and the absence of adults from Tonga may reduce the capacity to do so. Issues relating to the potential impact on fisheries of Tongan overseas residency are discussed further below.

5.2 Domestic fisheries

While the fish export sector is important to Tonga, the domestic fisheries sector is equally important. As a tropical island entity, Tonga has an ecosystem characterised by strong maritime dynamics. For example, Tonga's coastal zone in the Pacific Ocean constitutes a diverse ecosystem, which includes coral reefs, sandy beaches, sea-grass beds and mangroves. The total land area of the country is 747 square kilometres and the land is surrounded by 700,000 square kilometres of ocean (South Pacific Commission 2000). The sea to land ratio of more than 937 square kilometres of ocean to 1 square kilometre of land is an empirical reality,

one which highlights the urgent necessity to assess domestic fisheries issues that affect Tonga.

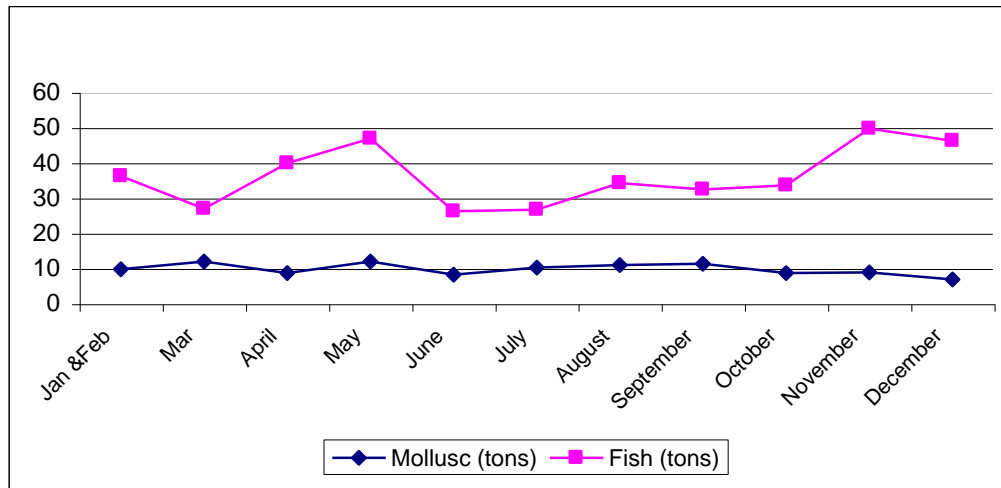
Fishing has always been an important subsistence activity in Tonga. It has played an important role in Tonga, especially in traditional food production. Domestic fisheries account for seventy nine per cent of fishing activity in Tonga and include the traditional inshore artisanal fisheries which involve small-scale fishing mainly to supply the local markets and also for subsistence.

Fisheries have continued to provide employment opportunities in Tonga, the number of households engaged in fishery activities having risen from sixteen per cent to thirty three per cent in 2001 according to the latest agricultural census figures. A total of 5,000 households, are engaged in fishing activities at the end of 2001. The main type of domestic fishing is hand-lining, followed by night diving and the use of fishing nets (Tonga Government 2002).

5.2.1 Estimated domestic fisheries landing

The data presented here were recorded in the main fish market in Nuku'alofa, Tongatapu by the staff of the Ministry of Fisheries during peak hours of landing over a period of two weeks. Their observation of the main fish market in Nuku'alofa showed that 10 tonnes of fish and 3.5 tonnes of shellfish were sold in a week. More than seventy five per cent of fishers sold their fish at Nuku'alofa, while the remainder sold their catches in the villages. Catches ranged from 12kg to 200kg per week per person for fish and from 5kg to 250kg per week per person for shellfish (Tonga Government 1997). As *Figure 5.1* shows, the fish catch fluctuated each week due to weather conditions, the lunar cycle, fishing grounds and festival times. Thus, for example, from June to August, the coldest season when fishermen spend fewer hours at sea, the catch is usually at its lowest. In May, however, the higher catch reflects a high demand for fish due to activities such as church conferences and family celebrations such as Children's Sunday, Mother's Sunday and Father's Sunday.

Figure 5.1: Domestic Fisheries Landing (in tonnes)



Source: Ministry of Fisheries Annual Report: 1997

As discussed above, the landing of domestic fisheries for sale was observed at the Nuku‘alofa fish market. However, a key issue that needs to be examined is the component of the domestic fisheries that is subsistence-related. In the next section, using a data set relating to the migration of labour from Tonga to New Zealand, an attempt is made to ascertain the potential impact on the country’s domestic fisheries of Tonga’s migrant residents overseas. The primary focus is the likely impact of this on nutrient and on the diet of migrants’ households, that is, the remaining members on households in which some members have migrated overseas. The analysis is intended to provide important background information (income level, education, age, household size and other related factors) about migration and, hence, about the potential impact of migration on domestic fisheries.

5.3 Data source

The Pacific Island-New Zealand Migration Survey (PINZMS) is a multi-topic detailed survey designed to look at many aspects of the migration process. Using data from the Tongan component of the PINZMS (conducted in the first half of 2005), an attempt will be made here to illustrate the likely impact of migration on subsistence fisheries in Tonga. The PINZMS uses a sample frame of applicants for the Pacific Access Category (PAC), which provides a special immigration quota for Tongans and several other Pacific Island groups to enter New Zealand

each year. More individuals apply to migrate than the quota allows, and so a lottery is used to allocate visas amongst applicants. In addition to sampling migrants in New Zealand who had come through the PAC, the survey also sampled applicants for the quota who had remained in Tonga. As well, the survey sampled non-applicants who are resident in the same villages as the applicants, and a sample of the remaining household⁸ members of the migrants who had moved to New Zealand. For the purposes of the analysis provided here, a sample of 65 migrant households in New Zealand and 230 households in Tonga was selected. In addition to surveying migrants themselves, it was possible to survey 28 of the 45 remaining members of the households of the 65 migrants who had moved to New Zealand. The sections of the PINZMS which were considered most relevant to the analysis and discussion below were those dealing with a twenty-four hour dietary recall, and a seven-day recall of food production and fishing.

5.3.1 The Pacific Access Category (PAC) and PINZMS data

The PAC was established in 2001 and allows quotas of 250 Tongans and 250 Fijians to immigrate to New Zealand each year.⁹ Applicants under this category must be aged 18 to 45, meet a minimum requirement relating to English language ability, meet health and character requirements, and have an offer of employment in New Zealand.¹⁰ Applicants to the PAC first register for the quota by filling out a form within a one month window each year. Many more registrations are received than the quota provides for, and so the New Zealand Department of Labour conducts a computer ballot to randomly select the successful candidates amongst the registrations. The odds of success in this ballot are less than 10

⁸ Household was adopted as the observation unit – it is defined as the usual occupants (whatever the ties between them are) of a private dwelling unit (separate and independent accommodation) used as a main place of residence.

⁹ Smaller quotas were created for Kiribati and Tuvalu and there is a long-standing (and larger) quota for Samoa. In addition to labour market considerations, these programs reflect broader development and political relationships between New Zealand and these Pacific Island countries.

¹⁰ Applicants with dependents must also meet a minimum income requirement. The person who registers is a Principal Applicant. If they are successful, their immediate family (spouse and dependent children) can also apply to migrate as Secondary Applicants. The quota of 250 applies to the total of Primary and Secondary Applicants.

percent. Individuals who are selected in this ballot are then notified and invited to apply for residence within six months. It is at this stage of the residence application that applicants must provide evidence of a job offer in New Zealand. Because of the low odds of success, few applicants arrange the job offer before this stage. Once applications are approved, those with successful ballots can then move to New Zealand with permanent residence, and bring their spouse and dependent children with them.

Thus, there is a group of immigrants and also a comparison group. Members of the comparison group (who remain behind in the Pacific Islands because they were not successful in the random ballot) are similar to the immigrant group. This is because, as shown by McKenzie, Gibson and Stillman (2006:7), other options for emigrating are limited unless applicants have close family members abroad, and those who could migrate under family or skills categories are likely already to have done so. Hence, *substitution bias*, which would occur if PAC applicants with unsuccessful ballots emigrated through an alternative visa category (the family or skills categories), should not be a serious concern in this setting. Even so, the fact remains that immigration to New Zealand, irrespective of the category under which that immigration occurs, has a potential impact on Tongan fisheries, one that needs to be examined in detail.

5.3.2 Survey outcome as related to fisheries

Two hundred and thirty households in Tonga were part of this data set. An estimated value of subsistence fish consumption per household, and in relation to the island economy of Tonga more generally, were calculated. Three important questions guided the survey. Firstly, participants were asked whether fish had been included in their diet the previous day. Secondly, they were asked whether they sold fish as income for their family. Lastly, they were asked how much of their households' subsistence production and consumption was fish. Refer to *Appendix 22* for details of the questionnaire.

Table 5.1 shows that the mean average household value of fish consumption averaged T\$121/person/year. With Tonga's total population of just over 100,000 people, the estimated value of subsistence fish consumption for Tonga then is just

over T\$12 million per year. If fish bought from the market or from other sources for the family’s consumption were included, the value would be much higher. It should be noted that T\$12 million is a significant contribution from the domestic fisheries sector for the subsistence and basic livelihood of households in Tonga.

Table 5.1: PINZMS fisheries statistics

	fish_meal	eat_fish	sell_fish	fish_va1	eat_own2	eat_own4
N Valid	230	230	230	230	230	230
Mean	.3565	.3522	.0391	22.7391	2433.2904	121.2472
Median	.0000	.0000	.0000	.0000	1631.5000	.0000
Std. Deviation	.48903	.47869	.19433	218.84946	2402.02763	258.55278
Variance	.239	.229	.038	47895.084	5769736.740	66849.541
Kurtosis	-1.204	-1.626	21.078	139.345	3.817	10.663
Std. Error of Kurtosis	.320	.320	.320	.320	.320	.320
Range	2.00	1.00	1.00	2880.00	14703.00	1560.00

5.3.2.1 Survey outcome: Fish as part of family diet

Firstly, to determine whether fish was part of the diet of the family, a twenty four hour recall of household diet was recorded and then tabulated. The analysis shows that 80 households, which constitute thirty five percent of the total sample, did indicate that fish was part of the family meal the previous day, see *Table 5.2*.

Table 5.2: Frequency of family that had fish in meal

Fish was part of meal	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	149	64.8	64.8	64.8
Yes	80	34.8	34.8	99.6
Not stated	1	0.4	0.4	100.0
Total	230	100.0	100.0	

5.3.2.2 Survey outcome: Subsistence fishing

Secondly, to determine whether, and if so, to what extent, the families consumed fish from their own harvest, information about households’ meal/diet over a week was collected. This information was relevant to determining how many of these families/households were involved in fishing for subsistence rather than for sale. Seventy one households, which is thirty one per cent of total households involved in the survey, were found to consume fish from their own harvest (see *Table 5.3*).

Table 5.3: Fish consumed from own harvest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	159	69.1	69.1	69.1
	Yes	71	30.9	30.9	100.0
	Total	230	100.0	100.0	

5.3.2.3 Survey outcome: Income from fish

Thirdly, to determine whether households earned income from fishing, information on sources of income was collected. Specifically, participants were asked whether they sold fish to earn income for the family. This was necessary in order to determine how many households depended on fishing as income for the family compared with those who fished for the household’s own consumption. Only 9 of the 230 households involved in the survey (just under 4 %) reported that they earned income from selling fish. This further highlights the importance of fishing in Tonga for family subsistence rather than for sale (See *Table 5.4*).

Table 5.4: Households that sell fish

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	221	96.1	96.1	96.1
	Yes	9	3.9	3.9	100.0
	Total	230	100.0	100.0	

5.3.3 Regression analysis

Several regression analyses were carried out to determine relationships between variables from the survey that would be useful in the context of this study. Key variables such as age, education level, household size and annual household earnings were analyzed to determine the nature of the relationships

5.3.3.1 Regression outcome: Fish in relation to the educational level of the head of the household

Firstly, a regression was run in order to determine whether there was a relationship between the educational level of the head of the household and the decision to include fish in the household diet. A robust result (95% confidence) indicated that the higher the educational level of the head of the household, the more likely it was that fish would be included in the household diet (see *Table 5.5*).

Table 5.5: Correlations between educational level (head of the household) and household fish consumption

		eat_fish	schyear
eat_fish	Pearson Correlation	1	.141(*)
	Sig. (2-tailed)		.032
	N	230	230
schyear	Pearson Correlation	.141(*)	1
	Sig. (2-tailed)	.032	
	N	230	230

* Correlation is significant at the 0.05 level (2-tailed).

5.3.3.2 Regression outcome: Fish in relation to size of household, household earnings, age and education

To further determine factors that might affect the decision as to whether to include fish as part of the household diet, regressions were also run with households which had fish in their diet. Here, the dependent variables were factors such as the size of the household (hhsz), household earnings (ann_earn), age of household head (Age) and, again, the educational level of the head of the household (schyear). *Tables 5.6 and 5.7* provide a summary of the results.

Table 5.6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.290(a)	.084	.068	.46097

a Predictors: (Constant), hhsz, ann_earn, Age, schyear

Table 5.7: ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.332	4	1.083	5.097	.001(a)
	Residual	47.174	222	.212		
	Total	51.507	226			

a Predictors: (Constant), hhsz, ann_earn, Age, schyear

b Dependent Variable: eat_fish

The results support the hypothesis that factors such as the size of the household (hhsz), household earnings (ann_earn), age of household head (Age) and, again, educational level of household head (schyear), influence the household decision to include fish in their meals. The p-value of 2.42 at 99 percent confidence is greater

than the calculated value of 5.097 as given in the *table 5.7* : the above factors are relevant to determining whether households included fish in their meal.

To further determine the correlation between households whose members eat fish and each of these factors, regression was also run to determine which of these factors are significant. The results are provided in *Table 5.8*.

Table 5.8: Coefficients(a)

Model		Unstandardized Coefficients	Standardized Coefficients	t		Sig.
		B	Std. Error	Beta		
1	(Constant)	-.589	.214		-2.750	.006
	Q3. Age	.009	.003	.240	3.469	.001
	schyear	.049	.015	.242	3.368	.001
	ann_earn	-2.82E-006	.000	-.039	-.567	.571
	hhszise	.010	.011	.061	.923	.357

a Dependent Variable: eat_fish

The results show the p-value of 1.96 at 99 percent confidence; hence the conclusion is that age (**3.469**) and education (**3.368**) are significant, but that household annual earnings and household size are not. These findings are significant at 99 percent level of confidence. We conclude therefore that there is a robust solution for age and school year but not for household size and annual earnings. The results show that households with older and more highly educated household heads are more likely to include fish in their diet.

5.3.3.3 Regression outcome: Subsistence fisheries as a social safety net

A key feature of Tonga’s domestic fisheries is the dependence of most households, especially in rural communities and the outer islands, on resources from the sea for their basic livelihood. Using the PINZMS data set, an attempt was made to determine relationships between the annual value of a household’s fish consumption (eat_own4) (can be described as subsistence fisheries) and the size of the household (hhszise), household earnings (ann_earn), age of the head of the household (Age) and, again, the educational level of the head of the household (schyear).

The regression model is therefore:

$$\text{Eat_own4} = a_00 + a_1\text{Age} + a_2\text{schyear} + a_3\text{hhszise} + a_4\text{ann_earn}$$

Tables 5.9 and 5.10 provide the result of this regression. Since the p value at 95 percent confidence interval is greater than the calculated value of 9.061, the conclusion is that there is a relationship between subsistence fisheries and these factors.

Table 5.9: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.375(a)	.140	.125	243.23239

a Predictors: (Constant), hhsz, ann_earn, Age, schyear

Table 5.10: ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2144229.353	4	536057.338	9.061	.000(a)
	Residual	13133963.093	222	59161.996		
	Total	15278192.446	226			

a Predictors: (Constant), hhsz, ann_earn, Age, schyear

b Dependent Variable: eat_own4

F_{tab} (4,222) = 2.42 at 0.05 ,F_{cal} = 9.061, F_{cal} is greater than F_{tab} hence there are relationships

To further determine relationships between subsistence fisheries and each of these factors, regression was also run to determine which of these factors are significant (see Table 5.11).

Table 5.11: Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error		
1	(Constant)	221.392	112.974		1.960	.051
	Q3. Age	.251	1.338	.013	.187	.852
	schyear	7.216	7.699	.065	.937	.350
	ann_earn	-.002	.003	-.063	-.937	.350
	hhsz	-31.600	5.563	-.363	-5.680	.000

a Dependent Variable: eat_own4

T_{tab} (222, 0.05)= 1.96 , T_{cal} hhsz is greater than 1.96 implies a significance relationship. This means that the more people there are in a household, the less the value of fish consumption.

It was also decided to attempt to determine whether claims that rural and low income households fish largely for family consumption. Hence, a regression on the correlation between household earnings and the value of fish for own consumption was run. The underlying question here was: Is there a relationship between subsistence consumption of fish and annual household earnings? *Tables 5.12 - 5.14* provide the results.

Table 5.12: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.159 ^a	.025	.021	255.81470

a. Predictors: (Constant), ann_hhea

Table 5.13: ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	387960.7	1	387960.660	5.928	.016 ^a
	Residual	14920584	228	65441.158		
	Total	15308545	229			

a. Predictors: (Constant), ann_hhea

b. Dependent Variable: eat_own4

Table 5.14: Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	164.695	24.555		6.707	.000
	ann_hhea	-.004	.002	-.159	-2.435	.016

a. Dependent Variable: eat_own4

The result indicates a robust relationship: that is, there is a higher value for consumption of own caught fish in the case of those whose total earnings are lower - so fishing does appear to be part of the social safety net.

The next chapters will build on these findings in an attempt to determine to what extent a dependent fishery community can afford to compromise in order to

embrace development opportunities. In *Chapter 6*, the specific focus is the Outer island community of Pangaimotu, the aim being to examine different economic activities with a view to determining how best the community can balance development activities against preservation of those natural resources which are fundamental to the basic livelihood of the community (such as mangroves which are important to fish stocks maintenance).

5.4 Conclusions

In the case of Tonga, the importance of fish as a component of household diet can be related to the age, educational level and earnings of the head of the household. The results indicate that the older and more highly educated the head of the household is, the greater the likelihood that fish will be part of the family diet. The contribution of more than T\$12million per year from subsistence fisheries highlights the importance of this relationship. Furthermore, the fact that only four per cent of survey households earned income from fish highlights the important relationship between fishing and subsistence in Tonga. The relationship between consumption of own caught fish and low earnings is a further indication of the fact that fishing is a crucial part of the social safety net.

The discussion of the relationship between overseas migration and Tonga's domestic fisheries included here provides an important context for subsequent chapters in that it highlights the fact that domestic fisheries are predominantly subsistence-related, playing an important role in the diet and basic livelihood of local and rural communities. Domestic fisheries in Tonga can therefore be analysed from the perspective of their contribution to the provision of a social safety net for low income earners rather than from the perspective of their commercial function. The importance of the sea to these rural island communities is highly significant and any decision to introduce commercial fishing to these communities will necessarily have a powerful impact on the other economic activities in which these communities are involved. Most importantly, the social security net provided by existing fishing resources (as a significant contributor to the community diet) and the social and cultural obligations of that community should take priority over any proposed economic development activities.

In the next few chapters, there is a discussion of those economic activities which represent an alternative to fishing and which, therefore, compete with fishing.

Chapter 6

Economic issues in Tonga fisheries: The domestic sector - Economic activities in a fisheries-dependent community

6.1 Introduction

Chapter 5 looked at relevant issues related to Tonga's domestic fisheries sector, focussing on the impact on subsistence fisheries of migration from Tonga. The domestic fisheries sector is also relevant in this chapter where the impact on mangrove use, and, hence, potentially on domestic fish stocks, of a range of economic development activities is explored in the context of a case study of the fisheries-dependent community of Pangaimotu in the Vava'u Islands. The overall aim here is to determine the optimal use of mangroves for the benefit of the community in the short and long terms.

The community of Pangaimotu, a fisheries-dependent community, is involved in three different economic development activities, fisheries, forestry and tourism. All of these activities have implications for its mangrove ecosystem. Mangrove swamps provide breeding grounds for fish and mangrove bark is used as a dye for tapa-making. Furthermore, tourist-related activities may involve land reclamation from some existing mangrove swamp areas and may threaten the ecosystem of others. Thus, all three economic activities compete for use of the same mangrove area around Pangaimotu. The key question underlying the research reported here is, therefore, how the Pangaimotu community can best manage its economic development activities so as to gain economic benefits in the short-term and longer-term while ensuring that the mangrove ecosystem, so fundamental to its livelihood, is maintained in a healthy state?

6.2 Domestic fisheries

In Tonga, domestic fisheries activity, also known as inshore fisheries, is carried out mainly in the lagoons, with the mangrove ecosystem playing a very important role. Rational use of natural resources such as mangroves is particularly critical in this case, since mangroves encompass both land-based and aquatic subsystems, with the natural movement of the water providing the essential linkages between

the two. Moreover, the mangrove ecosystem in Tonga not only provides a livelihood for the coastal communities, but is also an important resource for *tapa* making, an activity that has considerable cultural significance for Tongan women. The wood of the mangrove plant is also cut and used as posts for traditional kitchen houses and dry wood is fetched as firewood for cooking. For the community of Pangaimotu, the mangrove ecosystem provides a sustainable livelihood. The lagoon is rich in shellfish, seaweeds, crustaceans and molluscs, which form the basis of the food chain which ultimately sustains families.

The beaches and coral reefs of the mangrove ecosystem also have great potential for the development of tourism, including land reclamation. However, development decisions are often taken without due consideration being given to the potential loss of in wetland benefits that could result.

Pangaimotu is one of a string of islands and reefs along the eastern edge of Vava'u. This waterway shelters the Vava'u group from the strong southeast winds and ocean swells of the eastern Pacific making for excellent cruising and sailing conditions. Vava'u itself has unique protected waterways which attract tourists, including, in particular, cruising sailors and water sports enthusiasts. The yachting season, from May to October, is the peak season for overseas travellers to Vava'u. On average, more than 250 boats can be in port at any one time during that season. This is also the time of year when humpback whales migrate from the cold Antarctic to frolic in the warm Tongan waters. This provides an additional major attraction for visitors to the islands. There is, furthermore, a good choice of day cruises through the winding waterways to either nearby or outer islands for snorkelling, beachcombing or island feasts. Hinakauea Beach Resort, the only tourist resort on Pangaimotu, is a popular place for visitors to Vava'u to enjoy these activities. This was one of the motivations behind choosing the fisheries mangrove dependent community of Pangaimotu as a case study.

6.3 Domestic fisheries management

In Tonga, all land and sea belong to the King, which means that all territorial seas and internal waters, including the mangrove ecosystem, are the property of the Crown. Coastal communities in Tonga therefore have no preferential access to

adjacent resources. Every Tongan has the right to fish in these waters: there are no traditional fishing rights that give villages, communities or individuals exclusive rights to fish in certain areas. This open-access situation fails to lead to optimal resource allocation. In fact, it constitutes a sufficient condition for resource over-exploitation (Anderson 1997). This system is also anti-conservation. Since all Tongans have open access, there is a feeling that whatever someone does not take now will be taken by someone else soon so the perception is that it is best to harvest as much as possible as fast as possible. Thus, there is no incentive in the system to wisely conserve resources for the future. On the whole, this open-access situation may have worked reasonably well in the era of subsistence fisheries. However, it has recently collided with commercial realities. The situation in which it places commercial fisheries has become a major concern to villagers and outer island fisheries-dependent communities because community food security is being adversely affected.

Despite the open access, the Pangaimotu community, under the leadership of their town officer, has agreed that no more than five per cent of the total number of mangrove plants available to the community should be harvested each year (personal conversation with town officer, 2003). This is one of the agreements reached informally at a village ‘fono’¹¹. What we see in operation here is ‘customary law’, according to which agreement is reached through negotiation and consensus, with the good of the community taking priority over the rights of individuals. Thus, ‘talanoa’ is a very strong tool in village governance and decision-making.

6.4 Mangroves in Tonga

In Tonga, the total area of mangroves is estimated at 1,000 hectares. This represents 25 percent of Tonga’s total forest area (Food and Agriculture Organisation 2002). The information collected, from a baseline survey of mangrove species in Tonga using 45 mangroves transects at 20 mangrove locations, shows that there are 8 mangrove species altogether. The most common species are the *Rhizophora mangle*, *Rhizophora stylosa* (*Tongolei/Tongo*),

¹¹ The village *fono* is a village meeting where ‘customary law’ is used to preside over community decision-making

Bruguiera gymnorrhiza (Tongo ta'ane), *Excoecaria agallocha* (Feta'anu) and *Lumnitzera littorea* (Hangale) (ESCAP, 1999). Tannins from *Rhizophoraceae* are used for protection of nets and fish traps (owing to their fungicidal properties). The prop roots of *Rhizophora* are used for the construction of fish traps, fuel-wood or light construction. The timber of the *Lumnitzera littorea* is a good building material, being hard and durable, and resistant to marine borers. The bark of the *Bruguiera gymnorrhiza* is used in Tonga to make decorative dye for *tapa*

Mangroves are under constant development pressure because they are found in coastal and estuarine areas which are usually also centres of human settlement. In Tonga, the major threats to the mangrove ecosystem are clearance and reclamation for economic development activities. This situation needs to be considered in the context of the law that declares that all territorial land and sea (including areas where mangroves are found) belong to the Crown.

