

**SUSTAINABLE RESOURCE AND ENVIRONMENTAL  
MANAGEMENT IN TONGA: CURRENT SITUATION,  
COMMUNITY PERCEPTIONS AND A PROPOSED NEW  
POLICY FRAMEWORK**

A thesis submitted in fulfillment of  
the requirements for the award of the degree of

**DOCTOR OF PHILOSOPHY**

By

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**DECLARATION OF ORIGINALITY**

I, Netatua Pelesikoti, declare that this thesis, submitted in fulfilment of the requirements of the award of Doctor of Philosophy in the Environmental Science, Faculty of Science, University of Wollongong is wholly my own work unless otherwise referenced or acknowledged. This thesis has not been submitted for qualifications at any other academic institution.

Netatua Pelesikoti

24 November 2003

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## **ABSTRACT**

The success of Tonga's current and future development depends on sustainable management of its natural resources. However, with increasing population, changing socio-economic aspirations and activities, the quality and quantity of the biophysical environment are declining. This is likely to be exacerbated if the major environmental issues are not addressed immediately. Unsustainable practices in agriculture and fishing, and population related pressures such as waste generated and increasing demand for natural resources coupled with a specific system of management have been identified as the major causes of environmental degradation. The Government has not been committed to sustainable management of natural resources and to the management of the outputs of resource use. Thus, most of the previous legislation and policies have lacked provisions for environmental consideration in socio-economic developments.

This work aimed to fulfill a number of objectives that contribute to the process of sustainable resource and environmental management in Tonga. These are: 1) assessing the state of the environment; 2) evaluating the barriers to sustainable resource and environmental management; 3) determining the development priorities of the community in Tonga; and 4) formulating of a new national policy framework for sustainable resource and environmental management.

Identification of environmental problems was carried out through a review of the state of the environment of Tonga. However, the inconsistency of historical data available, varying quality, and the paucity of data in some areas highlight an urgent need to establish nationally agreed sustainable development indicators for reporting and informing decision makers.

The existing resource and environmental management regime was analysed to identify its weaknesses in addressing the national goal of sustainable development. The main weaknesses involve legislation, policy, institutions, lack of devolution of decision-making and community participation.

The identification of community environmental and management issues and priorities was carried out through community environmental perceptions survey. Two specific methods were used. The first method was a nationwide face-to-face survey using structured questionnaire, completed by 447 respondents. The second method used was a Delphi participatory survey conducted in a representative island/village for each of the main island groups of Tonga, Manuka in Tongatapu, Felemea in Ha'apai and Taunga in Vava'u. The Delphi surveys focused on investigating community perceptions of coastal resources and habitat trends. During the Delphi survey, and at the same locations, a biophysical condition survey of coastal habitats was carried out in order to compare community perceptions with biophysical conditions, and to identify biophysical issues relevant for sustainable management of habitats and resources.

Data from the face-to-face survey were collated and examined statistically but information from the Delphi survey was not subjected to statistical analysis, as it was mainly qualitative and conceptual in nature. The biophysical survey of coastal habitats followed a scientific design where high and low impacted areas were examined. The data from the biophysical survey were analysed, using a two factor ANOVAs and Cochran's test. Community coastal resource perceptions from the Delphi survey were then compared with the results of the biophysical survey.

The responses to the community environmental perceptions questionnaire were influenced by socio-economic factors, such as education level, gender, area where respondents lived, age and household income level. Further, the survey showed that community environmental perceptions are influenced by access to media, overseas experiences, and government policies. The study found strong consistency in community perceptions and the biophysical variables surveyed, highlighting an urgent need for a policy framework that focuses on community issues and participation for sustainable resource and environmental management.

The results obtained from the state of the environment reporting, the analysis of the existing environmental management regime, the face-to-face interview, the Delphi survey and the biophysical survey were used to develop a new policy framework for sustainable resource and environmental management for Tonga.

This framework promotes the need for an integrated approach by recommending:

- development of appropriate environmental legislation and policies;
- prioritising sustainable development policies;
- community participation in relevant decision and policy making;
- policies to be based on communities socio-economic and bio-physical issues;
- coordination and consultative policy making and implementation processes;
- and,
- strengthening relevant national institutions.

The proposed policy framework addressed six sustainable management themes:

- ❖ A Sustainable Development Planning Process
- ❖ Legislative Framework for Sustainable Development Policy
- ❖ Framework for Waste Minimisation, Recycling and Disposal Management
- ❖ Framework for Sustainable Management of Coastal Resources
- ❖ Sustainable Management of Land Resources
- ❖ Precautionary Planning for Climate Change, Sea Level Rise and related Extreme Weather Conditions.

Barriers to the implementations of this new policy framework are discussed. These include political apathy to shift from ‘traditional management’ to the ‘new’ process suggested in this study. Political apathy in Tonga is most likely caused by a lack of appreciation of the relationships/linkages between the social, economic, and ecological objectives for sustainable development. Decision makers may become cautious of shifting from their ‘comfort zones’ to a process/area that would require them to work more closely with the people and as a result lose control over their ‘traditional’ areas of responsibility. Other causes could be seen to be the general lack of awareness and understanding of the ‘grave’ state of Tonga’s environment, lack of public funds and management skills in the senior levels in the government and a general lack of scientific and technical expertise in the various areas of social, economic and ecological development in Tonga. This is all compounded by the common community perception that community members are ‘not responsible’ for environmental and natural resource degradation. However, without a new approach to environmental management, the state of the environment in Tonga is likely to continue its decline, with significant impacts on both community health and development.

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## **GLOSSARY OF ABBREVIATIONS AND TERMS**

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
ANOVA	Analysis of Variance
ANZECC	Australian and New Zealand Environment and Conservation Council
AWCR	Australian Water Resources Council
APHA	American Public Health Association
BCN	Biodiversity Conservation Network
CSD	United Nations Commission on Sustainable Development
CBD	Convention on Biological Diversity
CDU	Curriculum Development Unit
CMS	Convention of Sustainable Management of Straddling Fish Stocks
COT	Constitution of Tonga
CPD	Central Planning Department
CPUE	Catch Per Unit Effort
CROP	Council of Regional Organizations in the Pacific
CSO	Civil Society Organizations
DO	Dissolved oxygen (mg/L) - For a healthy aquatic ecosystem, DO would be at about 6 mg/L or 80-90% saturation. This is reduced directly by the addition of organic material, or indirectly through additional of plant nutrients
DPCSD	United Nations Department for Policy Coordination and Sustainable Development
DCC	Development Coordination Committee
DOE	Department of Environment
Ecosystem	A community of organisms and the physical habitat in which they live
EIA	Environmental/ecological impact assessment
EEZ	Exclusive Economic Zone
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
EPACS	Environmental Planning and Conservation Section under the Ministry of Lands, Survey and Natural Resources, until July 2001 EPACS became the Department of Environment
Faecal coliforms	Bacteria used as indicators of sewage pollution
FFA	Forum Fisheries Agency
FAO	Food and Agricultural Organisation
GOT	Government of Tonga
GEF	Global Environment Facility

GMO	Genetically Modified Organisms
GPS	Global Positional System
GHG	Green House Gases
HRD	Human Resource Development
ICPD	International Convention on Population and Development
ICLARM	International Center for Living Aquatic Resource Management
IEM	Integrated Environmental Management
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Co-operation Agency
MAF	Ministry of Agriculture and Forestry
MET	Tonga Meteorological Services
MOE	Ministry of Education
MOFA	Ministry of Foreign Affairs
MCA	Ministry of Civil Aviation
MLCI	Ministry of Labour Commerce and Industry
MLSNR	Ministry of Lands, Survey and Natural Resources
MOF	Ministry of Fisheries
MOH	Ministry of Health
MOW	Ministry of Works
MOFin	Ministry of Finance
MMP	Ministry of Marine & Ports
MOP	Ministry of Police
NBSAP	National Biodiversity Strategies and Action Plan
NEMS	National Environment Management Action Strategy
NGO	Non Government Organization
Nutrients	Elements such as phosphorus, nitrogen, and potassium
NZODA	New Zealand Official Development Assistance
NHMRC	National Health and Medical Research Council - Australia
PMO	Prime Minister's Office
PIFS	Pacific Islands Forum Secretariat
PICCAP	Pacific Islands Climate Change Assistance Program
PLA	Participatory Learning Appraisal
PRS-WSSD	Pacific Regional Submission for the World Summit on Sustainable Development
(per. obs)	Author's personal observations
Replicates	Repeated observations used to characterize a population (refers to any kind of statistical measurement)

SAC	Standing Advisory Committee, MLCI
SDP	Strategic Development Plan
SIDS	Small Island Developing States
SoE	State of the Environment
SPREP	South Pacific Regional Environment Program
SPC	Secretariat for the Pacific Community
SOPAC	South Pacific Applied Geosciences Commission
SPBCP	South Pacific Biodiversity Conservation Program
Standard Error	Standard deviation of the means. An expression of the spread of observations around a mean calculated by the general expression $SE = \sqrt{\sum((x - \text{mean})^2 / (n - 1))} / \sqrt{n}$ , where “n” = number of samples, “x” = an individual measurement
TEMPP	Tonga Environment Management Planning Project
TCC	Tonga Communications Corporation
TEPB	Tonga Electric Power Board
TNMCT	Tonga National Monitoring Core Team
TNAR-WSSD	Tonga National Assessment Report to the World Summit on Sustainable Development
TRB	Tonga Reserve Bank
TWB	Tonga Water Board
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNITAR	United Nations Institute for Training and Research
UNESCO	United Nations Educational, Scientific & Cultural Organisation
UNDEAS	United Nations Department of Economic and Social Affairs Division for Sustainable Development
VWC	Village Water Committee
Water Quality	Physical parameters such as pH, salinity, temperature, DO, water clarity, depth and faecal coliform.
WB	World Bank
WHO	World Health Organization
OECD	Organisation for Economic Cooperation and Development
WWF	World Wildlife Fund
WCED	World Commission on Environment and Development
Currency: Dollar = Pa'anga (T\$)	
	Cents = seniti

Exchange Rate: one Australian dollar is approximately equal to one Pa'anga and 20 seniti at current rates

# CHAPTER ONE

## INTRODUCTION

### 1.1 Introduction

Sustainable development is at the forefront of the world's attention, with global initiatives such as the 1972 World Conference on the Human Environment, the 1987 World Commission on Environment and Development, and the 1992 United Nations Conference on Environment and Development. However, the 2002 World Summit on Sustainable Development (WSSD) to renew commitments for the implementation of the Agenda 21<sup>1</sup> over the next decade confirmed that the world is far from the achieving sustainable development. The United Nations Department of Economic and Social Affairs Division for Sustainable Development (UNDESA, 2002)<sup>2</sup> report to the WSSD reaffirms that:

If current patterns of development continue, nearly half of the world's people will suffer from water shortages within the next 25 years, the use of fossil fuels, along with greenhouse gas emissions, will grow, and the world's forests will continue to disappear .

The UNDESA report highlights that despite over two decades of global efforts to promote sustainable development; unsustainable resource use still continues and may continue in the future posing threats to the livelihoods of nearly half of the world's population. These global scale efforts, however, underscore a range of socio-political, economic and ecological factors that determine the responses of each nation. Varying interpretations of these global initiatives according to different national development goals, cultural and socio-economic situations, have influenced national commitments and responses.

Similarly, the Global Conference on the Sustainable Development of Small Island Developing States (The 1994 Barbados Conference)<sup>3</sup> translated Agenda 21 into specific policies, actions and measures to be taken at the national, regional and international levels to enable Small Island Developing States to achieve sustainable development. However, successful implementation of the Barbados Plan of Action at the national level is determined by each Island State's capacity and commitment.

## 1.2 The Research Problem

### 1.2.1 Limitations of Previous Studies

Notwithstanding the amount of research completed to date on sustainable development, the Pacific Islands<sup>4</sup> countries have not been prominent in the sustainable development literature. When they have appeared though, they have been seen as small communities inevitably caught up in the wider impacts of global environmental change (Pernetta & Hughes, 1990; Overton & Scheyvens, 1999). This literary view is explained as the 'outside-in view' that sees the Pacific Island communities as victims of western-generated environmental change (Hau'ofa, 1994).

The previous literature in the Pacific on sustainable development, however, contributes to creating a perception among the Pacific Island countries that national and local environmental changes are due to external or exogenous forces. Sustainable development is therefore seen as yet another phenomenon which not only originates and is defined from outside the Pacific Region, but is largely outside the control of the people of the Pacific (Henrich, 1997). There could be some truth in this view, if one considers the causes of global warming and sea level rise and their impacts in the region.

The spill-over of this view has seen the Pacific Islands adopting environmental conservation models based on Western values and theories. This includes a central agency management of national parks (with no community involvement), and adopting legislation based on western cultures (new to local communities). For example, the *1915 Birds and Fish Preservation Act* declared Fangakakau and Fanga'uta Lagoon as Tonga's first national park (refer Section 4.5.3.1) yet; this Act was not enforced due to several factors such as:

- lack of understanding of the 'protected area concept' by the central government and the community such as limited or prohibited access to marine areas whereas Tongans are used to open access to all marine areas;
- lack of capacity in the central agency to implement related community education and awareness programmes; and
- lack of community participation in the planning and management of national parks.

(Chapter 4, Section 4.6 describes other specific factors that contribute to environmental management failure in Tonga).

The western originated conservation theories may not be the problem, but issues arise when the theories are not considered in the context of the 'new' society where they are going to be applied and implemented (Chambers 1983, 1997; Stokke, 1991; Blaike, 1996). A total lack of community participation is considered to contribute to the failure of these models (Brohman, 1996). These observations are valid in the case of Tonga (as explained in Chapter 4) where the central government does not have the resources and the skills to improve the community awareness of these models before they are implemented (per. obs).

The lack of community involvement in these management models, however, perpetuated a view within Pacific Island countries that environmental problems are not 'ours'; therefore 'others' should find a solution while existing unsustainable practices of resource use continue regardless. Further 'justifications' of unsustainable resource use are reflected in the view of some Pacific Island countries that the sustainability objectives are 'western luxury' that cannot be afforded while island communities are still struggling to improve basic human needs, such as health, education and improving living standards. Second, sustainability is generally perceived as an 'anti-development' concept imposed by developed countries that have gone through the process of unsustainable resource use themselves, and, upon reaching their 'desired' level of development, have realised that they made mistakes leading to global impacts (pers. obs).

Other researchers reinforce the above view. For example, Pernetta and Hughes (1990) take the opinion that generally Pacific Island countries perceive that their progress towards development is unnecessarily influenced by views of global environmental degradation and problems that they have played no part in creating. Koenig (1995) referred to the same sentiments in describing developing countries' standpoint in the negotiations leading up to UNCED between the North-South Policy agendas, as the 'right to develop' of the developing countries.

Despite these underlying perceptions, indicators of national<sup>5</sup> environmental problems, such as loss of forest, diminishing fish catches, and increasing waste management problems (SPREP, 1992)<sup>6</sup>, could not be always caused by 'others'. Researchers such as

Blowers (1993), Myerson & Rydin (1994), Buckingham-Hatfield and Evans (1996), Dragun and Jakobsson (1997) in discussing the linkages among economic, environmental and social development objectives provided by the sustainable development give emphasis to the integral role of the people, who own and use the resources daily. Generally, these researchers stress that local and national socio-economic development cannot continue without a continual supply of resources from a healthy environment.

The application of the above views to Pacific Island countries pointed first to previous literatures' focus, which was mainly on how and what the 'Western World' perceived sustainable development in the Pacific to be. Second, there was limited research on national strategies to translate the sustainable global initiatives to address local issues. Third, it seems that some countries in the Pacific are focusing on the previous literatures' view of 'western generated environmental problems' and 'western generated solutions to these problems' (i.e. always looking/waiting for assistance or for what the western world says or does) to solve local environmental problems rather than initiating from 'within' appropriate strategies to promote sustainable development. Fourth, the previous literature highlighted that the welfare of the people of the Pacific will be jeopardised without a continual supply of resources from a healthy environment. Therefore, policy decisions regarding economic developments based on natural resource use at the national level could either enhance or negatively affect society's future welfare and livelihood. It is, then, in the best interest of small Pacific Island countries to develop appropriate national frameworks to implement sustainable development objectives to ensure the continuous flow of the resources that provide for their livelihoods.

As such, this thesis argues that sustainable development issues are not just issues generated by the western world, but are also national/local issues that have huge impacts on the livelihoods<sup>7</sup> of the Pacific Islands peoples. Pacific Island countries need to examine sustainable development issues from 'within', define national sustainable priorities issues, and set up appropriate national/local frameworks to implement those priorities. This study investigates these, in the context of Tonga.

### **1.2.2 Traditional Skills and Knowledge in the Context of Sustainable Resource Management**

In the context of the Pacific Island countries, some researchers linked 'local or national' development with 'traditional' skills, knowledge, or perceptions of the indigenous people



and the role of 'traditional knowledge and skills' in resource management as the key practical application of 'sustainability' (e.g. Thaman et al., 1979; Bonnemaïson, 1991; Chambers & Conway, 1992; Thaman, 1993; Browne, 1994; Clarke, 1990; Burt and Clerk, 1997). It is these skills that have ensured habitation and survival in the region for centuries and still play a very important part in the daily lives of some communities in the Pacific.

The successful applications of traditional skills, knowledge of nature and traditional resource use in the context of a society changing socio-economic aspirations, population growth and technological development, however, were not clear in the previous literature. An argument that is commonly overlooked by the literature on the Pacific Region is the fact that unsustainable resource use leads to loss of traditional skills and knowledge in a society (per. obs), and loss of resources gives rise to 'new skills and knowledge or behaviour'. For example, the whole context of known local names of trees; how young leaves are used for specific ailments; where those trees are located, etc. could still be known and practiced and readily passed on to the next generation if resources were available for the application and practice of those skills. When resources become rare, people, however, may start to harvest other resources to use. One of the substantial threats to sustainability, then, is the loss of traditional knowledge and skills due to loss of resources.

While some still-traditional societies in Pacific Island countries managed to sustain a reasonable lifestyles for long periods, the idea that traditional knowledge and skills, as applied to resource use, would lead to the sustainable use of that resource could be somewhat out of context in some situations, as in the case of Tonga (pers. obs). Other influencing factors such as population growth, migration patterns, changes to harvesting ability where the impacts of new technology are not understood, changing needs and aspirations, education, monetary trade etc. have somewhat overtaken the traditional knowledge and skills in resource management with a combination of 'traditional and modern technology' to maximise the achievement of people's aspirations.

Johnson (1989) and Henrich (1997) have shown in their study of Indians in the Peruvian Amazon that indigenous groups are not consciously conservationists, but that at low population pressure they employ simple technologies and food procurement strategies to meet simple needs, which inherently conserve land and resources. Despite highly adaptive traditional knowledge and skills, however, community needs and aspirations have now moved far beyond the meeting of basic needs, to achieving 'progress', 'modernism',

‘development’, ‘wealth’, ‘improved standard of living’, etc. These have all changed the paradigm of traditional skills and knowledge of resource use from ‘simple’ to ‘complex’.

However, this thesis argues that there is a fundamental difference between ‘traditional’ and ‘local’ knowledge and skills, in terms of sustainable resource management. While traditional knowledge and skills, as applied to resource use, do not necessarily lead to sustainable resource use, local people have tremendous local ecological and socio-cultural knowledge and skills that are crucial for the achievement of sustainable development. Local knowledge and skills as referred to in this thesis could have elements of ‘tradition’ or ‘new and acquired’ knowledge and skills throughout one’s life experiences. Therefore, sustainable development must put local people’s priorities first, by promoting methods that stress dialogue, participation, and emphasizing the inseparability of social and environmental problems from the perspective of those experiencing them.

Although there are several generalisations that could be drawn from previous studies as discussed above, three logics become clear. One, there is no ‘one best way’ or a ‘blue print’ process for sustainable environmental and resource management that can be applied uniformly to all countries or all societies. Second, sustainable development has to demonstrate that it is based on local priorities to ensure its applicability to local issues and gather the support from the communities. Third, reverting back to traditional knowledge and skills does not necessarily mean that sustainable development would be achieved; rather it is acknowledging and incorporating appropriate local knowledge and skills through participation in the sustainable development processes. This logic provides the foundation for the investigations of this thesis in the context of Tonga in developing a policy framework for sustainable environmental and resource management in contemporary Tonga.

### **1.2.3 The Case for Tonga**

Tonga’s first five year Development Plan (DP1), (1966 – 1970) through to its fifth five year Development Plan (DP5), spans a period from 1966-1990 when the main objectives were focused on development that would bring economic growth. The DP6 (1991-95) was the first attempt to integrate environmental issues into the national planning framework (per. obs). DP6 argued that effective support for environmental planning and management will yield economic savings in comparison with potential costs of cleaning and

regeneration. The DP6 goal was to “achieve sustainable economic growth conducive to a higher per capita income” (GOT DP6, 1991). Effective environmental management was argued by DP6 to also contribute to other national objectives, particularly to:

- generate more employment opportunities;
- enhance the quality of life by raising health standards; and
- ensure the continued protection and management of natural resources for sustainable development.

The Strategic Development Plan Seven (SDP7), (2000-03)<sup>8</sup> has signaled another major shift in strategy from the five year Development Plans to a Strategic Rolling Development Program for three years instead of the traditional five year plan. This shift reflects the need for development objectives and plans to be more adaptable to upcoming issues and a sharp turn from past government’s involvement in commercial and economic development activities. The strategy now relies on the private sector as the engine of economic growth (SDP7, 2000). While sustainable development remains an important national objective, and still one of the core functions of government, priority is given to encouraging investment to stimulate economic activity and employment. This requires the creation of a more favourable environment for the private sector and to withdraw government activities to core functions, which support private sector investment and provide basic services. However, like the previous DPs, DP7’s priorities are based on economic growth and sustainable development objectives only become national priorities if they were ‘seen’ to support economic growth.

However, to make the new strategy work, this study argues that a sustainable policy framework should be developed with appropriate environmental planning and management responsibilities aiming at achieving sustainable development. This framework would be able to provide timely and sound project assessment and approval procedures to guide investors, donor-supported projects and the people of Tonga toward environmentally sound activities. However, there is a major gap that needs to be filled before a policy framework for sustainable environmental and resource management could be developed for Tonga. There is a need to identify relevant and appropriate priorities for sustainable development and then provide those areas with the appropriate management framework to guide timely and effective implementation. The identification of relevant and appropriate priorities for sustainable development and the development of a policy

framework for sustainable environmental and resource management in the context of Tonga are the research gaps that this study aimed to fill.

### **1.2.3.1 Barriers to Sustainable Development in Tonga**

The argument put forward by this study is based on the following assertions supported by gaps in the literature, the economic goals of Tonga as discussed above and the researcher's experiences in Tonga. There are two underlying barriers that perpetuate unsustainable environmental and resource use in Tonga. First is the existing environmental and resource management framework and its influence on resource use practices and community perceptions; and, second is the community environmental and resource use perceptions. This thesis systematically examines whether there is substance to these assumptions, and attempts to develop a policy framework to address these barriers to sustainable development should they exist.

#### **The Existing Environmental and Resource Management Framework**

The existing environmental and resource management framework in Tonga is not conducive to achieving or producing sustainable environmental and resource management results. Despite the recent shift in national development objectives to encompass sustainable development, there was not any parallel shift in the framework to allow for effective community participation in planning and decision making for resource management (detailed discussions in chapter 4, Sections 4.3, 4.4 & 4.6), and to encourage ecological conservation to ensure sustained economic development (refer Sections 4.5 & 4.6).

The current management structure is a typical top-down, centralized bureaucratic system that does not have the capacity to implement its sustainable development objectives. The structure does not have adequate guidelines for effective consultation, communication and involvement of communities and other stakeholders in environmental and resource management decision-making; however, it usually relies on communities and other stakeholders to participate in the implementation phase of activities or projects. This issue is discussed further in Chapters 3 and 4.

Therefore environmental and resource management responsibilities are segmented with very little coordination at the decision-making level or implementation level. Each sector develops and pursues its 'own' policies regardless of the impact on other sectors or the community. For example, resource utilisation in one sector does not consider the environmental impacts or output from the use of the resource, as that is another sector's responsibilities (discussed in Chapter 4).

There are areas of overlapping, vague or dominant responsibilities coupled with the lack of coordination among relevant government sectors resulting in the absence of appropriate environmental planning, ill developed and implemented donor funded projects and delayed or non-response to priority national and community issues with regard to environmental and resources degradation. Current environmental planning, activities and responses, then, are piecemeal and generally reactive to external incentives or pressures (i.e. aid, or environmental instruments and agreements), (discussed in Chapters 3 and 4).

Although the central government makes environmental and resource policies and decisions at the bureaucratic and national level, it is at the community level that the impacts of those policies and decisions are felt most. Therefore, local participation and empowerment are considered essential features of sustainable development, as local communities need to be involved in development activities concerning them (Agenda 21 - Chapter 26 (1992) & Ghai and Vivian (1995)); however, local participation in policy development and decision-making for sustainable development is lacking in Tonga (Chapter 4).

### **Community Environmental and Resource Use Perceptions**

This study considered three factors that shape the environmental and resource use perceptions of the people of Tonga. The first is the existing environmental and resource management framework lacks of community input and involvement in environmental and resource policy development and management. This creates community indifference to environmental issues and problems as a result of resource use, i.e. communities embrace the benefits of development and 'ignore' the negative impacts, as they 'see' these negative impacts as a government responsibility to address. The government, in turn, has very little knowledge of the priorities of the communities and the degree to which the public recognises environmental concerns to have direct implications on the quality of their lives.

The second factor is cultural beliefs and behaviour of the people of Tonga towards the environment and its resources. It is also reinforced by what Rees (1990) explained as a society's 'understanding' of their environment being shaped by cultural assumptions and beliefs over time and passed on through social interactions. There are two assertions that this thesis makes at the outset with regard to the influence of culture in environmental and resource use perceptions:

- the first assertion is that the Tongan society may not closely track ecological reality in its dealings, leading to poor and delayed response to resource utilisation stress; and
- the second assertion is that there is a prevailing cultural attitude that 'nature will always provide or correct environmental degradation', thus unsustainable practices continue.