Since mangroves are under constant pressure from economic development activities, it is important to consider how the mangrove ecosystem should be managed in the context of these activities. This is the issue with which I am concerned in this chapter. It is an issue which requires an examination of the functional interrelationships between "human needs and activities" (Costanza, d'Arge et al. 1997). Addressing this issue requires a framework wherein natural environmental benefits can be evaluated alongside the benefits of economic development. The need for such a balanced approach, one which is broad-based and ecologically oriented, cannot be overemphasised in the context of the importance of the mangrove ecosystem (Lal 2003). An economic model was developed in an attempt to provide statistical and quantifiable responses to the issue outlined above and, in doing so, to suggest economically viable solutions.

6.4.1 Fisheries and mangroves ecosystem

Captured fisheries production is believed to constitute the major value of marketed products from an unexploited mangrove ecosystem (Hamilton et al., 1989). Furthermore, the way in which mangrove ecosystems support commercialisation, recreational and subsistence fisheries is well documented. For instance, eighty per cent of all marine species of commercial or recreational value

in Florida, USA, has been estimated to depend upon mangrove estuarine areas for at least some stage in their life cycles (Hamilton and Snedaker, 1984). In Fiji (Hamilton and Snedaker 1984) and in India (Untawale 1996), approximately sixty per cent of the commercially important coastal fish species are directly associated with mangroves environments.

The relative contribution of mangrove-related species to total fisheries catch can also be significant, constituting sixty seven per cent of the entire commercial catch in Eastern Australia (Hamilton and Snedaker, 1984), forty nine per cent of the demersal fish resources in the southern Malacca Strait (Moser, Macintosh et al. 2005), thirty per cent of the fish catch and almost one hundred per cent of the shrimp catch in ASEAN countries (Singh, Chong et al. 1994).

Positive correlations have also been demonstrated between mangrove cover and municipal fisheries landings (Camacho and Bagarinao 1987) as well as panaeid shrimp catches (Turner 1977; Staples, Vance et al. 1985; Pauly, Christensen et al. 2002). In addition to commercial fisheries, coastal subsistence economies in many developing countries are heavily dependent on sustainable harvest of fish and shellfish from mangroves. The median fishermen density of about 5.6 fishermen per km² in mangrove environments is considerably higher than it is in other fished systems as is the yield per unit area (Matthes and Kapetsky 1988). Because a large portion of the world's human population lives in coastal or estuarine areas, for example, 70% of the population in South East Asia (Pauly, Christensen et al. 2002), fisheries are very important source of food (see section 6.9.6.1) and income (see section 6.9.6.2).

6.5 Empirical application: Methodology

A number of different tools have been suggested for evaluating the net benefits and costs of using a natural resource (Sinden and Worrell 1979; Hufschmidt, James et al. 1983 and Bann 1997). In all cases, the quantities consumed and the actual or surrogate market price of the resource and other inputs or the surrogate market price of their next best alternative are used. It is assumed that the demand for wetlands is the derived demand of goods and services that the ecosystem supports. Other tools that have been used include production function (Butlin,

1993), entitlement approach (Sen, 1999) and utility function (Bollard, 1974). In this study, the net benefits of various activities that make use of the mangroves ecosystem are estimated using three complementary approaches: the income approach, the alternative cost method, and the development net benefit approach.

6.5.1 The income approach

The income approach assigns monetary values to economic activities by the community and assesses the income received per labourer and for the community through such involvement. This approach has been the most common one in the determination of gross annual value of marshlands in the eastern coast of the United States (see for example, (Pope and Gosselink 1973; Gosselink 1980; Raphael and Jaworski 1979). A similar approach, based on the use of mangroves for forestry, fishery and recreational benefits, has been used for wetlands in Fiji (Baines 1979; Watling 1985; Lal 2003). In all these studies, the market price of fish has been used to compute fisheries benefits and it has been assumed that the value of the fish harvested depends only on the total wetland area. Similarly, forestry benefits have been estimated using the market price of forestry products. The net benefit and return to labour was therefore calculated on net annual income for the community as a whole.

6.5.2 The alternative cost method

The alternative cost method looks at values of economic activities within communities that are considered to be subsistence communities. The alternative cost or opportunity cost method assigns values to these activities using a shadow price instead of the market price. These estimates of fisheries and forestry net benefits do not include the value of other environmental services for which there are no direct market values. Therefore, shadow prices in the absence of market prices have often been imputed using other techniques. Hamilton and Snedaker (1984) used this approach for estimating the value of services to protect against shore erosion. When goods are treated as services for home consumption (i.e. subsistence), the alternative cost method is therefore used.

6.5.3 Development net benefit estimation

The development net benefit approach looks at putting values into reclaimed activities within the community, especially in the case of development activities such as tourism. Development net benefits can be evaluated by a number of different approaches using market prices of inputs and products (Sinden & Worrell, 1979). An income or economic approach is used to evaluate development benefits (Squire and van der Tak 1975). For this study, the net benefit of the reclaimed land is estimated using actual benefit and cost of tourism development.

For the analysis of the net benefit of different activities undertaken by the Pangaimotu community, the income approach was used to collate values of these activities that go through the market. Examples of such activities include fish that are for sale in the market, the proportions of dye for tapa making that are for sale, and also the actual income for labour involvement in the tourism development of Hinakauea beach resort. The alternative cost method was used to calculate the values of non-market activities, specifically fish for subsistence and the proportion of dye that is used in domestic contexts. The development net benefit approach was used for the actual cost and benefit of the operation of the only tourism development in the community, the Hinakauea beach resort.

6.6 Analysis of Pangaimotu community utilisation of its mangrove ecosystem

Pangaimotu has geographical features and natural resources that provide opportunities for economic activities that are unique, such as abundance of *hulali* and the rich resources from the lagoon. The region is also considered to be reasonably well preserved and the mangrove ecosystem plays an important role in the subsistence of the people. As noted earlier, the three economic activities undertaken by the community that impact on its mangrove ecosystem were fisheries, forestry and tourism, all three of which compete for the use of mangroves in the same area.

Fishing is an important activity for the people of Pangaimotu village. More than seventy five per cent of the households fish for subsistence (Fieldwork 2 survey results, 2004). A few families occasionally sell their catch (especially *hulali*) and

the few homes that own a boat also fish and sell their catch in Neiafu, the only urban centre of Vava'u. The sea forms part of the daily lives of the community, so fish (including shellfish) are vital for the food security of the community.

The bark of the mangrove is also important in making dye for tapa making. *Tapa* making is the commonly used name for a variety of traditional textiles produced in the Pacific Islands and is usually made from the inner bark of the Paper Mulberry. *Tapa* cloth plays an important part in religious rites and ceremonial gift giving in Tonga and the Pacific Islands at large. The strips of fibre are dried, soaked and pounded until they become wide and very flexible. A number of strips are then felted together to form a fine white cloth ready to be decorated with dyes mainly from the bark of the mangroves.

The ecosystem of Pangaimotu is also of interest for tourism development, leading to the establishment of Hinakauea Beach Resort in 1994. Hinakauea Beach resort is the only tourism development on Pangaimotu. The resort comprises two *fales* and a cultural house on 0.61 hectares of reclaimed land. This area constitutes 5% of the total mangrove area of Pangaimotu.

A detailed economic analysis of these activities would shed light on how best the community should utilise its mangrove areas. Such an analysis would also enable the community to assess the costs and benefits of these different activities. In this regard, the following points need reiterating. Firstly, mangroves are important for fisheries as a nursery ground. Secondly, an increase in the demand for dye for *tapa* making would mean the possible removal of more mangrove trees. Thirdly, reclaiming land for tourism development would have a greater impact on mangrove swamps than would the use of mangroves for dye for *tapa* making (since reclaiming land has a greater impact on the ecosystem and entails a greater loss of habitat). Thus, reducing the area of mangrove swamps has a direct impact on fisheries stocks and, eventually, on food security for the community.

6.6.1 Data sources

The empirical data for this study were collected through interview and survey of the Pangaimotu community during the month of February, 2003 and again over a period of two weeks spent with the community in February 2004. In total, thirty five households were surveyed, which is almost 40% of the total number of households in Pangaimotu.

For the villagers, a questionnaire was designed in English and then translated into Tongan, the purpose being to obtain information such as age, income level, and size of households as well as detailed information on costs and returns from fishing activities (see *Appendices 6 and 7* for survey questionnaires). A structured open ended interview format was used to elicit information from participants. However, underlying the questions was a written questionnaire that had been pilot tested on three households in my own village, that is, 'Alaki-fonua in Tongatapu, before the visit to the outer islands of Pangaimotu. An open ended interview format using the '*talanoa*' approach was most appropriate when approaching villagers because it puts them at ease and was less apparently invasive than a more structured approach would have been.

In the case of the tourist operator of the Hinakauea beach resort, a semi-structured and open ended interview format was found to be most suitable, with open ended questions used to obtain general information about the commercial business, and semi-structured interviews were used to obtain information about specific business costs and returns. Where published records were not available, the researcher was forced to rely on oral information provided by operators. In most cases, the recall method was relied on to obtain information about activities in earlier months or years. This was necessary because very few, if any, villagers kept written records. The data obtained was also validated using information collected from the Tonga Development Loan files and review papers.

6.6.2 Sampling design

The households selected were drawn from a list collected by the town officer of the village. The sampling frame was selected mainly on the basis of the advice of the town officer who had considerable local knowledge of households involved in

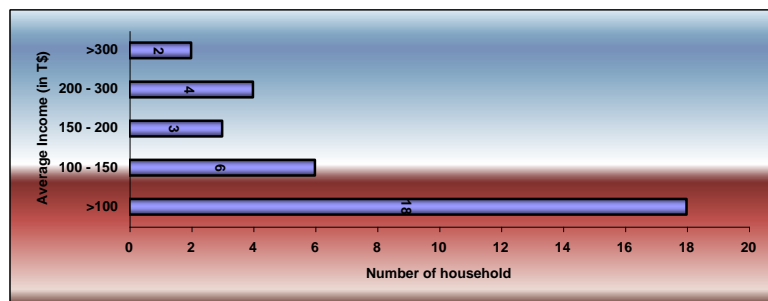
fishing and forestry as well as of the household that owned and operated the tourism development of Hinakauea beach resort.

A major project undertaken by the community during my field visits was the construction of a new hall and home for the minister of the Free Wesleyan church. I was given accommodation at the minister's house during my research visits and most of the participants were also present at the construction site. This meant that I was in an ideal position to secure the participation of those who turned up at the construction site. Furthermore, some of the early participants were able to recommend other households in the village which included fishermen. The chosen space for interviews was culturally appropriate. It is also important to note that the workers at the construction site did not affiliate to any particular church or group so I considered the participants to be representative of the community. The data analysis in the sections below is based on the survey data collected from the Pangaimotu community during the field visits in 2003 and 2004.

6.6.3 Average household income

More than 50% of the households earned less than T\$100 per week (see *Figure 6.1*). This level of income is quite common in rural communities in Tonga which depend on the sea and the land for their daily living. The few who earned more than T\$200 per week were those who either fished for commercial purposes or were farmers who sold their produce in the market.

Figure 6.1: Household income/week



Source: Survey result

6.7 Net benefit of forestry utilisation

In evaluating the net benefits to the Pangaimotu community of the use of their mangroves, the volume consumed and the actual or surrogate market price of

either the resource itself or its next best alternative were used. Where the use of the resources was largely for subsistence purposes (for which there is no direct measure of the resource), a shadow value was arrived at by using the opportunity cost of the next best alternative (Lal, 1989).

In Pangaimotu, the total mangrove area is 28.13 hectares. However, only 12.04 hectares, or forty three per cent of the total mangrove area, was under survey. The typical mangrove species in the area are *Fau*, *Lekileki* and *Tongolei*. This region is considered to be reasonably well preserved and the mangrove ecosystem plays an important role in the subsistence of the people. Mangroves were once used as building materials for posts for traditional kitchens. At the time of the survey, however, the only major use of mangrove trees was the use of bark for dye to make *tapa*. For this reason, it was decided to collect data on input costs and revenue to determine not only the net return but also the return on labour from such activity.

A survey of the mangrove population, size, and suitability for *tapa* making was carried out. For the area of Pangaimotu, the survey used three transects of a 25 sq metre mangrove area over three locations, starting from the area closest to the sea and moving inland to a space of 10 metres back. On average, for every location (a total of 75 square metres), there were 212 mangrove plants, with heights ranging from 342cm to 420cm. A detailed survey of mangroves suitable for *tapa* was also carried out which showed that, on average, 28 plants from each location were suitable for *tapa* making. The further inland the location, the more mangroves were identified as suitable for *tapa* making. The average height of mangrove tree trunks that were suitable for *tapa* was 134cm (the average height at tide level being 33cm). Several mangrove tree trunks were cut from the mangrove trees that were suitable for *tapa*, and these were taken as samples to determine the cost involved and also the yield (liquid for dye) that could be extracted from the mangrove plant.

6.7.1 Typical cost and benefit of mangrove use for dye for *tapa* making

Detailed costing for processing the dye from cutting the trunks of the mangrove trees for *tapa* making was then carried out (see *Appendices 16 and 17* for details).

The total cost of inputs included the hire of a chainsaw and transportation of the mangrove tree trunks. A special feature of the task of making dye from the mangrove tree is that it requires two weeks to rot (i.e. ferment) the bounded product from the bark. Then the process is again repeated. On average it takes 0.63 hours per tree trunk for the process to be completed. This includes the cutting, peeling, squeezing and hanging. When we tried making dye from a mangrove tree trunk, a total yield of 2.85 litres of dye was produced initially, followed by 3.5 litres of dye after two weeks fermentation when the process was repeated. The price for dye was based on the current market price of dye on sale in the main market in Nuku'alofa, Tongatapu. From the information provided by the community, it was determined that only twenty percent of the output of dye produced was retained by the women of Pangaimotu for tapa making. The rest was sent to the main market in Nuku'alofa for sale at the price of T\$15 per litre.

Table 6.1: Typical cost and benefit for dye for Tapa making - Pangaimotu community

	For one trunk	Annual Total
Number of trunks harvested/year		950
Cash inputs (T\$)		3,800
Labour inputs (hours)	6.3	5,985
Output (in litres)	6.35	6,032.5
Output for subsistence (in litres)	20% of total	1,206.5
Output for sale (in litres)	80% of total	4,826
Cash revenue (@ T\$10/litre)		48,260
Net cash revenue ¹²		44,460
Return to labour (T\$/hour)		7.43

The analysis provided a figure of T\$508 per annum as net revenue per household from harvesting mangroves for dye for tapa making (see *Appendix 16*). The return to labour per individual, based only on the amount of dye actually sold, fetched a very high return of T\$7.43 per hour (see *Table 6.1*). This is much higher than the minimum wage available to unskilled workers (T\$3.50 per hour).

¹² Cash Revenue minus cash input

As indicated earlier, in Pangaimotu a 5% harvest of the mangroves suitable for tapa making has been determined as the allowable harvest. According to the analysis above, the community of Pangaimotu, therefore, would expect a total net revenue from dye for tapa making in the vicinity of T\$44,460 per annum. With a total mangrove area of 28.13 hectares, the expected yield from dye production would be T\$1,580/ha/pa. Including the return from subsistence use of mangroves for tapa making by the community, an alternative price would be T\$8/litre. This is the market price of *koka* (an alternative plant to mangrove) that can be used as dye. From the alternative price, the yield from dye production would therefore come to T\$3,088/ha/pa. If 5% of the mangroves area in Pangaimotu was used for dye production, the expected return from this activity would be T\$61,761/ha/pa (see *Appendix 17*).

6.8 Tourism development

The net benefit of reclaimed land is analysed using actual benefits and costs of Hinakauea tourism resort developments, the only tourism activity in the community. These include initial capital costs of reclamation and maintenance. The Hinakauea Beach Resort started in 1994. It comprised 2 *fales* and a cultural house on 0.61 hectares of land. Each *fale* can accommodate 4 persons. This area constitutes five per cent of the total mangrove area of Pangaimotu. The *'api* in which the project is situated belongs to the 'owner' family. The decision to start the resort was due to the growth in tourist arrivals in Vava'u.

6.8.1 Typical cost and benefit of reclaimed mangrove area for tourism development: Hinakauea Beach Resort

The information collected was based on an interview with the owner of the Hinakauea Beach Resort guided by a questionnaire (see *Appendices 8 and 9*). This was a family project initiated by the eldest son of the household who was a loans officer at the Tonga Development Bank. He saw the opportunity for tourism development in Vava'u in the early 1990s and decided to pursue the venture. The viability of the tourist resort was given greater impetus when a causeway funded by the European Union was completed at Pangaimotu to allow yachts and boats to have easy access to the beach at Hinakauea beach resort. *Appendix 18* provides a detailed cost and benefit analysis of the project.

The initial investment for the project was T\$6,000 which came from a loan from the Tonga Development Bank. A bank fee of T\$445 and an interest rate of 13.5% for a period of thirty six months also constituted part of the terms of the loan agreement. The operational cost of the resort related mainly to labour. There are normally two full-time workers who work three hours a day for two days a week throughout the year. At peak times, during tours, there is an additional labour requirement of five workers for eight hours a day. Wages for these workers are fixed at T\$3.50 per hour. The other costs involve preparation of food for feasts during tours at a cost T\$10 per head. A feast usually includes a roast suckling pig, octopus, fish, clams, lobster, crayfish and taro cooked in the traditional underground 'umu. Entertainment is also part of the event. A group of eight to ten youths (floorshow) perform traditional dances and items during meal times. The cost of entertainment is T\$80 per performance for every tour. The maintenance cost of the *fales* is usually T\$25/month.

Hinakaua Beach Resort's main income comes from tourists visiting the resort. Peak times for tours run from March to October. November to February is usually the cyclone season for the island so fewer visitors visit the resort during this time. A fee of T\$30 per head is charged for the entire tour. The use of a *fale* is charged at T\$100 per night. It is estimated that at non-peak tour times there is fifty per cent occupancy whereas there is usually one hundred per cent occupancy during peak tour times. People from the village can also lease a stall to sell their handicrafts. There are six stalls available at T\$5 per stall per tour day.

Table 6.2: Typical cost and benefit for tourism development: Hinakauea beach resort

	Non-tour time	Non-peak	Peak tour	Annual total
Months	Jan-March	April, Nov-Dec	May-October	
Number of visitors	0	60	600	660
Cash input (T\$) *	75	915	8,070	11,646
Labour inputs (hrs)	144	219	888	1,251
Labour inputs (T\$) *				4,379
Cash Revenue **	0	2,190	23,520	25,710
Net Revenue (** minus *)				9,685
Less Depreciation				1,800
Net profit				7,885
Return for labour (T\$/hr)				6.30

An analysis of the Hinakauea tourist operation shows a net return of T\$9,685 per annum for the owner of the operation. Capital assets are discounted at 30% per annum which is the Tonga Development Bank's rate of depreciation for small tourist operators. This means that the net profit for the resort operator comes to around T\$7,885 per annum. In all, the net benefit of the Hinakauea Beach Resort as a development project was at T\$12,927 per hectare per annum (see Appendix 18 for details). The return for labour is T\$6.30/hour (see *Table 6.2*).

6.9 Typical cost and return for fisheries use

The village of Pangaimotu is surrounded by sea. Shellfish collection is widely practised at Pangaimotu by women and it is done at low tide during the day. Fishing grounds are situated near the lagoon or in shallow sea grass bed areas. The main edible shellfish found to be in abundance in the village include *folu'ohua* (thorny oyster), *kaloa'a* (ark clams), *kuku* (sea mussels), *to'o* (venus clams), *tu'ulalo* (lucina clams), *angaanga* (spider conches) and *nge'esitaha* (abalones). *Feke* (octopus) and *ngūfeke* (squid) are also in abundance. The main crustaceans

found, also in abundance, at Pangaimotu are 'uo (lobster), *tolitoli* (mangrove crab) and *kuka* (land crab). Some women also collect sea cucumber at the inner reef zone or lagoon.

The most important inshore fish include *Ngatala* (grouper), *Tanutanu* (emperor), *Kanahe* (mullet), *Hohomo*, *Olomea* and *Pose* (parrot fish), *Ō* and *Ma'ava* (rabbit fish). An important and unique mollusc, *Hulali*, is found in abundance specifically at Pangaimotu. This mollusc forms one of the basic meals and is also a main source of income for the community.

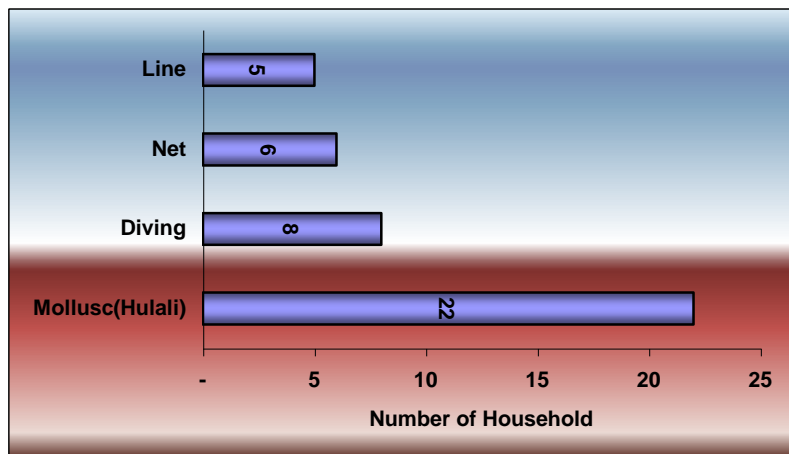
6.9.1 Fisheries harvests and consumption

In Pangaimotu, both the commercial and subsistence harvesting of fish and crustaceans largely depends on fishing activities carried out in the mangroves. A valuation of catches was performed by multiplying catches by the market price of the species or species group. An assumption of a constant price may be appropriate since catches in Pangaimotu represent only a limited amount of the total supplied to the market. This approach assumes that the amount of inputs used remains the same.

6.9.2 Types of fishing

Most of the households fish for molluscs, mainly *hulali* and *kaloa'a* (ark clams). Those who fish specifically for sale in the local market mainly used line, net and diving (see *Figure 6.2*).

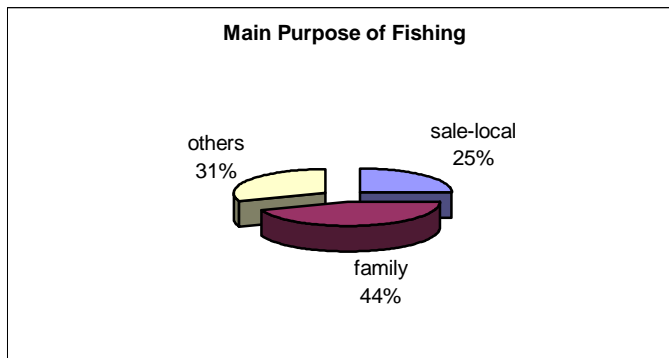
Figure 6.2: Types of fishing



6.9.3 Main purpose of fishing

Just over 75 percent of the households in Pangaimotu fish for subsistence. About 44 percent indicated that the purpose of their fishing is for family consumption. The sea forms part of the daily lives of the community and so fish and shellfish are vital for the community's food security. A few families (25 percent of the households) occasionally sell their catch, especially *hulali* (see *Figure 6.3*). The few homes that own a boat also fish and sell their catches in Neiafu, the main urban centre of Vava'u.

Figure 6.3: Main Purpose of Fishing

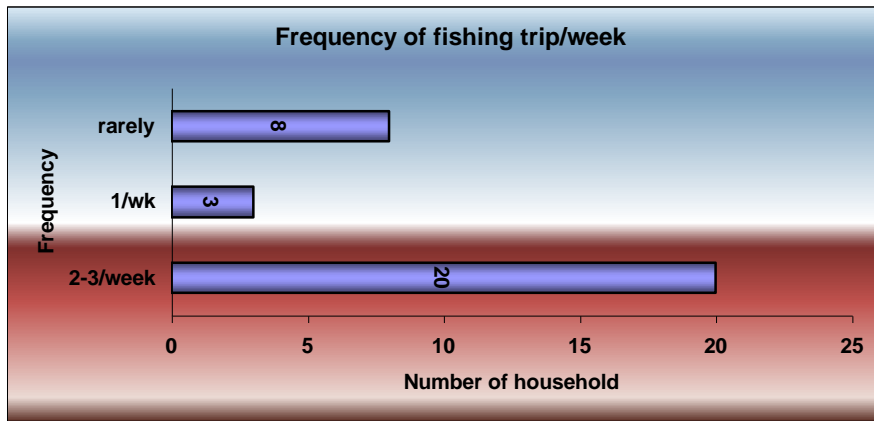


Source: Survey Results, 2003

6.9.4 Frequency of fishing trip

The frequency of fishing trips was closely related to those households who fish for *Hulali* either to sell or for family meals. Once a week was usual for those who owned a boat and they would usually spend 2–3 days at sea before returning to shore (see *Figure 6.4*). Night diving and net fishing were the common methods used by those who fished specifically for sale. Most families were found to rely on the sea for food for the family on Sundays. In Tonga generally, Sunday is marked as a day of sharing meals with neighbours. Hence, reliance on the sea for provision of food for this practice of reciprocity.

Figure 6.4: Frequency of fishing trip/week



Source: Survey Results, 2003

6.9.5 Fishing activities

Fishing activities at Pangaimotu can be divided into five categories:

1 Households who fish for subsistence. Women are usually engaged in this type of fishing which generally takes place twice a week, with Saturday being a day on which members of these households always fish unless prevented by circumstances beyond their control. Fishing trips can take up to three hours, with an average of 2.25kg of molluscs (*hulali*) and shellfish (such as *kaloa 'a*, *te'epupulu* and *to'o*) caught on each trip for each household. Crustaceans, such as mangrove crabs, are also collected twice a month in season (December to April), with an average catch of 18kg per trip. Each such trip takes an average of two hours.