The third factor that has shaped communities' environmental and resource use perceptions, and which is related to the existing management framework, is a poorly enforced set of resource management regulations; this has enormous implications for environmental and resource management. People may keep on doing activities prohibited by the law while they can get away with it. This study examines these factors and proposes some solution.

There are several generalisations that could be made from the barriers to sustainable development in Tonga discussed above. First, the national goal of sustainable development exists in a policy vacuum (discussed in Chapter 4). Tonga, like many other Pacific Island countries, is caught up in the pressures and incentives from international environmental instruments and programs to implement sustainable development goals. However, its national framework to effectively translate global and regional environmental instruments to address local priority issues is not coordinated and lacks input from the communities at the receiving end. Secondly, although the government adopted a new sustainable development goal, it still continues with the existing management framework that is not geared to support and deliver new challenges, i.e. sustainable environmental and resource management.

### **1.3 How would Tonga Achieve its Sustainability Goals?**

The answer to this question is confined to this study's main argument: that is, in order to achieve sustainable development objectives in Tonga, a policy framework should be developed with appropriate environmental planning and management responsibilities based on local communities' priority for sustainable development. Local communities have to see that they are genuinely consulted, that their priorities are important and included in relevant policymaking, that they are active partners in sustainable development activities, if sustainable development objectives were to be achieved. Community involvement in the decision making for resource management has been lacking in Tonga, therefore it is absolutely crucial to promote the acceptance and to give legitimacy to the new framework by consulting the communities who own and use the resources daily.

As discussed in Section 1.2.3.1, this study is an attempt to understand the barriers to sustainable environmental and resource management and proposes appropriate solutions. It requires that resource management be placed in a historical context, in order to identify and describe the social and economic underpinnings of environmental degradation. The underlying political institutions and society's perceptions that shaped environmental practices and processes evolved in the past, have to be examined and understood, if effective action for change is to result.

### **1.3.1 Aims and Objectives**

#### **1.3.1.1 Aim**

The overall aim of this study is to develop a policy framework for sustainable environmental and resource management in Tonga. The development of the new framework will be based on three general approaches. The first approach is based on the existing situation and available information in Tonga to describe the status and trends of environmental conditions. The second approach analyses the existing environmental and resource management framework in the context of sustainable development to demonstrate the need to develop a new framework. The third approach then is based on environmental perceptions, attitudes and practices of the people of Tonga to identify relevant priorities for sustainable development. Using this framework, it is possible to summarise the central propositions of this study:

*That the existing environmental and resource management framework and the environmental perceptions of the people of Tonga perpetuate environmental degradation and unsustainable practices.*

Therefore, Tonga's sustainable development goal will have a better chance of being effective if major efforts are made to develop a new policy framework for sustainable development that informs decision makers and the communities of the intentions of the sustainable development goal.

The logic of the approaches adopted in this study is based on the need to provide relevant national information to achieve the aim of this study based on the following rationale:

- there are critical information and communications gaps that impede effective decision making by policy makers;
- there is a lack of appropriate policies for sustainable environmental and resource management in Tonga;
- there is a lack of coordination in the planning process across agency boundaries and across media including marine, coastal and land resources;
- there is a general failure to apply existing knowledge to environmental problems; and
- there is a lack of community involvement in decision making for resource management, therefore there is lack of support for the existing management framework.

### **1.3.1.2 Objectives**

The objectives for this thesis are drawn to address the study rationale listed above as:

- To analyse the state of the environment in Tonga in order to identify environmental issues and problems;
- To analyse and describe the barriers to sustainable environmental and resource management within the context of the current environmental and resource management regime in Tonga;
- To identify the people of Tonga's sustainable development priorities through the investigation of the following:



- (i) general environmental perceptions, skills, knowledge, attitudes and practices at a national scale,
  - (ii) selected communities' perceptions of the trend of key coastal resources and the causes of those perceived trend, community management capacity and future options; and
- To develop a new policy framework for sustainable environmental and resource management for Tonga.

## 1.4 The Scope

In this study, environmental and resource management refers to the management of natural resources as well as managing the “outputs” from resource use, e.g. pollution, deforestation, erosion etc. Although anthropological resources are equally important to the process of sustainable development, it is considered in this study that most natural resources (fisheries, forest resources, agricultural land, biodiversity and other natural resources) are in worse conditions than many manmade resources. It is also considered that a sound management framework that supports the goal of sustainable development, although based on the management of natural resources, would be transferable to the management of other resources in Tonga.

Although unsustainable resource use is common to all natural resources in Tonga (as described in Chapter 3), the case of community coastal resource perceptions and use, and the condition of the coastal resource are considered very important and warrant specific investigation. The coastal area and its resources have supported the growing population of Tonga in both subsistence and for cash income. Tourism, which is also highly dependent on the quality of the coastal environment, provides Tonga with an estimated annual \$13 million *pa'anga* (US\$10 million) in gross revenues (TVB, 2000). Further, due to the size of the islands and the influence of the marine environment, sustainable coastal resource management could be applicable to a ‘whole island’ management situation. A coastal area and the use of its resources are classic examples of multiple uses, and often demonstrate conflicting interests. For these reasons, coastal resources management issues were

investigated to describe issues of relevance to the natural resource management component of this thesis.

The phrase ‘sustainable resource and environmental management’, ‘sustainable environmental management’ and ‘sustainable development’ are used interchangeably in this study to mean sustainable natural resource management.

## **1.5 Research Methodology**

The methodological approaches adopted in this study were a combination of qualitative and quantitative methods. Jick (1979) used the term ‘triangulation’ to explain the rationale for using multi-methods in a study. Triangulation was based on the assumption that any bias inherent in particular data sources, investigator and method would be neutralised when used in the conjunction with other data sources, investigators and methods (a more detailed discussion of methods is presented in each Chapter).

The theoretical and practical foundations of qualitative methodology were considered appropriate for this study. For example, there is a research gap in the empirical literature in the context of the South Pacific, and specifically for the case of Tonga. The few studies that have been completed on sustainable resource management in the South Pacific Islands and in Tonga have mainly emphasised the ecological (scientific) aspects of resource management. A number of researchers, however, have advocated that sustainable development cannot be based on ecological principals alone, but is inherently underpinned by the socio-economic and political setting of the area studied. The paths needed therefore by each nation to achieve sustainability would not be the same (Dragun and Jakobsson, 1997).

Secondly, the theory of social representation requires a methodology that captures the human ecology, and cognitive anthropology domains (Creswell, 1994; Cuba & Lincoln, 1994; Virginia et al., 1998). Both domains involve ways of finding out what people do, know, think etc; analysis of secondary data; the qualitative methodology provides tools and techniques such as observation, interview, review and analysis to gather such information. Further, the practical application of the qualitative inquiry is particularly useful for sector studies, which can be synthesised to draw larger conclusions on

sustainable development issues, generate concrete recommendations, and provide policy advice to decision makers (Patton, 1986).

The quantitative approach was adopted in the methods used in collecting field data. For example, a survey has the potential for being the most definitive (Punch, 1998), and field samplings were used. First, the survey was based on a structured interview, seeking to understand environmental attitudes and perceptions, knowledge and skills of the people of Tonga. Quantitative sampling methods were used in selecting the sample population to be interviewed so that the data can be statistically analysed and to determine any relationship between variables. Further, the Likert Scale was administered to a randomly selected sample to ensure the reliability and validity of answers given (details in chapter 5, Section 5.2). The advocates of the qualitative approach have opposed the quantitative method used to study human behaviour by taking the stand that reality cannot be subsumed within numerical classifications (Webb et al., 1986). They place an emphasis on the validity of multiple meaning structures and holistic analysis, as opposed to the criteria of reliability and statistical compartmentalisation of quantitative research. However, the quantitative viewpoint that the epistemological underpinnings of the quantitative motif maintains that there exists definable and quantifiable “social facts” (Rist, 1979) is considered in this study. One can infer perception and attitude by observing or listening to what people say (Burns, 1997).

Following this macro level analysis, ethnographic field methods were used to study and interact with three selected communities in their natural setting. The ethnographic process is flexible and typically evolves contextually in response to the actual realities encountered in the field setting (Grant & Fine, 1992; Hammersley et al., 1995). In particular, a participatory learning appraisal (PLA) methodology (Lubett, 2001) was used to gather information and explain community perceptions of the trends and conditions of coastal resources and factors affecting coastal resource management in the selected study areas. In order to see the relationship of what people say and the actual ecological condition of the coastal resources, ‘snapshots’ of the ecological conditions in selected coastal resources habitats were investigated through field surveys. Although the field survey of the state of the coastal resources (although repeated in three different sites) was done once for the purpose of this study, the techniques used followed established scientific methods that could be repeated to obtain trend data in the future.

Finally, findings from each Chapter will be reviewed in the light of the author's personal and professional experience in Tonga to develop a new policy framework for sustainable environmental and resource management for Tonga.

## **1.6 Contributions of the Study**

The justification for this study rests in its potential theoretical and practical contributions. There are a number of theoretical contributions primarily to the interdisciplinary field of sustainable environmental and resource management. First by suggesting an examination of sustainable development issues from a national/local perspective, this study goes some way to meeting the challenge of providing a framework that integrates community based priorities (Agenda 21-Chapter 26; Ghai and Vivian, 1995), ecological, socio-economic considerations, political and legal analysis (WCED, 1987; Burrows et al., 1991). Second, this research adds to the sustainable development literature through the development of a framework based on perspectives that have not been prominent and replaces misinterpretation of resource management views in the context of a specific society. Thirdly, this study contributes to the public policy literature by drawing attention to the importance of developing appropriate policies relevant to the welfare of the people that the policy would have impacts on.

The proposed practical contributions of this study concern improvements to sustainable development policy formulation and implementation processes in Tonga. Further, as sustainable development policy domains become complex and intertwined with other policy areas, the identification of the actual local/community environmental and management issues and priority concerns and addressing those issues will contribute to achieving sustainable development aims in Tonga. As this is the first such study to address sustainable development and related environment issues in Tonga, it not only investigated new areas but also collected baseline information that would be useful for future management planning and research in Tonga.

Although the study is based in Tonga, Tonga shares many characteristics with developing countries in the Pacific. The issues investigated in this study would be relevant to similar situations in the region. The importance of a biophysical environment that provides the primary sources for the livelihood of the majority of the Tongan people has generally been recognised. The argument, however, of coordinating appropriate policies based on

community priorities and relevant ecological information is relatively new in Tonga and gives further impetus for this study.

This thesis would also be useful to experts/consultants who are working in Tonga to avoid duplication of effort and to provide guidelines for relevant work. International agencies can utilise this thesis to gain a broader perspective of Tonga's environmental issues and needs so as to optimise its use for financial and technological assistance.

There were, however, important factors that were consciously considered throughout the study. There was the need for the new framework to be responsive to the priorities and needs of communities, to empower the communities, to be financially achievable both to the government and to the communities; the framework to be implemented and be socially and culturally acceptable in the context of Tonga.

## **1.7 Thesis Structure**

The study is designed to provide an examination of constraints to sustainability issues through problem identification, reviews of literature, community perceptions, and merging the findings into a new framework for sustainable environmental and resource management. It is thus arranged so that the problem, and the need for timely solutions, can be easily followed and understood. The remaining chapters of the study are arranged as follows.

Chapters 2, 3 and 4 are based on synthesising and assessing secondary data and available information relevant to this thesis. Chapter 2 reviews the relevant literature in relation to this study. Chapter 3 provides an overview of Tonga's state of the environment in terms of pressure, effect, state and response. The current environmental management framework including legislation and policies are discussed and analysed in Chapter 4. The analysis covers institutional, legislative, decision-making processes and social, political and economic underpinnings that drive the current resources management.

Communities are the main stakeholders of the socio-economic and bio-physical environment. Thus, a means to secure their support for, and identify their issues for the development a 'new' policy framework for sustainable resource and environmental management is central to this study. Therefore, Chapter 5 investigates community

sustainable development priorities through a survey of general environmental perceptions, attitudes, knowledge and practices of the adult population of Tonga. Chapter 6 provides a focus on specific resource use perspectives, in this case, coastal resource use, and investigates the relationship between community perceptions and actual ecological conditions. Chapter 7 develops the new policy framework for environmental and resource management in Tonga based on the findings of the previous chapters, and Chapter 8 contains the conclusions, and provides suggestion for future study.

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<sup>1</sup> Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organisations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment. Agenda 21 was adopted at the United Nations Conference on the Environment and Development (UNCED) in 1992. More on Agenda 21 can be found in <http://www.un.org/esa/sustdev/agenda21.htm>.

<sup>2</sup> United Nations Department of Economic and Social Affairs Division for Sustainable Development (UNDESA), (2002), Report to the Johannesburg Summit, <http://www.un.org/esa/socdev/>.

<sup>3</sup> The Barbados Conference is the Global Conference on the Sustainable Development of Small Island Developing States held in 1994. It was convened by the United Nations General Assembly to provide a comprehensive framework for the implementation of the Agenda 21 in the specific context of the small island developing states. Detail of the Barbados Conference can be found in <http://www.un.org/esa/sustdev/sidstbc.htm>.

<sup>4</sup> 'Pacific Islands', 'the Pacific' are generally used interchangeably to refer to Pacific Islands countries not including New Zealand, Australia and Hawaii.

<sup>5</sup> 'National' is used in this context, to refer to 'local' (village levels) and to 'national' (the whole of Tonga) – generally it is referring to all the community levels that exist in a country in the Pacific.

<sup>6</sup> South Pacific Regional Environment Program (SPREP), (1992), The Pacific Way: Pacific Islands Developing Countries Report to the United Conference on Environment and Development, SPREP, Apia, Samoa.

(SPREP – is an intergovernmental organization for the countries of the Pacific including New Zealand, Australia, France and the United States of America, that coordinate environmental programs in the region).

<sup>7</sup> Chambers and Conway (1992) provide a useful introduction to the concept of a livelihood as the means by which people make a living – 'A livelihood comprises the capabilities, assets (stores and resources, claims and access) and activities required for a means of living; a livelihood is sustainable which can cope with stress and shocks, maintain or enhance its capabilities and assets, and provide livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods and the local and global levels and in the short and long term'.

<sup>8</sup> The preparation of the Five Year Development Plan was delayed during the period of 1996 to 1999; the Seventh Plan was not completed until 2000 and was in a new format – the Three Year Strategic Revolving Plan.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Based on the main objective of this thesis, which is to develop a new framework for sustainable environmental and resource management in Tonga, a review of relevant literature was carried out. The literature review focuses on theoretical and practical basis of sustainable development and their application in Tonga. Sustainable development frameworks are inherently linked to the evolvments of development theories, resource management paradigms and their application in the Pacific Islands, specifically in Tonga. Therefore relevant literatures are reviewed to identify a sustainable management framework appropriate for Tonga. Further, Tonga is viewed in the context of global development theories and trends and the situation in the Pacific Region, in order to understand the development paths the country has undertaken with a view to developing a new policy framework that addresses current and future sustainable development issues in Tonga.

How a society views or responds to these development theories are important indicators of community priorities, community perceptions and resource use practices and community or national institutions that determine and shape environmental and resource management. As such, how development theories ‘change’ a society and how institutions ‘adapt’ to those changes either through the development of ‘appropriate policies’ or through ‘constructive dialog’ are also reviewed as they apply in the context of Tonga.

##### **2.1.1 Objectives**

This chapter has three main objectives. The first is to identify and review the literature relevant to the research questions and problems discussed in Chapter 1. The second objective is to develop and justify the theoretical and methodological models that are grounded in the research literature for the subsequent empirical investigation adopted in

this study. The third and final objective is to define the key concepts used in the context of this study and Tonga.

## **2.2 Theoretical Basis of 'Sustainability'**

The foundation of sustainable theory lies, first, in recognising the biological limits to growth, the ecological carrying capacity and the maximum sustainable yield - the ecological sustainability view (Rees, 1990; Adams, 1990; Shiva, 1992). Sustainability in this view means environmental sustainability. The environmental and ecological base of sustainable development is very strong (an ecocentric view). Tilton (1996) referred to this view as the 'Fixed Stock Paradigm'. Ecologists and other scientists are concerned about the irreversible exhaustion of finite resources.

The second foundation is sustainable economic growth. This refers to a situation where the economy is growing over a period of time (measured by continual rise in GNP per capita) and surviving periods of relative recession. Sustainable economic growth implies that if the economy is growing on its own momentum then there is sustainable development (O'Riordan, 1981). O'Riordan also refers to this view as 'technocentric' (believing in the technological capability of humans to control nature and to achieve the best use of the environment). The concern for project sustainability is also related to this view. Sustainable funding and participation, after the life of a project is the main concern here, regardless of the project being ecologically sustainable or not. Ecological economists, however, favour the merging together of environmental and economic concerns into one theoretical framework (Barbier, 1993; Pearce, 1993; Tisdell, 1993; Common, 1995). The economic system dealing with production and the question of distribution of goods and services is brought together with the ecological system. Economic growth is necessary and possible, though such growth should not irrevocably harm the environment.

The third foundation is sustainable societies. The social approach considers the poor people and their basic needs first (Chambers, 1986). Another key element of the social approach is an emphasis on social equity, justice and liberation. This is the elimination of injustices and major inequalities within a society, which includes, for example, division of society by race, class or gender; the abrogation of basic human rights by rulers; or the existence of extreme inequalities in wealth (Mies & Shiva, 1993; Merchant, 1995; Salleh, 1997). Another key consideration in this view is the inter-generational equity and the fair



distribution and access to life-support systems between generations and within the current generation (WCED 1987; Dover & Handmer, 1992; Elliot, 1994; Reid, 1995).

Sustainable development<sup>1</sup> then, is the merging of all three foundations: ecological carrying capacity, sustainable economic growth and a sustainable society. Several writers have defined sustainable development based on the three foundations discussed above.

### **2.2.1 Defining Sustainable Development**

Sustainable development, made prominent by the World Commission on Environment and Development (WCED), is defined as, "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The definition, however, is general, providing the direction, but open to varying interpretations (Brookfield, 1991; Stokke, 1991).

Different disciplines, with their different approaches and perspectives, may give emphasis to different aspects of sustainability, for example, sustainable communities/societies in Chambers (1986); Toman (1992); sustainable economic growth in O’Riordan (1981a and 1981b); Pearce et al. (1989 and 1993); World Bank (1992); Barbier (1993) and Commons (1995); and sustainable natural (ecological) systems in Rees (1990); Adams (1990); Shiva (1992) and Fuwa (1995). Taken together, these writings suggest several generalisations about how to plan for, and progress towards, sustainable development. First, there must be a political system that has both sustainability as a target to achieve, and allows for effective citizen participation in decision-making. Second, the solutions for achieving sustainable development need to be tailored to the social, ecological and economic realities of the locations where resources are being managed. In addition, there is a need for a technical system that can search continuously for new solutions, an administrative system that is flexible and has the capacity for self-correction and an international system that promotes sustainable trade and finance.

#### **2.2.1.1 Sustainable Development as Defined in Tonga**

The only place where sustainable development is ‘formally defined’ in Tonga is the 1999 Environmental Impact Assessment (EIA) Bill whose objective is to achieve sustainable development. Sustainable development is defined in the EIA Bill as:

Promoting development at a rate and such a way as to ensure that the quality of the environment and the supply of the resource is maintained and, wherever practicable, enhanced to meet the needs of the present generations without compromising future generations' need.

The Tongan 'definition' emphasised a 'process' whereby sustainable development would be promoted. Thaman et al. (1996) argued that in the context of Ha'apai (Tonga) biodiversity conservation is synonymous with sustainable use of resources. Sustainable development for the people of Ha'apai means sustaining biodiversity's scientific, economic (in monetary and non monetary terms), cultural, recreational or ecological values that maintain communities livelihood. Thaman's interpretation of sustainable resource use in the context of Ha'apai seems to combine all the three theoretical foundations (ecological, economic and societal) of sustainable development discussed earlier. In the context of this thesis, community's perceptions of sustainable development are sought (Chapters 5 and 6).

One useful explanation of sustainable development is offered by Cicin-Sain (1993) who argues that sustainable development is a process of change in which the exploitation of environmental resources, the focus of investments, the orientation of technological development, and institutional changes are made consistent with present as well as future needs and is:

...guided by a basic philosophy which emphasizes development to improve the quality of life of the people (assuring equity in the distribution of benefits flowing from development) and development that is environmentally appropriate, making proper use (and sometimes non use) of natural resources and protecting essential ecological processes, life support systems and biological diversity. Achieving sustainable development entails a continuous process of decision making in which certain questions are asked and whereby the 'right' choices and decisions are made. Thus there is not any 'end-state' of sustainable development since the equilibrium between development and environmental protection must constantly be readjusted.

The argument that sustainable development is a 'process' was further discussed by Sperling (1997). Sperling argued that:

Planning for sustainable does not demand a process in which sustainability can be proven or pronounced upon. Our state of knowledge is such that although we know (or should be expected to know) when our actions result in outcomes which are unsustainable, we have no way of understanding whether our behaviour is truly sustainable. Such knowledge can only be acquired over many generations. No decision maker is capable of determining whether sustainability has or has not been achieved, particularly in relation to individual projects. The planning process must be seen as a pathway – with sustainability as the ultimate destination.

Sperling further suggested a two-step design planning process as part of a system which contributes to the movement of planning for sustainable development. The first step is the

preparation of local or regional sustainability plans. The second step is the consideration of development projects and its contributions to achieving the goals of the sustainability plans. Both steps have objective, process and goal.

Pearce (1993) suggested that: "...defining sustainable development is really not a difficult issue. The difficult issue is determining what has to be done to achieve it". This lack of definitional clarity and unanimity of purpose should not discredit sustainability as a political goal and policy objective; on the contrary the fostering of a lively and informed public debate is likely to benefit the move to a more sustainable world (Pearce, 1993). Manstetten (1996) and Klauer (1999) further argued that an ideal precise definition of 'sustainability' would not be necessary as definitions of sustainability differ according to cultural and socio-economic context. However, the ideal of sustainability is a source of guidance on how to act fairly toward future descendants, fellow citizens and Nature. This situation may explain why there has been no single blueprint for sustainable development (Barbier, 1987; Mikesell, 1992) and highlights the problems associated with the borrowing and exchange of ideas and experiences.

Regardless of varying definitions and different socio-economic contexts the pursuit of sustainability, however, requires certain conditions (WCED, 1987). These conditions include:

- a good governance so that there is social equity and for the benefits of development to be distributed throughout society;
- a political system that allows for effective citizen participation in decision making;
- an economic system that can generate surpluses and technical knowledge on a self-reliant and sustained bases;
- a social structure that provides for solutions for the tensions resulting from disharmonious development;
- a production framework that respects the obligation to preserve the ecological base for development;
- a technical system that can search continuously for new solutions;
- an administrative system that is flexible and has the capacity for self-correction;
- and
- an international system that promotes sustainable trade and finance.

In the context of Tonga some of the conditions given by the WECD are investigated in this thesis.

### **2.2.2 Whose Sustainability?**

Although there are many problems to establishing a process, with a goal, to achieve sustainable development in the Pacific, and specifically in Tonga, the prospects, however, lie in developing a new management framework that allows/facilitates the process of sustainable environmental and resource management for the people and in the context of Tonga. The new framework, in turn, calls for an arrangement that would promote and allow greater community participation, address community priorities and have an overarching goal of sustainable development for Tonga.

‘Sustainability’, ‘sustainability development’, ‘sustainable livelihoods’ and ‘sustainable community’ are referred to in this study in a generic sense. ‘Sustainable’ in each case, however, refers to maintaining resources to meet the needs of the present and future generations, although the emphasis and details could be quite different. In the context of a small island community such as Tonga, it is important for the community to ‘see’ that sustainability (though it may be applied at different levels – home boundary, community or national levels) is relevant to community issues.

Constraints to sustainable development in the Pacific can be summarised by the following factors: economic, socio-cultural and environmental vulnerability, ecological fragility, cultural degradation, exposure to economic shocks, small internal markets, and limited natural resource endowments (PRS-WSSD, 2001). Although the special case for the Pacific Island countries is noted in the United Nations system, the perspective of these countries is frequently seen as subordinate to global perspectives.

The Pacific Regional Submission (PRS) to the World Summit on Sustainable Development (WSSD), called for recognition from the international community as the Pacific cannot achieve its mission<sup>2</sup> for sustainable development in the next ten years without assistance of the international community and the developed countries (PRS-WSSD, 2001). Specifically the Pacific as a region seeks (PRS-WSSD, 2001):

- to ensure the sustainable development priorities of the Pacific region are fully acknowledged and integrated in the World Summit on Sustainable Development process;
- to secure and strengthen political support from the international community for programs and initiatives that are essential to sustainable development of this region's peoples, their environment and natural resources;
- to promote new and existing partnerships beneficial to sustainable development of the region; and
- to secure and mobilise resources to build capacity for sustainable development.

One of the main arguments of this thesis, however, is that Tonga participated in these regional initiatives (usually in the form of development projects) ill-prepared (Pelesikoti 1999, SPBCP 2001). The national management framework (with a sustainable development goal) for implementing and adapting donor-funded initiatives to address local issues and priorities are not in place. Therefore the full potential benefits (either ecological, economic or social) of the development projects are not yet realised by the local community. This thesis argues then that with a new policy framework for sustainable resource and environmental management, Tonga would be in a position to effectively address local<sup>3</sup> sustainable issues as well as regional/international related initiatives.

## **2.3 Development Theories**

The link between management and development can be seen in Plange's definition of development as: "the attainment of the particular kind and quality of life one desires to achieve through a planned program with designed goals and necessary processes" (Plange, 1996). Over the last three to four decades, different theories have been put forward and used to provide directions and explanations of the development process. Development theories were based on the belief that nations or states are continuously seeking ways to transform from subsistence to cash-based economies, and that development theories were the formula or blueprint that would allow nations to become 'developed' (Plange, 1996).

Notwithstanding the development blueprint<sup>4</sup>, developing countries today, however, are still faced with "low rates of GNP per capita, calorie and protein intake; high rates of

unemployment in the farm and tertiary sectors; and high rates of urbanization, illiteracy, infant mortality, population growth, and resource exports” (Plange, 1996). Consequently, in most developing nations, the rapid changes from subsistence to cash base economies have been much faster than the socio-cultural changes evolving in the community. Therefore, new resource management systems were introduced to address what was seen by national governments as the ‘inability’ of local communities to manage their resources whilst pursuing cash-base economies. However, contemporary resource management systems (parks and reserves, fisheries catch size limitations) were put in place by the national government. However, such systems may not sufficiently account for the aspirations of the people in the communities who are responsible for enforcement. This lack of foresight has arisen from a lack of community involvement during the planning stages.