2 Overnight fishers who use punts with outboard motor engines and either use limited ice or none at all. These are mainly night divers, or net or line fishers, and they usually make three trips a week. This group usually catch an average of 10kg of fish in about five hours of fishing and 5kg of octopus for about an hour of work. Almost 80% of the catch is for family consumption, including sharing the catch with neighbours and other families. The surplus is occasionally sold within the community. The fish are sold at T\$3.50/kg and octopus at T\$5/kg.

3 Molluscs (*hulali*) fishers who specifically intend to sell their catches in the local market. Usually the price is T\$8/kg. The fishermen take two trips a week with an average catch of 4.5kg per trip. This fishing is usually done in a group as the cost of hiring a boat needs to be shared amongst the fishermen. The cost of hire is taken as 1.25kg of *hulali* per fisher. A fishing trip usually takes up to five hours.

4 Small scale fishers who fish for sale in the market. These fishermen make one trip a week lasting an average of 25 hours per trip. These are mainly night divers and fishing line anglers who also hire a boat, equipped with ice and a cooling system. The total time at sea for these fishermen is up to 23 hours of fishing and another 2 hours for catching Octopus per trip. This group of fishers usually target fish for sale and catch an average of 27.5kg of finfish and 5kg of Octopus per trip. The finfish is usually sold to shop owners or market vendors in the local market at Neiafu at a price of T\$3.50/kg. The octopus is sold at T\$7/kg. Almost Ninety per cent of the catch is for sale and the remaining 10% is for home consumption.

5 Commercial fishers who own a boat and engine and fishing gear, and usually a fishing net of 100m each. Major expenses for this group are the initial investments in a boat and engine and also fishing gear. This outlay, estimated at T\$6,000 (cost of second hand boat and engine), could be funded by a loan from the bank at an interest rate of 13.5% to be paid over 36 months. The bank fees set by the Tonga Development Bank which also finances these loans amounts to T\$445. These fishermen usually fish twice a week, with fishing determined by the tide. At high tide, the net is usually set and left overnight for 2-3 hours. A group of 3-4 fishers is required to carry out this task. Catches vary but an average catch of 210kg per week is common. The catches are usually sold in the local market at Neiafu, with prices averaging T\$3.50/kg depending on the type of fish.

6.9.6 Fisheries net benefit

Refer to *Table 6.3* for summary and *Appendix 19* for details of the benefit of these fishing activities.

6.9.6.1 Home consumption (subsistence)

When fish caught is for subsistence, the shadow marginal value is taken as T\$2/kg fish and T\$3.50/kg for crustaceans. This is the average price paid by commercial fishers when they buy surplus fish from villages in rural areas away from markets. Thus, the opportunity cost of subsistence consumption is the income foregone if the catch was sold.

For subsistence fishers, the catch per month is 54 kg, thus the net revenue per month amounts to T\$108. The net cash return for labour is T\$2.70/hour. For overnight fishers almost 80% of the fish catch is for subsistence. The average catch per household for a month comprises of 120kg of fish and 60kg of molluscs. The net return per month is T\$144, with return for labour at T\$6.11/hr.

6.9.6.2 Commercial benefit

For molluscs (*hulali*) fishers, the average monthly catch per family is 36kg. This group fish entirely for sale at the local market. The return for each family is T\$288/month, with return to labour at T\$3.88/hr. For small scale commercial fishers, ninety per cent of the catch is targeted for sale. That is an average of 110kg of fish and 10kg of molluscs per fisher per month. The net return per month is T\$409, with a return to labour of T\$1.01/hr. For large scale commercial fishers – considered large if they own a boat and engine and also use fishing gear – the main expense is their loan repayment of T\$218/month (refer to boat loan amortization attached). Almost eighty-five (85%) per cent of the total catch is targeted for sale at the local market. Fish are sold at an average price of T\$3.50/kg. Therefore, the net return per month for a large scale commercial fisher is T\$1,262. From this return is already deducted 30% depreciation of assets, a rate determined by the Tonga Development Bank for this type of fishing loan. The return to labour therefore is quite high at T\$8.10/hr (see *Table 6.3*).

Table 6.3: Typical cost and benefit of fisheries activities - per household/month

Fishing activities *	1	2	3	4	5	Tot. for 1mnth
Total Fish catch (kg)	0	120	0	110	840	1070
Total catch (others –kg)	54	60	36	10	0	160
Subsistence (%)	100	80	0	10	15	
Imputed Cash Input (T\$/month)	0	64	102	358	1,435	1,959
Labour inputs (hrs/mnth)	40	72	48	76	156	392
Imputed Cash Revenue (T\$/mnt)	108	504	288	435	2,751	4,086
Net revenue/month	108	440	186	77	1,316	2,127
Less Depreciation					53.18	1,489
Return to labour (T\$/hr)	2.70	6.11	3.88	1.01	8.10	5.43

* as outlined in section 6.9.5

6.9.6.3 Total fisheries use

An area of 28.13 hectares of mangroves supports the annual harvest for commercial and subsistence fisheries. This is the total mangrove area in the Pangaimotu community. An estimate of annual production of 556.7kg/ha/yr at full use shows that 437.3 kg/ha/yr relates to commercial use and 119.4 kg/ha/yr relates to subsistence use. For commercial fisheries, 380.4kg/ha/yr comes from fish and 56.9kg/ha/yr from non-fish, including crustaceans and molluscs. This is below the range of potential sustainable fish yield of 800 to 1,000kg per hectare expected from estuaries and lagoons with an aquatic primary productivity of 100 to 1000g per hectare per year (Marten & Polivina, 1982).

6.9.6.4 Total fisheries net benefit

The stream of fisheries net benefits to fisher people is a function of the fisheries stock, harvest rate, price and cost of fish (Clark & Munro, 1975). The fisheries stock is a function of the amount of mangrove forest present. The exact functional relationship between fisheries stock and mangrove is not known (Saenger et al., 1977; Hamilton & Snedaker, 1987; Hutchings & Saenger, 1987 and UNDP/UNESCO, 1987). Mangrove areas act as a habitat as well as spawning and nursery grounds for fish and non-fish fauna (Odum and Heald, 1972; Lal et al.,

1984; Robertson, 1988). Using the value of the commercial and subsistence fishing harvest, there is a total net return of T\$49,032 per annum. The annual yield therefore amounts to T\$1,749/ha/pa for the Pangaimotu community (see *Appendix 19* for details). Ronnback estimated the annual market value of capture fisheries supported by mangroves ranges from US\$750 to US\$1,670 per hectare (Ronnback, 1999:248)

6.10 Summary of projects

An activity is considered to be viable only if its net benefit is greater than zero. Relative profitability is the measure used by individuals to choose between different economic activities competing for the use of the resource. For the Pangaimotu community, for the short term, the assumption is that an activity that produces a higher return to labour is preferable over an alternative with lower return to labour.

In this study, a return to labour from the point of view of an individual villager is first undertaken to identify financial viability. Then the net financial returns are assessed in relation to whether individual labour would have financial incentives for switching from one economic activity to another. Because costs and benefits are spread over time, net present (economic) value estimate is used to compare the activities. *Table 6.4* summarises the net benefit for each activity. It compares the return for labour and also the expected return for each choice of economic activity in fisheries, forestry (*tapa* making) and tourism development.

Table 6.4: Summary of Economic Activity

<i>Project-net benefit</i>	<i>Net return labour (T\$/ hour)</i>	<i>Per hectare/annum (T\$/ha/pa)</i>
Forestry (<i>tapa</i> making)	7.43	3,088
Tourism development	6.30	12,927
Fisheries	5.43	1,749

The analysis of the activities highlighted in this chapter shows that development projects, such as the tourism development of the Hinakauea Beach Resort,¹³ yield the highest return. Forestry (i.e., the use of the bark of mangroves for *tapa* making) followed, with fishing providing the least net benefit for the community.

6.11 Conclusion

The analysis of the economic activities carried out by the community of Pangaimotu, indicates that reclaiming the mangroves for tourism development will provide the highest net benefit to the community. Tapa making will provide the next best choice and fishing the least. However, the decision on the best project combination for the community must take into consideration factors other than simply the return to labour of monetary value for every hectare of mangroves reclaimed. An analysis of the impact of reclaiming more land for tourism development will be of great interest to the community. Since forestry has been restricted to five per cent per annum, it is appropriate therefore to examine issues of interest to the community that relate to both the fishery and tourism sectors. Of particular importance is to determine the impact that an increase in the number of tourist operations would have on fishing.

¹³ A village community in Tonga comprises *kainga* (same family/clan), hence the expected return for tourism development is not considered in relation to an individual, but collectively for the village/community

Chapter 7

The Inter-Sectoral Economic Model

7.1 Introduction

The analysis of the economic activities carried out by the community of Pangaimotu in the previous chapter reveals that reclaiming mangrove area land for tourism development will provide the highest return to the community. *Tapa* making will provide the next highest net benefit and traditional fisheries activity, the least net benefit. However, any decision about what is best for the community should be based not simply on the monetary return to labour for every hectare of mangroves reclaimed but on a range of factors, including resource sustainability and community enjoyment of the activities involved. Above all, since fish are a necessary part of the community's diet, activities should never be allowed to jeopardise the sustainability of fish stocks.

Any analysis of the potential of development activities in Pangaimotu must take into account the fact that there is a community agreement that no more than five per cent of available mangroves should be harvested annually, this harvest being used largely to make dye for *tapa* cloth. Once this is taken into account, the two other main development activities, tourism and fishing, assume greater significance. In this chapter, the aim is to examine the impact of tourism development on the mangroves and, hence, on fish supply and fishing. A key issue to be addressed here is, therefore, the issue of mangrove sustainability in the context of tourism development. Essentially, the issue is what impact there would be on traditional fisheries should the number of tourist resorts be increased from one (the situation at present). In other words, the dilemma facing the Pangaimotu community is whether, and, if so, to what extent it can afford to embrace tourism (which has the potential for better job opportunities and more income) given the need to sustain its fish stocks. Should it content itself with its traditional fishing activities?

The challenge facing the Pangaimotu community (outlined above) is similar to challenges facing other rural communities in the Pacific who are dependent both

on development activities and on the maintenance of their fisheries resources. In stark terms, development activities such as tourism are often concentrated in coastal areas and lagoons, the very areas whose eco-systems are fundamental to maintaining the supply of seafood required for domestic fishing activities. With this problematic in mind, an inter-sectoral economic model has been developed in order to address some of the challenges facing the Pangaimotu community as it seeks to engage in money generating economic development activities.

In this chapter, the inter-sectoral economic model is designed to analyse the dynamic relationship between fisheries and tourism in the context of two fundamental issues - the need for clarification of the potential impact on domestic fisheries of tourism growth, and the changes that would be likely occur in the allocation of labour between the two sectors (and other changes to the status quo) were there to be an expansion of tourism activities. In considering the optimum allocation of workers between the two development activities discussed here, assumptions is made here of the findings reported in *Chapter 6* concerning the interaction between tourism and fisheries in Pangaimotu.

Given that both activities depend upon the preservation of the ecosystem functions and given that both require labour, the assumption is that the economic and ecological optima are interdependent. Workers can choose which activity (fisheries or tourism) they wish to engage in. Therefore, if it proved to be the case that the net benefit from fisheries is greater than that from tourism, then more workers would be likely to prefer to engage in fisheries, something that could lead to over-exploitation (and possible extinction) of the fisheries resource. However, in that growth in tourism is likely to lead to more land reclamation, and in that land reclamation may have an adverse effect upon mangrove swamps and, hence, on fish stocks, this could reduce volume of seafood catch and, therefore, impact negatively on the livelihoods of those involved in fishing.

In Pangaimotu, since there are no property right assignments in the case of mangrove areas, the allocation of workers between these two activities is based on the per capita benefit of each one. The models should provide us (more importantly, community members themselves) with the necessary tools to make

informed decisions about the optimal situation in relation to economic activity, as well as about the maintenance of the ecosystem (Grasso, 1998).

Grasso (1998) used a dynamic optimisation and simulation model to assess the optimal trade-off between forestry (logging) and fishery production, using Brazil as a case study. Since forestry activity usually takes no account of the importance of the fact that mangroves support fisheries, studying the relationship between these two activities provides useful insights into how they can be managed in a way that helps to preserve and maintain the ecosystem while optimizing community benefits. The model developed and used here differs from that of Grasso in Brazil in two respects. First, the community of Pangaimotu selected as the case study here is different from that of Brazil. Secondly, whereas in the case of Grasso (1998), the focus - forestry (logging) - allowed for the replanting and re-growth of the mangroves, here, reclamation of mangrove areas for development activity (tourism) implies an overall loss of available mangrove areas.

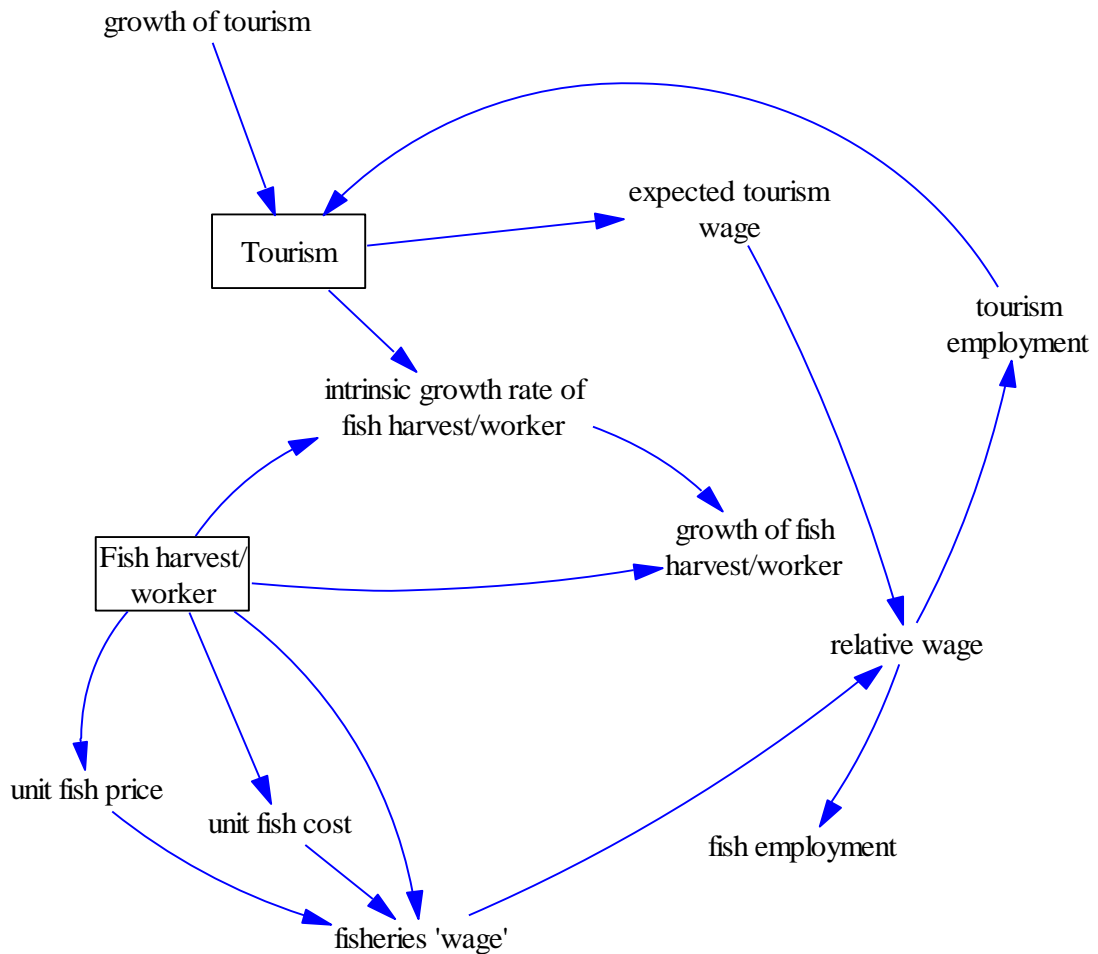
As indicated in the model, the two economic activities considered here (tourism and fisheries) are carried out by the Pangaimotu community in its 28.13 hectares of mangrove area. These activities are crucial to the livelihood of the community. Any decision to increase the number of tourist resorts in Pangaimotu from the current level (of one), would be likely to have the potential to increase job opportunities. Increased job opportunities would, in turn, impact on household incomes, something that would have implications so far as household diet and nutrients are concerned, and even wider implications so far as social and cultural activities are concerned (see *Chapter 6*).

It is intended that the inter-sectoral economic model used here will provide information that will help the community of Pangaimotu to make informed decisions about economic development activities in terms of their likely impact on individuals and the community as a whole. As such, this model could contribute to the development of a community development plan

7.2 The model sectors

In this section, I investigate how fisheries and tourism development may operate alongside each other, with mangroves being reclaimed for tourism development, while ensuring the maintenance and sustainability of fisheries resources. The mangroves play a significant role as they are spawning grounds for fisheries and provide habitat for a number of endangered species. This is important since the reclamation of mangrove areas for development activity, such as tourism, implies a loss of available mangrove areas, which will directly impact on the fisheries resources and activity. *Figure 7.1* presents the main sectors of the model and how they connect with each other. Data from the fishing community of Pangaimotu are included in the modelling design and process.

Figure 7.1: Model structure



7.2.1 Fisheries sector

The model in *figure 7.1*, illustrates the relationship between tourism and fishing, and the likely impact of tourism and fishing activity on the Pangaimotu

community. For instance, in the context of Pangaimotu, a decision to increase the current level of tourism activity from one to two or more resorts will imply a reduction in mangrove areas required for fisheries activity. Moreover, increasing tourism resorts would mean the availability of fish for harvesting will also be affected as illustrated by the impact on the growth of fish.

Regarding fisheries wage, any potential impact on the unit of fish harvested, the unit cost of fishing and price of fish, will trigger a response that will in turn impact on the wages provided by fisheries activity. The model shows that the allocation of workers between fisheries and tourism would automatically respond to any potential changes either on the unit of fish harvested, or the unit cost of fishing and price of fish, as described above. In other words, workers will move from fishing to tourism if fishing conditions deteriorate or decline, which will result in an increase in earnings from tourism. In other words, any change in fisheries wages will affect the allocation of workers between fishing and tourism, and will likely impact directly on tourism activity as well.

7.2.2 Tourism sector

A decision to increase the number of tourist resorts in Pangaimotu will most likely mean an increase also in the labour requirement for the tourism industry. In other words, labour re-allocation from fisheries to tourism will take place. This will in turn see an increase in expected tourism wages. This means that a healthy tourism sector would require more reclamation of mangrove areas for tourism development. This would in turn mean that the intrinsic growth in the rate of fish will be affected, which will consequently also affect fish harvest, and eventually lower fisheries wages. That is, relative wages in fisheries will be affected if tourism employment offers better returns to workers or labourers, labour will reallocate from fisheries to tourism, As illustrated in the model in *figure 7.1*, labour will most likely reallocate from fisheries to tourism if fisheries conditions, including wages, are reduced. For a more detailed discussion and analysis of the possible scenarios as explained above, refer to the simulation outcomes reported in *Chapter 8*, which also provides more detailed information regarding the scale and extent of these potential changes.

7.3 Model structure and variables used

The variables of the model and the basic assumptions used in its construction were based on the work of Grasso (1998). . The variables to be used for the construction of this model are as follows:

$T(t)$	<i>Number of hotels and hotel related activities at time t</i>
$F(t)$	<i>Fisheries stock at time t</i>
C_F	<i>Unit cost of fish harvest</i>
W_T	<i>Wage earned from tourism</i>
P_F	<i>Average unit price of fish</i>
B_F	<i>Fisheries Profit (wage)</i>
N_T	<i>Number of tourism workers</i>
N_F	<i>Number of fisheries workers</i>
Y_T	<i>Income from tourism activities</i>
Y_F	<i>Income from fisheries activities</i>
H_t	<i>Total Fish harvest</i>
h_t	<i>Fish harvest per unit boat at time t</i>
M	<i>Monthly fish harvest</i>
δ	<i>Social discount rate</i>
t	<i>Time in months</i>

It is postulated that the tourism sector, since it involves land reclamation, involves the total destruction of important breeding ground (mangrove swamps) for fish. The allocation of labour (as outlined earlier) is dependent on the relative wages between fishing and tourism. If for example, tourism is proven to be more profitable than fishing, labour from fishing will migrate to tourism, which will then call for more mangrove areas to be cleared for further tourism development. This, in turn, will likely mean that earnings from tourism (tourism wages) will increase due to this shift of labour (from fisheries to tourism).

As noted earlier, increased tourism development would mean that fisheries activity will be further affected due to a reduction in the available mangrove area. That is, the decrease in fisheries, due to the clearance of mangroves for the expansion of tourism development, would affect the habitat for fishing. This

would also mean that there would be less fish available to be harvested and the growth of fish would be affected too. However, there is a further possibility: the reallocation of labour (from fisheries to tourism), is resulting in fewer fisheries workers, could mean an increase in fish harvest per worker. This, in turn, would likely mean that the profit per worker in the fisheries sector would still continue to increase. Furthermore, with the possibility that fewer people involved in fishing activities would also mean less depletion of fish stocks. Such an ideal scenario would mean a win-win situation for both tourism and fisheries workers.

To return to the model and analyses, we make the following assumption. In the inter-sectoral economic model, we assume that a social planner is trying to make a decision about the optimum mangrove exploitation of a given area. The externalities of the tourism sector would directly affect fishery, which depends on the mangrove area for its sustainability and viability. The majority of the fish harvested in a mangrove embayment depend on this area for growth and reproduction. The following sections provide the details of the model structures.

7.3.1 Tourism

Let the growth rate of the tourism sector, defined here as the number of hotels and hotel-related activities, be a function of the stock of hotels and hotel-related activities, $T(t)$. That is:

$$\dot{T} = G(T(t)), \quad \partial G / \partial T < 0. \quad (1)$$

The number of workers employed in tourism depends on the size of the tourism sector:

$$N_T(t) = N_T(T(t)), \quad \partial N_T / \partial T > 0. \quad (2)$$

Lastly, the (monthly) wage earned in the tourism sector, W_T , is a function of employment in the sector:

$$W_T = W_T(N_T(t)), \quad \partial W_T / \partial N_T > 0. \quad (3)$$

7.3.2 Fishery

Let the fish stock, $F(t)$, grow logistically prior to harvesting (Conrad 1995), with an intrinsic growth rate, r . Note that $r = r(T)$; i.e., tourism impacts on the intrinsic growth rate of the fish stock by destroying mangroves ($\partial r / \partial T < 0$). $X(F, T)$ is the growth rate function describing net biological recruitment to the fish stock prior to harvesting:

$$X(F(t), T(t)) = r(T(t)) \left(1 - \frac{F(t)}{\bar{F}} \right) F(t), \quad (4)$$

where \bar{F} is the carrying capacity of the fish stock. The term $r \left(1 - \frac{F}{\bar{F}} \right)$ denotes the per unit growth rate of the stock. With harvesting, the growth rate of the fish stock falls:

$$\dot{F} = X(F(t), T(t)) - h(t), \quad (5)$$

where $h(t)$ is the harvest rate. Fish are sold at price $P_F(t)$. The total cost of catching fish, $C_F(t)$, depends on the fish stock.

Total net (monthly) incomes from production activities, Y , are given by:

$$\begin{aligned} Y_T(t) &= W_T(N_T(T(t))) \\ Y_F(t) &= P_F(h(t))M(t) - C_F(F(t)) \end{aligned} \quad (6)$$

where the monthly harvest $M = hF$.

We assume that $Y_F \geq 0$, $Y_T \geq 0$ and $Y = Y_F + Y_T > 0$.

The total number of workers, N , is fixed, where $N = N_F(t) + N_T(t)$. (7)

Define $d(t)$:

$$d(t) = \frac{Y_T(t) - Y_F(t)}{Y(t)}, \quad -1 \leq d \leq 1. \quad (8)$$

Workers allocate their effort between the two sectors depending on the size of d (Grasso 1998):

$$\begin{aligned} N_T(t) &= \frac{N}{2}[1 + d(t)] \\ N_F(t) &= \frac{N}{2}[1 - d(t)]. \end{aligned} \quad (9)$$

It is assumed that if $d = 0$, labour is split evenly across tourism and fishing.