### **2.3.1 Rural Development**

The rise of rural development principles was intended to address the needs of the local communities. However, rural development projects, for too long have ignored local people’s views, aspirations and needs (Chambers, 1983; Stokke, 1991; Blaikie, 1996), i.e. rural development in most cases is still from the perspectives of those who introduced them. For example, most experts and extension officers in the developed countries and their counterparts in developing nations commonly assume that development involves the dissemination of modern, scientific and sophisticated knowledge to inform and uplift the rural communities (Chambers, 1983).

Rural communities, however, have managed their resources up to now and therefore should be regarded as partners in contemporary management arrangements. The participation of local communities in projects can build on the many innovative ideas that people offer once they are convinced that their views will be considered. This helps to build self-reliance and community strength (Jackson, 1990). On the contrary, in developing countries, specifically in the Pacific Islands, generally the local communities are not ‘partners’ in management arrangements. It is at the outset that communities are ‘asked’ to implement certain activities or projects as perceived by the project developer (usually the government or an outside agency) to promote ‘local development’.

## **2.3.2 Evolution of Resource Management Paradigms**

The dominant theoretical paradigms that explain the evolution of resource management and development paths include the classic, the neo-liberal and neo-populist paradigms, the community-based development and the integrated management approaches.

### **2.3.2.1 Classic, Neo-Liberal and Neo-Populist Paradigms**

The 'classic' paradigm, which was predominant between 1950 and 1975, drew its sources from notions relating to rural development and environmental management (Blaikie, 1996). The model is top-down (more can be found in Jacobson & Weiss, 1995 and Milich & Varady, 1999), state instigated, informed by state-sponsored scientific institutions, and promoted via extension agents. The following steps characterise the classic paradigm's approaches:

- perceived problems are identified by external agents (government officers, donors, researchers etc.);
- technical measures are formulated by these external agents but require community cooperation; and
- plans are implemented using a combination of encouragement, persuasion and subtle threats.

(Jacobson & Weiss, 1995; Milich & Varady, 1999; Blaikie, 1996)

With the classic model, local knowledge is seen as defective, traditional, irrational, non-scientific and even superstition, which should be replaced by expert-led knowledge and officially sponsored innovations (Blaikie, 1996). Failure with this approach, however, is blamed on the community or the environment.

The neo-liberal and neo-populist paradigms were formulated at about the same time because of the rejection of the classic model. The neo liberal paradigm is closely associated with the World Bank (WB, 1992). The paradigm relies on incentives and regulations and is related to the economics of externalities and property rights. An issue with the neo-liberal paradigm is the absence of any universal or explicit criteria to judge the best technology.

The neo-populist<sup>5</sup> approach is a result of the rejection of the top-down, technocentric and state-led model of technology transfer. It is a reaction against the incapability of central or external authorities and the market to stop resource degradation and of the self-sufficient society against capitalist penetration of small-scale capitalism and urban interests of rural movement seeking to realize traditional values in a changing society. This approach, which promotes a more participatory style, became central to the development agencies by the 1980s. Many researchers advocate the neo populist approach (Gary, 1991; McGrath et al., 1993; Chambers, 1994; Ruddle, 1994; Western & Wright, 1994; White et al., 1994; Fisher, 1995; Imperial, 1999), among others, have argued for the need for 'community-based' or 'co-management' approach to ensure sustainability of local communities. Other features include flexible 'process oriented' planning in which local people use their own knowledge and skills to figure out solutions to their problems.

In recent years, the neo-populist approach has led to a shift away from 'supply-driven' approaches to 'demand-driven' ones and from centralised command and control to local management or co-management of resources and services. The shift has been aimed at increasing efficiency, equity, empowerment and cost effectiveness (Narayan, 1995). In order for development to serve the needs of a community, development should be based on appropriate strategies for encouraging participation, the existence of viable community groups, the appropriate fit of technology to the project and community needs, effective agency outreach strategies, client responsive agencies, and enabling policies (Narayan, 1995). In other words, successful community development relies on an integrated management approach.

However, the decline and disappearance of certain natural resources (i.e. diminishing fisheries, deforestation, grazing land degradation, water shortages etc.) in many parts of the world has led to crises in natural resources management. Recently, largely as a response to failure of development paradigms mentioned above, to attain sustainable development objectives, researchers and governments are looking at alternative resource arrangement as an attempt to reverse resource degradation and to achieve sustainable livelihoods for the community concerned (Chamarik, 1994). For example, Agenda 21 promotes the study of traditional resource management systems because of the lessons they offer to contemporary societies. However, Jackson (1990) cautions jumping to conclusions that traditional knowledge and skills would still produce the desired results, as was the case in the past. Questions that come to mind include: What aspects of the traditional resource management methods would still be applicable in contemporary local



societies? What characteristics of the traditional skills that can be strengthened or learned to provide for the needs and aspirations of communities now and into the future?

### **2.3.2.2 Integrated Environmental Management**

McManus, (in UNESCO, 1993) stressed that integrated environmental management (IEM) must have the following elements: holistic and interactive, address complex resource management issues, coordination and multi-sectoral, and:

...the coordination of multi-sectoral uses requires new methodological approaches and new legislation for access and use of environmental resources. Plans are needed to consider the available priorities and transform these into policies and goals. Choices will need to be made amongst competitive uses (McManus, 1993).

IEM's main objective is to break down the barriers between the various sectors of the environmental administration and to view the environment in its totality (Barrett, 1994). It goes beyond scientific and technological concerns and addresses the activities of society as a whole. It is the next step in the evolution of environmental policy making. Similarly, Cairns et al. (1991)<sup>6</sup> define IEM as the “coordinated control, direction or influence of all human activities in a defined environmental systems to achieve and balance the broadest range of short-and long-term objectives”.

Barrett (1994) listed the following characteristics of IEM Plans as:

- longer timescale (i.e. 10 to 15 years);
- goal of integrating the various measures (e.g. for pollution prevention, nature conservation and the creation of environmental amenities);
- establishment of environmental policy objectives agreed-on by all members of the community (local authorities, the prefectural population and developers);
- encouragement of voluntary activities, public participation and the promotion of greater environmental awareness;
- quality information;
- monitoring is an essential part;
- flexibility to allow adjustment; and
- good leadership.

The elements of an IEM as given by McManus are considered in this thesis as very appropriate for the sustainable resource and environmental management for Tonga. This thesis investigates barriers with the existing management system and recommends solutions to the barriers (Chapter 4). The barriers could be legislative, coordination or multi-sectoral. However, if these institutional barriers are not addressed the characteristics of IEM suggested by Barret would be still be ad hoc or hard to establish as is currently the case in Tonga (further discussed in Chapter 4). The 'available priorities' of the people of Tonga were identified through community surveys (Chapters 5 and 6) and transform into policies and goals (Chapter 7) in a new management framework.

Ecosystem-base management (ecosystem management) is another evolving approach to natural resource management. This integrated systems-based approach has been used to manage a growing number of environmental problems such as fisheries (e.g. Burroughs & Clark, 1995), large marine ecosystems (e.g. Alexander, 1993), management of terrestrial habitats (e.g. Kohm & Frankin, 1997) land use and water quality problems in various estuaries (e.g. Imperial & Hennessey, 1996), river basins (e.g. Costanza & Geer, 1995), and the Great Lakes (e.g. MacKenzie, 1996).

The general common elements that were emphasised by the studies above are institutional challenges associated with the implementing of an ecosystem-based program. Previous research suggests that ecosystem-based management has a strong administration and institutional orientation that emphasises redefining management units and building on the best ecosystem science to improve resource management (Slocombe, 1993; Imperial, 1999).

This thesis considers the state of the environment/ecology (science), (Chapter 3 and 6) together with the institutional rearrangement to develop the new framework for sustainable resource and environmental management for Tonga.

### **2.3.2.3 Participatory Management Approaches**

Participatory approaches allow greater community (direct or indirect) involvement in the policy formulation and decision-making processes or the technical aspects of the functions of the central authority (Imperial, 1999). This approach provides for consultation of the stakeholders or for the community to have some form of representation in the decision-making process. It promotes a more transparent and accountable management authority on

the one hand and creates a more responsive community in terms of implementation of the management programs and objectives, and greater compliance on the other (Imperial, 1999).

Ladder (1969) describes a ladder of participation with eight steps. The first step (at the bottom of the step) is 'manipulation', the second is 'therapy' both aiming at education the participants. The third step is 'informing', followed by 'consultation', 'placation', 'partnership', 'delegated power' and finally 'citizen control' at the top of the ladder. Ladder's description of the steps for participatory management implies an increasing degree of control if the participants were empowered enough.

'Community based' management is a form of participatory management, where the community has the total responsibility of managing the resources (Fisher, 1995). Another form of participatory management is 'cooperative management'. The community willingness to voluntarily co-operate goes beyond the requirement of a formal legal provision or a community rule (Gunningham, 1994). 'Co-management' regime, is a form of participatory management where the local community share resource management responsibilities with an external<sup>7</sup> agency or organisation (Pomeroy & Williams, 1994).

### **Community Based Management**

Management of common resources, or resources held in common by many individuals is where property rights are assigned to the community or a social group rather to private individuals or to the state (Berkes, et al., 1989; Gary, 1991; Rowse, 1993; Fisher, 1995). Communities develop the rules about using the natural resources, and they also develop the social values and norms, many of which are informal and non-contractual, that stress moderation and prudence rather than excessiveness and recklessness (Berkes, et al., 1989). Management of common resources may take place through completely self-regulated systems (community-based) or through 'co-management' arrangements.

Self-regulated (self-organising or self-governing) systems are those where the rules have been devised and modified by the participants themselves, and also are monitored and enforced by them (Ostrom, 1990). The Alanya, Turkey inshore fishery case study that Ostrom used as an example of a self-governing system (can also be found in Berkes, 1989) shows that:

...national legislation has given such cooperatives system jurisdiction over local arrangements has been used by cooperative officials to legitimize their role in helping to devise a workable set of rules. The local officials accept the signed

agreement each year also enhances legitimacy. The actual monitoring and enforcing of the rules, however, are left to the fishers.

There are examples in the literature of communities that have managed their resources relatively well over long periods of time, for example, the Maasai community and wildlife conservation have coexisted successfully, for centuries, in the Ngorongoro Crater area in Tanzania (Homewood & Rogers, 1991). However, once changes begin, (i.e. modern market economy or shift in community's preferences etc.), a totally harmonized community-based resource management faces a lot of challenges. A review carried out by Edwards & Rivera (1998) for IUCN of a community-based management of wildlife (two species of lizards) in Cosiguina, Nicaragua, noted the following important institutional structures:

- the co-operative leadership to the Omar Baca Cooperative<sup>8</sup> was stable;
- co-management agreements formalise working relationships among the people who are engaged in the program (local managers), the government and other partners (i.e. conservation organisations);
- Government authorises management and government officers are 'supportive' of the program; and
- External partners (IUCN, National university) continued their commitment.

Self-governance systems, however, have limits and drawbacks. They may be impractical where resources are migratory or overlap jurisdictions. Self-governance may be unacceptable where it excludes people with claims to common use-rights based on historical use or other notions of right (competing claims), for example, the special rights of the local people who depend on the resource, versus the rights of citizens or the public to the use of the resource. Another example given by Hanna et al. (1996), concerns the New Jersey coastal self-governance system, where court intervention was required to solve competing claims to resources:

People who go to the beach must pay for beach badges and/or parking, and the towns to maintain the beaches use that money. Very little of the coast is a state or federal park. However, courts have accepted that the intent and consequences is often exclusionary, favouring local residents, and they have delimited the power of the towns because under public trust law all citizens have common rights of access to the tidewaters and oceans.  
(Hanna et al., 1996).

Edwards and Rivera (1998) also identify constraints to sustainable management of the lizards and specifically the problems met with the community-based management in the

case study. They concluded that the program was not sustainable but if certain management needs are addressed, the sustainability could be enhanced substantially in the future. Lack of a monitoring program is a main constraint in order to assess the impact of the use<sup>9</sup> on the wild populations and there is a need to adjust their activities based on the monitoring information. Sustainability and maintaining community commitment would be enhanced if the government formalises the villagers' rights to manage and harvest the animals from the wild under the authority of the co-operative as: "...only when such access rights are clearly defined will the government have the ability to hold the managers accountable for their actions" (Edwards and Rivera, 1998). The success of the program and long term sustainability depend on the profit villagers receive from their management of the resources therefore, there is a need for education and awareness programs for marketing both local and external.

The regulatory aspects of community-based management regimes, however, have also not been given much attention in the literature. This could be partly due to a belief that communities will regulate themselves. However, threats to conservation do not disappear, either from within or from outside the community, just because land rights, or other community-based measures are introduced (Milner-Gulland & Mace, 1998).

### **Cooperative Management**

Davos (1998) applies cooperation management to the management of coastal zone area. He noted the characteristics of cooperative management as; the public is proactive in minimising conflicts and participatory in what he called the co-operative coastal zone management (CZM). Its main properties are: reliance on the social discourse and on a framework to guide this discourse through the integration of diverse and conflicting individual interests into 'co-operative' collective decisions-ones that can: (1) draw maximum support; and, (2) enhance the stakeholders' willingness to voluntarily co-operate in their implementation by inviting respect for the whole process of their selection and implementation.

However, there are circumstances where there are limits to the voluntary proactive response to achieve the 'best practice environmental management'. This is when there is an emphasis of corporations on short-term profitability. Markets, investors and others principally judged corporations on short-term performance, thus it is difficulty to justify investment in environmentally benign technologies. This is where the role for

governmental regulations remains – to nudge firms at the margin towards cleaner production, heightening their awareness of environmental issues, providing them with financial incentives, etc. In cases where corporations simply have little or no self-interest in environmental performance – a very different regulatory emphasis is needed<sup>10</sup>.

There are differences in attitudes and preferences towards co-operative management between different countries. Cooperative management agreements are a potential solution for management of forest fragmentation. Stevens and Dennis (1999) studied the attitudes and preferences towards co-operative agreements for management of private forestlands in the Northeastern United States. Most landowners believed that their actions affect land elsewhere and were favourably disposed to the idea of working with others in conserving the forest. In New Zealand, however, Hawes and Memon (1998) found out that although owners of indigenous forests agree that co-operative management is a potential solution to the problem of commercial logging and clearance of forest area for other uses, owners were looking for financial incentives from the government in order for farmers to conserve the forest.

### **Co-Management**

No single property-rights regime is sufficient to guarantee the sustainable use of resources (Fenny et al., 1990). More recently, resource users have been seeking and obtaining formal powers to participate in the decision making process, referred to as co-management. Co-management focuses on user group oriented approach as the self-governed system, but without neglecting or compromising the state role in resource management. It is a way to develop a dynamic partnership using the capacities and interests of both government agencies and the resource users (Pomeroy & Williams, 1994; Townsend & Pooley, 1995). In other words, co-management, where power is actually shared, provides an institutional response to the ‘commons’ problem, which essentially is the question of how private interests can better intermesh with collective interests (Pomeroy & Williams, 1994). In theory co-management will improve both the effectiveness and the equitability of resource management (Pinkerton, 1989).

The co-management process is influenced by both internal and external factors. Internal factors that affect resource use and management are based on beliefs and perceptions, experiences and observation of the local community and the environment. That is, resource management is regulated by socio-political institutions that are an integral part of

the cultural traditional practices (Crocombe, 1994). These institutions in turn are influenced by such factors as colonial manipulation, science and technology, population changes, urbanization, education and elements of modern economic development (Ruddle, 1994). However, Hviding (1994) argues that the strength of co-management lies in the dynamic character because of its adaptability.

### **2.3.3 Resource Management in the Pacific**

This section does not include Australia and New Zealand as they are regarded as developed countries. Instead it concentrates on the developing island countries of the Pacific. Some writers consider that customary marine or land tenure is synonymous to community-based management. Customary tenure is an evolutionary process of adapting to changing circumstances and the environment (Hviding, 1994; Veitayaki, 1998). From the few examples in the Pacific Islands, customary rights predominantly have communal structures. The following analysis of the governance process of customary rights structures shows how it operates. It is in this regard that community-based management is relevant. The degree of authority given to the local management institutions, such as, the community, would vary depending on the strength of the local institution's internal governance process or customary rights in addressing the management and development needs and demands of the present.

Therefore, 'community-based' or 'community driven' paradigms have been advocated by some researchers in the Pacific region, as one of the answers to the environmental problems of the island countries (Thaman et al., 1979; Bonnemaïson, 1990; Burt & Clark, 1997). Some of the reasons for the 'push' for community-based control could be related to the assumptions that Pacific communities have lived in harmony with the environment and hold the environment sacred<sup>11</sup>. Others believed that the Pacific peoples have survived for thousands of years in harsh environments with primitive technology, therefore let's 'go back' and use the 'olden/traditional' method of management as it has been proven to work (some of the problems with this view were discussed in Chapter 1, Section 1.2.2).

Pacific Regional studies on property rights regimes, however, are still very embryonic. Few studies on traditional rights, rights of a community or a clan or tribe to resources, usually referred to as customary rights, can be found. Some work though has been found in Johannes (1977), for Micronesia; Carrier (1981), for Ponam in the Manus Province and Baines (1982) for Fiji and (1989) for Solmons, Hviding (1996) for Marovo Lagoon, Lea

(1997) for Papua New Guinea (PNG), Smith A. in Morrison et al., (1994) (eds) for Yap. In general, there is very little published research on property rights in the Polynesian Islands of the Pacific.

Baines (1989) contends that in formulating a framework and preparing guidelines for tradition-based inshore fisheries management regimes in the Solomon Islands the following key factors need to be considered:

- Traditional cultures are dynamic and changing;
- Perceptions of traditional resources change;
- Traditional fisheries rights may involve areas, species and/or technology;
- It has not been clearly established whether primary traditional rights imply ownership in the western sense, or rights to use or custodial benefits only; and
- Both primary (direct inheritance) and secondary rights (acquired through marriage) are relevant.

While decentralisation of fisheries management can, however, be economically and socially efficient, governments should be cautious about pronouncing indigenous practices of resource management to be a panacea for all the ills afflicting coastal fisheries (Crocombe, 1994).

...the main thing to be aware of is that when we use the words 'custom' and 'tradition', they are used as tools to justify a particular position. They can be used rhetorically to support whatever argument you may wish to make (Crocombe, 1994).

In a traditional subsistence community with homogenous population the communal property rights system may operate well. Hviding (1996) observed such success during his study in the Marovo Lagoon area in the Western Province of Solomon Islands. However, as commercialisation of fisheries and other economic activities increase in the coastal areas, there is a greater chance of social conflict within the group as well as with outsiders. As conflicts increase in number, there may be need for some codification of general principles and outside intervention.

PNG land and marine tenure provide a good existing parallel example to learn from in considering the potential for conflict in fisheries management systems. In PNG, because boundaries are not fixed and determined through regulations, there is potential for several conflicts between competing claimants. Where the development and use of the resources are exclusive, the enterprise or industry, government and judiciary are often faced with a



problem of researching and adjudicating and solving numerous conflicting claims to land and sea (Lea, 1997). Sometimes, such claims are addressed in a heated politicised debate, which can inflame social problems and conflict. For example, in PNG, pole and line fleets used live bait caught within the customary fishing rights areas, although baitfish was not traditionally a food fish but was caught in the customary fishing rights areas. Conflicts among local communities, provincial governments and resource owners increased over the payment of royalties, and ultimately led to the closure of the bait fishing operations and the fishery<sup>12</sup> (Lea, 1997).

Another lesson from PNG comes from the case where an agreement was reached over use of resources and payment of compensation but problems occurred afterwards. As Lea, (1997) writes: “relying on custom to guide the distribution of moneys has often proved to be a serious miscalculation, sometimes with some unforeseen additional disastrous consequences”. Lea illustrates this kind of unfortunate cause and effect with reference to the events that led up to the Bougainville crisis. The compensation for the use of the customary land was paid to each clan’s designated principal title-holder, in the expectation that these titleholders would then distribute the money to the families and individuals according to indigenous customs. “In most cases, however, the individual title holders kept all the money themselves, and leaders ultimately precipitated a secessionist movement which forcibly closed the Panguna mine and called for the creation of an independent Bougainville” (Lea, 1997).

Samoa (former Western Samoa), has successfully demonstrated that By-laws can be used to manage community coastal and lagoonal fisheries resources. The Samoa Fisheries Act 1988 allows some village regulations to be made into By-laws, which have the force of the law behind them and are not retrospective or offensive to the general law of Samoa (King & Fa’asili, 1998). Recognition of these laws by government enables a village to prosecute and punish offenders accordingly. Many villages, with the support of the Fisheries Extension Service have now developed management plans for the conservation and management of their fisheries resources. An important part of their plans is often the establishment of fisheries by-laws<sup>13</sup>.

Many of the laws in Samoa are set by the Government, while local people on the other hand create by-laws with a real interest in the management and conservation of fishery resources. A village will therefore be inclined to act on breaches of these laws (Fa’asili et al., 1997). The general process for establishing by-laws is as follows. If a village decides

to establish fisheries by-laws they will have to consult amongst themselves on the rules they wish to introduce. The rules must be related to the conservation and management of the fishery resources. Once they have agreed on this they can then call the Fisheries Division for consultation as to the appropriateness of their rules. The Fisheries Division will then pass on a draft of the by-laws to the office of the Attorney General for review (Fa'asili et al., 1997).

However, the Samoa's community based fishery management program was not without problems. By 1999, 59 communities had participated in the program. Approximately 20% of communities perform poorly for various reasons; some management committees fail to hold meetings, some do not enforce village rules, many do not care for restocked clams, others fail to maintain shorelines, reserve signs and markers (Kallie et al., 1999). The readiness of a community for a long-term commitment with few immediate rewards is an unknown variable in the initial years of a community-based program. Nevertheless, the fact that at least 25% of the communities are managing their own fisheries very effectively indicates that communities are ready for self-management and indeed, value the opportunity (Kallie et al., 1999).

Other resource management studies in the Pacific can also be found in Adams and Ledua (1997), Adams (1997), Ram (1981), Veitayaki (1990), UNDP (1991), Johannes, (1982), Eaton (1985), Holthus (1990), and Preston & Wright (1990). Most of these studies have either focussed on biological or anthropological and socio-economic assessments. This thesis study, however, attempted to combine social and biophysical issues to develop a new policy framework for sustainable environmental and resource management for Tonga.

### **2.3.3.1 Pre-1839 Resource Management in Tonga**

There is very little written literature on resource management in Tonga prior to the civil war period. From the little available (for example Captain Cook's record of his three visits to Tonga), and from the oral history of Tonga, however, it appears that resource management then was the community based management of common pool resources (CPR) as explained by recent scholars (discussed in Section 2.3.2.3) and far from Hardin's 'tragedy of the commons' concept.

Villages began as fortifications known as *kolo* during the civil war period from 1779 to 1852 (Wood 1945, Thaman 1976, ESCAP, 1990). During the civil war, the two Kings (*Tu'i Tonga and Tu'i Ha'atakalaua*) lineage were overthrown and Tonga was divided and ruled by chiefs (Gifford 1929, Kirch, 1984, Latukefu, 1974). The chiefs owned the *tofi'a*<sup>14</sup> or land or an island where he and his *kainga* (extended family, relations, kinship etc) lived and also had 'right' to the sea surrounding his *tofi'a*. The chief lived together with his *kainga* in his *tofi'a*. The chief alone had the absolute right to all resources including those of his *kainga*. This arrangement allowed the chief to use the labour of the people any time he wished and to take whatever (goods, mats, tapa, even women) he fancied for himself. It also allowed access to the land and the coastal area for the commoners to plant crops and to fish for the chief and for themselves as well (Latukefu, 1974).

Evidence from the written history of Tonga pointed to the chief's interest lay in following: maintaining his power, forcing the loyalty of his people, ruling so that his needs were met and so that other chiefs would not attack him and his property. It was very much of the culture that the commoners presented the best crops and best fish to the chief and the remainder was for themselves. There is a lack of evidence that might be described or associated with any conscious 'conservation ethic' in the early Tonga history. This type of resource management during this era could be explained as a private property rights regime where the commoners had no rights at all (Bromley, 1988). These two different times (prior to civil war, and during civil war) under different rules in the history of Tonga could be what researchers (such as Perminow, 1996; Maude, 1965; Fairbairn, 1992; Gifford, 1929; and Malm, 2001) referred to as the traditional and customary land and marine tenure in Tonga.

The first written code of laws in Tonga was in 1839, known as the Vava'u Code. The early missionaries to Tonga were troubled by the arbitrary power of the chiefs and the inhumane way in which the commoners were treated, and with their advice, King Tupou 1 declared the first written code of laws.

It is my mind that my people should live in great peace, no quarrelling or backbiting, having no wish for war, but to serve the God of peace in sincerity, therefore I wish you to allow your people some time for the purpose of working for themselves, they will work for you as you may require them in working your canoe; in planting your yams, and bananas, and in what ever you may require their services; but I make known to you it is no longer lawful, for you mark their bananas for your use, or to take by force any article from them, but let their things be at their own disposal  
(Latukefu, 1974:237)

The total abolition of the chiefs' privileges was finally achieved in 1862 when a new Code of Laws stated the following:

All chiefs and people are to all intents and purposes set at liberty from serfdom, and all vassalage, from the institution of this law; and it shall not be lawful for any chief or person, to seize, or take by force, or beg authoritatively, in Tongan fashion, anything from any one.  
(Latukeyu, 1974:91)

The Constitution of Tonga (COT) was written in 1875 where it was specified that, "...there shall be but one law in Tonga. No laws shall be enacted for any special class to the detriment of another class; but one law equally the made for all persons residing in this land", (1875 COT, Clause 4). Of particular interest, is Tonga's 1875 Constitution, which still applies in Tonga – the rights to land were given to the three social classes<sup>15</sup> of Tonga (Section 4.2.1). The coast (starting at 15.24 metres from high water mark) and the sea (EEZ of Tonga) and resources therein 'belong' to the King (*ibid*, Clause 119). No community had exclusive fishing rights or responsibility for a particular marine area, and, under the Constitution the Government has the responsibility to manage coastal and marine resources and areas. It seems that the Vava'u Code of Laws and the COT were early attempt at what Chambers (1986); Salleh (1997) and others (Section 2.5) called a 'sustainable society'. Whether Tonga actually 'reached' a sustainable society or at what time in history Tonga reversed to an unsustainable path, at this stage and out of the scope of this study. Sperling (1997), however, believed that "...no decision maker is capable of determining whether sustainability has or has not been achieved..." (see Section 2.5.1.1).