7.4 The management objective function

Following Grasso (1998), the workers are free to interchange between fisheries and tourism and they do not have gear capacity to fish outside the mangrove areas. The social planner seeks to allocate workers according to per capita net incomes across sectors. The objective function for the two state variables, $F(t)$ and $T(t)$ becomes:

$$\max \int e^{-\delta t} \left[\frac{Y_T}{N_T} + \frac{Y_F}{N_F} \right] dt \quad (10)$$

$$\Rightarrow \max \int e^{-\delta t} \frac{2}{N} \left[\frac{Y_T}{1+d} + \frac{Y_F}{1-d} \right] dt$$

$$\text{s.t. } \dot{T} = G(T(t)) \quad (11)$$

$$\dot{F} = X(F(t), T(t)) - h(t) . \quad (12)$$

Define the current value Hamiltonian, H , as:

$$H = \frac{2}{N} \left[\frac{Y_T(T)}{1+d(T, F, h)} + \frac{Y_F(F, T, h)}{1-d(T, F, h)} \right] + \lambda_T G(T) + \lambda_F (X(F, T) - h),$$

where λ_T and λ_F are the current value multipliers. (13)

Among the optimality conditions, we require (T, F) to satisfy:

$$\frac{\partial H}{\partial T} = \frac{2}{N} \left[\frac{\partial Y_T / \partial T}{1+d} - \frac{Y_T (\partial d / \partial T)}{(1+d)^2} - \frac{Y_F (\partial d / \partial T)}{(1-d)^2} \right] + \lambda_T \frac{\partial G}{\partial T} + \lambda_F \frac{\partial X}{\partial T} = -\dot{\lambda}_T + \delta \lambda_T \quad (14)$$

$$\frac{\partial H}{\partial F} = \frac{2}{N} \left[\frac{\partial Y_F / \partial F}{1-d} - \frac{Y_T (\partial d / \partial F)}{(1+d)^2} - \frac{Y_F (\partial d / \partial F)}{(1-d)^2} \right] + \lambda_F \frac{\partial X}{\partial F} = -\dot{\lambda}_F + \delta \lambda_F . \quad (15)$$

7.5 The impact of tourism on fisheries output

From an increase in tourism, we now seek to determine the impact on fisheries output; i.e., the sign of $\frac{\partial F}{\partial H} \frac{\partial H}{\partial T}$.

Lemma. Define $H = f(F)$. Let there be an inverse function, $F = f^{-1}(H)$. Then

$$\frac{\partial F}{\partial H} \frac{\partial H}{\partial T} = \frac{\partial H / \partial T}{\partial H / \partial F}.$$

Proof. Since:

$$\begin{aligned} f \circ f^{-1} &= id \\ \Rightarrow \frac{\partial f}{\partial F} \times \frac{\partial f^{-1}}{\partial H} &= 1 \\ \Rightarrow \frac{\partial F}{\partial H} &= \frac{\partial f^{-1}}{\partial H} = \frac{1}{\partial f / \partial F} = \left(\frac{\partial f}{\partial F} \right)^{-1} \\ \therefore \frac{\partial F}{\partial H} \frac{\partial H}{\partial T} &= \left(\frac{\partial f}{\partial F} \right)^{-1} \times \frac{\partial H}{\partial T} = \frac{\partial H / \partial T}{\partial f / \partial F} = \frac{\partial H / \partial T}{\partial H / \partial F}. \end{aligned}$$

Proposition. An increase in the stock of tourism has an indeterminate impact on the stock of fish.

Proof. From the Lemma,

$$\frac{\partial F}{\partial H} \frac{\partial H}{\partial T} = \frac{\left[\frac{\partial Y_T / \partial T}{1+d} - \frac{Y_T (\partial d / \partial T)}{(1+d)^2} - \frac{Y_F (\partial d / \partial T)}{(1-d)^2} \right] + \lambda_T \frac{\partial G}{\partial T} + \lambda_F \frac{\partial X}{\partial T}}{\left[\frac{\partial Y_F / \partial F}{1-d} - \frac{Y_T (\partial d / \partial F)}{(1+d)^2} - \frac{Y_F (\partial d / \partial F)}{(1-d)^2} \right] + \lambda_F \frac{\partial X}{\partial F}}.$$

The proof follows from an inspection of the terms on the RHS of the equation.

Consider $\partial d / \partial T$:

$$\frac{\partial d}{\partial T} = \frac{\partial W_T}{\partial N_T} \frac{\partial N_T}{\partial T} \left[\underbrace{W_T + P_F M - C_F}_{\geq} \right] + \underbrace{W_T + P_F - C_F}_{\geq} \left[\underbrace{P_F M - W_T - C_F}_{\leq} \right],$$

with $\partial W_T / \partial N_T > 0$, $\partial N_T / \partial T > 0$ and $P_F M - C_F \geq 0$ (by assumption). The sign of $\partial d / \partial T$ therefore corresponds to the sign of $P_F M - W_T - C_F$, which is indeterminate. Similarly, indeterminacy holds for $\partial d / \partial F$.

The Lemma suggests that care be taken in analysing the economic impacts of tourism. Even in the case of our simple model, the impact on inter-sectoral labour allocation and that of tourism on the fisheries sector growth are by no means clear. It cannot be assumed that tourism will harm fisheries as much as the initial destruction of mangroves suggests. The relative importance of the above partial derivatives requires further research, especially if policy makers wish to influence food supplies and the structural transformation of the economy.

Chapter 8

Model simulation

8.1 Introduction

The dynamic relationship between the two economic activities, fisheries and tourism, undertaken by the Pangaimotu community highlights the importance for the community of being fully informed about the possible outcomes of any decision that will violate the status quo. The simulation model here uses VENSIM PLE32 to analyse the possible outcomes given the different options that the community has. The key question, once again, is how the community of Pangaimotu can best engage in development activities at the same time as ensuring that the traditional fishing activities, activities that the community has enjoyed for centuries, can continue. The first simulation looks at the impact on the community of a possible decision to increase the number of tourism-related hotels from one (as at present) to two or more. The second simulation looks at the impact on the community of an increase in the price of fish resulting from pressure from export companies operating in the outer island of Vava'u (the price of fish for export being much higher than it is in the local market, especially where fishers in the community decide to fish for export rather than for subsistence). A key decision made by Government of Tonga was to support the fisheries industry by providing a fuel subsidy for the fisher people (see the third simulation). This had a huge impact on the cost of production in fisheries. The Tonga government subsidy appears to have been a lucrative offer whose aim was to lure workers to the fisheries industry rather than engaging in other economic development activities available to them.

The model simulation starts with the initial conditions and parameter sizes that currently determine the paths of the key variables for the given activities. The simulation model then investigates the economic properties of the paths under different scenarios. Using VENSIM PLE32, we simulate the system (1) – (4) and (6) in *Chapter 7* to derive illustrative paths of the key variables. In particular, we investigate the potential impacts of increasing tourism on relative profits and employment opportunities across sectors, and therefore the potential impact on the

fisheries sector. The simulation was run for a period of one hundred and eighty months. This is considered to be the lifetime of the mangrove plant, and, therefore, important. The simulation model provides a laboratory in which one can experiment in order to understand how different elements of the structure of systems determine behaviour.

8.2. Vensim PLE32

Vensim is the simulation language developed by Ventana Systems Inc. of Harvard, Massachusetts in 1985. Models were developed using existing products combined with custom code written in programming language. However, practitioners discovered that it was difficult and very time consuming to find and correct imperfections in the models, hence Vensim was developed in order to decrease model development time. The Vensim software, therefore, is a visual modelling tool that allows one to conceptualize, document, simulate, analyse, and optimise models of dynamic systems. The Vensim programme provides a simple and flexible way of building simulation models from causal loop or stock and flow diagrams.

By connecting words with arrows, relationships among system variables are entered and recorded as causal connections. Equations are then created. Analyses of the model can be viewed throughout the building process, looking at the causes and uses of a variable, and also at the loops involving the variable. When the model is completed and can be simulated, Vensim allows one to thoroughly explore the behaviour of the model.

8.3 Current economic activity in Pangaimotu

8.3.1 Fisheries

The survey result from the Pangaimotu community (as discussed in *Chapter 6*) will be employed to discuss outcomes of any changes to the current status quo. The survey results indicated that most of the community identified fishing as their main job. The simulation was therefore run with an initial allocation of seventy per cent of the workers allocated to fisheries and thirty per cent allocated to tourism. With total employment of seventy workers in the community altogether, this accounts for an initial fifty eight workers in fishing and twelve workers for

the tourism sector. The survey results also indicated that average fish catch was 400kg per worker, up to a maximum of 450kg/worker per month. Average unit fish cost was \$1.49/kg with fish sales at an average of \$6.00/kg. The average fish profit per worker was therefore recorded at \$175/month. These figures include fish, whether for sale or subsistence.

8.3.2 Tourism

There is only one tourism resort currently operating in the Pangaimotu community. The resort occupies 0.61 hectares of the mangrove area of Pangaimotu. With a total mangrove area of 28.13 hectares, it is clear that the number of tourist resorts cannot exceed five (of the size of the Hinakauea Beach Resort). The town officer estimated that, given the five per cent allowable mangrove use for *tapa*, it was unlikely that more than twice that amount (10%) would be appropriate in the case of tourism development (Personal communication, town officer, April 2003). Reclaiming ten per cent of the mangrove area available for the community for potential tourism development amounts to 2.813 hectares. Using the 0.61 hectares currently occupied by the Hinakauea beach resort, as a measure of what the community finds acceptable, the maximum capacity would be five tourist resorts.

At present, with thirty per cent of the total employment in the tourism sector, this accounts for twelve workers altogether. These workers include the eight permanent and part-time workers currently employed at Hinakauea beach resort, and four others (stall owners who rent and sell handicrafts and local artefacts during tour times). The average monthly income from the operation of the tourist resort is T\$455/month (see *Appendix 18*).

8.4 Simulation model

The simulation model assumes there are a fixed number of workers and there is no cost involved in transferring workers from tourism to fisheries and vice versa. The transfer of workers will be determined by profitability of the activities as indicated in equations (7) to (9) in *Chapter 7*. The assumption is, therefore, that there will be no immediate influx of workers from other villages if economic activity is proven to be viable. The overall assumption is that tourism and fisheries activities

are carried out independently, within the current level of workers, resources and skills.

8.4.1 Simulation 1: The potential impact of increased tourism

The model is designed to assess the potential impact on fisheries of an increase in tourism activity in Pangaimotu. First, the most obvious impact would be that increased tourism activity would generate more jobs. This would mean that, so far as fisheries are concerned, increased tourism activity would entice more workers to move across from fisheries into tourism. As a result, fewer workers would be available to continue to fish for their families.

8.4.2 Scenario 1: Model equations and parameter values

Fisheries are the dominant sector, both in terms of production and employment. The following equations and parameters have been built into the VENSIM model to determine the allocation of workers between tourism and fishery activities for *scenario 1*. Initially there are seventy workers with seventy per cent allocated to fisheries and thirty per cent to tourism. The initial number of hotels is one and the maximum capacity is five hotels. The maximum fish harvest per worker is one tonne (1000kg) per month. The initial harvest per worker is 120kg/ month. There is also a total of 28.13 hectares of mangrove area for the community and the simulation is run for 120 months.

The simulation equations for scenario 1 are:

Employment (N)

Total employment $N = 70$

Tourism employment $N_T = \frac{N}{2}(1 - d)$

Fish employment $N_F = \frac{N}{2}(1 + d)$

Tourism (T)

Intrinsic growth rate of tourism $r_T = 0.05$

Maximum tourism (hotels) $\bar{T} = 5$

Tourism (hotels)	$T = \int \dot{T} dt$
Growth of tourism	$\dot{T} = \left(r_T - \frac{r_T T}{T} + 0.0001N_T \right) T$
(Expected) tourism wage	$W_T = 0.2T(400 + 5T_T)$

Fish harvest per worker (F)

Intrinsic growth rate of fish harvest/worker	$r_F = 0.01 - 0.00155T - 0.01F$
Maximum fish harvest/worker (ton/month)	$\bar{F} = 1$
Growth of fish harvest/worker	$\dot{F} = r_F F \left(1 - \frac{F}{\bar{F}} \right)$
Fish harvest/worker (ton/month)	$F = \int \dot{F} dt$
Fish cost per ton	$C_F = 500 - F$
Fish price per ton	$P_F = 3500 - 0.05F$

Profit (net earnings)

Fish profit	$Y_F = (P_F - C_F)F$
Total earnings	$B = Y_F + W_T$
Relative earnings difference	$d = \frac{Y_F - W_T}{B}$

Initial Conditions

Tourism	$T = 1$
Fisheries	$F = 0.12$

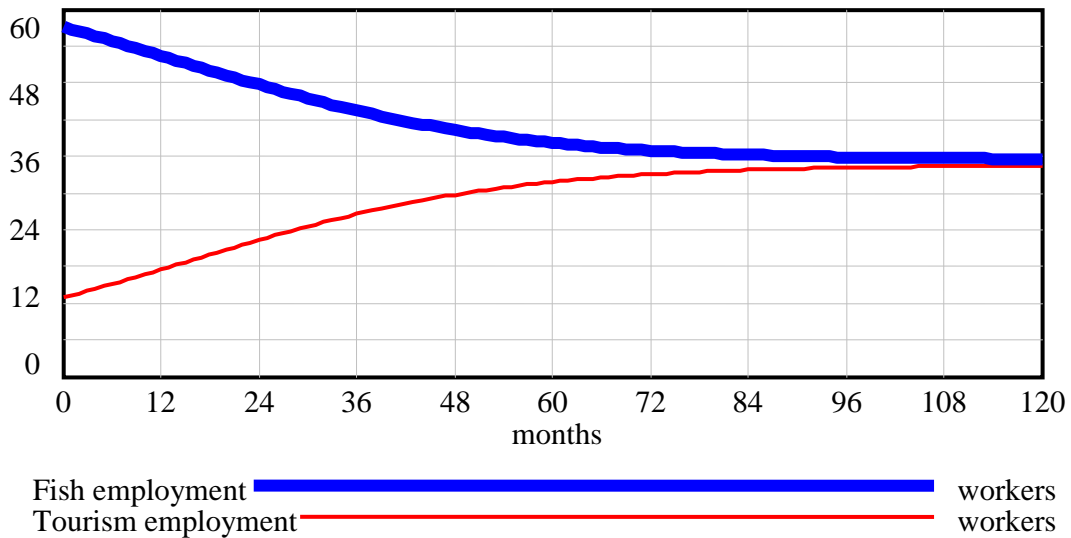
8.4.2.1 Discussions of results

Fisheries are the dominant sector in terms of labour and production for the Pangaimotu community. *Figure 8.1* shows the initial allocation of workers. At present, most workers are engaged in fisheries and only thirty per cent in the tourism industry. However, once tourism activity picks up, the number of workers in tourism also increases. In fact, the number of workers in tourism increases exponentially from twelve workers initially in the first six years and then levelling

off to thirty three workers after that. Correspondingly, in the face of increased tourism activity, fisheries workers declined dramatically over the same period. That is, increased tourism activity resulted in a decline of fisheries workers from fifty eight workers initially, levelling off at thirty seven workers after seventy-two months (six years). According to the simulation, after almost ten years of operation, the labour allocation would almost be equally split between tourism and fisheries industries (see *Figure 8.1*).

Figure 8.1: Labour Allocation

Number of workers

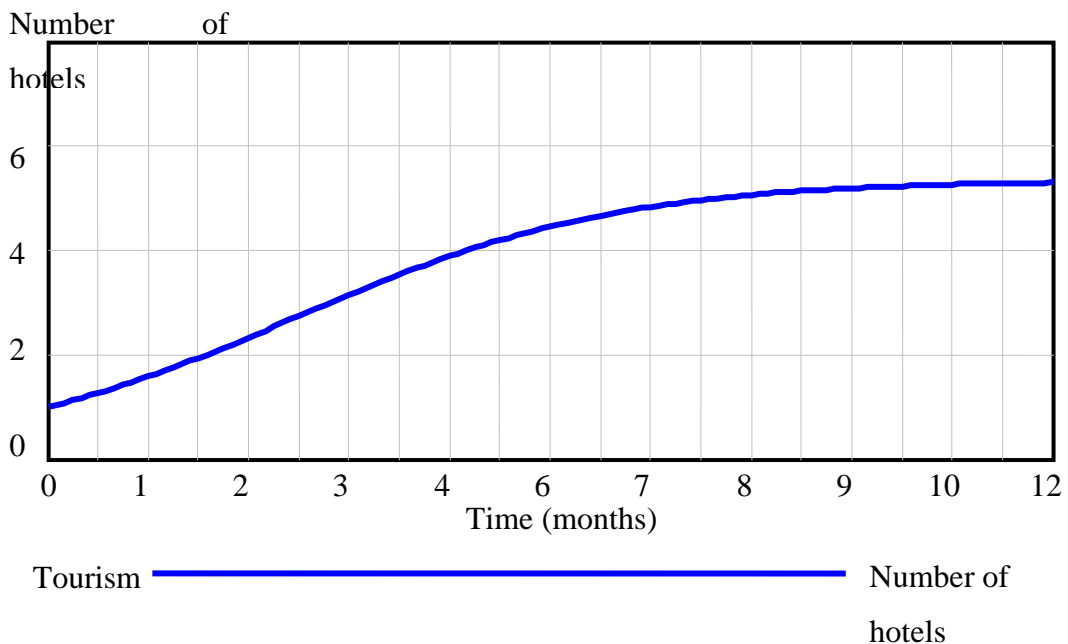


An increase in the number of tourism resorts would also mean reclaiming more mangrove areas for tourism development. Land reclamation would have a direct impact on mangrove areas that would otherwise be available as nursery grounds for fisheries, which, in turn, would mean a decline in fish stocks for the community. Therefore, an important decision the community would have to make is how much of their mangrove areas should be allowed to be reclaimed for further tourism development, that is, how much mangrove clearance is sustainable in relation to the food security of the community that derives from fisheries activities?

The simulation model seeks to highlight salient issues once the status quo changes for the community. Indeed, the model presented here seeks to demonstrate that increasing the number of tourism resorts will also increase job opportunities in a complementary approach to maintaining a sustainable level of fisheries for the

community due to the transfer of workers from fishing to tourism. In other words, the labour transfer from fishing to tourism (especially to obtain higher paid jobs) should be seen as an incentive to the community, given the benefits such as a better standard of living, a higher income to buffer external shocks, and better access to infrastructure and social development. That is, migrating to tourism work (if there is an expansion of the current level of tourism development) may enhance the living standards of the community. The variables in the simulation model are included to allow us to explore the linkages and interactions between the movements of fisheries labour into the tourism sector. In *Figure 8.2*, through the cause and effect flows in the model, we can study the proposition that job creation in the tourism sector, together with the growth of the tourism industry, would continue to maintain a sustainable level of fisheries for the community due to the transfer of workers from fishing to tourism. The number of hotels grows rapidly in the first nineteen months (see *Figure 8.2*), with the establishment of another tourism related hotel. The maximum capacity for the community reaches its peak after 100 months, with around five hotels built and then levelling off.

Figure 8.2: Tourism growth

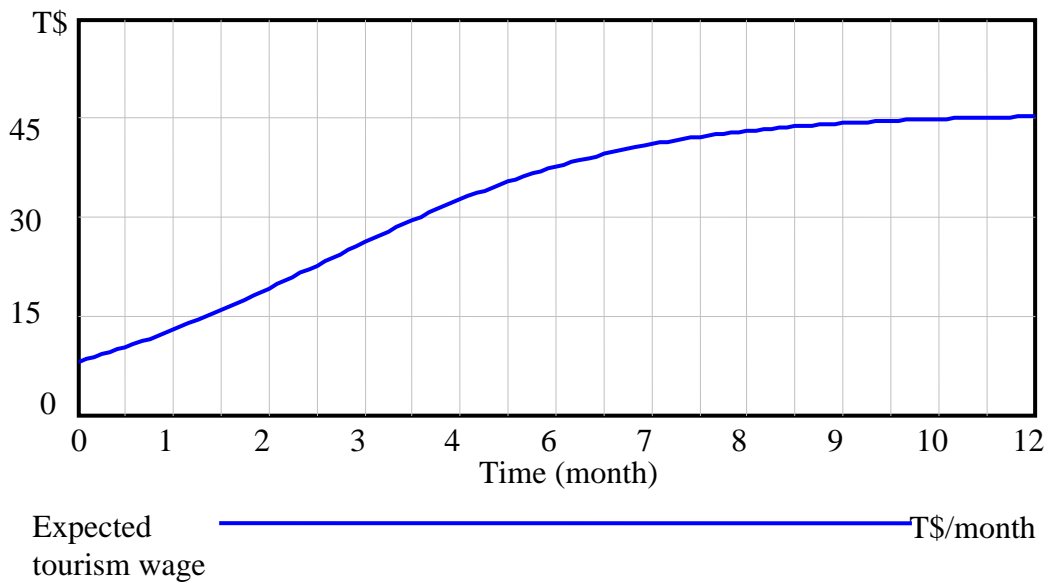


From *Figure 8.2*, it can be seen that growth in the number of tourism resorts will increase job opportunities, see *Figure 8.1* (hence fisheries workers will move from fisheries into tourism). This increase in tourism also, however, implies that more mangrove land will be cleared. An increase in the number of tourist activities will

have flow on effects so far as fish profit and the amount of fish harvest per worker are concerned (see *Figure 8.4*).

Since the model is also simulating a labour out-migration from the fisheries to tourism sector, variables related to the tourism sector are also included. The effects are modelled because we would like to include the effects of a reduction in fish catch (assuming workers shift from fishing to tourism jobs) and growth in tourism over time. Changes in the tourism sector then affect sector profit. This is shown in the simulation model.

Figure 8.3: Expected tourism income (wage)

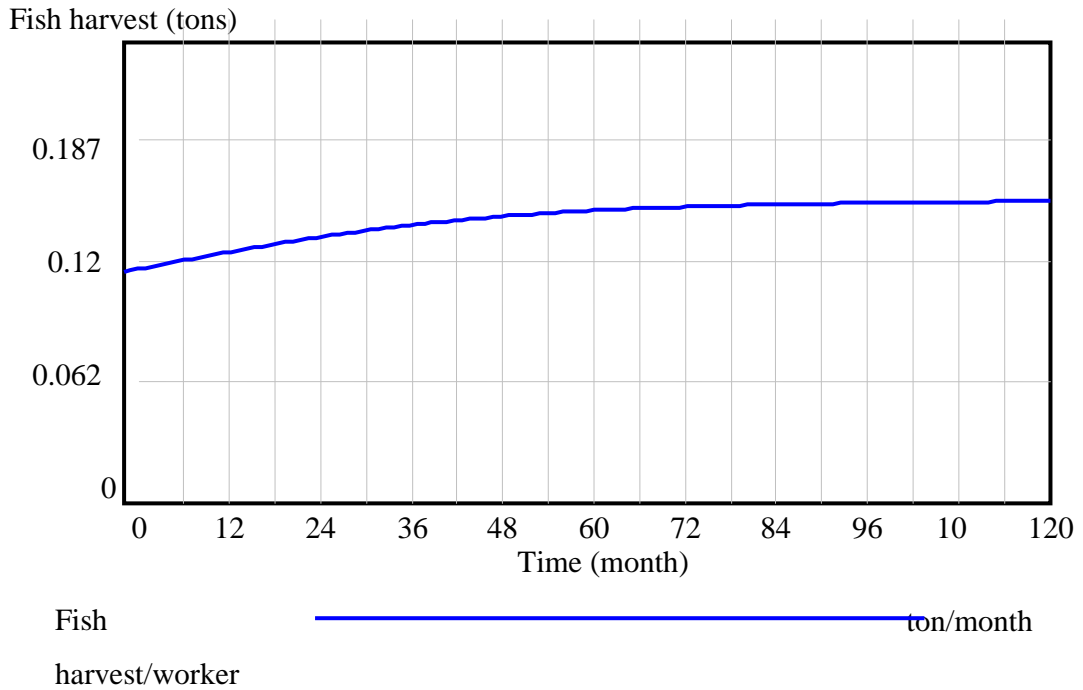


The expected income of the tourism sector in turn affects inter-sectoral profit differences (relative profit). Given a change in relative profits in favour of tourism, for example, as workers migrate from fisheries to the tourism sector, the tourism sector expands. An expansion in employment in tourism will therefore reduce fish harvest per worker. Hence, the simulation model links all the causes and effects of the complementary approach proposed.

From *Figure 8.3*, it can be seen that tourism income increases with the increase in tourism employment, from an initial income of T\$81 per month to around T\$450 per month after approximately 100 months. During this time a shift in workers from fishing to tourism occurs, given the relative wage difference.

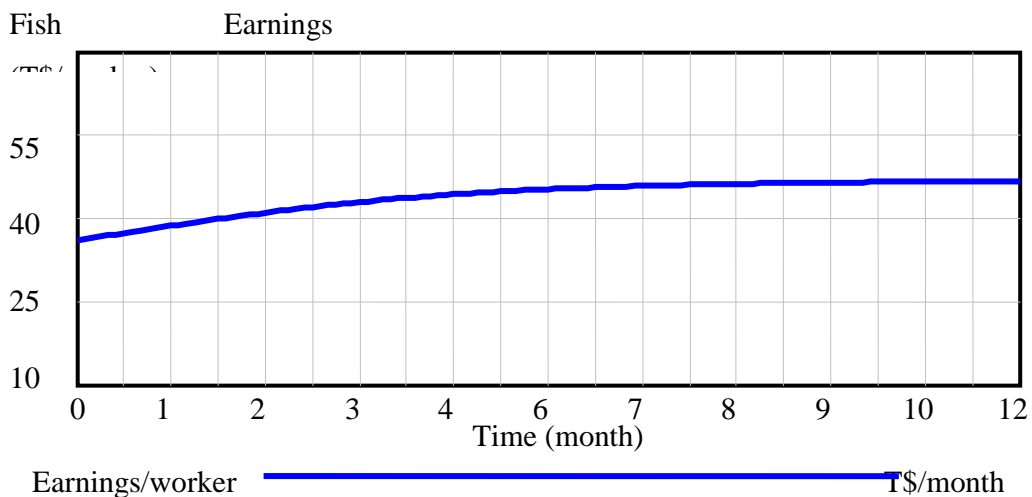
While there is a growth in the tourism sector, the opposite is happening in the fisheries sector. From *Figure 8.1*, it can be seen that fish employment falls from an initial labour allocation of fifty eight workers to thirty seven workers, with a general increase in fish harvest per worker from 120kg per worker per month to level off at 150kg per worker after about six and a half years (see *Figure 8.4*).

Figure 8.4: Fish harvest per worker (ton/month)



Net fish earnings per worker, on the other hand, generally increased at a much slower pace, from just over \$360/worker/month to level off at almost \$454/worker/month after about six and a half years (see *Figure 8.5*).

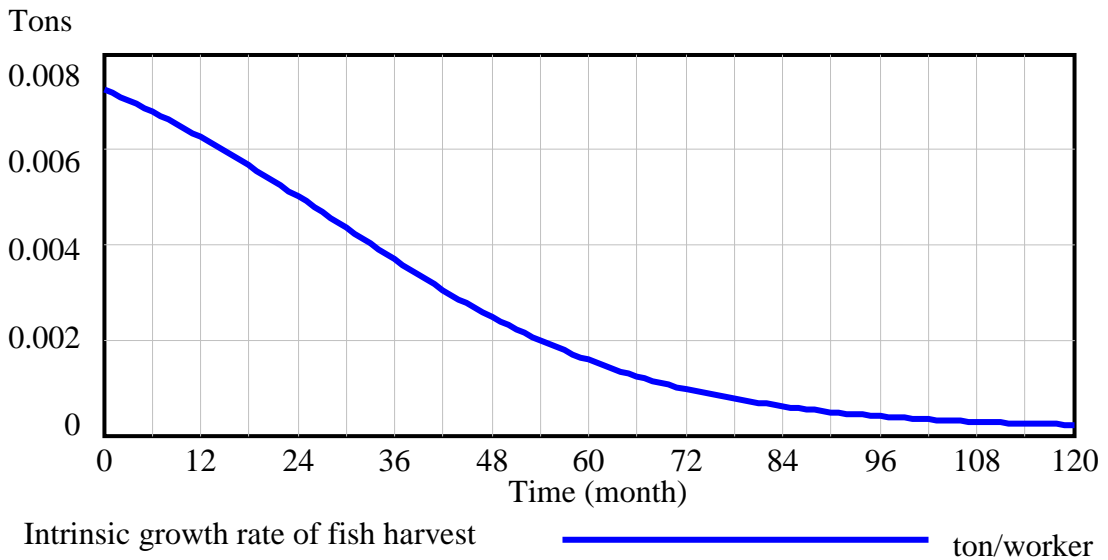
Figure 8.5: Fish Earnings (T\$/worker/month)



While there is a general increase in fish harvest per worker (*Figure 8.4*), intrinsic growth and fish growth were greatly affected indicating a fast crash of the system (see *Figure 8.6*). This is further affected by the growth in the tourism sector, which leads to an increase in reclaimed mangrove areas, hence a decrease in the breeding grounds available for fisheries.

An increase in the growth of the tourism sector will see workers moving from fishing to tourism. The expected income from tourism will also see an increase in total earnings for the community. With more workers moving to the tourism sector, there will be a decrease in the intrinsic growth rate of the fish harvest due to the lack of protection for the juvenile fish (see *Figure 8.6*). This happens because mangroves will have been cleared to meet the growth of the tourism industry (involving increased reclamation of mangrove land for tourism development).

Figure 8.6: Intrinsic growth of fish harvest (ton//worker/month)



But as *Figure 8.5* suggests, fish earnings per worker can rise (and eventually stabilise), despite the adverse impact of tourism on mangrove breeding grounds. Nevertheless, earnings are sensitive to the destruction of mangroves. With a twenty per cent increase in the adverse impact of tourism on mangroves (implying a reduction in the intrinsic growth rate of the fish harvest from $r_F = 0.01$ -

$0.00155T - 0.01F$ to $r_F = 0.01 - 0.00186T - 0.01F$, we note a resulting decline in fish harvest, see *Figure 8.7* and net earnings (profits) per worker see *Figure 8.8* .

Figure 8.7: Fish harvest per worker

Fish harvest (tons)

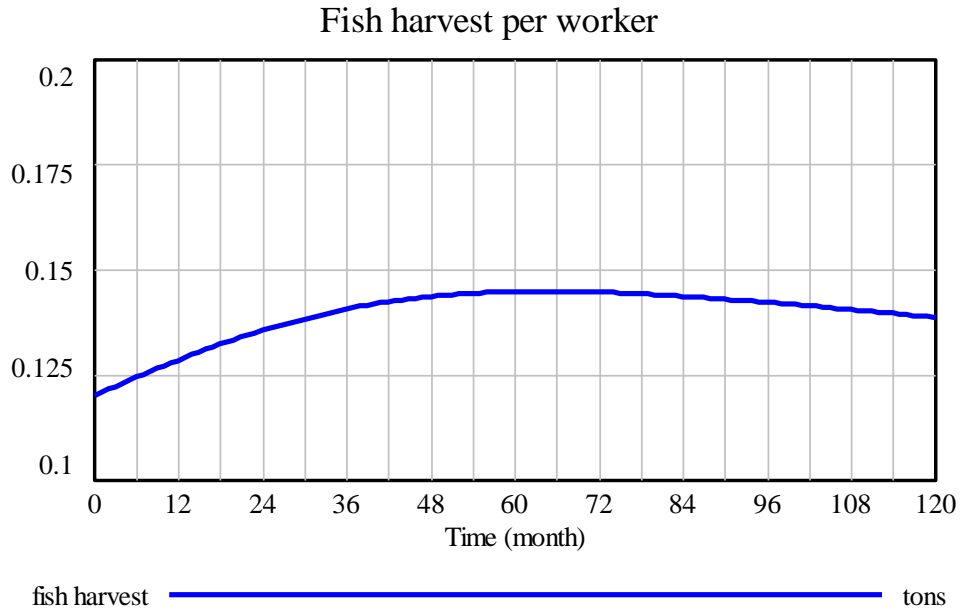
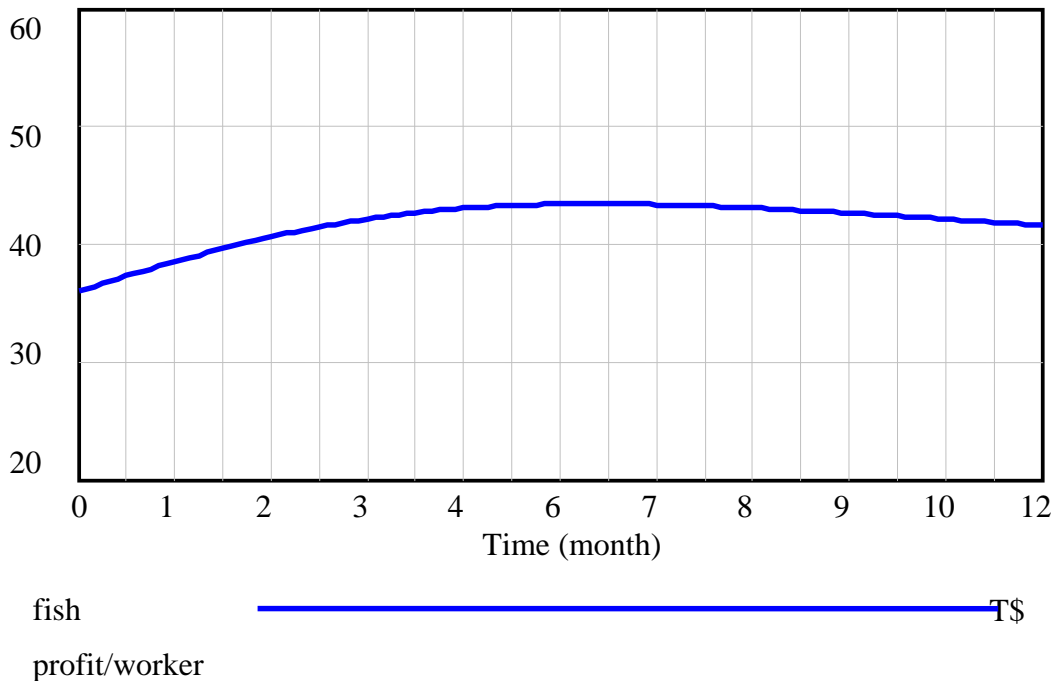


Figure 8.8: Fish profit per worker

Fish Earnings (T\$/worker)



8.4.3 Simulation 2: The potential impact of increased fish price

Consider a 33 percent increase in fish price, from \$3.50/kg (the price of fish if sold at the local market) compared to \$4.655/kg (the price if sold to the exporter). The price offered is higher, hence the decision to run a simulation to enable the community to be better informed of the consequences of such a decision. From the model, it can be seen that the 33 percent increase in the price of fish brings about a 15 percent increase in fish employment and a substantial increase in fish profit per month for each worker (see *Table 8.1*). Workers from tourism will transfer to fishing. In the context of this scenario, with five workers from tourism moving over to fishing (see *Figure 8.9*), the fish profit per worker increases from T\$360 per worker per month to T\$498 per worker per month for the first month (see *Figure 8.10*).

Figure 8.9 : Change in fish employment

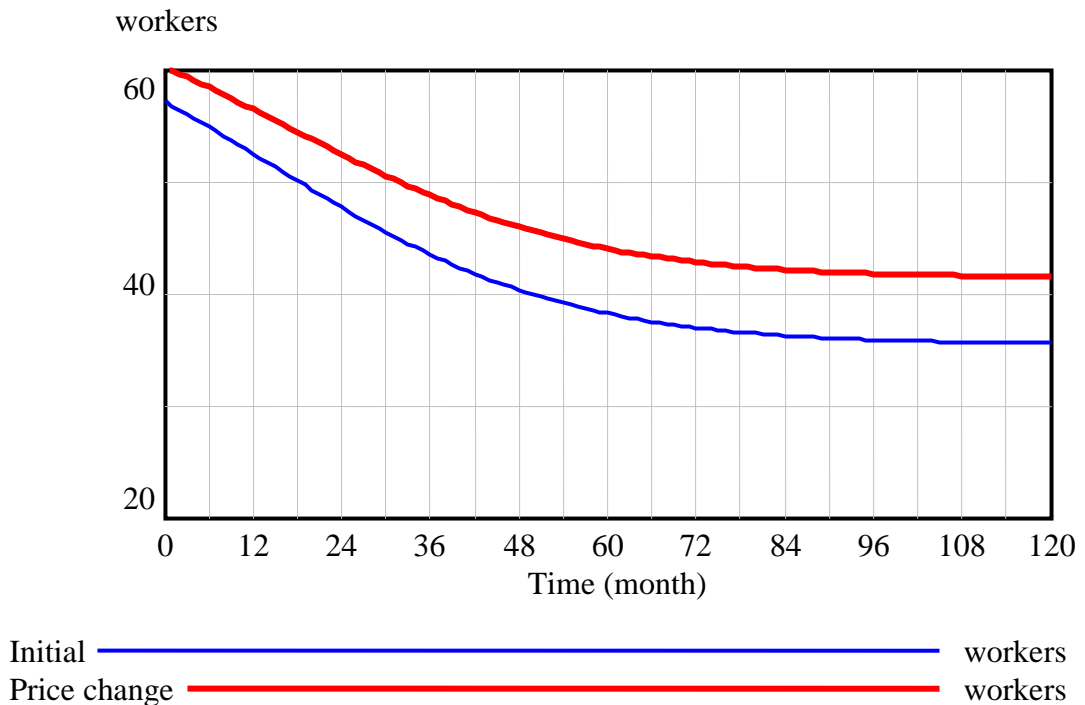
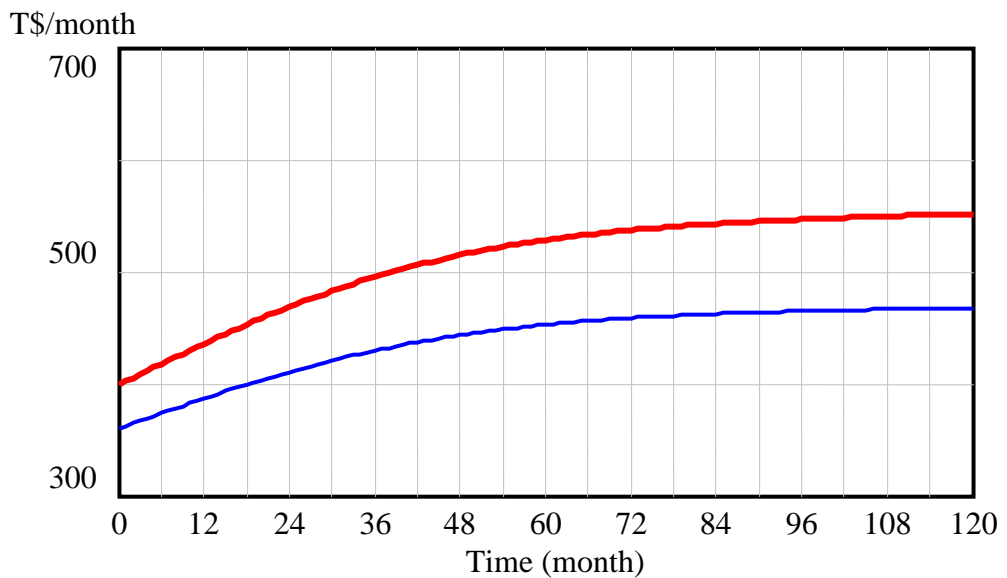


Table 8.1: Summary of effect of an increase in fish price

Variables	Status quo	Scenario 1 Increase in fish price	% change
Fish price (T\$/ton)	3,500	4,655	33
Fish employment (workers)	57	60	-3.4
Tourism employment (workers)	13	10	-16.7
Fish profit/ worker (T\$/month) 1 st month	360	498	38.3
Fish profit/worker (T\$/month) 120 th month	468	652	39.3

In terms of profit, a 33% increase in fish price induces a 38-39% increase in fish profits. The reason is that profit per unit increases significantly, both from the price side and the cost sides (the higher fish harvest/worker reduces unit cost).

Figure 8.10: Change in fish profit



Initial ————— T\$/month
 Price change ————— T\$/month

In this scenario, due to mobility of labour, the impact on the community of the increase in price of fish has little effect on the fish harvested/worker or on the number of hotels built (see *Figures 8.12 and 8.13*) Only tourism employment

shows a marked response to the increase in price, with 16.7 per cent of the tourism workers moving to fisheries (see *Figure 8.11*).

Figure 8.11: Change in tourism employment

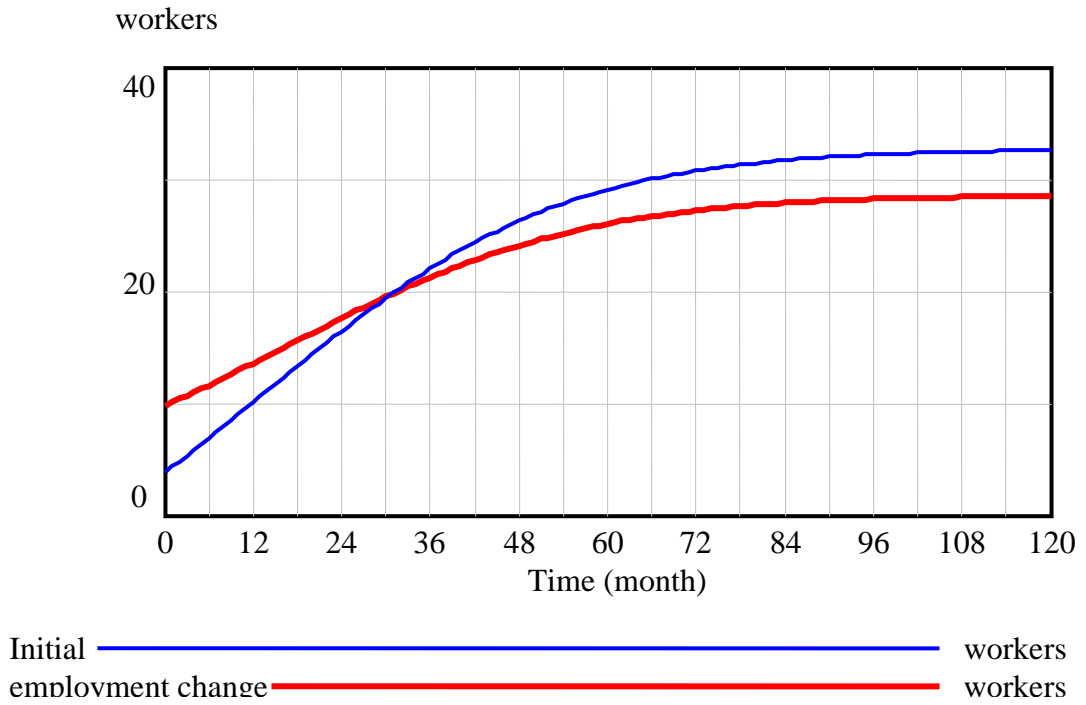


Figure 8.12: Change in fish harvest/worker

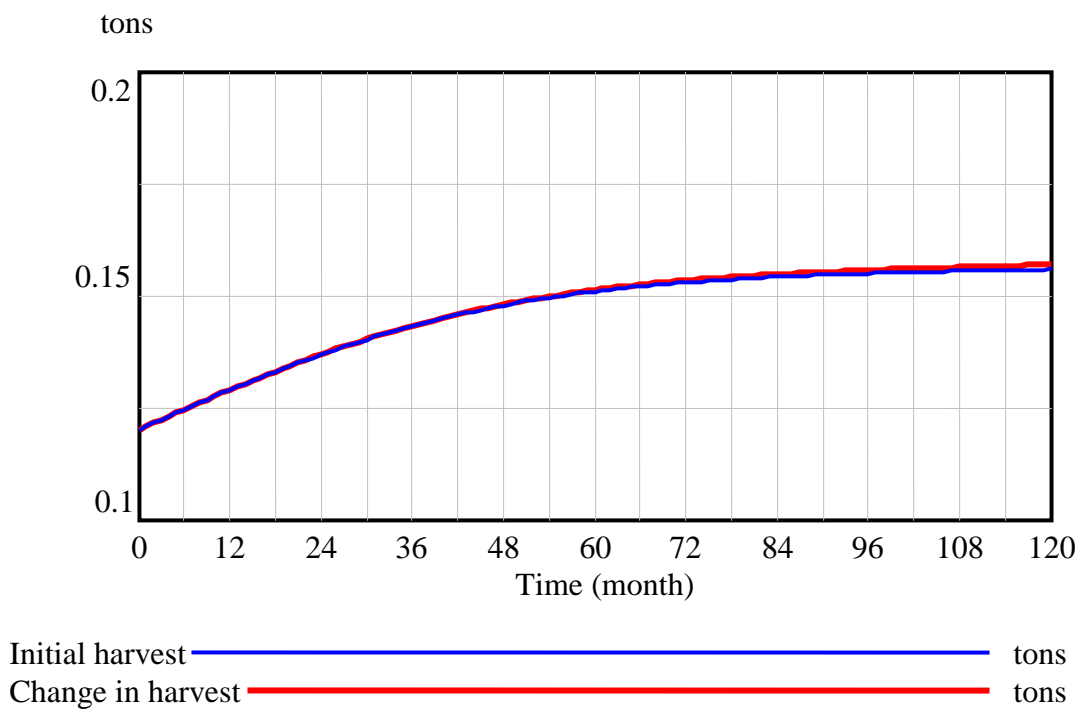
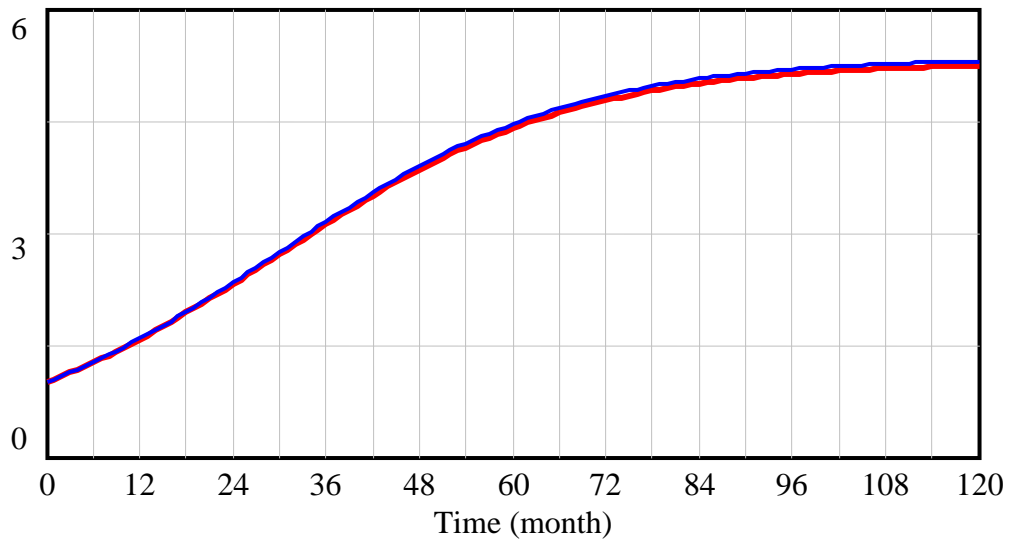


Figure 8.13: Change in tourism

hotels



Initial tourism ————— hotels
Change in tourism ————— units

8.4.4 Simulation 3: Potential impact of the elimination of fuel tax (subsidy)

This simulation looks at the impact of the Tonga government decision to provide a fuel subsidy to assist the fishers. Fuel constitutes 75 per cent of the cost of fishing activity. The downturn in the industry during 2003, coupled with the impact of el Nino, made the Government of Tonga see it as being necessary to assist fishers to continue their operations. Although the fuel subsidy offered by the government also meant a loss of revenue to the Tonga government, the decision was seen as a way forward for the fishery industry. It was therefore seen as necessary to model the effect of this change and its implications for the community. Therefore, the unit fish cost fell from a high level of \$500/ton to \$125/ton (see *Figure 8.14*), fish employment increased (see *Figure 8.15*), and fish profit also increased by more than 51 percent (see *Table 8.2* and *Figure 8.16*).