However, contradictory to views of earlier writers, such as Malm (2001), who recorded "that all people have the right to go gathering or fishing wherever they liked", in fact coastal and marine resource use, as practised in Tonga today – is perhaps the people taking advantage of the ineffectiveness of the government to enforce the laws of the country, thus rendering the management role of the central government ineffective (per. obs.). The incapacity of the government to monitor resource utilisation and operations, or to develop an effective management regime, created an open access situation that led to unsustainable resource use and degradation (per. obs.).

## **2.4 Perceptions, Attitudes and Behaviour**

Research on perceptions, attitudes and behaviour emerged as a distinctive area of inquiry in the early 1960s. It was rooted in the 'man-environment' research tradition, and

characterised by interdisciplinary studies (Mitchell, 1997). Surveying public attitudes and perceptions is critical for successful planning at any level and is considered to be a vital input. However, there has been much controversy, about the ability of attitudes to predict specific behaviours. The fundamental weakness to this theoretical underpinning is that the symbolic interpretation does not link what people say and what people do in any systematic way (Knickerbocker, 1998, in Review of Peterson, 1997; LaPiere, 1934, in Steel, 1995). Others have argued for situational factors having influence on the relationship between attitudes and behaviour (Sherman and Fazio, 1983).

The view of properly assessing the relationships between attitudes and behaviour requires theoretically related measurements (Weigel and Newman, 1976 as in Steel, 1995). If the attitude measure is not related to the target behaviour, then one could not expect the attitude indicator to predict the behaviour under analysis. Another factor considered critical for attitude-behaviour consistency pertains to variations in the wording of an attitude question. Multiple-item indicators of attitudes have been found to be preferable to, and more robust than, single-item indicators. These factors were considered in developing the questionnaire surveys in Chapters 5 and 6 of this thesis. For example, environmental attitude questions were derived from behaviour questions relevant to the context of Tonga and to behaviour practised in Tonga. The surveys were conducted in the Tongan language to ensure uniformity of 'meanings'. A question may be asked in different ways using different example in order to have some form of confirmation or validation of previously given answers (Appendices 3 and 19).

Other writers have expressed concern that if researchers treat environmental perceptions, attitudes, and behaviour as an end in themselves, rather than as a means to understanding spatial processes, man-environment relationships, or local and regional complexity, the research will not make a substantial contribution to the progress of scientific inquiry. Further, the problems that hinder the comparability and verification of findings have been the wide range of definitions of the terms 'perceptions' and 'attitudes'. Moreover, there are more dominant and less dominant attitudes (Mitchell, 1979). It is common for more dominant attitudes to override concerns about preservation. For example, a depleted fish stock is still being aggressively exploited, in order to transform it into capital, which could be used to upgrade education or health services. Upgrading education and health services are the dominant attitudes in this case.

Schiff (1971 cited in Mitchell (1979)) and Saarinen (1976 cited in Mitchell (1979)) drew attention to the complexity of these concepts. Schiff (1971 cited in Mitchell (1979)) defined perception as:

...the impression one has of a social stimulus or set of stimuli, as that impression is modified by the perceiver's past experience in general, his/her previous experience with the same or similar stimuli and the individual's state at the moment he/she is viewing the stimulus of interest.

Since an individual's perception is governed by past experience plus present outlooks, conditioned by values, moods, social circumstances, and expectations, two people viewing the same stimulus may 'see' different images, in accordance with the definition by Hornby (1995) as "a way of seeing, understanding or interpreting something". The concept of 'attitude' is even harder to define. It is defined as "way of thinking" (Hornby, 1995), or "an organised set of feelings and beliefs which will influence and individual's behaviour" (Mitchell, 1979).

Many psychologists agree that attitudes may be broken down into three basic dimensions, namely affective, cognitive and behavioural. The affective component consists of feelings with regards to liking and disliking an object. The cognitive component incorporates the beliefs, which may or may not be true about an object. The behavioural components cover the way in which a person will react or behave relative to the object (Mitchell, 1979). These three components are built into this thesis to uncover and reveal the attitudes of the Tongan people to environmental and resource use in general and to management, i.e., to find out the likes and dislikes of Tongans, what they think, and how they react, or are likely to react, to environmental and resource management processes. It is vital to understand, however, that attitudes are pre-eminently social. Society acquires them through, or they are held in place, or modified by, direct or indirect social interactions. Through behaviour, people learn about each other's attitudes and priorities (Terry & Hogg, 2000).

#### **2.4.1 Environmental Perceptions – Contribution to Environmental Planning and Management**

Notwithstanding the weak relationship between attitudes and behaviour discussed above, perceptions, attitudes, knowledge and behaviour, emerged as a distinctive area of inquiry during the early 1960's, rooted in the man-environment research tradition (Mitchell, 1979). The early reviewers of the paradigm (Burton, 1971; Lowenthal, 1972) and more

recently reviewers such as Etzioni & Lehman (1980), Sarantakos, (1998), and Bruun & Kalland (1996) all agree that the society or community under study is represented by the perception, attitudes, knowledge and behaviour of its people. This kind of study has the potential to contribute to improving environmental decision (Bruun & Kalland 1996). Similarly, Etzioni & Lehman (1980) observed that: “the social role of attitude and perception studies is to provide an input into the planning process and to serve as a vehicle for public participation in decision making”.

In the same line of argument, Shannon (1992), argued that it is essential that enlightened environmental planning and management connect the biological foundation of natural resources with the sociological constraints facing those who use them for a variety of purposes; to do otherwise invites “short sighted and potentially disastrous consumptive practices”. Similarly Sack (1992), Williams (1995), and Quinn & Potter (1997) based their work on a social construction paradigm, where ecosystem management is as much about identifying and understanding human values, attitudes and relationships, as working out the ecology of the flora and fauna. This thesis combines socio-economic parameters and ecological parameters in the development of the new policy framework for sustainable resource and environmental management (Chapters 5, 6, and 7).

#### **2.4.2 Some Approaches to the Study of Perceptions**

Craik’s (1968 and 1970) cited in Mitchell (1979) model for comprehensive environmental displays is one of the first few research paradigms that offer some structured approach for a study of perceptions. The paradigm has four components. Whose comprehension is to be studied (who is to be studied/observed)? By what means could the environment be displayed to those being studied (means/media of presentation)? What behavioural reactions would be elicited and recorded (response formats)? What were the pertinent characteristics of the environmental displays and by what standards would the observer’s comprehension be judged (environmental dimensions)? Craik suggested that research is required concerning a variety of people or communities to be studied. “The general public deserves greater research since their views are needed in public involvement programs”. Chapter 5 selected a sample population of the adult populations of the whole of Tonga to be surveyed (Section 5.2).

Following the selection of communities/peoples to be observed, a decision has to be made as to how to present the environmental display (media of presentation). Practical problems to consider are: How to present the environmental issues or 'pictures' within a reasonable and efficient time span and in such a way that the full and complex character of the environment is conveyed? What are the different forms of presentation to ensure that reactions are prompted by the actual environmental issues and actual problems rather than by the way the issue was presented? Other difficulties must be taken into account such as controlling other variables which may influence reaction, such as weather, time of day, or season (Mitchell, 1997). The environment issues/information was 'displayed'/explained and in questionnaire format using bold typefaces, cards (A, B, C etc.), (Appendix 3) and using local examples unique to locations and familiar to those interviewed. The survey was conducted at a suitable time indicated by the respondents and the interviewees had to be flexible to be available at that time (Section 5.2.4).

Mitchell (1997) listed a variety of formats that could be used to record the responses to environmental display. These are descriptive responses (the direct and free responses using standardised ratings, Likert scale, checklists, close questions, open-ended questions etc.), and global responses (indirect responses, by drawing sketches or telling a story about an environmental display)<sup>16</sup>. There is not yet, however, a coherent system of classification of environmental dimensions. Environmental displays may be classified and measured relative to such dimensions as size, shape etc. This thesis adopted descriptive response formats to record the survey data (Chapter 5, Section 5.2.1).

#### **2.4.2.1 Previous Studies in Perceptions and Attitudes**

The review below only summarises some of the studies relevant to this thesis. For example in the Philippines, Pomeroy and Pollnac (1996) investigated community perceptions of changes in social and economic variables resulting from the implementation of the Central Regional Project, funded by the WB. The survey used a baseline-independent method developed by the International Centre for Living Aquatic Resource Management (ICLAM), University of Rhode Island's Coastal Resource Centre (URI/CRC), and relied on respondents' perceptions of changes in such indicators as local income, community conflict, and control over resources prior to and after the project. The survey indicated that level of education, income from outside the household, and the



ability of community members to cooperate with each other, were the most relevant variables in explaining the project's perceived impact on human behaviour. The project's impacts on natural resources and household well-being were explained by the perceived level of degradation prior to the project implementation, community ability to work together, and the degree of community participation in project planning. Though the ICLARM/URI study benefited from the fact that the villages surveyed were subjected to common project interventions, the study was conducted in a relatively small number of villages, and success variables explained could not be compared at the site level (Pomeroy & Pollnac, 1996).

In the Netherlands, Meulen van der et al. (1996) successfully demonstrated that taking into account farmers' perceptions together with environmental and ecological benefits and economic costs, plus consideration of nature conservation policies at the farm level, not only improved conservation policies, but also the level of acceptance of the policy. Meulen's study was based on interviews of conventional arable farmers. An analysis of farmers' perceptions was used to assess the importance to the farmer of five types of unsprayed crop edges. These features relate to agronomy, farm equipment and the social environment of the farmer. For each of the five types of unsprayed crop edges, the individual scores of the features were measured on the Likert scale. Respondents were asked to indicate on a five-point scale their degree of agreement or disagreement with each of the various features. The perception scores were used to explain the farmer preferences for one of the types of unsprayed crop edges. Statistical analysis of survey data demonstrated the relevance of these behavioural aspects. It appeared that flexible width is most important for acceptance in farming practice, because it is the width that determines compatibility with existing farming organization and parcel lay-out.

In the United States of America, Monroe (1998) reviewed the extent to which policy decisions of the U.S.A. government have been consistent with the preferences of the public. Monroe used results of national public opinion surveys and compared these with the actual policy outcomes on over 500 issues from 1980 and 1993. Monroe's study found a high correlation between public preferences and positive policy outcomes. The public opinion surveys were based on mail and telephone survey.

Different disciplines also use the study of perceptions and attitudes in their respective fields to gain insight to the human-environment relationship. For example, studies in cognitive psychology (Hemenway, 1983; Kok & Siero, 1985), political science (Sears &

Funk, 1991) and environmental advocacy (Cantrill, 1992; Kraft & Wuerts, 1996) suggest that it is the environment as perceived by the people, rather than the reality or condition of ecology, that matters in the promotion of environment policy. They all alluded to the concept that in order to advance environmental policies in the public sphere, resource managers must learn to develop and master environmental discourse that persuades and mobilizes their intended audience.

Other findings, such as in Steel (1996), who used a mail survey and telephone follow-up, suggest that attitude intensity is correlated with self-reported environmental behaviour and political activism in environmental issues. Additional findings suggest that women are significantly more likely than men to participate in environmentally protective behaviours and policy issues, and the gender difference in behaviour appears to be greatest among older adults.

On a different level, several researchers have analysed the effect of attitudes upon resource management strategies. In Australia, Staats et al. (1996) assessed the impact of Landcare participation upon key program outcomes. The study used the methodology of pre-and post-Landcare perceptions by mailed survey. A survey was also mailed to non-Landcare participants. Victorian Landcare groups were increasingly seen as the key element of an emerging Australian success story. The assumptions underlying Landcare are that limited funding of group activity will produce more aware, informed, skilled and adaptive resource managers with a stronger stewardship ethic, increase the adoption of sustainable practices, and assist the move to more sustainable resource use. However, research findings also suggested a number of flaws in program logic<sup>17</sup>.

On the other hand, community opinion is a major factor, which can influence the development of policy by governments and action by business and industry. Lothian (1994) presented an overview of community attitudes in Australia towards the environment, covering the period 1975 to 1994, based on evidence of a range of surveys. The following survey instruments were used:

- longitudinal polls: surveys which pose the same questions over a period of time;
- general surveys: surveys which cover broad environmental issues;
- specialised issue surveys: surveys which cover one or several environmental issues; and

- surveys of special groups: surveys which seek the views of a particular group regarding environmental issues.

Results of opinion polls, which rank environment with other issues, indicated that the environment has maintained its importance. This is an indication of a strong pro-environmental preference of the Australian community. The dominant environmental concerns were pollution and waste, followed by loss of biodiversity; natural resources issues such as land degradation; urban issues; and finally, the global topics of ozone depletion and population. Conclusions presented cover the need for continuous monitoring of environmental community attitudes and for more comprehensive surveys to be undertaken which probe the dimensions and characteristics of these attitudes. However, there have been few in-depth national surveys of environmental attitudes, representative of the general population; most of those undertaken have concentrated on one or two capital cities or states.

Indigenous forests on private land in New Zealand have long been vulnerable to commercial logging and clearance for agriculture and forestry. Haws and Memon (1998) analysed the potential of a government's new environmental policy initiative as a means for sustainable management of privately owned indigenous forest -- indigenous forest policy (IFP) and the Forests Amendment Act 1993 (FAA) as the principal mean of implementing the IFP. The FAA bans the export of woodchip, provides harvest quota and permits, and established the Forest Heritage Fund<sup>18</sup>. A survey of the farmers in the western southland region of New Zealand was carried out to gain insights into the farmer's perceptions of the new forestry management. An in-depth qualitative survey was conducted of 20 property owners in the Southland/South Otago Indigenous Forest Owners' Association.

The forest owners interviewed perceived management of indigenous forests on a sustainable basis, defined as sustained yield management, as important. Respondents explicitly expressed the view that the traditional method of harvesting -- clear felling was 'bad news' and had to stop. All of those surveyed expressed a strong desire to retain indigenous forest on their properties. However, land owners claimed that for economic reasons -- all have continued to clear fell in the recent past to allow for conversion to alternative land uses. Although forest owners were supportive of sustainable management, all argued, to varying extents, against the way in which it had been defined in the FAA legislation<sup>19</sup>. Farmers were concerned with their inability to harvest sufficient timber to

achieve a financial return. In other words, to achieve sustainable forestry management will depend on the landowner acceptability of the FAA operating prescriptions.

Other aspects to which perception and attitude studies have been applied are:

- evaluation of programs, Curtis & De Lacy (1996)<sup>20</sup>, Staats, et al., 1996;
- linking ecological and environmental problems with cosmological and philosophical beliefs, Brunn & Kalland (1996)<sup>21</sup>;
- coastal zone management problems, Redclift (1993), Davos (1998)<sup>22</sup>;
- water management problems, Huang and Xia (2001)<sup>23</sup>;
- siting of waste management facilities, (Miranda et al., (2000)<sup>24</sup>; and hazardous waste facilities, Kunneuther and Easterling (1990) and (1996)<sup>25</sup>;
- agricultural problems and land use problems, Bebbington (1993)<sup>26</sup>, Dunn (1997)<sup>27</sup>;
- gathering insights into peoples' perception of the environment, Environmental Protection Authority (EPA) 1994 and 1997 studies of 'Who Cares about the Environment in New South Wales' and attitudes towards environmental quality and safeguards, Australian Bureau of Statistics (ABS, 1999)<sup>28</sup>, using mail and telephone surveys; and
- forestry management problems, Amornsanguansiin and Routray (1998)<sup>29</sup>, using a structured questionnaire and interviewing randomly samples households; and population -- environment management (Harrison, 1992) .

Several important methodological factors were raised by the studies reviewed above. The issue of the size or number of the 'sample' or villages to be surveyed (raised by Pomeroy & Pollnac 1996) is very important for the validity of any survey for comparison purposes and its application to whole population. This issue was considered in this thesis to make sure that the results obtained are representative of other areas of Tonga (Chapter 5, Section 5.2.3 and Chapter 6, Section 6.3).

The studies referred to above show the important contributions of perceptions and attitudes studies to natural resource policy and management (other studies reviewed in this section display similar contributions). For example, Meulen's use of a Likert scale which allows for statistical analysis and interpretation, was also used in this thesis (Section 5.2.1). Results of Monroe's study indicate that where policy is based on public concerns and priorities there can be positive policy outcomes. The contributions of the studies

reviewed above are expected to be similar to the contribution of this thesis to the sustainable resource and environmental management in Tonga.

#### **2.4.2.2 Previous Studies on Perceptions and Attitudes in the Pacific Region**

There have been very few studies on environmental perceptions and attitudes within the Pacific Region. The World Bank (WB) recently carried out the first major study of its kind in the Region. WB (1999) carried out a comparative study based on coastal resource use and management in five countries in the Pacific (Fiji, Palau, Samoa, Solomon Islands and Tonga). Selected communities from each of the five countries participated in the study. The study relied entirely on community perceptions and attitudes to coastal resources use and management. The WB study methodology was adapted from Pomeroy & Pollnac et al. (1996) and (1997)<sup>30</sup>. The key issues common across the study communities were: (WB, 1999)

- population and economic pressures;
- ecological degradation;
- weak institutional coordination;
- low awareness; and
- technical challenges.

Kerslake (1998) carried out a survey in Apia, Samoa to assess the knowledge and level of public waste management awareness. The survey was based on interviewing respondents using a questionnaire. The survey collected information to assess the knowledge and waste management awareness of the people in Apia. Lutui (2001) carried out a similar study in Tonga, looking at community perceptions and attitude to waste management in Tonga. Lutui also used a questionnaire, but each respondent was asked to fill the questionnaire in his/her own time. Other similarities of the two studies (Kerslake and Lutui) were that both were based in the capital towns where waste management is a major environmental issue, both were conducted in English and only distributed to those who could read English, and both recommended ways to improve waste management.

This thesis has some similarities with the above studies, though there are methodological differences. For example, Kerslake and Lutui's studies were conducted in the capital towns, in English, and focused on waste management awareness issues only. This thesis

was conducted on a national scale and in the Tongan language, and considers biophysical issues both from existing data and from fieldwork samplings together with people's environmental perceptions and attitudes (Chapter 5). Similarly, the WB study and this study, though similar in some aspects (investigating coastal communities' perceptions), differ in emphasis and methods. The WB study compared perceptions among selected sites in the region whereas as this study focused on Tonga only. The criterion for selecting study sites and recording community responses differs between this thesis and the WB study. The WB study developed in advance parameters to be investigated where as this study relies on continually emerging community coastal issues or concerns to inform what was to be investigated (Chapter 6).

In reality, resource and environmental management policies however, are not always determined by the public's perceptions and attitudes. Development goals and policies of a country or a government have been greatly influenced by prevailing development goals, and as such, it is considered important to look at how development theories have evolved and their application to this thesis.

## **2.5 System Change Theories and Institutional Adaptation**

Talcott Parson's system change theory conceived of a social system<sup>31</sup> as being in balance or in equilibrium between its related parts, a theory was most influential in the 1950s and 1960s. Sociologists such as Luhmann (1982) and Herbermans (1989), however, stressed that in reality, conflicts arise and do occur when a social system attempts to change, or when there are contradictory claims between parts of the system. Social systems inevitably engage in some form of dialogue in an attempt to develop an understanding of divergent viewpoints or of divergent goals (Luhmann 1982; Handler, 1988; Herbermans 1989). If a political or bureaucratic system is not open to dialogue and to exploring new ideas, it is more likely than not to develop arrogance or complacency or both. In other words, there is an inevitable distinction between a bureaucracy that puts into practice the policies that are legitimately decided upon by a government in the democratic system, and something that exists to perpetuate itself (Handler, 1988, based on Weber 1949).

Papadakis (1996) added to the notion of dialogue emphasising the need for system effectiveness through constructive dialogue<sup>32</sup>. Papadakis defined 'effectiveness' as the capacity of organizations to attract support for public policies, and then implement policies for which there is broad consensus. Hence, Papadakis (1996) focussed on the

need to identify obstacles to effective policy-making and drew attention to the possibilities for effective policy-making. Examples of obstacles identified were varying levels of power between government, industrial and business interests or the legislature, and the different interests of political parties.

Based on the work of Luhmann, Handler, Herbermans and Papadakis (discussed above), this thesis attempts to identify the obstacles to sustainable resource and environmental management in Tonga through identifying priority environmental issues (Chapter 3). Obstacles which originate from the state of resource management are also analysed (Chapter 4). It appears that social systems (resource use systems such economic systems, community aspirations and values, technology etc.) in Tonga have evolved at a faster pace than the management system. Thus unsustainable resource use and environmental degradation occurs. Although Tonga has only one level of government, varying levels of power occurs between government and the private sector and within the government agencies, where, for example, some departments are more powerful<sup>33</sup> than others. As indicated in Chapter 1, environmental degradation and sustainable development are fairly recent concerns; however this creates opportunities to assess how the political (management) system in Tonga works or how 'dialogue' occurs in practice in order to 'legitimize' policies that deal with the new environmental challenges (discussed further in Chapter 4).

### **2.5.1 Effective Policy Making and Constructive Dialogue**

There are a large number of perspectives on the effectiveness of the government in responding to the new challenges of environmental protection and promoting sustainable development. Some focus on the 'persuasive' role of the government in encouraging industries which help to protect the environment, in educating people, and in setting standards (ANOP, 1991). Others favour the 'market solution' views to problems, and argued for a reduction in government activity (Wilson, 1980; Breyer, 1980; Goodin, 1992).

Yet, Marsh (1995) and Papadakis (1996), advocated possibilities for collaboration or dialogue, and that government is or ought to be the central force that can bring about change. Other writers though argued that government is not or cannot be a central force (Jänicke, 1990; Luhmann 1990). Luhmann's argument is based on the unrealistic expectations by some writers on the capacity of the government to address environmental

problems or other problems for that matter, when there is a focus on responsiveness of institutions and organizations<sup>34</sup>. Jänicke, on the other hand, believes that, in contemporary societies, the state and politics play a limited role in determining policy outcomes. In order for the government to become effective in implementing environmental protection, the government has to adopt a ‘radically reformist’ approach, rather than a prevailing one.

### **2.5.2 System Change Theory in the Context of Tonga**

Luhmann’s (1990) and Jänicke’s (1990) views on the failure of governments to effectively respond to environmental problems were based on the context of industrial and developed countries that have large influential industries and business, large markets, political parties and strong civil society movements, coupled with an informed media and population whereby government policies can be supported or changed. In the context of Tonga (small isolated developing islands, a small market, and no political parties etc.), however, initiation of change must start from where management decision and management are being currently controlled – that is the government. The most appropriate level of institutional change to employ in this study then is in line with what Papadakis (1996) called ‘an institutional responsiveness to environmental concerns’. Papadakis (1996) wrote that:

No great improvements in the lot of mankind are possible, until a great change takes place in the fundamental constitution of their modes of thought. By contrast, David Hume recognised that we draw assurance from precedents and past practices, and from beliefs, customs and ways of thinking that have been passed on to us.

Both of the views above, though contrasting could be applied to the context of Tonga. Current institutions and organisational behaviour are firmly embedded in precedent practices, traditional beliefs and customs. Again, and different from countries where environmental lobby groups are active and are informed in environmental matters, the government has a role to inform and promote awareness within the population of Tonga so that people have the right information and the confidence to become active in environmental lobby groups. There is a need for the government to do things and not just to decide things (Putnam 1993). For example the government needs to improve the Tongan people’s capacity in various skills, to improve awareness raising programs, and to conduct appropriate education programs in schools and in communities. This would place the people of Tonga in a position to effectively influence government’s policy. Therefore, the following questions need to be answered during the course of this study and are investigated in Chapter 4:



- How have institutions dealt with new environmental challenges during periods of rapid social and economic change?
- What are the barriers to sustainable policy outcomes in the area of environmental protection or the new forms of compromise between economic and environmental objectives such as sustainable development?
- What are the ways in which institutions could become more responsive, and could contribute to effective implementation of sustainable development policies?

This thesis then aims to inform the need for the current management systems (government systems) to be more responsive to environmental concerns in the context of Tonga. A new policy framework for sustainable resource and environmental management would provide the most effective strategy for Tonga to achieve sustainable development goals. The new policy framework developed in this thesis is based on social change theory whereby existing management systems need to bring about policy changes that are relevant to the community priorities (being responsive). The crucial questions then to ask at this stage are -- how would the new policy framework be responsive to community priorities? and what are the community priorities? The literature summarized below provides the answers to the questions. In order for a management regime to be responsive to community environmental priorities, management objectives and activities must be based on community priorities. Previous research on community environmental and resource perceptions, attitudes, practices etc. has provided theoretical and methodical bases for gathering community priorities for management purposes.

## **2.6 Summary**

A general viewpoint that can be derived from the literature reviewed is that sustainable development processes need to be tailored to the social, ecological and economic situations of the locations where resources are being managed. This thesis uses Tonga as a location. The evolution of development theories, and resource management in Tonga has been influenced both by the international trends in development paths and thinking, and by the national socio-economic, political and environmental context.

The global trend of societies progressing from traditional and agrarian organisation to a cash based economy has also happened to Tonga. During pre-European contact resource management was not an issue. There was no evidence of land subdivision or organised

villages. Natural resources must have been abundant in order to create peaceful communities as observed by Captain Cook. Resource management then could then have been a form of community-based regime. The civil war years saw a shift to a private property rights regime. Any successes of these two management regimes in resource conservation are attributes of their particular eras. For example, populations were very small, and the economy was still very subsistent. This is no longer the case.

The ‘new’ policy framework for sustainable resource and environmental management for Tonga proposed in this study is considered appropriate in the current socio-economic and political context of Tonga, now, and into the future. The approach to the ‘new’ policy framework is based on Papadakis (1996) which is a framework that is responsive to community environmental concerns (Section 2.5.2). The characteristics of the envisaged policy framework is of an IEM as listed by Barrett (1994), (Section 2.3.1). In the context of Tonga, it means a shift to a new policy framework for sustainable resource and environmental management responsive to current and future community environmental concerns and priorities.