Table 8.2: Effect of fuel subsidy (summary)

Variables	Status quo	Scenario: Fuel subsidy	% change
Fish cost (T\$/ton)	500	125	-75
Fish employment (workers)	57	61	7
Tourism employment (workers)	13	9	-30.7
Fish profit/worker (T\$/month) 1 st month	360	544	51
Fish profit/worker (T\$/month) 120 th month	652	712	9.2

Figure 8.14: Change in fish cost

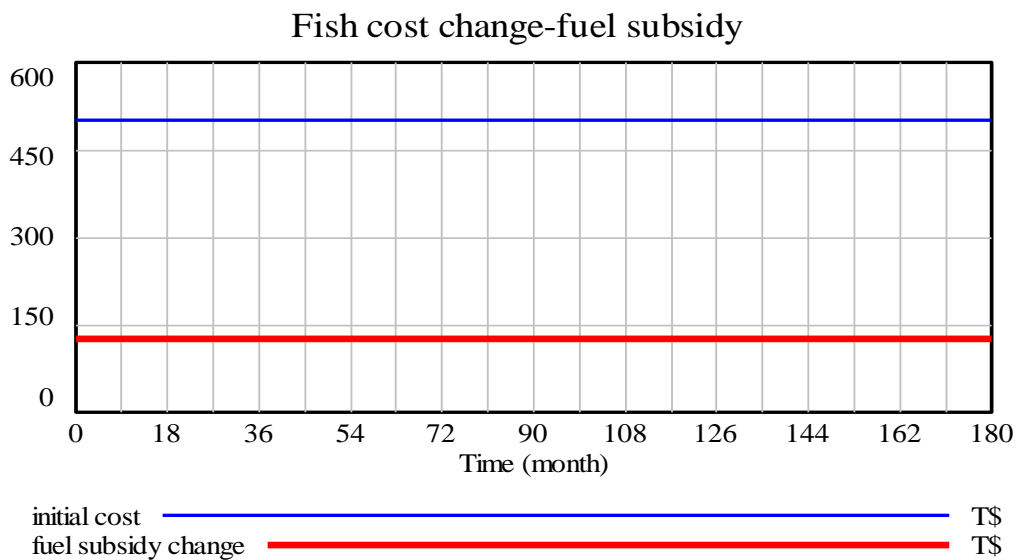


Figure 8.15: Change in fish employment

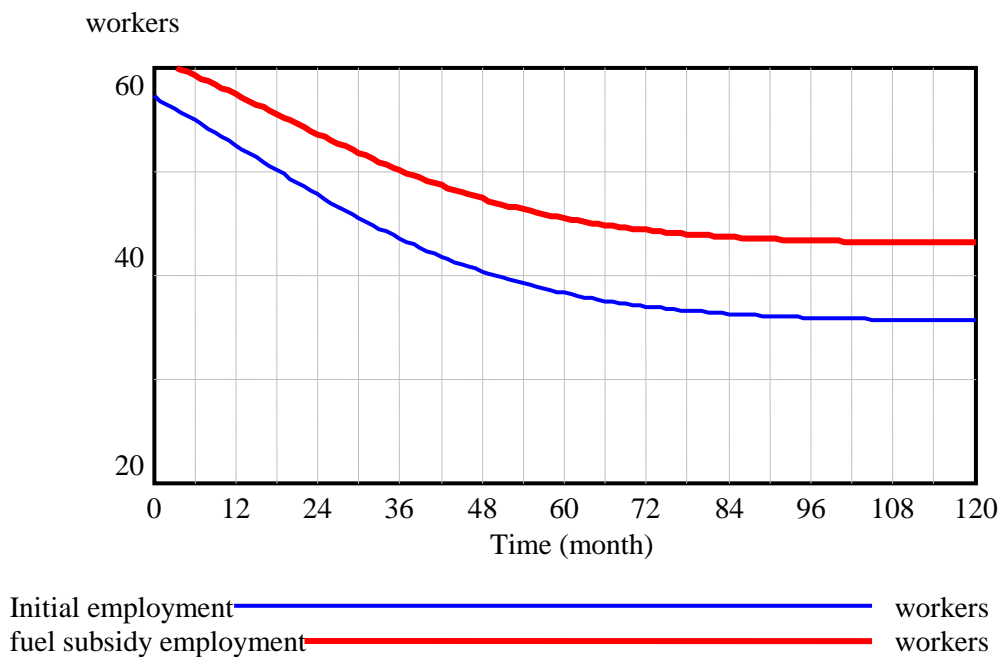
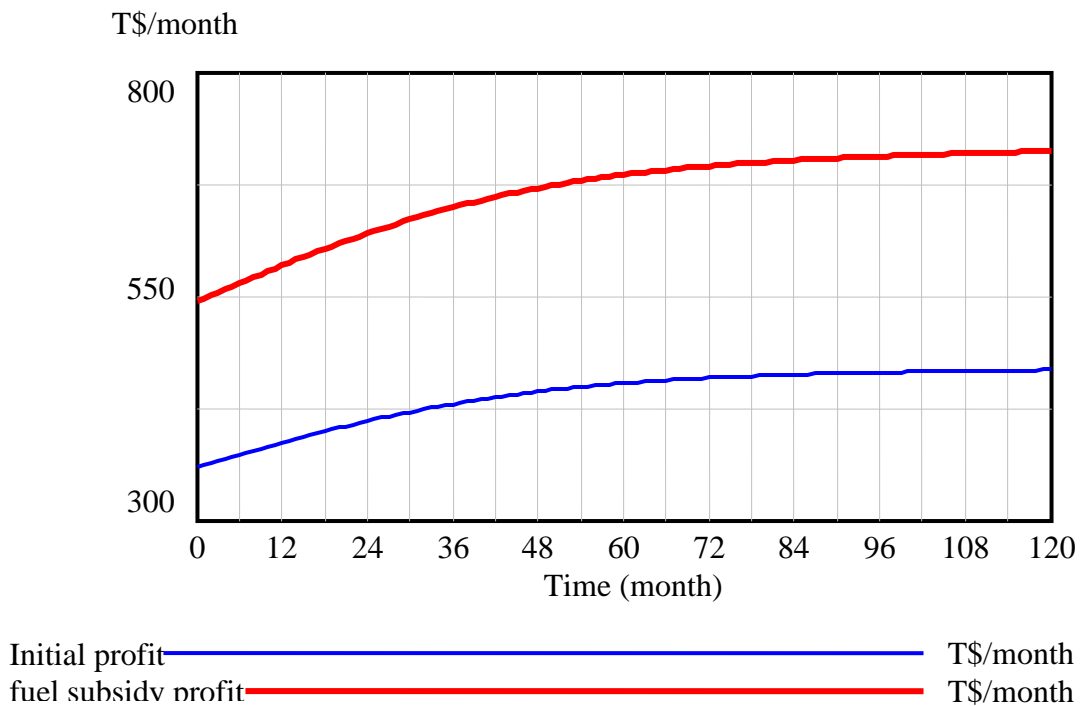


Figure 8.16: Change in fish profit



8.5 Conclusions

The model is sensitive to the initial number of workers in each sector activity. The best management option is to have more workers in the fishery sector. The impact of increase in tourism (simulation 1), although impacting negatively on fish harvest, is seen as an incentive for the community. The available paid jobs and income received from an increase in the number of tourism venues will provide the community with better access to infrastructure and development. This is seen as contributing towards the enhancement of the quality of life of the community. So far as a potential shift from community fishing for subsistence to commercial fishing for export (due to high price offered by the export market) is concerned (simulation 2), the impact on the community is, once again, a positive one. The increase in profit does not seem to result in the community increasing fishing activity. Instead, labour migrated from tourism to fisheries, the fish harvest per worker and number of tourism resorts remaining unchanged. The impact of fuel subsidy (simulation 3) on the Pangaimotu community highlighted the important role played by the government in reducing costs, leading to an increase in profit per worker in fishery. Fish profits, moreover, increased by more than fifty per cent. Hence, it is clear that both the law and taxation should be designed in such a

way as to be a disincentive to mangrove cutting. In the case of small island communities, some participative management technique should be used to demonstrate to local people the advantages of rationally managing the mangroves so as to preserve the mangrove ecosystem.

The models presented here are based on simple interactions between the economic activities of tourism and fisheries and those depending on them, and the benefits that could be gained when planners have an overview of how the ecosystem works. Knowledge of the interactions of physical systems gives a wide range of options for using policy tools for the preservation of areas and, consequently, for securing economic benefits for local people, especially as workers. Increasing the ecological and socio-economic knowledge of the communities will help them to understand that, for example, reclaiming mangrove areas for increased development activities may involve social costs that will far outweigh the immediate benefits and that; therefore, this type of activity should be carefully controlled. The development of models such as those included here inevitably leads to many new questions whose answers must await further field research and further adaptation of the models themselves. This, in turn, results in more questions, and so the cycle continues (Swartzman and Van Dyne, 1972).

Chapter 9

Overview and concluding statement

9.1 Overview

The fact that Tonga, an island nation, has 1 sq km of land to more than 900 sq km of ocean indicates the importance of the ocean to Tonga. As an island nation, Tonga derives great benefit from the sea and the sea and coastline provide opportunities for further benefits. The relationship between Tonga's natural resources and the utilisation of those resources for social and economic development is a symbiotic one. Thus, current utilisation of natural resources must be done in a way that does not represent a threat to the future availability and use of these resources. This is one of the underpinning principles of sustainable development. With specific reference to Tonga, and, in particular, one area of Tonga, it has been demonstrated here that it is important that small island countries should manage economic development, and, hence, use of natural resources, in a way that gives careful consideration to the issue of sustainability.

Tonga shares with other small island economies of the Pacific a continued dependency on the sea and seafood will continue to be a significant dietary requirement for rural island communities for the foreseeable future. So far as the island economy of Tonga is concerned, the potential impact of development activities on this necessary resource should not be overlooked, especially in a context where Tonga, along with other small Pacific island economies, must also come to terms with issues that affect fisheries on a global scale.

The Tongan government and development planners within Tonga have identified the fisheries sector as offering the most promising growth potential and as being fundamental to improving the country's trade deficit. Fishery activity not only provides food security and employment opportunities for rural communities but also makes a major contribution to government revenue. The sea therefore provides an invaluable natural resource.

9.2 Summary and conclusions

9.2.1 Economic issues: Fish exports

In seeking to explore the economic issues relating to the fisheries sector in Tonga, I made a distinction between two sectors – fisheries at a national level (the Tonga fisheries export sector) and domestic fisheries. So far as the first of these is concerned, the focus was on financial returns fisher people derive from the export of fish to overseas markets.

From the point of view of Tonga as a whole, the fishery export sector is an important source of foreign exchange earnings. The importance of fish exports is increasing and has great potential in helping to address the Tongan economy's current account imbalance. In relation to this, the expansion of tuna long line fishing operations at the beginning of 2000 was a major contributing factor to the improved performance of the fishing industry as whole.

Fisheries have continued to provide employment opportunities in Tonga, the number of households engaged in fishery activities having risen from 16 per cent to 33 per cent in 2001 according to the latest agricultural census figures (Tonga Government: Agriculture and Census Report, 2004:28). The expansion of the fisheries sector has, furthermore, contributed to improvement in the health of the community. The increase in tuna by-catch has led to an overall fall in the price of fish, thus making it more affordable for consumers and therefore reducing dependence on imported fatty meat and tinned food.

So far as overseas fish markets are concerned, these are categorized/ segmented in terms of demand focus. Thus, for example, the demand in East Asian markets is mainly for crustaceans and molluscs while the demand in the Pacific region, American Samoa in particular, is for tuna as raw material for local canneries. In Hawaii, the market demand is mainly for snapper and grouper, while in Japan, the demand is only for fish for its local sashimi market. The other overseas fish markets are Australia and New Zealand where, so far as Tongan providers are concerned, the demand is for tuna and bottom fish. Market segmentation relates to demand. Segmentation of operators relates largely to vessel size, with the larger

fishing vessels being generally owned by the fish exporting companies and the smaller fishing vessels being owned by individual fishermen.

At the national level, Tonga fisheries are dominated on the whole by the private sector. Four major companies export fish from Tonga. These are, however, segmented. The Sea Star Company, which is part owned by the Government, is mainly involved in tuna long line fishing. The 'Alatini and Maritime Fisheries and the Capricorn Company (which owns a long-liner fishing boat) mainly target bottom fish. While the price of snapper and yellow-fin tuna both increased from late 1990 to 2004, the relatively small volume of fish exports from Tonga has meant that the exporters have tended mainly to target individual seafood markets and restaurants overseas.

As demonstrated in *Chapter 4*, so far as the Tongan fish export sector is concerned, the major economic issue is financial return. The results of the analysis indicate that the size of the operators and the type of fish exported have an important bearing on financial returns. Thus, for example, exports of tuna to Australia by small operators provided the highest return at \$3.08/kg; small operators exporting bottom fish to Hawaii could expect a return of \$2.13/kg; medium sized operators exporting fish to Japan could expect a return of \$1.99/kg. Except in the case of Hawaii, medium sized operators exporting bottom fish were found to be operating at a loss and small operators exporting to Japan and Australia were also found to be operating at a loss. Except in the case of medium-sized operators exporting to Hawaii (which yielded a positive return), others - small-sized and medium-sized long-line exporters could be seen to be operating at a loss. The main factor affecting financial returns to fisher people was difference in the cost of air freight.

In conclusion, so far as the Tonga fish export market is concerned, the following important economic issues have been identified as those that need to be addressed bearing in mind the fact that Tonga's remoteness from its major overseas fish markets and international trading partners will always work against its competitiveness. First, the lack of additional air cargo space is a major constraint on fish exporting as is the fact that airline schedules/routes and aircraft types

change in ways that create difficulties for fish exporters. Second, government customs and ports and services charges such as the 0.5% fisheries export tax are such as to create a fiscal disincentive in the case of bottom fish and tuna long-lining exports. Furthermore, the cumbersome process exporters have to go through each time there is a shipment is neither efficient nor cost effective. Third, there is lack of proper understanding of the fishery industry. There is a fundamental difference between fishing and other primary production activities. Unlike the agriculture and tourism industries, the fisheries industry is not tied to a fixed location. Tuna stocks are highly mobile and so too are the vessels that hunt them. Therefore, it is important that fishermen should be able to unload their catch, refuel, and re-provision their vessels at ports far from their home base. Unless these critical issues are addressed, the fisheries export sector in Tonga is unlikely to realise its full economic potential, underpinning Tonga's aspirations in relation to economic growth.

9.2.2 Economic issues: Domestic fisheries

Domestic fishing, largely involving hand-line and night diving, is largely subsistence-related and provides employment for more than a third of Tonga's households. Since the community foreshore throughout Tonga is considered to be a common pool resource, over-exploitation is likely to be very common.

Only four per cent of households in Tonga earn income from fishing although subsistence fisheries contribute more than T\$12 million per year to the economy, something that highlights the importance of subsistence fishing, own caught fish being a critical part of the society's social safety net. As indicated in *Chapter 5*, the extent to which fish is included in the household diet relates to the age, income and educational level of the head of the household: the older, the higher the income and the higher the educational level of the head of the household, the greater is the likelihood that the household diet will include fish. An interesting further dimension to Tonga's domestic fishery is the extent to which it is impacted on by migration and overseas residency.

As part of the investigation of Tonga's domestic fisheries, a case study involving Pangaimotu, a typical fishery-dependent community, was conducted. In

Pangaimotu, as in many other areas of Tonga, mangroves play a significant role in domestic fisheries and more than seventy per cent of the population indicated that fishing was their main economic activity. In Pangaimotu, mangroves are a significant factor in the overall economic activities of the community: mangrove areas are used as fishing grounds, mangrove bark is used to make the dye used in tapa making, and mangrove swamp areas are cleared to make way for tourist development. To some extent, the community appears to understand the importance of protecting its mangroves so far as fishing sustainability is concerned, an indication of this being the community's decision that no more than five per cent of the mangroves should be used annually in tapa-making activities.

Mangroves provide a nursery for fish and a location where fish and shellfish are readily accessible to the community. They are, however, also important in relation to the other economic activities in which the community engages. Thus, studying the economic activities undertaken by the Pangaimotu community in Vava'u in relation to its mangrove areas provided an opportunity to better understand significant issues relating to domestic fishing in Pangaimotu and, by extension, also in other areas of Tonga. In connection with this, it is interesting to note the impact of the decision by the village '*fono*' that no more than five per cent per annum of the available mangrove areas should be harvested in relation to dye-making, a decision that indicates an appreciation of the need to protect an important natural resource.

Analysis of the potential return to labour indicated that reclaiming the mangroves for tourist development would provide the highest net financial benefit to the community, with *tapa* making yielding the next best return and fishing the lowest return. However, any decision about what economic activities or mix of economic activities is best for the community would need to take into account factors over and above immediate financial returns: every hectare of mangroves reclaimed for other purposes is a hectare of mangroves lost. In seeking to determine the sustainability of the mangroves in relation to the fishery needs of the community, an inter-sectoral economic model was designed. The analysis revealed that a maximum of four additional tourist resorts (of approximately the same size as the existing one) is all that the community can build.

Within the context of the inter-sectoral economic model, the focus was on two broad issues: (i) the impact of the tourism sector on fisheries and (ii) changes in labour allocation between the tourism and fisheries sectors. The model was designed to look at the interaction between tourism and fisheries and, in particular, at the impact on labour of different development scenarios. An assumption built into the model was that workers could choose between either of these two activities each month, the majority being likely to choose whichever activity was likely to yield higher income. Since there are no property rights assigned to mangrove areas in Pangaimotu, the best allocation of workers between tourism and fisheries would have to be based on the per capita benefit of each development activity. If, therefore, fishing yielded higher income, workers were likely to choose fishing, a choice which could lead to over-exploitation and possible extinction of the natural resource that sustains that particular development activity even though a more rational choice might be one that was calculated to maintain the mangrove ecosystem at a sustainable level. It is important, however, to bear in mind that the economic model was intended simply as a tool to assist in decision-making. In that it does not incorporate mangrove ecosystem sustainability measures, it cannot provide any definite answer to the community's economic dilemma (Grasso, 1998).

In terms of the economic analysis in *Chapter 7*, the Lemma suggests that care should be taken in analysing the economic impact of tourism. Conventional wisdom suggests that mangrove ecosystem sustainability is of paramount importance and that tourist development has an adverse effect on fisheries. However, the results of the inter-sectoral economic model are unclear in terms of the likely impact of different types of economic development on labour allocation. It is far from certain, in terms of the results, that increased tourism development activity would harm fisheries even though it would initially involve land reclamation and some reduction in the total mangrove area. The fact that the data is inconclusive indicates the need for a more nuanced interpretation of the concept of sustainable development and further analysis that includes detailed information about the precise impact of each hectare of mangrove loss on breeding and seafood supplies. If policy makers are to make decisions that impact on food

supply and that involves the structural transformation of economies, they will need to base these decisions on detailed understanding of ecosystems, understanding that will need to be built into their models.

The simulation model used in *Chapter 8* demonstrated that increasing the number of tourism resorts would have an effect on labour, involving the transfer of workers from one area (fishing) to another (tourism). This transfer of workers would be likely to be motivated by the desire to secure higher wages, a better standard of living, and, hence, better community infrastructure and social development. That is, labour migration from fishing to tourism could lead to enhancement of the standard of living of the community of Pangaimotu.

9.3 Weaknesses and limitations

All research has its weaknesses and this research project is no exception. Those weaknesses/ limitations of which I am currently aware are outlined below.

9.3.1 Process and procedure

In the case of the Pangaimotu community, sampling was influenced by a direct relationship with the Wesleyan church minister. This was useful in one respect but limiting in another. The interviews were held at the minister's residence where the workers from the village were involved in the construction of the village hall. Furthermore, the use of '*talanoa*' methodology restricted data collection to oral communication and, thus, to what could be recalled by the interviewees since there were no written records available at the village.

The Tonga Development Bank provided ready access to information. However, it was sometimes difficult to reconcile information available on exporters' files at the bank with the information provided during interviews.

9.3.2 Information and time frames

The changing nature of policies relating to the fisheries sector meant that information collected during the field survey in 2003 and 2004 may have changed by the time the thesis was compiled. Thus, for example, a decision in 2006 by the Tonga government to provide a subsidy to fishermen is not reflected in the

analysis of the Tonga fisheries exports sector although this policy provision does have implications for the actual cost structures of both production and marketing. Furthermore, the global context in which fisheries operate means that there are inevitably many factors affecting the fisheries sector that are beyond the control of the researcher.

9.3.3 Scope of the research

So far as domestic fishing is concerned, this study focused only on a single community in the Tonga outer islands. Although the case study of the Pangaimotu community has implications for similar communities, a comparative study involving both Pangaimotu and another similar fisheries-dependent community from the main island of Tongatapu would have yielded valuable insights. This was, however, not possible in terms of the time and resources available.

So far as fish exports are concerned, this study focused on marketing and production costs associated with Tonga's main overseas markets. However, there are other barriers to overseas trade, including, for example, the costs associated with attempts to break into new markets and maintain a presence in existing markets (both of which involve keeping up to date with competitor activities). Identifying further trade barriers would have provided a more accurate picture of the potential financial gains of Tonga's fish exporters.

9.4 Possibilities for future research

So far as domestic fisheries in Pangaimotu are concerned, it would be extremely valuable, in collaboration with someone with expertise in fish breeding, to conduct an analysis of the probable impact on fish stocks of reclaiming mangrove swamps to build four new tourist resorts in Pangaimotu.

A comparative study of rural fisheries-dependent communities in different parts of Tonga would add further insight into the Tonga domestic fisheries sector.

An examination of the in-kind cash payments in return for remittances could be an important consideration for the future.

A study of the possibility of compensating community for any future development, such as building another resort, will shed more light into the community's utilisation of its natural resource.

A more comprehensive study of Tonga's fisheries export sector, one that took account of the 'hidden' costs (including regulatory impositions placed on Tonga fish exporters by overseas markets) which constitute barriers to international trade between Tonga and its main fish markets overseas, would be of considerable value as would a study that looked at the implications of Tonga's membership of the WTO. This would provide a fuller picture of the economic issues affecting Tonga fish exports.

9.5 A final comment

The research design and modelling tools employed in this research project could be adapted and applied both to other sectors of the Tongan economy and to a range of sectors, including fishing, of other small island economies such as those of neighbouring countries of the South Pacific which share similar characteristics to Tonga.

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Appendix 1: Approval Letter - Tonga Cabinet

Ref: ORG 1/8 V8

8 September 2003

Mrs. Halahingano Rohorua
Economics Department
Waikato Management School
University of Waikato
Hamilton 2001
NEW ZEALAND

Dear Mrs. Halahingano

Re: Request for Permission to conduct Research in Tonga.

I have the pleasure in advising you that your application to conduct research in Tonga on 'the impact of barriers to trade on the export of fish from Tonga to its major export markets', has been approved by His Majesty's Cabinet on the 26th August, 2003.

Please be reminded that one of the conditions for approval of your request was to waive the research deposit fee & for you to provide the Prime Minister's Office with two(2) completed copies of your research findings free of charge. I hope you will be able to fulfil the above in due course.

May I take this opportunity to apologise for the long delay in responding to your request and should you require further information please do not hesitate to contact me.

Malo & good luck.

Yours sincerely

'Aleiteisi L Tangi(Mrs)

for Chief Secretary & Secretary to Cabinet

Appendix 2: Invitation letters – Tonga Government Ministries

*Economics Department
Waikato Management School
University of Waikato
Hamilton 2001
NEW ZEALAND
12th November, 2003*

*The Secretary
Ministry of Finance
Nuku'alofa,
TONGA
Fax # (676) 26011*

Dear Sir/Madam

Re: PhD research in International Trade - Economics

My name is Halahingano Rohorua. I am a Tongan national currently enrolled as a PhD candidate in the Economics Department of the University of Waikato.

I am writing to seek your assistance on the above subject matter.

After working for almost five years with the Tonga Development Bank I recognise the great opportunity that fisheries will provide for Tonga. My thesis therefore attempts to address 'the impact of barriers to trade on the fish export sector of Tonga.' I believe the study is crucial at this point in time for Tonga since the implications of the study will enable policy makers to be fully aware of the benefits/costs of Tonga's accession to the WTO. Tonga, as a small island economy, must be able to reap the full benefits of trade liberalisation.

I expect that this exercise will demand a lot of dedication and commitment but I believe that the time and relevance of the study for the country, your Ministry and me personally will be a worthwhile endeavour.

The Cabinet on its meeting of 28th August granted approval for this research to be carried out in Tonga.

I would therefore wish to request your kind permission to allow me to be able to obtain information available at your Ministry to assist the research. I expect this research will eventually result in the formulation of a trade-sector model that could become a useful tool for your Ministry in its analysis of sectoral performance in the export market but especially with the increasing debate over trade liberalisation.

*I will be in Tonga from 24th November - 12th December 2003, hence wish to request for an appointment on **Friday 28th** to discuss this further at a time that will be suitable to you or any of your staff.*

*Attached is an **Information Sheet** for the research. Your indication of time available for appointment will be very useful in finalising my schedule for the trip.*

It is my earnest and sincere hope that the professional and academic intentions behind the exercise have been clearly stated.

In closing, I wish also to take this opportunity to express my gratitude and appreciation of your time and consideration of my humble request, and look forward to your kind response on the matter in due course.

Yours sincerely,

.....
*Halahingano Rohorua
PhD Student Researcher
Fax: 647 838 4087
Email: hala@waikato.ac.nz*

*Cc ; Director of Education, Ministry of Education, Nuku'alofa, TONGA Fax # (676) 23866
The Secretary to Cabinet, Prime Minister's Office, Nuku'alofa, TONGA
The Secretary, Ministry of Fisheries, Nuku'alofa, TONGA Fax # (676) 23891
The Secretary, Ministry of Foreign Affairs, Nuku'alofa, TONGA Fax # (676) 23360
The Secretary, Ministry of Labour, Commerce and Trade, Nuku'alofa, TONGA Fax # (676) 23887
The Secretary, Ministry of Land and Survey, Nuku'alofa, TONGA Fax # (676) 23216
Governor, National Reserve Bank of Tonga, Private Bag No. 25, Nuku'alofa, TONGA Fax #
(676) 24201
General Manager, Tonga Development Bank, Nuku'alofa, TONGA
The Government Statistician, Statistics Department, Nuku'alofa, TONGA Fax # (676)
24303/21010*

Information Sheet for Participants

1. **Title of Project:** The impact of barriers to trade on fish export sector of Tonga

2. **Researcher(s) name and contact information:** Halahingano T. Rohorua, Economics Department (PhD Student), Waikato Management School, University of Waikato, Hamilton, New Zealand. Phone (647) 838 4466 ext 6278; Fax (647) 838 4087; Email: hala@waikato.ac.nz

3. **Chief Supervisor's name and contact information:** Dr Steven Lim, Economics Department, Waikato Management School, University of Waikato, Hamilton, New Zealand. Phone (647) 838 4315; Fax (647) 838 4331; Email: SLIM1@waikato.ac.nz

4. Brief Outline of the Research Project

The research is basically to examine the impact of barriers to trade (tariffs and non-tariffs) to the flow of fish export from Tonga to its main markets namely Hawaii, Japan, Australia and New Zealand.

5. Company or Organisation sponsoring or funding the research:

Presently none.

6. Confidentiality and anonymity:

Participants are assured of their confidentiality and anonymity. Participants will not be identified in any publication or dissemination of the research findings without their explicit consent. Participants will be further verbally assured that they will remain anonymous if they wish and that, therefore, neither their names nor any material through which they may be identified indirectly, will appear.

7. Participants right:

If you take part in the study you have the right among other things to

a) refuse to answer any particular question, and withdraw from the study at any time.

a) ask any further questions about the study, which occur during participation.

c) be given access to a summary of the findings from the study when it is concluded if requested.

8. Information collected.

You can be assured that I will only follow whatever you agreed to. The information supplied will be stored securely to ensure continued confidentiality.

Please indicate below time available for appointment and either fax or email it back to me to assist with final arrangements for this trip:

Date Available and Time: _____

Other Comments : _____

THE UNIVERSITY OF WAIKATO
Waikato Management School

Consent Form for Participants

Project Title: The impact of barriers to trade on the fish export sector of Tonga

I have read the **Outline of Research Project** form for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study at any time, or to decline to answer any particular questions in the study. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Information Sheet**.

I agree to participate in this study under the conditions set out in the **Outline of Research Project** form.