The contributions of community environmental or resource perceptions for the development of appropriate policies for the community concern was well established in the literature reviewed. However, there was no established methodology for the study of environmental perception, and attitudes and behaviour. Therefore multiple data collection methods were used in this study not only to limit the bias of one method but also to use methods appropriate in the context of Tonga.

Chapter 3 begins the task of establishing the case for a ‘new’ new framework for sustainable environmental and resource management, by describing and analysing the environmental conditions in the study area (Tonga).

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<sup>1</sup> Further discussion on ‘sustainable development’ regarding its evolution from the 1960s and 1970s with the publication of the Rachel Carson’s ‘Silent Spring’ can be found in Jackson (1990), Pearce and Warford (1993), WCED (1987).

<sup>2</sup> The Pacific Region sustainable development mission is a call to reinvigorate the implementation of Agenda 21 to achieve priority outcomes, including from the WSSD that reflect and respond to the people, oceans and island dimensions of sustainable development in the Pacific region to assist in achieving measurable sustainable development in the Pacific region towards improving quality life for all, (PRS-WSSD), (2001).

<sup>3</sup> ‘Local’ as used here refers to either an island or a village or the whole of Tonga versus regional or international context.

<sup>4</sup> More on ‘Development Blueprint’ can be found in Pearce & Barbier (2000) or [www.earthscan.co.uk](http://www.earthscan.co.uk).

<sup>5</sup> Support for the neo-populist paradigm could be found in Heilbroner (1974); Ophuls (1977); Carruthers &

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Stoner (1981).

<sup>6</sup> Cairns et al. (1991) defines IEM for the Savannah Region of Georgia and South Carolina, United States of America.

<sup>7</sup> 'External' is not only referring to agencies in other countries (foreign countries), but includes the central government or an organization outside (for example, located in the capital) the 'local area' concerned.

<sup>8</sup> Omar Baca Co-operative is the principal institutional structure for community involvement in the management program. The co-operative provides a forum for the members to exchange information, monitor progress and contribute to the development and implementation of the management program.

<sup>9</sup> The iguanas are sources of protein for families. They also supplement income through sales to the pet companies.

<sup>10</sup> Further discussion on other regulatory enforcement for corporations who do not voluntarily move beyond compliance to achieve a 'cleaner product or a cleaner environment' can be found in Braithwaite (1993).

<sup>11</sup> Pre-Christianity era gods were from nature (i.e. sharks, special trees, birds, the sun etc.), and a bad harvest or a disease is a 'punishment' from the gods for the 'wrong doings' of the community.

<sup>12</sup> Papua New Guinea has one of the richest skipjack fishing grounds. Thus to avoid conflicts, bait fishing was stopped by customary fishing rights owners which meant a major impediment to the industry and to government.

<sup>13</sup> More on the application of Samoa's By-Laws in community fishery management can be found in Fa'asili (1997); King & Fa'asili (1998b) and Kallie et al. (1999).

<sup>14</sup> *Tofi'a* means my land or my people (a word only used by chiefs when referring to his land or his people (as my *tofi'a*).

<sup>15</sup> Tonga is a highly stratified society with three distinct social classes, at the top of the apex, the King and the Royal Family (about 0.02 % of the total population), next the chiefs (nobles) and their families (about 0.05 % of the total population) and at the bottom of the pyramid are the commoners (made up around 98 % of the total population) of Tonga.

<sup>16</sup> Detailed discussions on the various format to record survey responses both descriptive responses and global responses could be found in Creswell (1994); Salant, and Dillman, (1994); Jones et al. (1994); Pomeroy & Pollanac (1996); and Bunce et al. (2000).

<sup>17</sup> Given the low levels of profitability amongst landholders, the vast scale and intractable nature of key issues and the considerable off-site benefits of remedial action, it is problematic whether limited funding of a community development process will effect behavioural changes that are sufficient to make a difference at the landscape level. Program emphasis upon developing landholders' stewardship ethic also appears misplaced in that there was not a significant difference in the stewardship ethic of participants and non-participants.

<sup>18</sup> To allow for compensation to farmers who might lost income due to the new controls provided by the FAA. The Fund however, has annual financial constraints due to very high claims based on clear felling of forest blocks for timber and chip.

<sup>19</sup> The FAA intention of sustainable forest management is to provide for a balance between timber production and forest protection. From the perspective of the forest owners economic rewards have to be attractive enough to manage forests under the new regime.

<sup>20</sup> Mass media were employed intensively to make the public aware of the nature and causes of the greenhouse effect, its consequences and possible ways of dealing with this environmental problem. Curtis and De Lacy assessed the changes made in knowledge, problem awareness, willingness to show ecologically sound behaviours and perceived necessity of additional superimposed policy measures. The results show that it is hard to change current cognitions and behaviours but, more importantly, the data suggest that knowledge and problem awareness may be less instrumental in promoting behavioural change than was assumed before the campaign. These results are reflected upon from a social dilemma perspective. This perspective stresses that it is unlikely that individuals are willing to forfeit some of their personal comfort in favour of long-term collective interests if not only the desired collective goal (the prevention of ecological disaster) but also the contributions made by other parties are both surrounded by much uncertainty.

<sup>21</sup> Bruun and Kalland argue against the assumption that Asian people are more successful than others in taking care of their environment because they "live in harmony with their environment due to their Buddhism or Hinduism teaching. The fact is Asian philosophies and cosmologies seem to have little effect in

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preventing environment problems such as over exploitation of soils, deforestation, pollution of waterways, etc. – problems which are currently happening in most Asian countries.

<sup>22</sup> The interdisciplinary nature of coastal zone sustainability is highlighted from the point of view of social sciences by critically exploring ways in which coastal sustainability policies: (1) are socially constricted; and (2) can be implemented with the sustainable co-operation of stakeholders with conflicting preferences and priorities.

<sup>23</sup> Perspectives on sustainable water-quality management in the twenty-first century were investigated, demonstrating many demanding area for enhanced research efforts, including issues of data availability and reliability, concerns about system complexity and methodology validity, limitations of computer techniques, usefulness of research outputs, difficulties in policy implementation, and the necessity of training programs

<sup>24</sup> A quantitative scoring scheme is used to systematically and simultaneously evaluate issues that policymakers and the public might care about in landfill siting decisions. Its appropriate use should reassure the public that the government is committed to working in the best interests of the public and to improve public participation in the decision making process of siting landfill in their community.

<sup>25</sup> Despite the passage of a legislation (1984 Resource Conservation and Recovery Act) to track the disposal of hazardous substances from cradle to an authorized grave, the Nevada government improve related policy and management through conducting analysis and applying the results of a telephone survey of Nevada's residents' attitudes and willingness to accept a proposed high-level commercial nuclear waste repository. Kunreuther and Easterling found that compensation (in the form of a tax rebate) has little influence on the siting of such a facility. Residents must be assured first that the risk to themselves and future generations are sufficiently low before compensation is considered -- and so the developer would be advised to focus on mitigating the facility's impacts before introducing compensation.

<sup>26</sup> The Bebbington study was based on the conviction that sustainable use of land is predicted not only on appropriate technology but through understanding "what the community wish to sustain". His study of the Andes community concludes that for sustainable livelihood development there is a need for political commitments, institutional strengthening, enhanced local organization capacity, environmental education and economic development for local populations.

<sup>27</sup> Dunn demonstrates a move away total dependence on formal "scientific" attempts to address changing environmental conditions, particularly with respect to food production, and towards a greater reliance on innovative ability and indigenous technical knowledge of the local people. Dunn shows this by "seeing the forest as the local see it" through studies of three villages in South-eastern Nigeria.

<sup>28</sup> Both studies are primarily aimed at providing policy makers with information concerning the people of Australia.

<sup>29</sup> Mounting environmental concerns and problems of sustainable forestry management linked to improvements in environmental performance underlie the urgent need for added research into the dependency of communities on the forest resources, their perceptions about forest management, and current practice in the Phayao Province in Thailand.

<sup>30</sup> Pomeroy, Pollnac et al. (1997) also review the available literature for factors which may be important in determining coastal management success.

<sup>31</sup> The notion of 'social system' is widely used in the social sciences to refer to the connections between the interrelated parts that may constitute a society or the components of a society. Parts of the social system could be the political system, the legal system, the economic system, the health system etc. (Papadakis, 1996).

<sup>32</sup> Constructive dialogue refers to a dialogue in which both parties are looking for solutions that will benefit both sides (Papadakis, 1996).

<sup>33</sup> Powerful in terms of the most senior minister, or whether the minister is from the nobles or royal family, and in terms of budget (received most funds). The Environment Department is at the bottom of the 'power scale'.

<sup>34</sup> North (1990) made a distinction between 'institutions' and 'organisations'. Institutions represent the 'rules of the game' or the humanly devised constraints that shape human interaction. Their role is to reduce the uncertainty in human interactions. Where as, organisations can be political parties, regulatory agencies, different houses of parliament etc. Organisations and their development can of course influence the institutional framework and vice versa. "Both what organizations come into existence and how they evolve are fundamentally influenced by the institutional framework. In turn they influence how the institutional framework evolves" (North, 1990).

## **CHAPTER THREE**

### **ENVIRONMENTAL ISSUES AND PROBLEMS: AN OVERVIEW OF TONGA'S STATE OF THE ENVIRONMENT**

#### **3.1 Introduction**

This overview is based on a review of existing information and data in Tonga. The information and data reviewed in this study were collected from various sources and were in various formats as there is no central environmental information clearing house. They were produced by the sources for reasons other than those pertaining to the environment.

Chapter 3 starts with a brief introduction to the study area. For the purpose of this study, the state of the land, marine and coastal resources are discussed in terms of the driving forces that shape the resources, the state, and the responses both from the government and or the community. The identification of information gaps follows this. Land, marine and coastal resources use are central to the sustainability issues, due to the dependency of the people of Tonga on these resources coupled with a general lack of alternative sources of livelihoods.

In the small island context, pressures such as high population growth and high density economic activities such as commercial agriculture or fisheries, natural disasters and sea-level rise, may have an effect on and shape the status of both land and coastal resources. To avoid repetition, these pressures or common driving forces are only discussed once.

##### **3.1.1 Objectives**

This chapter aims to identify and assess major environmental issues and problems in Tonga, with regard to the management of the land, marine and coastal resources. Specifically the objectives of this chapter are as:

- to qualitatively and quantitatively assess, where possible, the state of the environment (SoE) of Tonga;
- to consider opportunities and constraints for achieving or hindering sustainable development;
- to analyse community and government responses to environmental issues;
- to identify data and information gaps required for sustainable development; and
- to determine issues central to achieving sustainability in Tonga as the basis for the empirical investigation undertaken in this thesis.

### **3.1.2 Method**

A SoE reporting framework is useful in delivering information about the environment to all sectors of society, by identifying environmental issues and assessing actions designated to deal with them. The purpose of a SoE report is to assist the decision making process and to inform the wider community about major issues affecting the local environment.

There has been, to date, no SoE report for Tonga, so the SoE reporting in this study is based on existing sector reports and studies available in Tonga, and from other sources<sup>1</sup> in an attempt to synthesise and assess the existing information from a wider national environmental perspective. The little information and data available were not produced for the purpose of SoE reporting. It is expected that this section would be descriptive as it would be difficult to determine changes and trends. Major information gaps that may exist in this section of the thesis are due to:

- lack of consistency in the historical data available;
- information available having been collected according to the different sectors of government priorities;
- the varying quantity and quality of the information available, making it difficult to analyse;
- the different methods used for data analysis and information collection; and
- a lack of data in some areas.

Since there are no nationally developed environmental indicators<sup>2</sup>, established indicators, such as those developed by UN organisations (e.g., FAO, and WHO), OECD, and the World Bank, and those used by the South Pacific Cooperation of Regional Organisations Program (CROP) are adopted in this study.

## **3.2 The Study Area**

### **3.2.1 Geographical and Geological Context**

The 1887 Constitution of Tonga declared the boundaries of Tonga as being between longitudes 177° and 173° W, and latitudes 15° and 23° 30' S (see Figure 3.1). The Territorial Sea and Exclusive Economic Zone Act 1978 is not yet in force. If it were, it would establish a twelve nautical mile territorial sea and a 200 nautical mile exclusive economic zone. The total area of the EEZ would be about 700,000 km<sup>2</sup> as compared to the 397,282 km<sup>2</sup> covered by the 1887 Royal Proclamation (ESCAP & GOT, 1990).

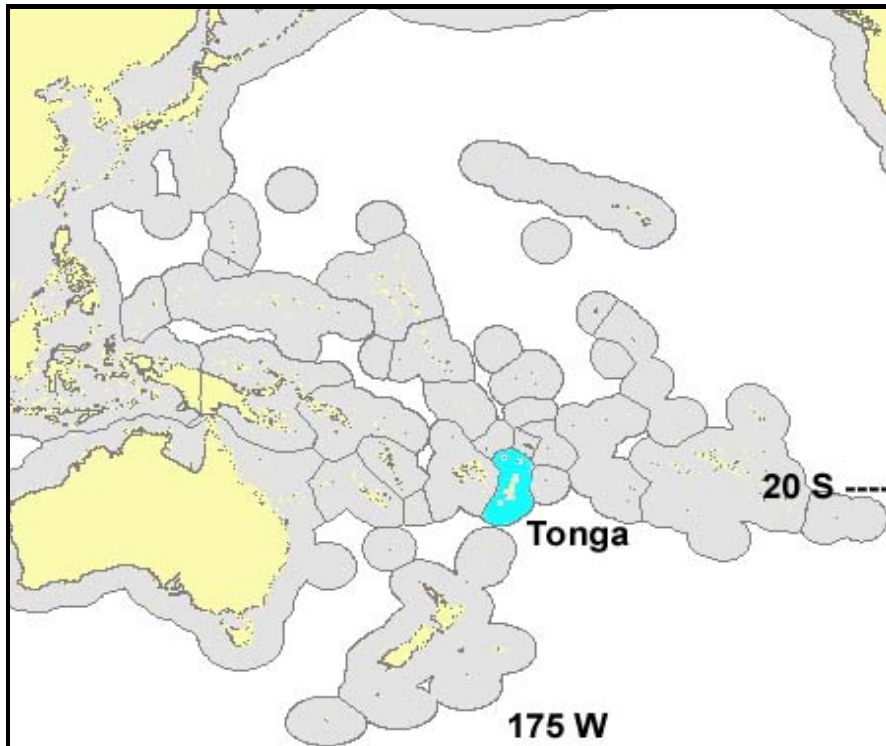
Tonga is situated at the eastern most edge of the Australia-India Plate, formed as a response to the subduction of the Pacific Plate beneath the Australian-Tonga Plate (Francheteau, 1983). The three main island groups, Tongatapu, Vava'u and Ha'apai, are elevated masses of tertiary limestone and volcanic rock capped by quaternary limestone, which rise above a central platform area. The young volcanic islands and sea-mounts of the west of the Ha'apai group (Tofua Arc) rise from a separate, mostly submerged cordillera west of the central area of the Tonga Ridge, and extend from Tafahi in the north-east to 'Ata in the south west (see Figure 3.2).

The Tonga Trench, the second deepest ocean trench (> 10,800 m) in the world, lies parallel to the east of these submerged ridges (Scholl, et al., 1985; Cunningham & Anscombe, 1985). Tonga is located near two geological plate boundaries, so the islands are in a zone of frequent earthquakes and volcanic activity (Gatliff, 1990). Taylor & Bloom (1997) divided the geological formations of Tonga into three main groups as:

- uplifted limestone from a submerged sea floor caused by the subducted plate, such as Tongatapu, Vava'u and Ha'apai;

- volcanic islands such as ‘Ata, Tofua, Kao, Late, Niufo’ou and Tafahi; and
- mixed limestone and volcanic islands such as ‘Eua and Niuatoputapu.

**Figure 3.1: The Location of Tonga (and relative EEZ) in Relation to other Countries in the Pacific**



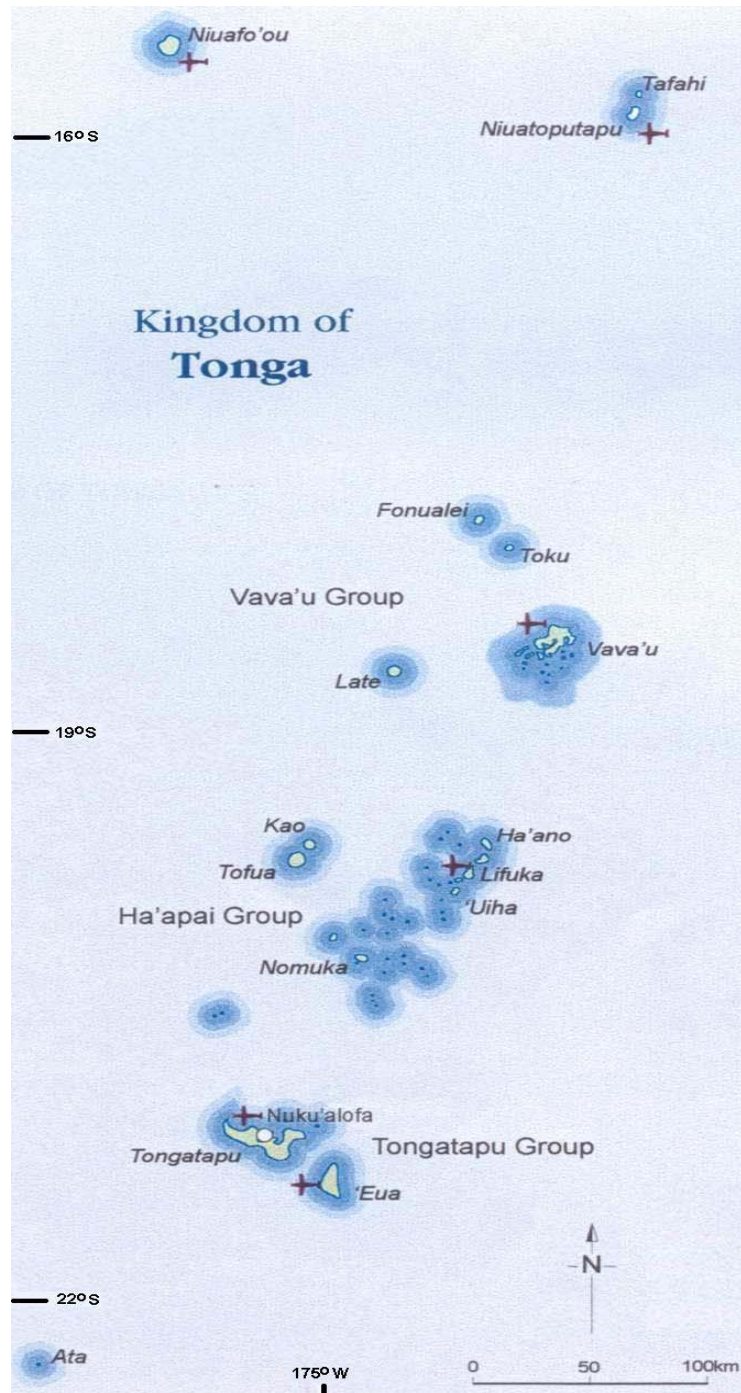
Source: Adapted from SOPAC, Suva, 2002

### **3.2.2 Main Island Groupings**

Tonga comprises of 176 islands of which about 36 islands are inhabited. The total land area is only 649.91 km<sup>2</sup>. Administratively, Tonga is divided into three main island groupings (see Table 3.2.1 and Figure 3.2). The Tongatapu Group (including ‘Eua), the Vava’u Group (including the Niuas), and the Ha’apai Group (ESCAP & GOT, 1990).



Figure 3.2: The Tonga Archipelago



Source: Adapted from NZODA, Vava'u Tourism Feasibility and Design Study, 1999

**Table 3.2.1: Main Island Groupings: Name of the Group and Largest Islands in the Group by Number of Islands in the Group and Major Physiographic Features of the Main Islands**

Island Grouping	Main Islands in the Group	Capital Towns	No. of Islands in the Group <sup>1</sup>	Total land area of the Group (sq km)	General Physiographic Features
Tongatapu Group	Tongatapu <sup>2</sup>	Nuku'alofa <sup>3</sup>	17	347.92	<p>It has low flat relief, rises from broad tidal flats and lowland coastal swamps and mangrove forests along the northern edge to a maximum elevation 85 metres towards the southeast. Most of Tongatapu is less than 17 metres above mean sea level. The upwind south coast has rugged limestone cliffs and terraces from 6 to 46 metres in height.</p> <p>A narrow fringing reef surrounds the east, south and west coast of the island. Coral reefs extend northward from the north coast along an extensive submerged terrace. There is an extensive shallow lagoon in the central part of the island (Fanga'uta and Fangakakau). It extends 6 – 10 km into the island and is surrounded by low-lying swampy areas.</p> <p>One of the oldest (geological) island in Tonga, high relief, minimum relief of 312 meters, no lagoons, few caves and fresh water springs</p>
Vava'u Group	Vava'u	Neiafu	97	192.69	<p>Vava'u has distinct terraces to the highest point at 213 meters, extensive tidal flats, fringing reefs, submerged barrier reef on the eastern side of the group, protected harbours, well developed beaches, and numerous small islands.</p> <p>Volcanic, 260 m above sea level, small internal lake in old crater in the middle of the island, barrier reef, active volcano at Niuafu'ou</p>
Ha'api Group	Lifuka	Pangai	62	109.30	<p>Low relief generally only a few metres above mean sea level, exceptions the volcanic islands of Kao (1,030 m asl) and Tofua (507 m asl), numerous small islands formed on coral reef platforms, extensive coral reefs</p>

Sources: Various National Reports; <sup>1</sup> Includes uninhabited islands; <sup>2</sup> Tongatapu is the largest island in Tonga; <sup>3</sup> Nuku'alofa is the capital of Tonga

### **3.2.3 The Environmental Context**

#### **3.2.3.1 Climate**

Tonga's maritime environment moderates its climate. The mean annual minimum temperature increases from 20.7°C from Tongatapu in the south to 23.7°C in the Niuas at the north. The mean annual maximum annual temperature increases from 27.1°C to 29.8° C (See Figure 3.3). 1998 was recorded as the warmest year on record with temperatures ranging from 13.6° C on 31 July, to 32.6° C on December 24 (MET, 1998).

Rainfall is perhaps the most important climatic variable for both the people of Tonga and the environment. Extreme climatic fluctuations persisting for months and even years can have a dramatic impact on the economy as well as the lives of all inhabitants in Tonga. The rainfall regime of Tonga shows a pronounced wet season from November to April (also the cyclone season), when about two-thirds of the annual amount falls, and a dry season (May to October). Rainfall is highly variable from year to year reflecting the sporadic nature of the intensity and amount of rainfall (Thompson, 1986). High intensity, short-duration rainfall can occur at any time of the year, but particularly during the cyclone season.

#### **3.2.3.2 Tropical Cyclones**

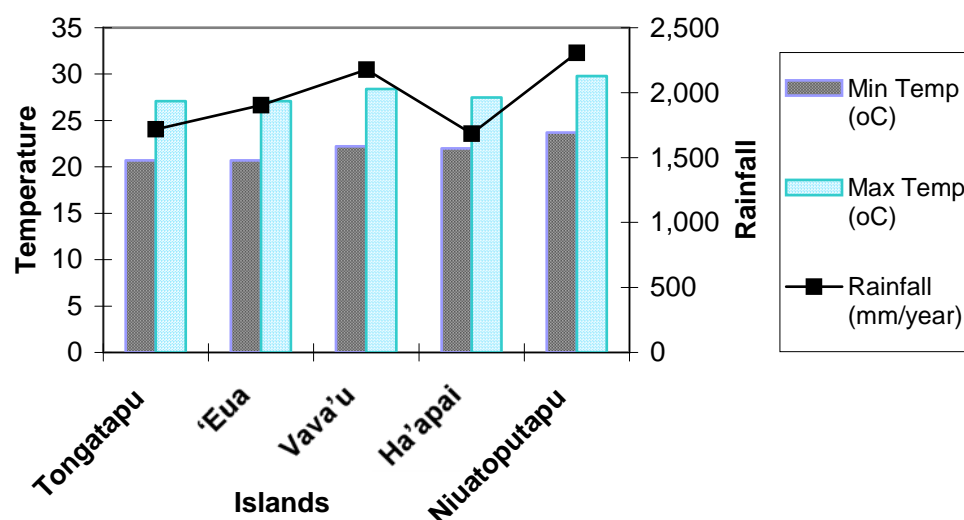
Another important feature of Tonga's climate is tropical cyclones. This is important because of the damage cyclones cause, not only to infrastructure, settlements, and agriculture, but also to the environment. Most notable is the damage to habitats (forests, other vegetation cover and coral reefs); associated storm surges cause coastal erosion and inundation, salt spray and flooding, ruined crops and properties, coupled with related health issues, such as water borne diseases and sewage pollution.

From 1986 to 1998, seven cyclones affected Northern Tonga, 2 affected the Southern Tonga, and four cyclones affected the whole country. Except for one cyclone, all the other 12 cyclones had winds between 50 and 140 knots (MET, 1999). In 2000 to 2003 alone, five

cyclones hit Tonga and two of those caused severe damage in northern Tonga (Niua and Vava'u), (per.obs).

**Figure 3.3: Annual Mean Minimum and Maximum Temperatures and Total Rainfall (50 year average) for the main Islands of Tonga**

Data of 'Eua were estimated from 10 years' data (1989-1998); Ha'apai data was from the record stations in Lifuka in the northern part of the group, which could distort the estimation of the total rainfall of the whole group. The same could apply in the Vava'u group; the data are from the Lupepau'u Airport recording station.



Source: Meteorological Service Database, Nuku'alofa

### 3.2.3.3 Soils

Tongatapu soils are predominantly derived from andesitic volcanic ash and are classified as Mollisols in the USDA classification because of their dark colours and soft feel reflecting high organic matter content (Cowie et al., 1991). They are derived from wind blown ash varying in age from 5,000 to 20,000 years. The origin of the ash was a series of volcanic islands to the north (Tofua and Kao) and west (submarine volcanoes) of Tongatapu. They are physically superior soils, friable, well structured, and well drained. In contrast, the volcanic islands themselves, with their steeper slopes, are covered with lava that has not weathered significantly so there is very little topsoil (Orbell, 1983).