Signed: _____

Name: _____

Date: _____

Appendix 3: Fieldwork Report First visit & Schedule

First Field Visit Report : 23rd November – 13th December 2003

Main Summary

- The Fishing Industry was at a downturn during the time of the visit. The main reason is the effect of El Nino. Fish tend to move up North, hence operators were forced to tie up their boats and look for other options.
- Impact of fuel subsidy was welcome news for the fishermen especially at a time when the industry is at the crossroads.
- Main exporters raised concern over government policies in the industry which seem to take a long time in implementing, hence delay sometimes forced these operators to tie up their boats and experienced fishermen are out of jobs
- Tuna long-line Industry is close to non-existence. There are 34 tuna long line licences and only 5 are still operating full time and 6 part time. Main contributing factors to the failure of the industry include high import duties; high costs of production; high air freight, inadequate infrastructure and excessive administrative procedures especially with the fuel concession.
- Main exporter of tuna will be closing down. Deletion of stock and high overhead costs are the main reasons
- Incentives given to the fishing industry include Development licences and tax-free imports of fishing gear and equipment. Industry though, still has concerns about port and service fees.
- Discrepancies in reported data are also a concern. Government had set up a committee to oversee this. The conditions laid down for the fuel subsidy also meant that exporters and fishing operators now provide a more accurate data on fish catch etc.
- Freight cost and space is still a major concern for exporters.
- Government had no clear policy on alternative methods of gaining extra revenue to compensate for the fuel subsidy.
- Fishermen in Vava'u have a different perception of fishing as a 'business' to those on the main island. The incentive of 75% funding assistance provided through the 'Waka Project' saw an increase in fishing boats, yet not in the catch of fish.

- Game fishing is increasingly becoming an important business for Tonga especially in Vava'u. There are currently four registered game fishing operators. In 2002 thirty five thousand visitors were in Tonga mainly from New Zealand and Australia for game fishing. Future prospect is good.

○ **Field Visit Schedule : 23rd November – 13th December 2003**

Date Time	Venue	Who?
23/11 9:45pm	Depart Auckland Airport	Flight Number NZ47
Week One		
Mon 24/11 10am	Statistics Department	Mrs Seini Filiai -Government Statistician
Mon 24/11 2pm	Prime Minister's Office	Ms 'Aleiteisi Tangi – Acting Secretary to Cabinet Ms Fanau'ifo'ou 'Akau'ola – Deputy Secretary – Public Service Commission
Tues 25/11 10am	Tonga Development Bank	Mr Afu'alo Matoto-Managing Director Mr Simione Sefanaia –Deputy Managing Director – Operations Ms M Piutau – Manager-Planning Marketing and Research
Tuesday 25/11 pm	Tonga Development Bank	Library – selected reports and publications
Wed 26/11 9 am	Ministry of Labour, Commerce & Trade	Ms Vika Fusimalohi – Deputy Secretary
Wed 26/7 2 pm	Ministry of Labour, Commerce & Trade	Ms Samentha Newton – WTO Consultant
Thur 27/11	Ministry of Finance	Ms Kilisitina Tuamei'api – Senior Economist Ms 'Ofa Ketu'u – Deputy Secretary

11am		
Thur 27/11 2pm	Ministry of Fisheries	Ms 'Apisake Makasini – Acting Secretary Mr Samisoni Naupoto -Senior Economist Mr Vilimo Fakalolo – Principal Fisheries Officer Ms Lupe Falalelu _ Data Input Division Ms 'Emeline Tupou – Librarian Mr 'Anitimoni Petelo - Principal Fisheries Officer Mr Tevita Finau Latu - Senior Fisheries Officer
Frid 28/11 9am	Tonga Development Bank	Lending Section – Files on Fisheries ; Squash; Tourism and Macro Data on Tonga
Frid 28/11 2pm	Ministry of Foreign Affairs	Mr Tevita Tupou – Senior Assistant Secretary
Saturday 29/11	Main Fish Market	Observation of sales and processes involved

Field Visit Schedule : 23rd November – 13th December 2003

Week	Venue	Who?
Two		
Mon 1/12 am	Tonga Development Bank	Research Division – Look at Bank's Operation papers – Review of major Fisheries Projects
Monday 1/12 pm	University of the South Pacific - Centre Library	Ms Salote Fukofuka – Director Ms Losaline Kamitoni – Librarian Ms Taumafa Kaloni - Librarian
Tues 2/12	Department of Environment	Mr Sione Tukia Lepa – Assistant Conservation Officer Mr Fine Lao – Conservation Officer Ms Suliana Vi – Assistant Secretary
Wed 3/12	Customs Department	Mr Sione Likiliki – Collector of Customs
Thur 4/12	Public Holiday Nukuleka/Talafo'ou	Meet Town Officer – asked for assistance with identifying fisher-people in the area that will be willing to participant in the interview schedule for the second field visit. Identified two fisher-men who would be willing to accompany/assist the Researcher in carrying out the interview for the second field visit (Mr Taniela Po'uli and Mr Hauati Anga'aetau).
Fri 5/12 11am	Off to Vava'u Tonga Development Bank – Vava'u Branch	Flight Number WR803 Mr Sitino Maka – Branch Manager
Saturday 6/12	Pangaimotu Village	Meet Town Officer and Minister of Free Wesleyan Church – Tour island and identified fisher people to participate in second field visit. Identified two fisher-men who are willing to

		accompany/assist the Researcher in carrying out the interview for the second field visit (Mr Kali Foliaki and Mr Tupou Nau)
Sunday 7/12	Pangaimotu Village	Attend Services at FWC Pangaimotu

Field Visit Schedule ; 23rd November – 13th December 2003

Week	Venue	Who?
Week Three		
Mon 8/12 am	TDB Vava'u	Review 15 files on TDB waka project – these were fishing boats project assisted by the Bank (Subsidised by the Tonga Government –75% funded by the Government and 25% borrowed by owner from TDB) Look at file for Main Fish exporter from Vava'u
Mon 8/12 pm	Ministry of Fisheries 'Alatini Fisheries Whale Watching & game fishing	Ms Silika Ngahe – Manager Vava'u Branch Exporter of fish from Vava'u to Tongatapu Collect pamphlets and publications from these operators – Main tourist attraction to the Island
Tues 9/12 10am	To return from Vava'u to Tongatapu	Fight Number WR804
Tues 9/12 pm	Tonga Development Bank – Main Office	Ms Leta Havea Kami – Manager – Lending Operation
Wed 10/12 10am	Maritime Project Tonga Limited	Mr Lennie Nitt – Managing Director
Wed 10/12 2pm	Central Planning Department	Ms Polouini Fakava – Deputy Director Ms Lusitania Latu – Senior Economist

Thur 11/12 am	‘Alatini Fisheries	Mr Bill Holden – Managing Director
Thursday 11/12 pm	‘Uta‘atu & Associated	Mr Shalendar Kumar – Senior Accountant This Company collates fishing statistics from main exporters in Tonga and so provide a quarterly report on the performance of the Industry to interested parties.
Fri 12/12 10 am	Sea Star Fishing Co. Ltd	Ms Naitilima Tupou – Personal Assistant to Managing Director
Saturday 13/12 11am	Return back to NZ	Flight Number NZ63

Appendix 4: First Fieldworks - Detailed Schedule

Field Visit 1 – End November to Mid December 2003

1. ***To meet the following Government Ministries including the Tonga Development Bank. Semi structured Interviews will be used here:*** I wish to include questions relating to the following:

Most of information sought from the Government Ministries will be on published reports and documents that are readily available to the public.

Ministry of Education Introduce study and seek permission for access to research facilities.

Ministry of Finance Look at government policy on tariffs overall especially to identify major changes in tariff structure since conversion to Harmonised System (requirement for application to be a member of WTO).

Identify specific policies in the fisheries sector
Data on revenue generated from tariffs and fisheries specifically.

National Reserve Bank of Tonga Look at macro data for the country and fisheries specifically (GDP, Real exchange rate, trade etc.).

Statistics Department Data on latest household survey

Data on trade and fisheries specifically

Data on Squash and Tourism performances.

Ministry of Trade and Commerce Policies on trade
Price of fisheries domestically and export markets

Policies on import/export of fish regarding tariffs and non-tariffs (not only from Tonga but also at export markets – NZ, Australia, Japan and USA).

Ministry of Fisheries	Policies on Fisheries – inshore and also off-shore Data on fisheries especially with fuel subsidy Data on license holders specifically on fisheries.
Tonga Development Bank	Data on fisheries sector performances. Data on Costs – production, marketing and freight requirements. Data on revenue fisher-people received from sale of fish – as exporter and also as small operators. Data on Squash/Tourism as alternative firms for reclaiming mangrove area for development.
Ministry of Land	Identify issues/policies related to land especially with mangroves.

2. **To meet Fish Exporters:**

Semi-structured Interviews will be used on the following:

To Fish exporters:

- Historical data that might be available from exporters' annual reports. This is also available from Trade Statistics reports and Ministry of Fisheries Annual Reports.
- Identify barriers to fish export from the point of view of fish exporters.
- Problems encountered so far.
- Operation of the business.
- Perspective of changes to the sector when Tonga will become a member of WTO.

Please note:

- There are currently only four exporters of fish from Tonga.
- Target Export markets are segmented depending on the type of fish each company export.
- It will be make clear to these companies that information collected during this research will be for the industry as a whole – there will be no specific reference to company's name or performance and confidentiality of information shared will be adhered to. This is again spelt out in the Consent Form for Participants and also Information Sheet for Participants.

3. **To identify a mangrove-fisheries dependent community**-This will be a pilot survey with the intension to return to the field in February 2004 to carry out this interviews and data collection.

Based on information provided from the Government Ministries and the Tonga Development Bank it will be necessary to identify the above community.

- Need to approach the town officer of the community for his consent to the research.
- Need to collect information already available from the proposed area for the study – include number of households, main income etc. (Published reports available from Statistics Department)
- Need to identify sample and approach them for consent to be part of the study.
- Need to confirm whether tourism or squash will be used as the sector justifying the reclamation of mangrove area (i.e. as development alternatives).

Field Visit 2 – February 2004

Survey of fisheries community identified during first visit.

Appendix 5: Invitation letters – Tonga Fish Exporters

Economics Department
Waikato Management School
University of Waikato
Hamilton 2001
NEW ZEALAND
12th November, 2003

Mr Lennie Nitt
General Manager
Maritime Project Tonga Ltd
PO Box 560
Nuku'alofa,
TONGA
Fax # (676) 23955

Dear Sir

Re: PhD research in International Trade - Economics

My name is Halahingano Rohorua. I am a Tongan national currently enrolled as a PhD candidate in the Economics Department of the University of Waikato.

I am writing to seek your assistance on the above subject matter.

After working for almost five years with the Tonga Development Bank I recognise the great opportunity that fisheries will provide for Tonga. My thesis therefore attempts to address 'the impact of barriers to trade on the fish export sector of Tonga.' I believe the study is crucial at this point in time for Tonga since the implications of the study will enable policy makers to be fully aware of the benefits/costs of Tonga's accession to the WTO. Tonga, as a small island economy, must be able to reap the full benefits of trade liberalisation.

I expect that this exercise will demand a lot of dedication and commitment but I believe that the time and relevance of the study for the country, your company and me personally will be a worthwhile endeavour.

The Cabinet on its meeting of 28th August granted approval for this research to be carried out in Tonga.

I would therefore wish to request your kind permission to allow me to be able to obtain information available at your company to assist the research. I expect this research will eventually result in the formulation of a trade-sector model that could become a useful tool for your Ministry in its analysis of sectoral performance in the export market but especially with the increasing debate over trade liberalisation.

I will be in Tonga from 24th November - 12th December 2003, hence wish to request for an appointment on **Friday 28th** to discuss this further at a time that will be suitable to you or any of your staff.

Attached is an **Information Sheet** for the research. Your indication of time available for appointment will be very useful in finalising my schedule for the trip.

It is my earnest and sincere hope that the professional and academic intentions behind the exercise have been clearly stated.

In closing, I wish also to take this opportunity to express my gratitude and appreciation of your time and consideration of my humble request, and look forward to your kind response on the matter in due course.

Yours sincerely,

.....
*Halahingano Rohorua
PhD Student Researcher
Fax: 647 838 4087
Email: hala@waikato.ac.nz*

*Cc ; General Manger, 'Alatini Fisheries Export Co. Ltd, Po Box 49, Nuku'alofa, Tonga Fax # (676) 23759
General Manager, Sea Star Fishing Co Ltd, Po Box 2291, Nuku'alofa, Tonga. Fax # (676) 24779
Senior Accountant, 'Uta'atu and Associates, Po Box 1573, Nuku'alofa, Tonga Fax # (676) 23815*

Appendix 6: Fisheries Dependent Communities: Semi-structured Interviews (English)

This questionnaire forms the basis of the second field work (1st Feb to 21st Feb 2004).

The second stage of the fieldwork is targeted mainly at fisheries-dependent communities. The communities selected were identified during the first field visit. The initial plan was for one community only, but after the first visit, the Researcher saw it necessary to include a fisheries dependent community from the Outer islands as well, as that will provide another dimension to the robustness of the data.

The communities selected were identified using the household survey carried out by the Tonga Government in its Agriculture Census in 2001. The Ministry of Fisheries also assisted in the identification process.

Nukuleka/Talafo'ou was selected from the main island, Tongatapu, and Pangaimotu was selected from Vava'u, the second major island in Tonga. These communities were selected on the basis that not only do fisheries activities form a major part of their everyday lives, but mangroves also form an important part of the fisheries ecosystem.

Background information on the above communities was collected during the first visit, which justifies their selection for the study.

Thirty five (35) households from Pangaimotu have confirmed their willingness to participate in the second fieldwork and the town officer of Nukuleka/Talafo'ou was already approached and is collecting names of fisher-people from these communities who will be willing to also participate in the survey questionnaire.

The first field visit was completed from 23rd Nov to 13th December.. The first visit was especially targeted at Government Departments, Supporting institutions such as Banks and Fish exporters.

19. How big is your boat?
20. If you have an engine(s), how big is (are) the engine(s)?
21. How did you get the money to buy the boat and engine?
22. How much does it cost to maintain your boat and engine and fishing gear per year?
23. Give an estimate of the cost for each fishing trip?
24. Give an estimate of average catch per week?
25. Who do you sell your fish to? – Consumers; middlemen or others
26. How much of weekly catch:
 - i. is for export?
 - ii. Local market
 - iii. Home consumption
 - iv. Others
27. List some of the problems/difficulties that affect your fishing activities?
28. List some of the things/ways that can help improve the fishing?
29. How much is your family income per week?
30. What is your family's main source of income?
31. At what stage will you give up fishing in order to do other things?
32. What other alternative can you opt for apart from fishing?
33. Any changes you've seen in the mangroves surrounding your area?
34. What alternative activity would be appropriate if there was a decision to clear some of the mangrove area?
35. Has there been any reclamation done to the mangrove area in this place?
36. Any other comments you wish to add.

*Appendix 7 Fisheries Dependent Communities: Semi-structured Interviews
(Tongan language)*

Savea fekau'aki moe toutai 'i Tonga

Savea fakapulipuli

'Oku taumu'a 'ae savea ko eni ke fai hano vakai'i 'a e mahu'inga 'o e toutai ki he mo'ui moe tu'unga faka 'ekonomika 'ae kolo pe komuniti 'oku ke kau ki ai.

Koe savea ni koe konga ia 'o ha fekumi fakaako 'i he mala'e 'o e 'Ekonomika, 'a ia 'oku lolotonga fakahoko 'i he Univesiti 'o Waikato, 'i Nu'usila.

Ko ho'o tali 'e tauhi fakapulipuli pea 'e 'ikai ke ngaue'aki ha hingoa ke fakamatala'i'aki 'a e savea ni.

'E fu'u matu'aki hounga 'aupito ho'o kau mai ki he savea ni

Ngaahi fehu'i

1. Hingoa:
a. Fefine/tangata
2. Tokolahi e memipa ho famili:
3. Koe ha ho'o tefito'i ngaue?(ma'u'anga mo'ui ho famili)
4. Koe ha e fuoloa ho'o fai e toutai?
5. Koe ha ngaahi naunau toutai 'o ku ma'u?
6. Koe ha e fa'ahinga toutai 'oku ke fai?
7. 'Oku ke toutai toktaha pe 'oku ke kaunga toutai mo ha ni'ihiki kehe?
8. 'Oku tu'o fiha nai ho'o 'alu 'o toutai he uike? Mahina etc
9. Koe fe taimi 'oku ke toutai ai? 'Aho pe po'uli
10. Koe ha e loloa e taimi 'oku ke fa'a fai ai ho'o toutai?
11. Ko fe 'ae tefito'i potu tahi 'oku ke toutai ai?

12. Kuo ke fakatokanga'i nai ha liliu he potu tahi 'oku ke fa'a toutai ai. Koe ha nai hono 'uhinga?
13. Fefe 'ae lalahi 'o e fingota/ika 'oku ke toutai'i. Kuo 'iai nai ha liliu kuo ke fakatokanga'i.
14. Fefe 'a e totongi 'o e ika – kuo 'i ai nai ha liliu – ma'ama'a pe mamafaange – koe ha e lahi e hiki?
15. Fefe e lahi ho'o toutai – kuo 'iai ha liliu 'i he lahi 'o e ika/fingota kuo ke touta'i?
16. 'Oku 'i ai nai ha liliu 'i he lahi e pa'anga 'oku ke ma'u mei he toutai? Koe ha nai hono lahi?
17. Koe ha me'a kuo ke fai ke fakalahi ai e pa'anga 'oku ke ma'u mei ho'o toutai?
18. 'Oku 'iai hao vaka toutai?
19. Kapau 'oku 'Io – na'e fakatau ho vaka 'anefe?
20. 'Oku fute e fiha ho vaka?
21. 'Oku 'iai mo ha'o misini vaka, 'Oku hoosipaoa 'e fiha?
22. Na'e fakapa'anga fefe 'ae fakatau ho vaka mo e misini?
23. Koe ha e lahi ho'o fakamole ki hono monomono e vaka moe misini?
24. Koe ha nai ha'o fakafuofua ki ho'o fakamole ki he taimi kotoa pe 'oku ke 'alu ai 'o toutai?
25. Koe ha nai e lahi ho'o toutai he uike?
26. Ko hai 'oku ke fakatau ki ai ho'o toutai?
27. Koe ha e lahi ho'o toutai he uike 'oku
 - i. Fakatau atu ki muli
 - ii. Fakatau fakalotofonua?
 - iii. Fiema'u 'ae famili
 - iv. Fiema'u kehe

28. 'Oku 'iai nai ha ngaahi palopalema ;oku ke fehangahangai mo ia talu ho'o fai e toutai?

29. Koe ha nai ha ngaahi founa ke fakasi'isi'i pe solova ai e ngaahi palopalema ni?

30. Koe ha nai e lahi e pa'anag humai fakalukufua ho famili ki he uike?

31. Koe ha e tefito'i mau'anga pa'anga ho famili?

32. Koe ha nai ha fa'ahinga tukunga te ke loto ai ke tuku e toutai kae fai ha fa'ahinga ngaue 'e taha?

33. Koe ha nai e fa'ahinga ngaue ko ia?

34. Kuo 'iai nai ha ngaahi lilo 'i he tu'unga 'oe tongo he matatahi?

35. Kuo fai nai hano ta e tongo koe'uhi ko ha fa'ahinga ngaue pe langa fakalalakaka?

36. Ko e ha nai ha fa'ahinga ngaue a ngali fe'unga ai ke ta e tongo he matatahi?

37. 'Oku to 'iai nai mo ha me'a 'oku fie lave kiai e ala 'aonga ki he savea ni.

Malo 'aupito ho'o fakakakato 'a e savea ni. 'Oku hounga 'aupito ho'o lototoo ke foaki mai ho taimi mo ho'o ngaahi fakakaukau ke lava e ki'i savea 'oku fai ni.

Faka'apa'apa atu

.....

Halahingano Rohorua

Appendix 8: Hinakauea Tourism Development (English)

Confidential

1. Name: Age female/male Place

2. What is the total land area occupied by Hinakauea beach resort?

3. Was there mangrove in this area before the business start?

4. If yes to (3) how many hectares?

5. What kind of business that is currently operate from Hinakauea?

6. Provide a brief history of the establishment of this resort.
 - a. When was is started?

 - b. What was the initial plan/ purpose?

 - c. How much was the total cost of the project?

 - d. How did you fund this project?

 - e. How many people are currently employed ?

 - f. Provide a detail of cot of running/operation of the resort?

 - g. How much does it cost to visit/stay here ?

 - h. Provide estimate of total number of visitors to the resort for a year

 - i. Is there peak and off peak season?

 - j. Provide an estimate of number of visitors by month?
 - January;
 - February..... ;
 - March
 - April.....
 - May.....
 - June.....
 - July.....
 - August.....
 - September.....
 - October.....

November.....

December.....

7. Any changes to the place/environment since business start.
8. Compare to when it start is there change in the number of visitors ?
9. How much is the change – by how many?
10. How about the change in revenue/income for the business – by how much has it change?
11. What do you think is the main cause of the change?
12. Any future plan for the resort .
13. Any further comments

Appendix 9: Hinakauea Tourism Development (Tongan language)

Savea fekau'aki moe toutai 'i Tonga

Savea fakapulipuli

'Oku taumu'a 'ae savea ko eni ke fai hano vakai'i 'a e mahu'inga 'o e toutai ki he mo'ui moe tu'unga faka 'ekonomika 'ae kolo pe komuniti 'oku ke kau ki ai.

Koe'uhi koe mahu'inga 'o e matatahi ki he toutai 'i Pangaimotu ni, 'oku faka'amu ai ke tanaki ha ngaahi fakamatala fakaikiiki mei ho'o taukei/'ilo ki he ngaue 'oku ke fai 'i he matatahi ko Hinakauea ki he ki'i fakatotolo ni.

Koe savea ni koe kongia ia 'o ha fekumi fakaako 'a Halahingano 'i he mala'e 'o e 'Ekonomika, 'a ia 'oku lolotonga fakahoko 'i he Univesiti 'o Waikato, 'i Nu'usila. Ko ho'o tali 'e tauhi fakapulipuli pea 'e 'ikai ke ngaue'aki ha hingoa ke fakamatala'i'aki 'a e savea ni.

'E fu'u matu'aki hounga 'aupito ho'o kau mai ki he savea ni.

Ngaahi fehu'i

1. Hingoa: Ta'u motu'a
 - a. Fefine/tangata Feitu'u
2. Ko e ha e lahi e kelekele 'oku ngaue'aki 'e he matatahi Hinakauea?
3. Na'e 'iai nai ha tongo he matatahi ni ki mu'a pea toki fai hono langa ke ngaue'aki ki he talitali e kau tour?
4. Kapau 'oku tali 'Io ki he fika (3) koe ha nai hano lahi e 'elia na'e kapui 'e he tongo?
5. Koe ha e fa'ahinga ngaue/pisinisi 'oku fakalele he matatahi ko Hinakauea?
6. Faiange mu'a ha'o fakamatala ki he hisitolia 'o hono kamata mai e matatahi ni.
 - Na'e kamata 'ane fe?
 - Koe ha nai e taumu'a na'e langa ai e matatahi ni?
 - Koe ha e lahi fakapa'anga na'e fakamole ki hono langa/kamata e matatahi?

- Na'e ma'u nai mei fe e pa'anga ki he langa fakalalakaka ni?
 - Koe ha e tokolahi e kakai kuo fakangaue'i he matatahi ni?
 - Ko e ha e ngaahi naunau/fale 'oku ngaue'aki he matatahi – Fale nofo totongi 'e fiha – loki fiha? Fale fai'anga fakafiefia – moe ma'u me'atokoni?
 - Faka'avalisi koe ha e totongi ki ha tokotaha te ne fiengaue'aki e matatahi –
 - Koe ha e totongi ki ha fale/loki ke malolo ai?
 - Koe ha ha totongi kapau koe kau tour pe ke ma'u me'atokoni mo mamata he ngaahi fakafiefia 'o e matatahi?
 - Faka'avalisi ki he ta'u koe ha nai ha tokolahi e kakai kuo nau 'ahia e matatahi ni?
 - 'Oku faka-taimi e manakoa/tokolahi e kau tour 'e ala 'a'ahi mai ki he matatahi?
 - Katakai kae 'omi pe ha fakafuofua ki ha tokolahi e kau tour te nau 'a'ahi ki he matatahi Hinakauea he mahina kotoa?
 - Sanuali Koe toko
 - Fepueli koe toko ;
 - Ma'asi koe toko
 - 'Epeleli.....
 - Me.....
 - Sune.....
 - Siulai.....
 - Aokosi.....
 - Sepitema.....
 - 'Okatopa.....
 - Novema.....
 - Tisema.....
7. Faiange mu'a ha fakamatala nounou ki he liliu kuo ke fakatokanga'i he matatahi ni talu hono kamata mai.
8. 'Oku tokolahiang e kau tour he taimi ni fakatatau ki hono kamata mai?
9. Na'e toko fiha he taimi na'e kamata ai 'o fakatatau ki he taimi lolotonga ni?

10. Kapau 'oku liliu e lahi e pa'anga 'oku ma'u – Na'e fa'a fiha e pa'anga na'e ma'u he taimi na'e kamata mai ai fakatatau ki he taimi ni – koe pa'anga pe 'e fiha 'oku ma'u?

11. Koe ha nai e tefito'i 'uhinga ki he liliu kuo hoko?

12. Ko e ha ha'o palani ki he kaha'u ma'ae matatahi ko Hinakauea? Fai pe ha fakamatala nounou.

13. 'Oku toe 'iai nai mo ha me'a 'oku fie lave kiai e ala 'aonga ki he savea ni.

Malo 'aupito ho'o fakakakato 'a e savea ni. 'Oku hounga 'aupito ho'o lototoo ke foaki mai ho taimi mo ho'o ngaahi fakakaukau ke lava e ki'i savea 'oku fai ni.