Beecroft (1976) studied the soils of Ha'apai and showed that they are deficient in N, P and S. Orbell et al. (1985) studied the soils of Vava'u, while Wilde and Hewitt (1983) surveyed the soils of 'Eua. The main soil deficiencies for crop growth as indicated by these studies are similar to the findings of Beecroft in Ha'apai. These studies all indicated that, with adequate fertilisation and reasonable management, the soils of Tonga are capable of sustained production involving a wide range of crops.

### **3.2.3.4 The People and the Economy**

The Tongan people are Polynesian in origin and the socio-political order is a blending of traditional Polynesian elements and Western influences. The Tongan society is divided into three social classes (see also Chapter 2, Section 2.3.3.1). There is, however, an emerging social class made up of the educated and successful business commoners. The main elements of the Tongan culture lie in its kinship ties that are inherently underpinned by social values and structures, and Tonga's political paths. The Tongan language is the main language, spoken throughout the islands, but English is widely used.

Tonga's economy is based on subsistence agriculture and controlled by factors such as weather conditions and world market prices. About 60 % of the workforce is employed in the agricultural and fishing sectors. Squash (*Cacurbita maxima*) is the main foreign exchange earner in terms of exports with fishery increasing in the last five years. A drought in 1993 escalated the market price for squash, while excellent weather in 1994 resulted in an oversupply in the market, which caused a low market price. Droughts in 1995 and 1998 resulted in a small increase in price, and the other years were affected by low market prices (Table 3.2.2). Tonga's total exports were valued at T\$12.6 million for the 1997/98 periods, while the total imports were worth T\$100.7 million. The remittances from Tongans living overseas in this period were estimated at T\$61.7 million in 1998 (TRB, 1999).

**Table 3.2.2: Proportion of Principal Exports (f.o.b. value) of Tonga (1993 – 1999)**

Years	Squash (% of total)	Fish	Kava	Vanilla	Root Crops	Others	Total (T\$ (10 <sup>6</sup> ))
1993/94	56.0	15.5	0.9	9.9	4.3	13.4	23.2
1994/95	48.1	23.8	1.6	15.1	3.2	8.1	18.5
1995/96	46.4	23.2	3.3	11.6	5.5	9.9	18.1
1996/97	45.5	14.7	10.5	5.6	8.4	14.7	14.3
1997/89	48.0	26.4	12.0	1.6	4.0	8.8	12.5
1998/99	35.8	24.2	16.7	6.7	2.5	14.2	12.0

Source: National Reserve Bank of Tonga 1999, Quarterly Bulletin

Diversification of the economy is constrained by Tonga's very narrow resource base, remote location, small domestic market, and scarcity of skilled manpower in the areas of technology, electronics and manufacturing. The country has a large foreign exchange deficit (T\$25million in 1997/98) and relies heavily on foreign aid, and remittances. This is not sustainable as donors are reducing aid. Economic recessions in overseas countries also affect the Tongans who send money back home (TRB, 1999). However, there are signs from other sectors, such as tourism, fisheries and the services industries that they could contribute more to the national economy if they were strategically managed (GOT, 2001).

Tonga's economic growth is characterised by large trade deficits throughout the 1990s, large net private transfer flows, and a negative current account balance that is often a reflection of foreign borrowing to finance public investment projects (ADB, 2002).

### 3.2.3.5 The Constitution and Government

Tonga has a Constitutional Monarchy Government under His Majesty King Taufa'ahau Tupou IV and his heirs and successors (1875, Constitution of Tonga (COT), Clauses 30 and 31), (see also Chapter 4, Section 4.3). The Government is divided into three bodies:

- The King, Privy Council and Cabinet (Ministry);
- The Legislative Assembly (nine people's and nine nobles' representatives); and
- The Judiciary System.

Although Tonga was not colonised, Tonga was strongly influenced by British missionaries throughout the 19<sup>th</sup> century and by British rule (1900 –1970), whilst Tonga was a British Protectorate (Latukefu, 1974). Tonga's constitution is based on the British model.

### **3.3 The Land Resources**

The Tongan people have very strong links to the 'land' of Tonga. It is the sense of land ownership that links a Tongan to his or her origin in Tonga. The 'land' is not only the most valuable economic resource but it also shows one's status in the Tongan society. The land tenure system underpins this 'connection' with the land.

#### **3.3.1 The Land Tenure System**

The issue of land allocation is central to the very existence of the people of Tonga. All land in Tonga is Crown Land (technically owned by the King). This is comprised of the hereditary estate<sup>3</sup> of the king, the estates of the rest of the royal family, the hereditary estates of the nobles and titular chiefs (*matapule*)<sup>4</sup>, and government land. Land allotments are granted from both hereditary estates of the nobles and government land depending on where a person resides (COT, 1875, Part III). A Tongan male, sixteen years and over, is required by the *Land Act* to have a town (minimum of 1,618 metres<sup>2</sup> for residential purposes) and a tax (12 acres for farming) allotment. Title to allotments is individualised and becomes hereditary, passing to the eldest legal son according to the prescribed rules of succession (*Land Act, 1903 s. 4*). When there is no male heir, women can only lease land or hold land in trust for their sons or husbands, otherwise the land reverts to the Crown (*ibid. s. 41*). Sale of land is prohibited, but allotments have been used as mortgages for bank loans. Although there is no freehold land in Tonga, the control of the land lies in the hands of the individual 'landholder'.

Land, as defined by the *Land Act 1903* of Tonga, includes all land and its resources such as biodiversity and minerals. This definition includes land above water and below water, for example, the seabed. Water is regarded as 'minerals', and is therefore a land resource. For the purposes of this study, land resources are divided into three categories, the land itself, the biodiversity, and the fresh water resources (water lens and rain water).

The pressures that change and shape the state of the land resources are population growth and density, settlements, and different forms of land use. These pressures not only rely on resources (inputs) from the land resources but also release outputs that further shape land resources. This chapter deals with the environmental impacts of the use of land resources (the land, water and biodiversity) the pressures leading to those impacts, the responses taken to the changing state of the land resources, and the information required for SoE reporting and for decision making. For the purpose of this study, other forms of human activities on land, such as, transport, tourist facilities, industries and manufacturing, although important, are not covered.

### **3.3.2 Pressures on Land Resources**

#### **3.3.2.1 Human Settlement**

After the cessation of 53 years of civil wars in 1852 and a series of epidemics, which followed contact with Europeans, an 1891 population census revealed that there were fewer than 20,000 people in Tonga (Maude, 1965). Within a century the population recovered well beyond the former resident population (Matoto, 1971). The 1996 census recorded 97,784.

Presently, Tonga's demographic profile is characterised by declining mortality and fertility trends, increasing life expectancy and a highly migratory population. This has consequently altered the nature of the population's age structure, whereby there is an increase in the working age and a slight decrease in the dependent population (GOT, 1996). This has implications for employment availability and sustainable management of natural resources.

#### **3.3.2.2 Population Growth and Density**

The 1996 census estimated a natural population growth of 2.3% per annum. However, the 1986-1996 inter-censal period indicated that Tonga's annual population growth rate was 0.3, suggesting an annual net migration rate of approximately – 2.0% (Table 3.3.1).



**Table 3.3.1: Non-migrant<sup>1</sup>, In-migrants<sup>2</sup>, Out-migrants and Net Migrants by Division, (1986-1996)**

<sup>1</sup> Non-migrants are defined as those who still reside at their place of birth and were counted there as their usual place of residence during the census night.

<sup>2</sup> In and Out migrants were those who moved from their place of birth and reside at a different place that they identified as their usual place of residence.

Division	Non-migrants	In-migrants	Out-migrants	Net-migrants
Tongatapu	49,225	14,821	3,570	+11,251
Vava'u	13,459	2,337	5,489	-3,152
Ha'apai	7,194	1,093	6,640	-5,547
'Eua	3,126	1,711	1,350	+361
Niuas	1,626	581	1,672	-1,091
Abroad	408	423	2,245	-1,822
Not Stated	16	1	1	-
Total	75,053	20,967	20,967	0

Source: Government of Tonga (GOT), Census, 1996 -- Internal Migration

A comparison of the natural increase of the population with actual census counts reveals that about 20,000 to 40,000 Tongans were probably absent from Tonga as of 1986 (CPD, 1987). The migration rate then was estimated to be from 1.4 to 1.5% annually between 1976/1986. Therefore, it is estimated that between 1986/1996 there was an increase of annual migration by 0.5 to 1.0%. This means that the migration out-flow of people has helped to offset the natural increase in the population of Tonga.

Tongatapu accounted for 70% and 17% of the in-migrants and out-migrants respectively. Vava'u accounted for 11% and 26% of in-migrants and out-migrants respectively. Except for Tongatapu and 'Eua, all other divisions lost more people than they gained. Not surprisingly, Tongatapu gained the most, with a net in-migration of 11, 251 persons. Tongatapu gained 9,919 persons (net in-migrants) since the 1986 Census. The majority of these gains were from Ha'apai (31 %) and Vava'u (26 %).

Tongatapu's population growth rate slowed down from 1986. The other island groups also continued the downward pattern exhibited in the 1986 census, declining on average by 0.9% every year since 1986 (see Table 3.3.2).

**Table 3.3.2: Population, Average Annual Rates of Growth by Divisions (1976, 1986 and 1996) and Density (main Islands only) in 1996**

<sup>1</sup> Mainland Vava'u, Pangaimotu, 'Utungake and Koloa

<sup>2</sup> For Lifuka and 'Uiha only

Division	1976	1986	1996	Average Annual Growth Rate (%)		Density (sq.km) 1996
				1976-86	1986-96	
Tongatapu	57,411	63,794	66,979	1.1	0.5	259.1
Vava'u	15,068	15,175	15,715	0.1	0.4	141.2 <sup>1</sup>
Ha'apai	10,792	8,919	8,138	-1.9	-0.9	221.9 <sup>2</sup>
'Eua	4,486	4,393	4,934	-0.2	1.2	56.4
Niuas	2,328	2,368	2,018	0.2	-1.5	28.1
Total	90,085	94,649	97,784	0.5	0.3	

Source: Government of Tonga (GOT), Census 1986 and 1996

Between 1976, 1986 and 1996, Tongatapu's population increased from 63.7% of Tonga's population to 67.4% and 68.9% respectively, while the rest of the main island groups decreased at the same period with the exception of 'Eua (Stats Dept, 1999). Although internal migration occurs within the Vava'u Group or the Ha'apai Group, for instance, from the outlying islands of Vava'u to mainland Vava'u usually, this is just a stepping-stone to Tongatapu.

Population density varies dramatically from one island to the other (see Table 3.3.2). The density of Tongatapu increased from 244.9 people per sq. km in 1986 to 259.1 people per sq. km in 1996.

### 3.3.2.3 Agriculture

Apart from Tonga's vulnerability to natural disasters, the influences on the land resources are overlain by centuries of human influence, which has included intensive agriculture. The two most profound changes in the agricultural systems in Tonga were the switch from a traditional agriculture system to a large-scale planting of coconuts at about the beginning of the 20th century, and the steady increase in cash cropping and mechanisation after World War II (ESCAP & GOT, 1990).

The traditional agriculture in Tonga is mainly intercropping with rotational farming. It is essentially a multistory agroforestry system with planted or protected coconut palms, fruit trees and a wide range of other useful trees creating an open over-story for the shifting agricultural production of a wide range of root crops, supplementary food crops and fallow vegetation in various stages of regeneration (Thaman, 1976). This protects the soil, reduces clearing and maintenance work, reduces the risk of disease affecting a whole garden, and spreads the harvest period for the garden (Thaman, 1976).

Cash cropping by intensive horticulture production, e.g. squash, watermelon and vegetables requires high inputs of fertilisers and pesticides, and the clearing of the land for ploughing. Although agricultural soils are fertile in Tonga, most of the agricultural crops for export rely heavily on pesticide and fertiliser applications (Manu, 2000). In 1998 alone, 3,921 tonnes of pesticides and fertilisers were imported to Tonga from Australia, New Zealand and the U.S.A. costing \$T3.5 million (Department of Customs, 1999).

The sale of fresh agricultural produce with potentially significant chemical residues needs to be addressed as a serious health and environmental issue under either the Pesticides Act or the Public Health Act. For this to be effective, however, both MAF and MOH need to consult and closely co-operate in monitoring and regularly testing samples of produce sold at the produce markets. Such coordination is not carried out. Further, with the increase in commercial farming, native forests have been cleared to allow for mechanization. This has led to major loss of forest, forest resources (firewood, medicines, seeds etc.) and habitat for wildlife (per.obs).

#### **3.3.2.4 Forestry**

The indigenous forests in Tonga are diminishing rapidly due mainly to pressures from human activities on forest resources. Forest resources are used as sources of food, firewood, construction products, for traditional medicines, for cultural perfumery and costumes (oils, garlands and dancing costumes). They are cleared for agriculture, for settlement and for recreation. Other sources of pressure on the forests of Tonga are gale force winds and cyclones (Section 3.2.3.2).

As a result, only limited and fragmented areas of indigenous forest remain in Tonga, primarily in very steep or otherwise inaccessible areas, unsuitable for agriculture. The total area of 'good' forest in Tonga was estimated to be about 4,000 ha of, with 3,779 ha estimated on 'Eua, of which 1,747 ha was considered accessible (Larsen & Upcott, 1982). Thompson, (1976) estimated a further 324 ha of potentially exploitable forest on Tofua (a volcanic island in the Ha'apai Group). Both studies were reported in Thistlethwaite et al. (1993). There is a small area of forest on the island of Late in Vava'u. The islands of Tafahi and Kao have undisturbed cloud forest on steep slopes. There is a small, indigenous forest on the island of Niuatoputapu (Thistlethwaite et al., (1993). These areas could be significantly smaller nowadays. Much of the forest, however, is secondary, except for a small area in 'Eua.

### **3.3.2.5 Pressures caused by Domestic Animals**

The presence of free ranging and unfenced animals, particularly pigs and goats, is widely reported at village meetings, and women's organisation meetings, to be one of the major environmental problems in Tonga (pers. obs). Uncontrolled pigs and goats lead to devegetation and dusty conditions in towns and villages and to the destruction of crops, valuable trees and plant seedlings in both urban and rural areas (Thaman, et al., 1995a; Thaman et al., 1995b).

A major threat to most bird species is the introduction of mammals, among which cats and roof rats, *Rattus rattus* are the most devastating. Blue crowned lorikeets (Henga), *Vini australis*, Fiji shrikebills and Friendly ground doves have almost been wiped out by cats and rats (Rinke, 1990).

### **3.3.3 The Impacts**

Increasing numbers of people (Fig. 4) place a severe stress on all features of the environment, including access to land/land availability, waste management problems, water supplies, agriculture and forestry. The most recent available data on land holdings indicate that only 35% of the 1996 male population could have been accommodated if they had chosen to exercise their rights to a full grant of heritable land as provided by the *Land Act* of 1903

(MLNSR, 1999). The heritable land is passed from a father to his heir (the eldest son) (*Land Act, 1903*). The second, third and subsequent sons who wish to exercise their legal rights may migrate to Tongatapu. Tongatapu provides a better opportunity, not only because it is bigger in land size compared to the other islands of the Tonga, but other pull factors such as the centre of government, business and industries, better health services and schools and a stepping stone to migration overseas also play a significant role. It would be very useful if data on land titles and where the holder of the title is residing could be made available.

From the 1996 Census, there are 27,746 Tongan and part Tongan males over 16+ years, which is 57% of the total male population and 29% of the total population. Legally, this is the number of males entitled to town and tax allotments. However, in 1994 the MLSNR recorded a total of only 15,485 tax allotments, 13,609 town allotments and 3,736 leaseholds. By the year 2000, registered tax allotments increased by 3.5% (to 16,021), town allotments increased by 13.2% (to 15,406), and leaseholds increased by 29% (to 4,818). As would be expected, land registration was recorded at its highest in Tongatapu, accounting for 53% of tax allotments, 32% of town allotments, and 78% of leaseholds for the year 1994 (MLSNR, 2000). From 1995 to 2000 there was a 10% decline in town allotment registration for Tongatapu suggesting that pressure for space at Tonga's main commercial centre has compounded against limited available land (MLSNR, 2000).

Taking into consideration the number of males that have turned sixteen since the 1996 census, to fulfill only the agricultural (bush allotment) provisions of the *Land Act* would have required 50% more land than exists in the whole of Tonga – 90, 214 hectares of land, versus 59, 130 hectares of land judged suitable for dwelling or agriculture (MAF, 1999). It is currently estimated that 75 % of eligible males are without a tax allotment (MLSNR, 2000). This is an issue central to the goal of sustainability in Tonga and in small island countries.

Several management problems arise from this land shortage. The subdivision/allocation and subsequent conversion of ecologically important coastal wetlands, coastal land and mangrove areas, especially in Tongatapu is increasing (see Section 3.5). Since land is scarce, competition in the form of 'harvesting as much and as quickly' of land resources is common (pers. obs) The other implication of the land tenure is that those who obtain control of the land also control all resources in that allotment (forest, water, biodiversity and minerals if any).

Therefore, landowners can do whatever they want with those resources. As the number of people without land increases every year, the number of leases and unsecured tenures (e.g. non formal lease arrangements) also increases. These problems are major obstacles to the sustainable management of land resources in Tonga (pers. obs).

### **3.3.3.1 Impacts Incurred by Leasehold Arrangements**

Cabinet grants formal lease arrangement for various purposes and for various durations. In 1999 there was a total of 4,548 leaseholds, an increase of 250 leaseholds from 1998 (MLSNR, 1999). The significance of this number is in the lease formal agreement. There are no environmental standards required by law to protect or enhance the environment and land resources (see Chapter 4, Section 4.5.1.1). Similarly, non-formal arrangements are increasing between absentee landowners (either overseas or migrated to other islands within Tonga) and family members or relatives. Anecdotal evidence has pointed to the leased land being severely damaged in terms of pollution, deforestation and soil degradation.

### **3.3.3.2 Impacts of Urban Sprawl**

The incidence of rural to urban, and outer islands to main islands migration is significant in Tonga in terms of demands for land in the main islands. Migration from the rural areas of Tongatapu, Vava'u and Ha'apai make up 78 percent of the in-migrants into Greater Nuku'alofa (Stats. Dept., 1999). Land demand for settlements in the Nuku'alofa has increased in recent years and has led to allocation of allotments in mangrove areas, wetlands and low-lying areas around Nuku'alofa (Table 3.3.3). Agricultural land (tax allotment) around the periphery of Nuku'alofa has been subdivided for settlements.

As a result, Popua, Sopu and Tukutonga villages sprang up to the north east and north west of Nuku'alofa. These villages are in areas where mangroves were removed to build houses, and are subject to frequent inundation from the sea or by heavy rain. Poor drainage means water tends to stay on the surface for long periods of time (ECAP & GOT, 1990). Residents face major health risks from water borne diseases and sewage problems, and environmental problems such as pollution, and smoke from the nearby Popua public rubbish dump. Table

3.3.4 gives the number of households and people living in these communities. The population of Popua and Tukumonga increased three and four times respectively within ten years.

**Table 3.3.3: Settlements of Swampy Areas**

Settlements	NR – not recorded			
	Number of People (1986)	Number of People (1996)	Number of Households (1986)	Number of Households (1996)
Popua	256	1,206	93	180
Tukumonga	110	341	38	55
Sopu	(NR)	1,624	(NR)	240
<b>Total</b>		<b>3,171</b>		<b>475</b>

Source: Derived from the Government of Tonga, 1986 & 1996 Census

These settlements represent 10.6% of the total urban population of Tongatapu. These data shows that quite a large percentage of the urban population live in environments where hazards and health risks are significant. The number of persons per household (large but ‘normal’ in Tongan households) is significant when one considers the type and houses in these areas. Most of the houses in the Tukumonga area are very small and made from temporary material found in the rubbish dump nearby (per. ob.).

### 3.3.3.3 Waste Outputs and Impacts on Land Resources

#### **Solid waste**

The waste management problems, although are more conspicuous in urban areas, have important implications for the country in general. They are a reflection of the expanding population and a lack of sound urban (national) and regional management and planning policies that should have accommodated the associated rapidly rising generation of waste (SPREP & EU, 2000; Brodie & Morrison, 1984). Tonga shares this situation.

Related to the human environment and human activities is the generation of waste and how it is being managed. Only the capitals of Vava’u (Neiafu) and Tongatapu (Nuku’alofa) have some data on waste output (see Table 3.3.4). In Nuku’alofa, there is a weekly collection system for the collection of solid wastes from households and businesses. Most households do not utilise this service despite a very small cost of \$2.00 per month collection fee. Therefore,

a very common form of solid waste disposal is 'back yard burning'. Sinclair Knight Merz (1999) surveyed the only official rubbish dump in Nuku'alofa (Popua Rubbish Dump). The survey reported that it was common to find hazardous wastes such as cleaning fluids, used batteries, waste oils, solvents, pesticides and fertiliser waste in the rubbish dump. The Popua rubbish dump is not lined, so it is possible for leachate from the site to find its way into groundwater, and the nearby marine environment.

Solid pharmaceuticals related waste is burned in an incinerator block. This is not a high temperature incinerator, so there are emissions of incomplete combustion products, such as polynuclear aromatic hydrocarbons (Bagchi & GOT, 2000).

Only Nuku'alofa and Neiafu have rubbish collection services and dumps managed by the government. The Ministry of Health (MOH) has responsibility for the collection and for managing the rubbish dumps. The MOH annual report in 1998 reported that there was no registration for the service in Neiafu, and only 752 registered households in Nuku'alofa. From the 1996 census there were 29,954 and 4,159 households in Nuku'alofa and Neiafu respectively. In 1999 there was an increase in the number of households in Nuku'alofa, registered for the rubbish collection service, to 950, i.e. approximately 20% of the total households of the Nuku'alofa area. The rubbish collection is heavily subsidised by the government (Dever, 2000). There is one rubbish truck since late 1980s servicing just a small proportion of Nuku'alofa, and the Public Health rubbish services in Neiafu have been closed down due to lack of funds, skilled staff and appropriate equipment. However the Vava'u dump is still open to the public (per. obs).

Typical of small islands, finding suitable sites for landfill is a problem. The current dumpsites in Nuku'alofa and Vava'u are both in mangrove areas. The sites are open pit dumping with no prior sorting and very little onsite management. Both sites reached full capacity some time ago. Domestic animals such as dogs, pigs and cats commonly scavenge at the dumps (Dever, 2000).



**Table 3.3.4: Summary of Waste Output and Impacts**

<b>Waste Output</b>	<b>Amount/Quantity (if available), Impacts and Explanation</b>	<b>Sources of Information</b>
Solid waste	<ul style="list-style-type: none"> <li>- In Tongatapu 65% of the volume of waste that goes to the dump is organic waste (wood, grass/green waste)</li> <li>- Very few returnable bottles are reaching the dump (royal beer bottles, coca cola)</li> <li>- Little hazardous waste in the dump apart from some hospital waste (needles, swabs, etc.)</li> <li>- Average waste generation per capita of 0.82 kg/person/day</li> <li>- A lot of domestic waste is not accounted for (44%) or feed to animals (81%)</li> </ul>	WHO (1996) Sinclair Knight Merz (1999)
Litter and indiscriminate dumping	A major problem in Tonga – in urban areas, beaches, vacant plots, road sides, mangroves	DOE (1999) Dever (2000)
Hazardous waste	<ul style="list-style-type: none"> <li>- Estimated 202,000 L of PCB oil</li> <li>- School and other laboratory chemicals not known</li> <li>- Waste oil 2,000 L</li> <li>- Three potential contaminated sites – MOW and Electric Power sites with waste oil and oil contaminated, Government stores depot with CCA</li> </ul>	SPREP (1999)

### **Chemical/Liquid/Gases Waste**

Little data are available pertaining to the types and amounts of chemical waste generated. Whilst some industrial operators do keep track of their liquid waste inventories, most do not, and there is no database listing the types and amounts of chemical (or other) wastes that are generated. Few estimates of these amounts are available (Brodie & Morrison, 1984).

Liquid industrial wastes are often discharged into septic tanks. This is particularly true for some of the smaller industrial operators. Petrochemical wastes from Shell and BP, the principal Tongan petrochemical industries, are stored in drums and periodically shipped overseas to Fiji for disposal and/or recycling. There is no chemical recycling, such as redistillation, but motor oils are often reused. The principal paint manufacturers, Asian Paints and Pacific Paints, both store their solvent wastes in drums, which are periodically collected by the Ministry of Works. They are then transported to sludge beds, near the Popua landfill. The liquid waste is placed in the sludge beds and the liquid phase is allowed to seep through a sand filter. The sand is periodically replenished. Industry has indicated that volumes of generated liquid waste are not large enough for the establishment of recycling/redistillation facilities and the export of wastes is not cost-effective (Bagchi & GOT, 2000).

Of special concern is the waste generated by obsolete transformers left lying on land near the lagoon. As the transformers are quite old, around 20 years, the dielectric fluids used in these contain high levels of PCBs. To an unknown extent these oils have leaked into the soil and may have found their way into the groundwater and lagoons. It is estimated that 25% of transformers in use are old, so this may continue to be a problem for some time (SPREP and AusAID, 1998).

A study of persistent organic pollutants by SPREP, in 1998, documented that there was 20,000 L of transformer oil, potentially containing PCBs. This study also estimated that there was approximately 2,000 L of waste oil, some directly dumped into soil. Other wastes, which were found to be significant but not quantified, were timber treatment wastes, particularly CCA. Sites that were identified as potential problems areas included the Ministry of Works – Depot and Garage, Shoreline – Popua Power Station, MAF – Research Stations in Vaini and Vavau, MOH – Hospital, Tonga Timber, and Government Stores (SPREP, 1999).

Concerns related to waste management in Tonga are manyfold. Table 3.3.5 lists the main waste outputs. Many others, however, have not been addressed because of the lack of adequate reporting in this area.