Faka'apa'apa atu

.....
Halahingano Rohorua

Appendix 10: Second Field visit Report

Second Field Visit Report : 1st February – 21st February 2004

Main Summary

The second field visit was mainly to conduct an intensive interview of mangrove-fisheries dependent communities identified during the first visit.

- Three days were spent in Tongatapu to finalise questionnaires and printing of materials.
- A detail cost of production of ‘tongo’ a traditional dye from mangrove mainly for tapa making in Tonga was also carried out.

- Eight days were spending with the community in the Outer Islands of Pangaimotu Vava‘u.

The following activities were carried out:

- Interview
- Observation of mangrove
- Measurement and data collection on mangrove areas
- Information on Hinakauea Beach Resort (An alternative development)
- Visit Governor’s office for map work required.

- The remaining ten days were spending in the main island of Tongatapu to interview fisheries community in Talafo’ou/Nukuleka area.

The following activities were carried out:

- Interview
- Observation of mangrove
- Measurement and data collection on mangrove areas
- Information on Squash development (An alternative development)
- Meet Secretary for the Ministry of Land and Survey – map work required.

Appendix 11: Letter of Support - Fiji Field work: Tonga Ministry of Foreign Affairs

11th December 2003



*Ministry of Foreign Affairs
Nuku'alofa*

To whom this may concern

Subject: Mrs Halahingano Rohorua

We are to hereby confirm that Mr Rohorua has received Cabinet approval to conduct a research paper in Tonga on the "Impact of Barriers to Trade on the Fish Export Sector of Tonga".

This is a very important study to the development of Tonga and indeed other Pacific Island countries, which share similar traits.

We understand that Mrs Rohorua will be seeking assistance with regards the provision of appropriate information and data from Pacific Island regional organisations (such as the Forum Secretariat, South Pacific Commission, University of the South Pacific, Forum Fisheries Agency and South Pacific Trade Office).

We therefore would be grateful for your assistance with regards the provision of this information and any further assistance rendered on our behalf to ensure the successful completion of her research project.

Should you need further information on the above please do not hesitate to contact the undersigned.

Yours sincerely

A handwritten signature in black ink, appearing to be 'T Tupou'.

T Tupou
For Secretary of Foreign Affairs



Appendix 12: Invitation letters - Fiji Field work

Economics Department
Waikato Management School
University of Waikato
Hamilton 2001
NEW ZEALAND
5th November, 2004

The Secretary General
Forum Secretariat
Private Mail Bag
Suva
FIJI
Fax # (+679) 3301 102

Dear Sir

Re: PhD research in International Trade - Economics

My name is Halahingano Rohorua. I am a Tongan national currently enrolled as a PhD candidate in the Economics Department of the University of Waikato.

I am writing to seek your assistance on the above subject matter.

My thesis therefore attempts to address 'Issues on Fisheries in a small island economy specially the impact of barriers to trade on the fish export sector of Tonga and concept of sustainability on inshore fisheries.' I believe the study is crucial at this point in time for Tonga since the implications of the study will enable policy makers to be fully aware of the benefits/costs of Tonga's accession to the WTO. Tonga, as a small island economy, must be able to reap the full benefits of trade liberalisation.

I expect that this exercise will demand a lot of dedication and commitment but I believe that the time and relevance of the study for the country, your organisation and me personally will be a worthwhile endeavour.

The Tonga Cabinet on its meeting of 28th August granted approval for this research to be carried out in Tonga. A letter of support from the Ministry of Foreign Affairs in Tonga is also attached.

I would therefore wish to request your kind permission to allow me to be able to obtain information available at your organisation to assist the research. I expect this research will eventually result in the formulation of a trade-sector model and an optimisation model for sustainable use on inshore fisheries that could become a useful tool for your organisation in its analysis of sectoral performance in the export market but especially with the increasing debate over trade liberalisation.

I will be in Fiji from 30th November - 9th December 2004, hence wish to request for an appointment to discuss this further at a time that will be suitable to you or any of your staff.

Attached is an **Information Sheet** for the research. Your indication of time available for appointment will be very useful in finalising my schedule for the trip.

It is my earnest and sincere hope that the professional and academic intentions behind the exercise have been clearly stated.

In closing, I wish also to take this opportunity to express my gratitude and appreciation of your time and consideration of my humble request, and look forward to your kind response on the matter in due course.

Yours sincerely,

.....
*Halahingano Rohorua
PhD Student Researcher
Fax: 674 838 4087
Email: hala@waikato.ac.nz*

*CC : The General Secretary, The Secretariat of the Pacific Community, Suva Regional Office, FIJI
Fax # (679) 3370021
Dr Tim Adam, Director Coastal Fisheries Resource, SPC, Suva Regional Office, Suva, Fiji Fax #
(679)3370021
Dr Timothy Pickering, Acting Director, Institute of Marine Resources, USP, Suva, FIJI
Fax (679) 3309494
Professor Kanayathu Koshy, Director-Pacific Centre for Environment & Sustainability
Development (PACE-SD), USP, Fax #: (679) 3232891
Head of Economic Department, USP, Suva, Fiji Fax # (679) 3232522
Director, Institute of Management and Pacific Development, USP, Suva, Fiji Fax # (679) 3232165*

Appendix 13: Thank You letters - Tonga Field work

*The Secretary and General Surveyor
Ministry of Lands, Survey and Natural Resources
Nuku'alofa,
TONGA*

Dear Sir

Re: Thank you

This is to respectfully express our sincere gratitude to both you and your staff for the valuable support and assistance rendered to us during our visit to Tonga. The support provided allowed us to complete this visit successfully.

Thank you once again and best wishes to you and all your staff.

Sincere regards,

*Halahingano Rohorua.
PhD Student Researcher*

Appendix 14: Thank You letters - Fiji Field work

20th December, 2004

*The Secretary-General
The Forum Secretariat
Suva
FIJI
Fax # 679 312226*

Dear Sir

Re: PhD research in International Trade - Economics

This is to respectfully express my sincere gratitude to your organisation for the invaluable support and assistance rendered to me in providing valuable information to assist in my field research in Suva recently.

A special word thanks goes to Ms Gail Olsson and Mr Theodore Yasause from the Trade and Investment Division for their time and valuable contribution. And a very 'big vinaka vakalevu' to Kesa in the Secretariat library.

Your organisation's support and contribution to my study research is very much appreciated.

Best wishes to you all. A Very Merry Christmas and Prosperous New Year.

Sincere regards,

*Halahingano Rohorua.
PhD Student Researcher*

Appendix 15: Participants Information & Consent Form

Information Sheet for Participants

1. **Title of Project:** The impact of barriers to trade on fish export sector of Tonga

2. **Researcher(s) name and contact information:** Halahingano T. Rohorua, Economics Department (PhD Student), Waikato Management School, University of Waikato, Hamilton, New Zealand. Phone (647) 838 4466 ext 6278; Fax (647) 838 4087; Email: hala@waikato.ac.nz

3. **Chief Supervisor's name and contact information:** Dr Steven Lim, Economics Department, Waikato Management School, University of Waikato, Hamilton, New Zealand. Phone (647) 838 4315; Fax (647) 838 4331; Email: SLIM1@waikato.ac.nz

4. Brief Outline of the Research Project

The research is basically to examine the impact of barriers to trade (tariffs and non-tariffs) to the flow of fish export from Tonga to its main markets namely Hawaii, Japan, Australia and New Zealand.

5. Company or Organisation sponsoring or funding the research:

Presently none.

6. Confidentiality and anonymity:

Participants are assured of their confidentiality and anonymity. Participants will not be identified in any publication or dissemination of the research findings without their explicit consent. Participants will be further verbally assured that they will remain anonymous if they wish and that, therefore, neither their names nor any material through which they may be identified indirectly, will appear.

7. Participants right:

If you take part in the study you have the right among other things to

- a) refuse to answer any particular question, and withdraw from the study at any time.
- b) ask any further questions about the study, which occur during participation.
- c) be given access to a summary of the findings from the study when it is concluded if requested.

8. Information collected.

You can be assured that I will only follow whatever you agreed to. The information supplied will be stored securely to ensure continued confidentiality.

Date Available and Time:

Other Comments :

THE UNIVERSITY OF WAIKATO
Waikato Management School

Consent Form for Participants

Project Title: The impact of barriers to trade on the fish export sector of Tonga

I have read the **Outline of Research Project** form for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I also understand that I am free to withdraw from the study at any time, or to decline to answer any particular questions in the study. I agree to provide information to the researchers under the conditions of confidentiality set out on the **Information Sheet**.

I agree to participate in this study under the conditions set out in the **Outline of Research Project** form.

Signed: _____

Name: _____

Date: _____

Appendix 16: Tapa Dye making –Typical Budget for one family per year)

		Cost for one (\$)	Cost for one (hrs)	Annual \$	Annual Labour (hrs)	
No of trunks harvested per year	10					
Cash Inputs						
Hire of chainsaw	3	10		30		3 days hire for 10 trunks
Transport	2	5		10		2 hrs at \$5/hr
Total cash input				40		
Labour Inputs						
Harvesting Labour			1.5		15	
Debarking			0.5		5	
Pounding			1.5		15	
Squeezing			0.8		8	
Fermentation etc			0.5		5	
Squeezing & Filling			1.5		15	
Total Labour			6.3		63	
Output	Litres				63.5	litres
	20% retained for family use				12.7	litres
	Quantity sold (80%)				50.8	litres
						Price per litre 10.00
						Litres per trunk 6.35
		\$ 508.00				
# Returns to Labour (per hour)				\$ 7.43		
#	Calculate based only on amount sold					

Appendix 17: Tapa Dye making –Typical Budget for Pangaimotu Community per year

		Cost for one (\$)	Cost for one (hrs)	Annual \$	Annual Labour (hrs)		
No of trunks harvested per year	950						
Cash Inputs							
Hire of chainsaw	285	10		2850			
Transport	190	5		950			
Total cash input				3800			
Labour Inputs							
Harvesting Labour			1.5		1,425.00		
Debarking			0.5		475.00		
Pounding			1.5		1,425.00		
Squeezing			0.8		760.00		
Fermentation etc			0.5		475.00		
Squeezing & filling			1.5		1,425.00	Price per litre	Market Price 10.00
Total Labour (hours)					5,985	Litres per trunk	6.35
Output	Litres				6,032.50		Alternative Price 8.00
	20% retained for family use				1,206.50		
	Quantity sold (80%)				4,826.00		
Cash Revenue whole island per year (amount sold)					\$ 8,260		
Subsistence revenue					\$,652		
# Returns to Labour (per hour)					\$ 7.43		
# Calculate based only on amount sold							

Appendix 18: Typical budget for Hinakauea Tourism Development (one year)

	Cost of non-tour times (\$)	Cost of tour times hrs	Cost of non-peak tour times \$	Cost of peak tour times hrs	Cost of tour times (\$)	Cost of peak tour times hrs	Annual \$	Annual Labour (hrs)		
Number of months	3		3		6		12			
Number of tour/month	0		1		4					
Average number of visitors/tour	0		20		25					
Total number of visitors	0		60		600		660			
Cash Inputs										
Feast Preparation	0		600		6,000.00		6,600.00		Estimated cost	\$
Entertainment	0		240		1,920.00		2,160.00		Price/head	10.00
Maintenance	75		75		150.00		300.00		Price/tour	80.00
@ Loan repayments							2,585.88		Price/month	25.00
									Payment/month	215.49
Total cash input	75		915		8,070.00		11,645.88			
Labour Inputs										
		No of workers								
Full year	3hrs for 2days a week	2	144		144		288		576	
Part-time	only at tour time for 5hrs/tour	5	0		75		600		675	
Total Labour			144		219		888		4,378.50	1251
Cash Revenue										
Tourism- visitors			0		1,800.00		18,000.00		19,800.00	Price/head 30.00
Accommodation (50% occupancy at non-peak and 100% occupancy at peak)			0		300.00		4,800.00		5,100.00	Price/fale/night 100.00
Lease for sales of handicraft			0		90		720		810.00	Price/tour 30.00 \$5 for 6 leases

	Cost of tour non tour times (\$)	Cost of tour none tour times hrs	Cost of tour non-peak tour times \$	Cost of tour non-peak tour times hrs	Cost of tour peak tour times (\$)	Cost of tour peak tour times hrs	Annual \$	Annual Labour (hrs)
Total Cash Revenue	0		2,190.00		23,520.00		25,710.00	
Net Revenue/annum							9,685.62	
# Less depreciation of assets (@30.0% pa)							1,800.00	
Net Profit							7,885.62	
Return to labour (T\$/hour)							6.30	

@ Loan repayment is as that provided by Tonga Development Bank(TDB) tourism loan amortization . Loan amount is \$6,000 with bank fees of \$350. Loan term is 36 months at 13.5%

Rate of depreciation was that charged by the Tonga Development Bank which finance this project

Appendix 19: Typical budget for Fishing Activities (one month) – one family

	Type 1	Fishing time (hrs)	Type 2	Fishing time (hrs)	Type 3	Fishing time (hrs)	Type 4	Fishing time (hrs)	Type 5	Fishing time (hrs)	Total Monthly \$	Total Monthly (hrs)	
Number of trips/week	2		3		2		1		2				
* Average catch -fish (kg)	0		10		0		27.5		105				
# Average catch-molluscs (kgs/trip)	2.25		5		4.5		0		0				
@ Average catch -others/month (kgs/trip)	18		0		0		5		0				
												Total Production	
Total catch-KgFish/month	0		120		0		110		840		1070		
Total catch-Kgothers/month	54		60		36		10		0		160		
Subsistence (% of catch)	100%		80%		0%		10%		15%				
Total catch-KgFish/month	0		96		0		11		126		233		
Total catch-Kgothers/month	54		48		0		1		0		103		
Cash Inputs	\$		\$		\$		\$		\$		\$		
## Boat	0		5.00		12.50		37.50		218.71		273.71		
Fishing equipment	0		3.00		8.00		6.00		60.00		77.00		
Food/Ration	0		3.00		0		6.00		20.00		29.00		
Fuel	0		5.00		5.00		30.00		60.00		100.00		
Ice	0		0		0		10.00		0		10.00		
Total cash input/trip	0		16.00		25.50		89.50		358.71		489.71		
Total cash input/month	0		64.00		102.00		358.00		1,434.84		1,958.84		
Labour Inputs	hrs/trip	total/week	hrs/trip	total/week	hrs/trip	total/week	hrs/trip	total/week	hrs/trip	total/week			
** Time at sea/trip for *	0	0	5	15	0	0	18	18	6	36			
Time at sea/trip for #	3	6	1	3	5	10	0	0	0	0			
Time at sea/trip- for@	2	4	0	0	0	0	1	1	0	0			
Time on land/selling	0	0	0	0	0	2	0	3	1	3			
Total Labour / month		40		72		48		76		156		392	
											Price	Market \$/kg	Subsistence \$/kg

	Type 1	Fishing time	Type 2	Fishing time	Type 3	Fishing time	Type 4	Fishing time	Type 5	Fishing time	Total Monthly	Total Monthly
		(hrs)		(hrs)		(hrs)		(hrs)		(hrs)	\$	(hrs)
Cash Revenue (sales)/month(1)												
Fish sales	0		84.00		0		346.50		2,499.00			
Molluscs and other sales	0		60.00		288.00		63.00		0			
Cash Revenue (subsistence)/month(2)												
Fish sales	108.00		192.00		0		22.00		252.00			
Molluscs and other sales	0		168.00		0		3.50		0			
Total Cash Revenue/month(1+2)	108.00		504.00		288.00		435.00		2,751.00		4,086.00	
Net Cash Revenue/month	108.00		440.00		186.00		77.00		1,316.16		2,127.16	
& Less Depreciation @ 30% pa									53.18		638.148	
Net Profit for Type 5									1,262.98		1,489.01	
Returns to Labour (per hour)	2.70		6.11		3.88		1.01		8.10		5.43	

Type 1- 2.00
Type 2,4 5-fish 3.50 2.00
Type 2 non-fish 5.00 3.50
Type 3 non-fish 8.00
Type 4 non-fish 7.00 3.50

& Only for type 5. Depreciation rate as offered by Tonga Development Bank (TDB) loan to secondhand boat & engine

Cash input for boats on Type 2,3 & 4 were those indicated by fishermen on how much they spend especially in hiring boat (from survey result)
Cash input for boats on Type 5 is loan repayment for purchase of second boat and engine as condition of loan offered by TDB(refer to attach boat loan amortization)
Loan amount for the boat total \$6445, in which \$6,000 is the cost of the second boat and engine and \$445 is bank fee for the loan. Loan term is 36 months at 13.5% interest.

Remaining cash inputs were as data collected during survey

Time at sea for Type 5 estimated for total of 3 fishermen

Appendix 20: Loan Calculator : Hinakauea Beach Resort

Loan Calculator

Enter Values	
Loan Amount	\$ 6,350.00
Annual Interest Rate	13.50 %
Loan Period in Years	3
Number of Payments Per Year	12
Start Date of Loan	07/08/2006
Lender Name:	Pangaitour

Loan Summary	
Scheduled Payment	\$ 215.49
Scheduled Number of Payments	36
Actual Number of Payments	36
Total Early Payments	\$ -
Total Interest	\$ 1,407.61

PmtNo.	Date	Beginning Balance	Scheduled Payment	Extra Payment	Total Payment	Principal	Interest	Ending Balance
1	08/08/2006	\$ 6,350.00	\$ 215.49	\$ -	\$ 215.49	\$ 144.05	\$ 71.44	\$ 6,205.95
2	09/08/2006	6,205.95	215.49	-	215.49	145.67	69.82	6,060.28
3	10/08/2006	6,060.28	215.49	-	215.49	147.31	68.18	5,912.97
4	11/08/2006	5,912.97	215.49	-	215.49	148.97	66.52	5,764.00
5	12/08/2006	5,764.00	215.49	-	215.49	150.64	64.84	5,613.35
6	01/08/2007	5,613.35	215.49	-	215.49	152.34	63.15	5,461.01
7	02/08/2007	5,461.01	215.49	-	215.49	154.05	61.44	5,306.96

8	03/08/2007	5,306.96	215.49	-	215.49	155.79	59.70	5,151.18
9	04/08/2007	5,151.18	215.49	-	215.49	157.54	57.95	4,993.64
10	05/08/2007	4,993.64	215.49	-	215.49	159.31	56.18	4,834.33
11	06/08/2007	4,834.33	215.49	-	215.49	161.10	54.39	4,673.22
12	07/08/2007	4,673.22	215.49	-	215.49	162.92	52.57	4,510.31
13	08/08/2007	4,510.31	215.49	-	215.49	164.75	50.74	4,345.56
14	09/08/2007	4,345.56	215.49	-	215.49	166.60	48.89	4,178.96
15	10/08/2007	4,178.96	215.49	-	215.49	168.48	47.01	4,010.48
16	11/08/2007	4,010.48	215.49	-	215.49	170.37	45.12	3,840.11
17	12/08/2007	3,840.11	215.49	-	215.49	172.29	43.20	3,667.82
18	01/08/2008	3,667.82	215.49	-	215.49	174.23	41.26	3,493.60
19	02/08/2008	3,493.60	215.49	-	215.49	176.19	39.30	3,317.41
20	03/08/2008	3,317.41	215.49	-	215.49	178.17	37.32	3,139.24
21	04/08/2008	3,139.24	215.49	-	215.49	180.17	35.32	2,959.07
22	05/08/2008	2,959.07	215.49	-	215.49	182.20	33.29	2,776.87
23	06/08/2008	2,776.87	215.49	-	215.49	184.25	31.24	2,592.62
24	07/08/2008	2,592.62	215.49	-	215.49	186.32	29.17	2,406.30
25	08/08/2008	2,406.30	215.49	-	215.49	188.42	27.07	2,217.88
26	09/08/2008	2,217.88	215.49	-	215.49	190.54	24.95	2,027.34
27	10/08/2008	2,027.34	215.49	-	215.49	192.68	22.81	1,834.66
28	11/08/2008	1,834.66	215.49	-	215.49	194.85	20.64	1,639.81
29	12/08/2008	1,639.81	215.49	-	215.49	197.04	18.45	1,442.77

30	01/08/2009	1,442.77	215.49	-	215.49	199.26	16.23	1,243.51
31	02/08/2009	1,243.51	215.49	-	215.49	201.50	13.99	1,042.02
32	03/08/2009	1,042.02	215.49	-	215.49	203.77	11.72	838.25
33	04/08/2009	838.25	215.49	-	215.49	206.06	9.43	632.19
34	05/08/2009	632.19	215.49	-	215.49	208.38	7.11	423.81
35	06/08/2009	423.81	215.49	-	215.49	210.72	4.77	213.09
36	07/08/2009	213.09	215.49	-	213.09	210.69	2.40	0.00

Appendix 21: Loan Calculator: Boat

Enter Values		Loan Summary	
Loan Amount	\$ 6,445.00	Scheduled Payment	\$ 218.71
Annual Interest Rate	13.50 %	Scheduled Number of Payments	36
Loan Period in Years	3	Actual Number of Payments	36
Number of Payments Per Year	12	Total Early Payments	\$ -
Start Date of Loan	07/08/2006	Total Interest	\$ 1,428.67

PmtNo.	Date	Beginning Balance	Payment	Scheduled Payment	Total Payment	Principal	Interest	Ending Balance
1	08/08/2006	\$ 6,445.00	\$ 218.71	\$ 218.71	\$ 218.71	\$ 146.21	\$ 72.51	\$ 6,298.79
2	09/08/2006	6,298.79	218.71	218.71	218.71	147.85	70.86	6,150.94
3	10/08/2006	6,150.94	218.71	218.71	218.71	149.51	69.20	6,001.43
4	11/08/2006	6,001.43	218.71	218.71	218.71	151.20	67.52	5,850.23
5	12/08/2006	5,850.23	218.71	218.71	218.71	152.90	65.82	5,697.33
6	01/08/2007	5,697.33	218.71	218.71	218.71	154.62	64.09	5,542.71
7	02/08/2007	5,542.71	218.71	218.71	218.71	156.36	62.36	5,386.36
8	03/08/2007	5,386.36	218.71	218.71	218.71	158.12	60.60	5,228.24
9	04/08/2007	5,228.24	218.71	218.71	218.71	159.90	58.82	5,068.35
10	05/08/2007	5,068.35	218.71	218.71	218.71	161.69	57.02	4,906.65
11	06/08/2007	4,906.65	218.71	218.71	218.71	163.51	55.20	4,743.14

12	07/08/2007	4,743.14	218.71	218.71	165.35	53.36	4,577.79
13	08/08/2007	4,577.79	218.71	218.71	167.21	51.50	4,410.57
14	09/08/2007	4,410.57	218.71	218.71	169.09	49.62	4,241.48
15	10/08/2007	4,241.48	218.71	218.71	171.00	47.72	4,070.48
16	11/08/2007	4,070.48	218.71	218.71	172.92	45.79	3,897.56
17	12/08/2007	3,897.56	218.71	218.71	174.87	43.85	3,722.70
18	01/08/2008	3,722.70	218.71	218.71	176.83	41.88	3,545.86
19	02/08/2008	3,545.86	218.71	218.71	178.82	39.89	3,367.04
20	03/08/2008	3,367.04	218.71	218.71	180.83	37.88	3,186.21
21	04/08/2008	3,186.21	218.71	218.71	182.87	35.84	3,003.34
22	05/08/2008	3,003.34	218.71	218.71	184.93	33.79	2,818.42
23	06/08/2008	2,818.42	218.71	218.71	187.01	31.71	2,631.41
24	07/08/2008	2,631.41	218.71	218.71	189.11	29.60	2,442.30
25	08/08/2008	2,442.30	218.71	218.71	191.24	27.48	2,251.06
26	09/08/2008	2,251.06	218.71	218.71	193.39	25.32	2,057.67
27	10/08/2008	2,057.67	218.71	218.71	195.56	23.15	1,862.11
28	11/08/2008	1,862.11	218.71	218.71	197.76	20.95	1,664.35
29	12/08/2008	1,664.35	218.71	218.71	199.99	18.72	1,464.36
30	01/08/2009	1,464.36	218.71	218.71	202.24	16.47	1,262.12
31	02/08/2009	1,262.12	218.71	218.71	204.51	14.20	1,057.60
32	03/08/2009	1,057.60	218.71	218.71	206.81	11.90	850.79
33	04/08/2009	850.79	218.71	218.71	209.14	9.57	641.65

34	05/08/2009	641.65	218.71	218.71	211.49	7.22	430.15
35	06/08/2009	430.15	218.71	218.71	213.87	4.84	216.28
36	07/08/2009	216.28	218.71	216.28	213.85	2.43	0.00

Appendix 22: PINZMS Questionnaires

Household in Tonga

Sections related to Fish

Name (for household head and total household), age, education

Section 4b – current activity in Tonga

Q2 –Did (Name) you work for at least an hour last week in growing food, catching fish or making articles for sale.

Q3 Did (Name) you work for at least an hour last week in growing food, catching fish or any other primary activity for the household's consumption or use?

Section 6 –Food in the diet – Q1 2-fresh fish

Section 11 –Agriculture and other household income – 2003 – how many months in 2003 did you and your household members sell fish. In the months in which you did sell fish, what was your average net monthly income from selling fish after paying expenses such as petrol. Repeat again for the last 12 months (q9)

Question 16 – Ask about food consumed by household in the last weeks which include crops grown by household, fish caught by the household, or livestock raised by the household. For each item, say whether the household has produced the item in the last week, and if so, estimate the quantity and cost of buying the amount produced at the local market.

Code 1 – 19 Fish

Total subsistence production – sum all

Total fish production (code 19)