**Table 3.3.5: Waste Output Issues and Contamination Concerns**

<b>Nature of Problem</b>	<b>Brief Description of Problem</b>	<b>Availability of Statistical Data</b>	<b>Pollutant(s)</b>
Inappropriate use of Agricultural chemicals	Chemical poisoning on farms, use of a nematocide (Furadan) as a general pesticide and to kill pigs	No data available	Pesticides, fertilisers
Air pollution	No control of emissions from power plant and vehicles	No data available	CO, CO <sub>2</sub> ,NO <sub>x</sub> , drugs when burnt, pesticides, petroleum, smoke, dust particles
Mismanagement of chemicals and chemical wastes	No proper labelling of chemicals, no protective clothing for staff or students in school laboratories, Obsolete chemical wastes including POPs discharged into environment	No data available	Laboratory chemicals Laboratory, pesticides, PCBs
Dumping of expired/unused pharmaceuticals/ waste oil	No safe methods of disposing expired drugs, and those not required anymore, no high temperature furnace or	No data available	Antibiotics, cytotoxins, mercury, petroleum products

Nature of Problem	Brief Description of Problem	Availability of Statistical Data	Pollutant(s)
	chemical cleanup procedures		
Land contamination	Dumping of chemical waste	No data available	Pesticides, PCBs, petroleum, sewage Industrial chemicals
Drinking water Contamination	Rain water collection system (tank) and underground water contaminations	No data available	Dust, leaves and animals (birds, insects, rats etc.); Pesticides PCBs, petroleum, e-coli, sewage
Occupational Health	Workers using chemical solvents without adequate protection	No Data Available	Industrial chemicals
Occupational health - agricultural	Workers applying pesticides without adequate safeguards	No Data Available	Pesticides

Source: Adapted from Bagchi & GOT, 2000.

### 3.3.3.4 Impacts on Water Resources

From the 1996 Census, out of the total 16,194 households in Tonga, 13,705 or 84.6 percent have access to a piped water supply; 9,444 or 58.3 percent of all households have their own water tank; 393 or 2.4 percent had their own well, and 175 or 1.1 percent had other sources of water supply. It is common for a household to have access to more than one source of water supply. For example, a household may have access to piped water as well as have its own water tank (Statistics Department, 1999).

Water consumption per household per month, in the Greater Nuku'alofa area was estimated at 0.03 ML in 1998. These are only the households that have water meters. For the same year, in Nuku'alofa, it was estimated that 906 ML of water was for non-domestic uses. A total average of 4900 ML was for domestic use and 70.45 ML was unaccounted for (TWB, 1999). The non-domestic water users were mainly from the small industries sector and service industries such as hotels and motels, restaurants and service stations. Water use for agricultural purposes was not recorded. The large amount of water unaccounted for is from pipelines leakage (TWB, 1999).

The projected water requirement for the Nuku'alofa area is given in Table 3.3.6.

**Table 3.3.6: Projected Average Daily Water Production Requirements (Units=ML/d otherwise stated)**

Year	1996	1998	2001	2011
Nuku'alofa Area Population (based on 0.3% annual growth rate)	29,509	29,686	29,295	30,865
Population served (d)	26,558	26,717	26,959	27,779
Consumption per capita (l/c/d)	120	140	150	180
Domestic demand	3.07	3.04	4.04	5.00
Non-domestic demand	0.17	0.16	0.20	0.25
Total demand	3.24	3.20	4.24	5.25
Unaccounted for water	2.50	3.63	1.36	1.30
... (%)	0.44	0.53	0.24	0.20
Total Consumption	5.74	6.83	5.60	6.55

Source: Derived from the Tonga Water Board (2000) Data Base

The increasing water consumption has grave implications for the size and the amount of the fresh water lens on Tongatapu (the main source of water). Another important factor is the impact of climate change and sea level on Tonga's water sources. Of particular concern is the IPCC predicted prolonged drought periods and the sea level rise. These will impact on the level of the water table and potential mixing with salt water (Mimura & Pelesikoti, 1997).

### **3.3.3.5 Impacts of Agriculture and Forestry on Land Resources**

Very limited data are available on the impact of human activities on land resources. The following are based on singular studies, from 'frequently reported' impacts of which the author is aware, and from anecdotal evidence (also see Table 3.3.8).

#### **Impacts on Water Resources**

The corridors of indigenous forest that protect 'Eua's water catchment are under threat from encroaching agricultural activities and the changing of indigenous forests to exotic timber plantation (pers. obs) The people of 'Eua have always complained to authorities (Water Board, Ministry of Health, and the Parliament) in Nuku'alofa of the 'muddy' water from their pipes. In the last five years, however, the Ministry of Lands, Survey and Natural Resources

(MLSNR) has allocated fifty more tax allotments (120 ha) within the forest plantations (MLSNR, 1995 – 1999). Although ‘Eua is a smaller island in comparison to the other main islands of Tonga, this study shows that the impacts of agricultural activities and land allocation on water resources are detected. However, there is limitation in extrapolation of the ‘Eua study to the rest of Tonga.

In 1995 the Tonga Water Board (TWB, 1995) took water samples from eight wells in Mataki’Eua (supply water for Nuku’alofa) and had them analysed for:

- volatile organic compounds (30) by GC/MS; and
- organochlorine and organophosphorus pesticides analysis (27) by GC/MS.

The findings showed that there were traces of all the compounds tested, although the concentrations were <1 µg/L.

### **Impacts on Indigenous Forest Resources**

Impacts of human pressures and related activities are summarised in Table 3.3.7.

**Table 3.3.7: Impacts of Human Activities on the Forest Resources**

<b>Impacts</b>	<b>Explanation of Impacts</b>	<b>Sources of Information</b>
Easy access to logging and clearing of forest for other uses and for agriculture	No permits required for logging your ‘own’ land/trees Informal arrangement if logging from ‘someone’ else’s land From government land (coastal area), no permit required (as regulation is not enforced) Led to less shade and humus for the soil, less nutrients being brought up from the lower soil horizons, faster run-off of storm water Coastal forest strip dramatically reduced, therefore more exposure to wind and sea sprays, more rapid drying Native forests are cleared to allow for mechnisation in commercial agriculture	EPACS, (1990) Wiser et. al., (1999).
Increased weeds and pests	Spread into remaining forest area due to increased fragmentation and disturbance	Wiser et. al., (1999).

Impacts	Explanation of Impacts	Sources of Information
Free-Ranging Domestic Animals	Pigs, dogs, goats and horses led to destruction of new plants, crops and dug up the ground Commonly reported by women's groups as the major environment problem Introductoin of mammals (rats, <i>Rattus rattus</i> ) and cats). Blue crowned lorikeets (Henga), <i>Vini australis</i> , Fiji shrikebills and Friendly ground doves have almost been wiped out by cats and rats	EPACS, (1990) Thaman, (1995b) Per. obs. Rinke, (1990).
Increased demand for wood for firewood, carving and medicinal of oil perfumery	Common in all types of forest, tracking is common. Indigenous tress species which are good for carving are also in high demand Lack of firewood, fruits and nuts, medicines, cultural perfumery and timber. Bark stripping is for preparation of medicines or fragrances. These activated further disturbed the remaining forest Wildlife dependent on forest habitat is also affected i.e. fewer birds	EPACS, (1990) Wiser et. al., (1999).

### 3.3.4 State

The state of Tonga's land resources is shaped by the changes of land use, which lead to changes in land cover, and soil conditions combined with Tonga's climatic features. 'New' pests and diseases also arise from changes from traditional agriculture to commercial agriculture. Land cover as a concept is important for describing the conditions of the land resource, since it moderates the effects of weather and disturbances (Lloyd, 1996).

#### 3.3.4.1 State of the Land/Soil

##### Changes in Land Conditions

The nature and changes in land use exacerbate the changes in land conditions. The advent of production of squash for export in 1987 resulted in a three-fold increase in the cropped area in Tongatapu, Vava'u and 'Eua (MAF, 1999). The use of mechanical tillage generally reduced the soil fertility at a much faster rate when compared to the traditional no tillage cropping system. In lands that have been cropped continuously with mechanical tillage it is generally known that crop failures are highly probable, and with sub-optimal climate, such as in a drier than average growing season, very low crop yields are likely to result (Manu, 2000).

### **Changes due to Agricultural Practices**

The tillage preparation of land for squash occurs within the main rainfall season in Tonga, and the clay loam soils are prone to a dramatic increase in degradation. Due to the high clay content of the soil, the soil structure is very fragile when it is wet and prone to damage when tilled. As the soil structure is degraded, combined with the increased mixing with subsoil, and exposure to air, there is an increased mineralisation of soil organic matter. This is exacerbated by the current trend of increasing the length of the cropping phase with very short fallow periods, to almost continuous cropping. Consequently, soil organic matter declines, which results in concomitant reductions of biological, physical and chemical fertility of the agricultural lands of Tonga. This is accelerating at an alarming rate (Manu, 2000).

Another important characteristic is the high evaporative water demand by vegetation and crops, and the variable nature of the rainfall, creating soil moisture deficits at any time of the year, and especially during the dry season (Manu, 2000).

### **Pests and Diseases**

The state of pests and diseases that affect natural resources in Tonga has not been studied in any systematic manner apart from few disjointed studies carried out the by Research Division of the MAF. For example, Fakalata (1993) reported on the fruit fly (*Bactrocera facialis*) which is found only in Tonga and not yet found or recorded in any other Pacific Islands.

Fakalata (1993) also reported that where there is commercially oriented agriculture (such as in Tonga), with the introduction of new crop varieties, pest problems are more common. The frequent pesticide applications could cause pest outbreaks in phases, and could lead to the collapse of the control system. It is believed that such phases may already be happening in Tonga with crops such as bananas, cabbage, water melon and, lately, squash.

MAF (1996) reported on mushroom type fungi that have caused diseases of the Kava plant (*Piper methysticum*), such as root necrosis, resulting in chlorosis, stunting, wilting or dieback. Kava is one of Tonga's main exports.

### 3.3.4.2 State of the Forest<sup>5</sup>

More recent forest surveys include the following: Drake et al. (1996) in an old-growth forest of the island of ‘Eua; a survey in the old-growth and regenerating forest stands on islands in the Vava’u Group (Franklin et al. 1999); a survey in old-growth forest of the volcanic islands of Kao and Tofua, in the Ha’apai group (Park and Whistler 1998); and in secondary forests in Tongatapu (Wiser et al., 1999). All of these studies concluded that human activities are the main threats to the remaining forests in Tonga.

Wiser et al. (1999) reported increased fragmentation and disturbance which promotes the introduction and spread of invasive weeds and pests into the remaining natural forest in Tongatapu. The coastal forest strip, which serves the essential function of preventing shoreline erosion and protecting inland agricultural and inhabited areas from salt-water sprays, has been dramatically reduced in extent (Wiser et al., 1999). Human related disturbance is common in all forest types and in most forest patches sampled. Tracking is common, as is cutting of stumps or branches (usually for firewood). Bark stripping (generally for the preparation of extracts for medicines, fragrances, etc.) is a common practice (Wiser et al., 1999). Weiser’s findings on the Tongatapu forest could be also applied to the whole of Tonga as the same socio-cultural activities are happening.

#### **Protected Areas**

Since the enactment of the *Parks and Reserves Act 1976*, two parks have been gazetted, the ‘Eua National Park and the Mount Talau National Park, gazetted in 1992 and 1994 respectively. The ‘Eua National Park represents remnants of indigenous vegetation, including forests with associated fauna, and represents the last chance to conserve this part of Tonga’s natural heritage for future generations (Drake et al., 1990). Logging, other forest intervention and land clearing have had less impact on the eastern part of the island, mainly due to its inaccessibility. Moreover, there has been relatively little impact from introduced plants and animals (Rinke 1990; Whistler 1998). The Mount Talau National Park represents a cultural and traditional landmark in Vava’u, which still has indigenous and native tree species.

The protected status of these parks however, ends with their being gazetted. Further, the state of the parks before they were gazetted was not properly recorded, (removing the chance for



baseline information). This is one clear example of where government is not committed to 'follow up' its decisions. The Parks became subject to degradation with human encroachment as resource for management were not forthcoming and communities were not involved in the planning and their possible roles in Parks management (see also Chapter 4, Section 4.5.3.1)

### **Changes in Land Cover**

Land cover refers to the physical state of the land surface and includes vegetation, soil, rock, water and man-made structures. Man-made structures are not covered here although they have significant impacts on land cover.

Land, particularly in Tongatapu, is becoming increasingly scarce, (unavailable for new users) and changes of land cover in environmentally sensitive areas, such as mangrove swamps, lagoons and coastal areas, are common practice. As this trend is not likely to change, a regime for environmental conservation, encompassing not only pollution control but also land use planning and the exploitation of natural resources on a sustainable basis, becomes imperative.

The following description of the forest type is taken from Wisser et al., (1999). On Tongatapu most of the land surface is actively farmed, including coconut and other tree plantations (Table 3.3.8). Together these classes comprise 72 percent of the land-cover. Regeneration forest or fallow areas comprise eight percent of the cover, of which five percent is in non-forest types such as mangroves and swamps, while only three percent of the land surface has natural forest as its cover. The area of natural forest is 863 ha. This forest is predominantly coastal swamp forest (56 %) and coastal forest (36 %). Interior forest comprises only eight percent of the total natural forest area and less than (1 %) of the total land surface. There is lack of historical data to determine the trends in the change of land cover.

### **3.3.4.3 State of Wildlife<sup>6</sup>**

As to be expected, many of the native biodiversity assets of Tonga, notably primary forest and the myriad of plants, birds and other animals that are dependent on forest habitat, are now confined to the limited remaining forest areas. There are few areas left, especially in Tongatapu.

Land birds<sup>7</sup> such as *Ngutulei*, (*Sula dactylatra*), the red-tailed tropic bird (*Tavake Toto*) *Phaethou rubricauda* are now very rare, and may disappear completely from Tonga (Rinke, 1992)<sup>8</sup>.

Thaman et al. (1996) is the only study that attempted to list the endangered or rare biodiversity in Tonga, although it concentrated on the Ha'apai Group. An early list was included in the now repealed *Birds and Fish Preservation Act 1934*. Thaman et al. (1996) listed 103 trees, 20 birds, 20 seabirds (only 11 was protected by the existing regulation). As socio-economic situations are similar in all the islands in Tonga, Thaman's et al. (1996) study could reflect the state of biodiversity in the whole of Tonga.

#### **3.3.4.4 Status of the Water Resources**

Water, like the land, is a very valuable and critical resource for Tongans. Tonga does not have any surface water except in low-lying areas after heavy rains. The volcanic island of Tofua has a large salty lake of about three kilometres in diameter while smaller lakes in Late and Niufo'ou are also salty. The main source of water is from rainwater collection or from a thin fresh water lens within highly porous limestone substrate. The volcanic island of 'Eua gets its water from caves high above sea level. A large number of small islands in the Ha'apai and Vava'u rely entirely on rainwater tanks for their water.

Several studies have been conducted to investigate the hydrogeology and water supply of Tonga. Pfeiffer (1971) reported that the chloride contents of 46 wells tested in Tongatapu ranged from 30 to 558 mg/L. A comparison of values from 1959 and 1965 showed an increase in chloride content (Furness, 1993). Previous water investigations carried out in Tonga include Waterhouse (1976) and (1984), Forbes (1977), Hunt (1978), Lao (1979), Wilkinson (1984), Belz (1985), Dale & Waterhouse (1985), and Fuavao (1989). However, there has not been any recent studies until the 1997-2000 AusAID project to assist the upgrading of Tonga Water Board operations.

**Table 3.3.8: Tongatapu Land-cover Types and their Respective Areas as Mapped from 1990 Aerial Photos**

Mapped October 1997 and adjusted in October 1998 based on ground assessments made in November 1997

Land-cover type	Area (ha)	Percentage of Surface Area
<b>Natural forest</b>		
- interior forest	69	0.3
- coastal forest	310	1.2
- coastal swamp forest	483	1.8
<b>Other natural cover types</b>		
- mangrove	716	2.7
- swamp or marsh	316	1.2
- coastal shrubland	164	0.6
- non-vegetated: outcrops, sand, mudflats	175	0.6
<b>Regeneration forest or fallow</b>		
- coconuts or planted trees with regeneration forest or shrubs beneath	1,705	6.4
- interior shrubland	420	1.6
<b>Activity farmed land</b>		
- coconut plantations	13,269	49.4
- non-woody vegetation excluding marsh, usually cultivated	6,120	22.8
- plantations of trees (not coconuts)	22	0.1
<b>Towns, Villages settlements</b>	3,076	11.4
<b>Total</b>	<b>26,844</b>	

Source: Wisner et al., 1999.

Characteristics of the water quality and level found in the above studies include:

- increasing mixing of water with underlying saltwater;
- increasing chloride ion concentration in freshwater lenses;
- private wells have a high risk of contamination from pit toilets and domestic animals;
- maximum elevation of 0.5 metres above sea level in the widest parts;
- groundwater levels are very dynamic and respond to tides, sea level variation; atmospheric pressure, lagoon levels, pumping and recharge;
- 1992 data record low water levels due to very little recharge to the water lens because of a eight continuous months of draught (El Nino effect); and
- groundwater is very hard throughout Tonga and often exceeds the WHO guideline value of 500 mg CaCO<sub>3</sub>/L.

### **3.3.5 Responses**

Early settlers' perceptions of the land resources in Tonga were that it was a 'land of abundance' and had 'infinite resources' (ESCAP & GOT, 1990). In recent times, with growing socio-economic pressures coupled with high population growth, land resources have either declined or the land of 'abundance' has become a land of 'scarcity'. Tongans have responded with mixed success by using technological developments or local knowledge of the environment to 'meet' various needs from the land resources, by seeking assistance from bilateral or multilateral organizations, and by investing in overseas land schemes.

#### **3.3.5.1 Government Response**

Government priorities were reflected in earlier attempts at plantations, with coconuts as the major cash crop, starting as early as the 1940s and followed later by bananas. The boom and bust of the copra price and diseases attacking bananas in the mid-1960s saw the government responding with a coconut replanting scheme, assistance with machinery for clearing and ploughing land in preparation for replanting, supplying farmers with pesticides to control the banana scab moth and nematodes. Such government run schemes, as well as a variety of agricultural extension programs, has directed the kinds and extent of agricultural export in Tonga. Further, government participation<sup>9</sup> and membership of various regional and international inter-governmental organizations, bilateral and multilateral arrangements, international NGOs, and related global and regional conventions, has also initiated projects to address land use problems, loss of biodiversity, diversification of agriculture, soil erosion, etc. The response to land resources issues, however, focused on improving the productivity of the land and capacity building<sup>10</sup>.

#### **Legislation**

There is a large body of legislation containing provisions of environmental importance that are related to the development of land resources, reflecting the government's concern for and response to land development. However, this body of legislation often lacks regulations, does not include sustainable resource use management or development requirements, and is poorly enforced (refer Chapter 4 Sections 4.3, 4.4 and 4.5).

### 3.3.5.2 Civil Society Responses

Civil society's responses to land resources issues, so far, have focused on decreasing medicinal and culturally important plants, litter and problems caused by domestic animals, especially pigs. There are several NGOs and community groups who carry out tree planting programs, village cleanliness competitions, adopt a beach programs and are involved in campaigning to put pigs in pens. These NGOs are Langafonua-'a e-Fefine Tonga (the National NGO umbrella for all women's organisations in Tonga), 'Aloua Ma'a Tonga, the Tonga branch of Pan-Pacific South-East Asia Women's Association (PPSEAWA), and the Tonga Community Development Trust (Tonga Trust) with its Village Women's Development (VWD) Program. Further, the NGOs in collaboration with the government (MAF, DOE, TVB, MOH) and the private sector, have raised awareness in the communities of various natural resources and environmental issues<sup>11</sup>.

## 3.4 The Coast and Sea

The Royal Proclamation of 24 August 1887 declared the sea boundary of Tonga (Section 3.3.1), whereas the *Land Act 1903* defined the coastal area as the land adjacent to the sea, alternatively covered and left dry by the ordinary flow and ebb of the tides and all areas adjoining this and lying within 15.24 metres (50 feet) of the high water mark of ordinary tides (ibid. s. 2).

Munro and Fakahau (1993) defined coastal resources to include all non-living and living components of the area of waters from the shoreline to the outer edge of the reef or where no reef exists, the open ocean for which it is practical for small craft to operate. ESCAP & GOT, (1990); Thistlethwaite et al. (1993) referred to 'inshore pelagic zones', which varied in depth from 75 m to more than 600, m and usually not exceeding 30 km from land.

For the purpose of this thesis, the definition of coastal area or coastal zone and resources is adapted from the three above definition. For example, coastal area is the area starting from 15.24 m above high water mark (*Land Act 1903*) to the outer edge of the reef or where no reef exists, the open ocean for which it is practical for small craft to operate (Munro and Fakahau 1993), usually not exceeding 30 km from land (ESCAP & GOT, 1990; Thistlethwaite et al.

1993). Coastal resources then, as referred to in this thesis, are the non-living and living resources found between 15.24 m above the high water mark to about 30 km out into the sea.

The reefs and lagoons are the prime fishery for subsistence. In addition to fishing, a wide range of shellfish and other marine life is harvested from the tidal flats at low tide for consumption or for production of shell handicrafts for sale to tourists. Offshore commercial pelagic fishing comprises of large tuna species of albacore, yellowfin, bigeye, and skipjack. Marlin and sailfish are also common. Albacore tuna is the most highly valued and most abundant species of the zone (ESCAP & GOT, 1990; Thistlethwaite et al. 1993). Very little information and data, however, is available on 'offshore' resources, thus the state of coastal and marine resource refers to coastal area resources.

### **3.4.1 The Driving Forces that Affect Coastal Resources**

#### **3.4.1.1 Climatic Pressures (Cyclones and Climate Change)**

Land, marine and coastal resources of small islands ecosystems are equally affected by natural and man-made extreme climatic changes (see information presented in Section 3.3.3). Associated sea level rise, as a result of climate change, is a major pressure in Pacific Island countries including Tonga. Mimura & Pelesikoti (1997) carried out a vulnerability assessment of Tongatapu to sea level rise. Two scenarios were used for the assessment (0.3 m slr and a 1.0 m slr) combined with the local conditions (sea levels and chart datum) (see Table 3.4.1).

The assessment found that Nuku'alofa would break into islands (Refer Fig 3.5), 58 km<sup>2</sup> of coastal area would be inundated, and 10.7 km<sup>2</sup> of residential area and 63 % of the population of Tongatapu would be affected (Mimura & Pelesikoti 1997). Other islands of Tonga have not been studied in such detail.

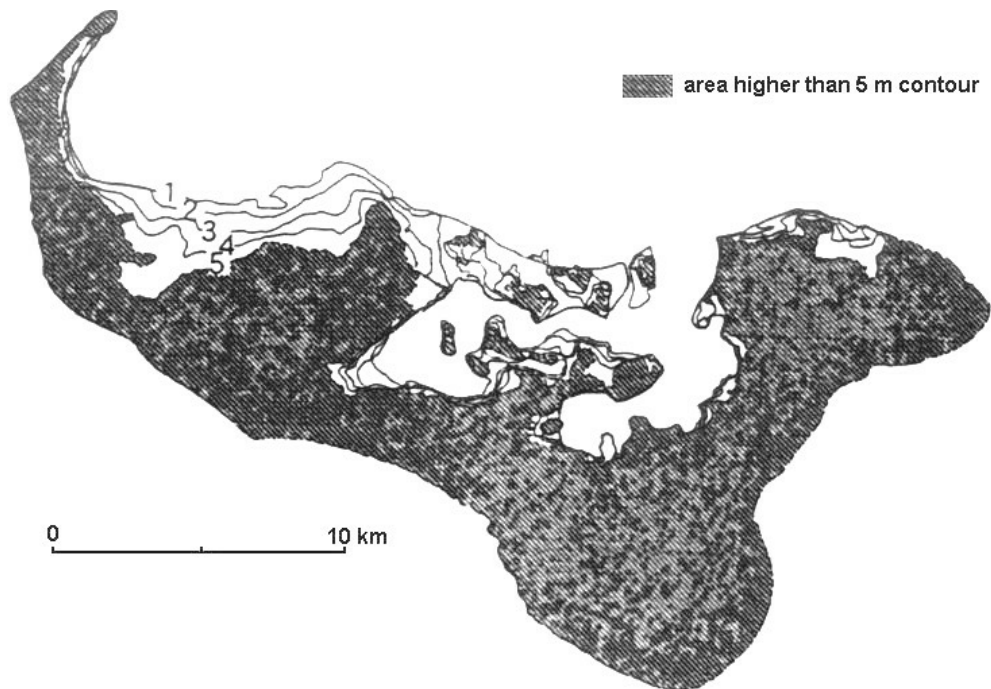
**Table 3.4.1 Scenarios for Local Water Levels<sup>1</sup>**

<sup>1</sup> Elevation is based on the chart datum. One metre contour corresponds to the high water level, i.e. the present coastline; SLR = Sea Level Rise

Cases	Present Condition	SLR 1 (+0.3 m)	SLR 2 (+ 1.0 m)
Ordinary Condition (High water level)	1.0 m	1.3 m	2.0 m
Extreme Event (Storm surge)	2.8 m	3.1 m	3.8 m

Source: Mimura, N., & Pelesikoti, N., (1997)

**Figure 3.5: Map of Tongatapu with areas below 5 m contour that would be affected by a 3.8 m SLR**



(Note: The chart datum is nearly 1 m below high water level, therefore 5 m contour corresponds to 4 m above the present coastline)

Source: Mimura, N., & Pelesikoti, N., (1997)

### 3.4.1.2 Coastal Development

Most waterfront construction is carried out without precautions to prevent siltation of the marine environment during the activity. Chesher (1984) found evidence of deep-water pollution from a construction plume, and black coral being killed by siltation from the Queen

Salote Wharf and Fuaa Boat Harbour projects. This situation was continuous, resulting from poorly constructed roads and rain-drainage systems in Vava'u (ESCAP & GOT, 1990).

Kaly et al. (2001a) recorded the following observations of the Neiafu Harbour (the main harbour of Vava'u):

- Existing drainage system runs straight into the harbour;
- Rubbish, especially in the boat section and wharf;
- Runoff is increasing turbidity that may lead to clarity and sedimentation problems;
- Harbour waters are often brown after rain;
- Development around the harbour is unplanned and no EIA is carried out;
- Nearshore land around the harbour is being increasingly cleared and modified, including steep slopes;
- Approaches to care and management of the land requires attention (pigs restrained, better land management);
- Causeway at Muikilekila is restricting water and possibly fish movements into the harbour;
- There is the risk of damage to corals by anchors; and
- Sewage is finding its way into the lagoon

Vava'u and 'Eua have higher terrain than Tongatapu, and there is severe gully erosion washing soils into bays and harbours of these two islands (per.obs).

Waterfront development in Tonga has been limited to the construction of wharves, jetties adjoining major towns and villages, and housing developments in mangrove swamps. After the 1982 cyclone, the Nuku'alofa sea wall was reconstructed. Three thousand, four hundred metres of protection wall now extend along the Nuku'alofa foreshore. It is also notable that sand has disappeared from these areas. Several causeway constructions to link outlying islands to the main island in Vava'u and Ha'apai have been completed. However, causeway constructions have resulted in the death of corals on the lagoon side and fishermen have complained to DOE staff of a decrease in fishing productivity in the area (per.obs). Flow of



the water is completely diverted or stopped such as the causeways between Lifuka and Foa (Ha'apai) and between 'Uta Vava'u and Okoa (pers. obs). Other Vava'u causeways have only a few, widely spaced concrete culverts, which do not allow adequate tidal flushing as they are too small. Further, the culverts also do not permit passage of small boats, thus hampering fishing activities in the area. The causeway between 'Uta Vava'u and Koloa also caused the loss of a valuable mullet migration route and the death of large numbers of shellfish and mantis shrimp (ESCAP & GOT, 1990).

### **3.4.1.3 Construction Material**

#### **Sand Mining**

Sand is used in the production of concrete and it is also used traditionally as a ground cover around houses and to cover graves. The rapidly increasing rate of construction of houses and buildings, using primarily concrete blocks and concrete foundations, has resulted in a rapidly increasing demand for sand (EPACS & GOT, 1990).

Sand is surfaced-mined by bulldozers or shovels from beaches<sup>12</sup>. On Tongatapu and Vava'u, sand is mined by the MLSNR and then sold to the public. In 1987, 3,564 tonnes of sand was sold to the public from the government's stockpile in Vava'u and 21,909 tonnes was sold from the Tongatapu stockpile while in 1999, 29,000 tonnes was sold from the Tongatapu stockpile (MLSNR 1988, 1999).

The environmental impact of present beach-mining activities is obvious in Tonga, as many of the more popular beach areas have already been stripped of sand and are now little more than beach rock (pers.obs). In Laulea, Monotapu and Lavengatonga beaches, all beach rocks are exposed and in some areas beach erosion occurs when sand mining has been carried on above the high water level. Little, however, has been done in Tonga to determine the rate of sand replenishment, but beaches in Tonga are generally small and in protected waters, and so replenishment can be expected to be negligible (SOPAC, 1982). The replacement by long-shore sediment transport is temporary as the beaches are all limited in extent and many are small pocket beaches with no input from adjacent areas (SOPAC, 1982).

### **Limestone Quarries**

Limestone rock is mined<sup>13</sup> on all the major islands, and used for road construction and maintenance, and for cement, in home and building construction. There are 12 quarries in Tongatapu, 6 in Vava'u, and 2 in Ha'apai. Quarrying activities also, opened up the coastal area towards the sea by destroying coastal vegetation, thus salt spray affects other useful plants and agriculture. In Vava'u, however, considerable silt is washed into the Vaipua Lagoon from the steep terrain.

The current allocation of sites for quarries is unplanned and ad hoc. A quarrying license is required, however, environmental impact assessment and rehabilitation of the site at the conclusion of quarrying are not components of the licence.

#### **3.4.1.4 Habitat Destruction and Modification (Impacts)**

Most notable habitat destruction and modification are population pressure related. With increasing population relying on limited inshore resources that are 'free for all', people in desperation revert to destructive fishing methods. The most common and, hence the most damaging activity to shallow-water coral reefs in Tonga, are breaking the coral while fishing, and fish poisons<sup>14</sup> (Chesher 1984 and 1985, as recorded in EPACS & GOT, 1990). Almost all people gleaning the reefs bring bush knives, iron poles and even hammers to pry loose living corals and smash them into small pieces.

Observations from the Ha'atafu Reserve on Tongatapu showed that coral bleaching is common on the reef slope and in the lagoon (Lovell et al., 1999). The near shore lagoon is dominated by *Montipora hispida* with *M. incrassata* subdominant. Though representing areas of substantial coral cover, these species showed only minor bleaching. By contrast, *Goniastrea retiformis*, *Platygyra sinensis* and *P. daedalea* were invariably 80-100% bleached.

On the outer reef slope, the corymbose *Acroporas* were mostly affected with the tabulate colonies showing only minor bleaching and, in many cases, unaffected. Coral death was minimal with a visual estimate of 2-5%. Those that had died were covered in part or wholly by algal growth were the hydrozoan corals *Millepora exaesa* and *M. dichotoma*. Among the *Acroporas*, *A. monticulosa* and *A. robusta* were characterized by varying degrees of death.

Some colonies of *A. robusta* were apparently entirely unaffected, though other colonies were partly or totally dead. Many colonies of this species were totally bleached though living (Lovell et al., 1999). Lovell's observation that coral bleaching in Tonga was common in 1999 could be an effect of the 1998 global bleaching event linked to one of the largest ever El Nino events (<http://www.reef.crc.org.au>).

A comprehensive set of coastal data was collected between 1998 and 2001 for the Tongatapu lagoon (Refer Section 3.4.2). Previous data were singular studies. As a result it is difficult to see any trends or patterns.

### **Coastal Pollution**

Little data pertaining to the types and amounts of pollutants affecting marine and coastal areas are available. An estimate, however, is available in Table 3.4.2).

Liquid household wastes are generally collected in septic tanks. The Public Health Act provides for the Minister to specify where these may be located, frequency of emptying, ventilation, control of discharge, and proximity to public or domestic water supplies. This Act also specifies that toxic, explosive, or inflammable materials are not permitted to pass into sewers or septic tanks. The enforcement of these provisions is rarely carried out, as there are insufficient resources to adequately police this. Therefore septic tanks are often in bad repair, thus leaking with eventual leaching of contaminants into the groundwater aquifer and coastal could occur. There is also some concern of the inefficiencies of the septic systems in the infilled coastal urban areas such as Sopu and Popua where septic tanks are built in tidal areas.

### **Coastal/Wetlands Forest**

There is little data available on coastal/wetlands forest in Tonga apart from Weiser et al. (1999) for Tongatapu forest only (see also Tables 3.3.9 and 3.4.4). The mangrove area of Tonga is small in global terms, but the community structure of mangroves in Tonga makes them unique among the world's mangroves (Ellison, 1998). The mangrove<sup>15</sup> ecosystem, however, has been reduced in area by humans cutting trees down or reclaiming areas, and has been damaged by careless use of the resource, and damage by pigs. The mangrove areas have

significant uses for local people, being traditionally exploited for construction wood, and the gathering of crabs, fish and fuel wood.

**Table 3.4.2 Sources and Nature of Pollution in Marine and Coastal Areas**

Nature of Problem	Availability of Statistical Data	Sources and Nature of Pollution
Pollution of Inland Waterways (Lagoons)	No Data Available	Oil Pesticide and fertilizers Solid waste (rubbish dump located in mangrove areas)
Marine and coastal Pollution  Neiafu Harbour	Insufficient	Sewage from yachts is uncontrolled. Possible PCBs contaminants from old transformers by the Electric Power Board (located by the coast) Disposal of paints and cleaning agents from ships. Fish waste products. Waste oil from ships dumped into marine waters. Pollution of Fanga'utu Lagoon by hospital and other wastes Septic tank contamination and sewage constituents Sewage from yachts is uncontrolled  Observed runoff into the harbour (Kaly et al., 2001a) and anecdotal evidence of pollution from yachts anchored inside the Neiafu Harbour
Chemicals used for fishing	No Data Available	Chemicals used illegal for fishing

Source: Adapted from Bagchi & GOT, 2000.

### 3.4.2 Status

#### 3.4.2.1 Inshore Resources

##### The Reef System and Main Physical Features

The reef systems in Tonga are generally small, semi-enclosed, easily accessible and thus sensitive to over-harvesting or environmental degradation. Existing populations of many organisms are, like the living coral environment, small and easily over-fished, especially in a commercial environment where certain species are prime targets (e.g. lobster).

Though the coral reefs extend along the fringes of all of the islands, a comprehensive overview has only been conducted for selected areas<sup>16</sup>.

MacLean (1982) reported the destruction of more than a kilometre of coral reef in Vava'u due to methods of reef gleaning<sup>17</sup> in Vava'u. Coral reefs in Tonga are commonly infected by cyanophyte bacteria *Oscillatoria sp.* as the coral reefs are repeatedly broken or bruised on a daily basis by people walking on them and by other activities (ESCAP & GOT, 1990). Further, Holthus (1990) surveyed the coral reefs of Vava'u and found that reefs of the northern group islands had suffered damage from *Acanthaster planci* plagues.

The extent of run-off of agricultural chemicals from farms into the coastal waters are unclear although studies (refer to Tables 3.4.3, 3.4.4, 3.4.5) to date have shown that nutrient and pesticide levels, especially in the central lagoon of Tongatapu, are currently not critical (Morrison, 1998, 1999a, 1999b).

### **Fishery**

In the past fishing areas were restricted owing to the lack of outboard engine boats and time required to reach more distant coral reefs. Breeding activities on the more remote coral reefs provided, and still provide, larvae and juveniles for the more heavily fished areas. As the number of fishing boats and the sizes of outboards increase, the extent of 'un-fished' reef area is dwindling and replenishment can also be expected to drop.

Estimates, in 1993, of fish landings at two landing sites, Vuna and Fuaa in Nuku'alofa, indicate that shallow-water reef fish make up 70% of the 200 mt total artisanal finfish landings. The main fish family recorded was parrotfishes. This is a decline from the 333 mt (including 140 mt of mullet) in 1987 from the same landings, where emperors were the main family (MOF, 1994). Relevant data collection, however, by the MOF has been ad hoc, and a reliable pattern could not be determined.

**Table 3.4.3: Summary of Critical Physical Features of the Tongatapu Lagoon (Fanga'uta and Fangakakau Lagoon)**

<b>Feature</b>	<b>Characteristic</b>	<b>Explanations</b>	<b>Source(s) of Information</b>
Geology	Lagoon formed by tilting, then uplift	Shallowness is at least in partly attributable to uplift event in 1750, but ecological adjustments to this would have long since been made	Zann et. al. (1984) Furness (1993)
	No rivers or streams	Freshwater inputs are filtered through the soil and groundwater	Zann et. al. (1984)

<b>Feature</b>	<b>Characteristic</b>	<b>Explanations</b>	<b>Source(s) of Information</b>
Soils	Formed from volcanic ash	Do not release much phosphorus into the groundwater	Orbell et al. (1985) Cowie et al. (1991)
	Some acid-sulphate soils	On drying / exposure to oxygen may result in very acidic conditions	Morrison (1999a)
Vegetation	Cover in catchment is generally good	Limits amount of sediment which can move into the lagoon	Chisholm (1998) and Morrison (1998 and 2000a)
Farming	Pesticides and fertilizers	Can move into lagoon through groundwater and wind and are a risk to humans and fisheries	Naidu et al., (1991) Morrison (1999a)
Freshwater	Runoff limited, most water moves by evapotranspiration or infiltration	Freshwater inputs are largely filtered through the soil and enter as groundwater	Dever (1999) Morrison (2000b)
	May be some runoff during heavy storms	Sediments may be washed into the lagoon at these times	Chisholm (1998) and Morrison (1998 and 2000a)
	Groundwater seepage	Significant, contributes most of the 26,000 m <sup>3</sup> per day entering the lagoon	Zann et al. (1984)
Sedimentation	Low relief in catchment, good cover by vegetation, road acting as silt trap	Little movement of land sediments into lagoon except during heavy storms. There may be significant contributions from increasingly common reclamation activities	Chisholm (1998) and Morrison (1998 and 2000a)
Circulation and tides	High residence time for water and low tidal range, particularly in Pea	Potential for eutrophication is high, impacts from dredging could be very high	Zann et al. (1984) Kaly (1998)

The reefs and lagoon areas near villages, or with easy access from shore or by short boat trips, are heavily over-fished and catches are generally poor in quantity and size of fish (ESCAP & GOT, 1990). Stocks of lobsters and tridacnid clams are of particular concern owing to over fishing (ESCAP & GOT, 1990).

The inshore fisheries<sup>18</sup> are further pressured by improved access to markets, rising prices in the local market, and population growth. Destructive fishing practices further aggravate the situation. There are numerous indications that the condition of the resource is deteriorating. Where quantitative field surveys have been undertaken on particular species (e.g., giant clams, lobster, beche de mer, mullet and turtles) and subsequently repeated years later, remarkable declines in abundance are evident (MOF, 1998-2000). A few commercial fisheries have virtually collapsed, e.g., beche de mer, mullet, while some species are close to

extinction, e.g., coconut crabs and devil clam. Further, the development of the aquarium fish trade in Tonga has led to the utilisation, not only of the small colorful reef fishes, but also juvenile giant clams, other shellfish species, coral and sea anemones (Matoto et al., 1996)<sup>19</sup>.

Thaman et al. (1996) listed 100 species of finfish (only turtles and whales has some form of protection in the existing regulations), 33 species of shellfish, 17 species of holothurians, 13 species of seaweed and 40 other species of marine invertebrate animals reported to be rare, endangered or in short supply based in Ha'apai alone.

#### **3.4.2.2 Diversity of Marine Plants and Animals<sup>20</sup>**

Despite Tonga's diverse marine environment, the diversity of inshore marine species in Tonga, is significantly less than Fiji to the east. It is hypothesised that the more recent geological history of the islands of Tonga is responsible for this phenomenon. Species such as the commercial trochus (*Trochus niloticus*), the blue anchovy (*Stolephorus heterolobus*), and the Spanish mackerel (*Scomberomorus commerson*) are examples of an invertebrate, an inshore fish, and a near shore pelagic fish, respectively, which are common in the eastern Lau Islands of Fiji but do not occur naturally in Tonga less than 400 km to the east (Thaman et al., 1996).

#### **3.4.2.3 Status of the Coastal Ecosystems and Habitats**

Four sites in Tongatapu have an elevation below 0.5 metres and drainage of rainwater and sewage effluent is considered a problem (Belz, 1985). They are the Sopu lagoon to the west of Nuku'alofa, the edge of Fanga'uta lagoon, parts of Ma'ofanga and Kolofo'ou and Popua to the northeast of Nuku'alofa. There are also islands in the Ha'apai group that are very low.

Previous studies of coastal ecosystems and habitats in Tonga have concentrated on the main island of Tongatapu, with very few singular studies in the outer islands. Table 3.4.4 summarizes the Fanga'uta and Fangakakau lagoon study, which covers one tenth of the total area of Tongatapu, made up of 36 % of the total coastal line of Tongatapu which extends 6 to 10 kilometres inland and is surrounded by low-lying swamps (Mimura & Pelesikoti, 1997).

**Table 3.4.4: Status of the Fanga'uta and Fangakakau Lagoon**

<b>Biological Indicators</b>	<b>Status</b>	<b>Pressures and Potential Impacts</b>	<b>Source(s) of Information</b>
Corals	Only 10-20% alive	Heavy sedimentation and poor water quality have killed off patch reefs and their associated fisheries	Kaly (1998, 1999, 2000)
Seagrasses	All seagrass beds in the lagoon are under stress and patchy in distribution Up to 100% cover by epiphytes	Heavy sedimentation, high nutrients and high turbidity are stressing seagrasses which are important habitats for fishes and productivity of the lagoon	Kaly (1998, 1999, 2000)
Mangroves (see also Table 3.5.6)	High human impact. Massive clearance and only narrow strip around the capital and villages with few remaining intact areas	Reduction in mangroves leads to loss of fisheries, habitats, foreshore protection and stabilization and resources for building, crafts and medicines.	Ellison (1991), Pelesikoti (1992a & 1992b)
	Land allocation and fragmentation	Most of the mangrove area between Nukuhetulu and Veitongo has been assigned for allotments. Losing this area of mangroves is likely to lead to major further damage to an already stressed lagoon.	MLSNR Land Records, Ellison (1991)
	Die back problem	Large area of mangrove die back from Pea to Mu'a	Ellison (1991) Pelesikoti et al. (2001)
	Pig damage	Damages mangrove ecosystems, particularly the growth of young trees.	Ellison (1999) Pelesikoti et al. (2001)
Fisheries	Declining  Fish kill in the lagoon	Many of the fishes, shellfish and jellyfish are affected.  Several species of silver biddies, tilapia, and craps were washed up on the shores from the National Centre to Veitongo during November 1998. Similar events have happened before  Most recent incident of fish kill in a different area in brakish lakes in Sopus, west of Nuku'alofa, tilapia and eels were floating dead during December 2001	Lubett (2001), Spiller (2001), ESCAP & GOT (1990)  Kaly (1998)  ESCAP & GOT (1990) pers.obs
Shellfish	No major contamination by metals	Concentrations of trace metals expected to cause health problems are either below the detection limits (< 2 mg/kg dry weight) or similar to values for shellfish in uncontaminated areas elsewhere. However, it was recommended that due to increasing urbanisation and industrialisation, such studies should be carried out on a regular basis (every 1-2 years) and other health problems such as microbiological contamination should be investigated on a regular basis.	Brown & Morrison (2000)



Rapid population growth and unplanned development in Nuku'alofa have resulted in a significant loss of coastal habitats with the pollution and eutrophication of adjacent lagoons and reefs, particularly in leeward reefs with limited ocean exchange, such as Fanga'utu Lagoon. Existing levels of contaminants, in association with their persistence and trends in agrochemical usage, could compromise the future of the ecosystem including sustainable fisheries and the potential for developing aquaculture. Other activities in the area, namely those related to urban and industrial growth, cause additional impacts on the coastal lagoon system (Table 3.4.5).

### **3.4.3 Responses**

#### **3.4.3.1 Government**

The three driving forces that shape government responses to marine and coastal issues are economic development (fisheries development) and infrastructure development (tourist facilities, roads, land extension (reclamations), wharfs etc.); responses to regional and international marine and coastal instruments and initiatives (i.e., UNCLOS, UNDP, CBD, UNFCCC; and relevant programs executed by SPC, FFA, SOPAC, SPREP etc. including NGO; bilateral and multilateral assistance.

For example, the Ministry of Fishery (MOF) manages the development of aquaculture and research in this area in Tonga. A number of projects involving the propagation and/or growing of marine organisms have identified a number of organisms as suitable to conditions in Tonga. Promotion of aquaculture is to relieve pressure on over-exploited traditional inshore fisheries. Programs include the enhancement of giant clams stocks, and the introduction of trochus (*Trochus niloticus*) and green snails (*Turbo marmoratus*) to create new commercial fisheries, and pearl oyster farming and seaweed (*Cladosiphon sp*) culture for export. Aquaculture research projects have been made possible with technical and financial assistance from the Government of Japan and FAO (Ministry of Fisheries Annual Report, 1998). None of these programs, however, required any environmental assessment.

MOF and communities in Ha'apai have achieved mixed success in joint government and communities giant clam circles<sup>21</sup>, where the Ministry provides technical advice and seed

clams, and the community provides protection for the clams. A comprehensive list of projects, and discussion of the government's responses to marine and coastal issues, can be found in Tonga's National Assessment Report to the World Summit on Sustainable Development (TNAR-WSSD, 2001).

### **Legislation**

The MOF is making efforts to enforce and monitor compliance with the *Fisheries Act* and its Regulations. Undersized sea cucumber, lobsters and giant clams, as well as turtle fishing during the closed season from August to February were the types of offences that the Ministry enforced. The first ever court case relating to undersized lobster was successfully prosecuted in the Supreme Court in 1999. Each offender was fined T\$100, (refer Chap. 4, Sec. 4.5.2).

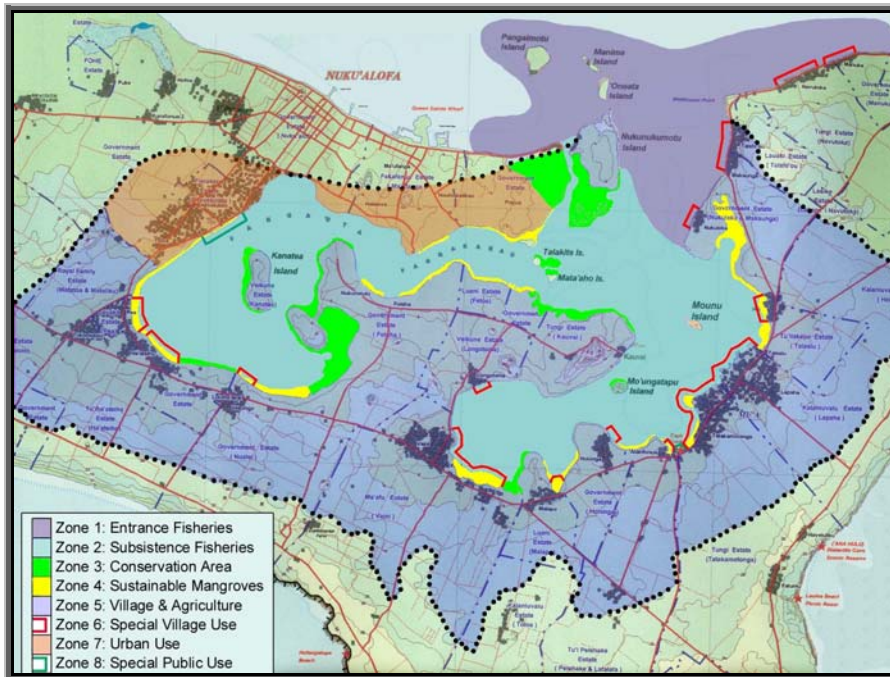
### **Management Plan Preparation**

The development of the Fanga'uta Lagoon System Environmental Management Plan (EMP) was funded by AusAID based in the DOE in collaboration with ten other government agencies, three NGOs and more than 20 communities around Fanga'uta Lagoon (see Fig. 3.6). It has been prepared in response to increasing pollution and decreasing of marine resources observed by communities and government departments which have interests in the lagoon and its resources (Pelesikoti et al., 2001).

Physical Indicators	Status	Pressures and Potential Impacts	Source(s) of Information
Water quality	Certain parts of the lagoon have shallowed  Water greenish and brownish most of the time, suggesting high level of planktonic algae	<ul style="list-style-type: none"> <li>▪ A lot of reclamation around the lagoon and the removal of mangroves</li> <li>▪ General trend of decreasing water clarity</li> <li>▪ Further impacts of biological indicators already under stress</li> <li>▪ Heavy foam formation on the shores of the lagoon and sulphur smelling compounds and rotting sea grass</li> </ul>	Morrison (1998, 1999a, 1999b, 2000a, 2000b, 2001)  Kaly (1998)  Kaly et al. (1998, 1999, 2000)
Faecal coliforms	Level exceeded Australian standard for seafood and recreational use	<ul style="list-style-type: none"> <li>▪ Increasing population coupled with high water table and frequent flooding</li> <li>▪ Toilet septic and pit toilet susceptible to overflowing and the Popua rubbish dump to the north of the lagoon</li> <li>▪ Some drainage drain directly into the lagoon</li> </ul>	Kaly et al. (1998, 1999, 2000)  Morrison (2001)
Nutrients	Levels of nitrate, nitrite and phosphate all exceeded Australian standard for seafood and recreational use  Amount of dissolved inorganic nitrogen (DIN) and level of ammonia (NH <sub>4</sub> ) were generally low	<ul style="list-style-type: none"> <li>▪ Lagoon watershed area is the biggest agricultural area</li> </ul> <p>High nutrients could lead to lagoon eutrophication</p>	Kaly et al. (1998, 1999, 2000)  Pelesikoti et al. (2001)
Metals in lagoon sediments and soil samples	Relatively free from any significant contamination by metals. Sediment samples were dominated by calcium as expected of materials generate in or close to reef environment	<ul style="list-style-type: none"> <li>▪ Suggested continued monitoring to avoid any possible metal contamination of sediments and to avoid any possible transfer of contaminants from sediments to shellfish</li> </ul>	Morrison (1999b)
Pesticide in sediment samples	Very low concentration of chlorfluazuron (Atabron) and fluilazole (Punch), carbaryl and dimethoate	<ul style="list-style-type: none"> <li>▪ Suggested continued monitoring and presents of pesticides confirm off-site migration and accumulation in sediments</li> </ul>	Morrison (2000a)

**Table 3.4.5: Physical status of the Fanga’uta Lagoon System**

**Figure 3.6: The Fanga'uta Lagoon System Management Zonation**



Source: Pelesikoti, N. et al., 2001

The EMP is a guide for action by government, and action by individuals taking responsibility for their own environment. A multi-use zoning plan was developed (Fig. 6), based on scientific information and the voice of communities to provide guidance for development and spread the benefits of the lagoon as fairly as possible and to allow for sustainable use of the lagoon and its resources.

Cabinet approved the Management Plan in 2001; however, financial and other commitments required for the implementation of the Plan were not included in the Cabinet approval. Although the DOE was required by the Cabinet, approval to coordinate the implementation of the Plan, and an overall structure to oversee the implementation of the Plan were not included, and sectoral differences would still be a challenge (per. obs)

### **Marine Protected Areas**

Under the *Parks and Reserves Act 1976*, five marine parks were designated in Tongatapu only<sup>22</sup> (Thistlethwaite et al., 1993). Only 284 ha are being protected by these five marine protected areas, out of approximately 700,000 sq. km of EEZ for Tonga. Similar to the National Parks, the Marine Parks are poorly managed (refer to Chapter 4, Sections 4.4 and 4.5).

### **3.4.3.2 Civil Society Response**

There is very little community (people at the village level) response (appropriate community activities concerning marine and coastal issues) apart from coastal tree planting, adopt a beach program, and beach/coastal area clean up campaigns (TNAR-WSSD, 2001). There is currently no NGO involving in marine and coastal issues activities apart from a Fishermen Association coordinated by the MOF which addresses concerns with fisheries quality control for export (MOF, 2001).

## **3.5 Discussion**

### **3.5.1 Land Resources**

The pressures on land resources are mainly related to population growth and the development of services required by the population and economic development such as agriculture. Several key environmental issues and problems become apparent as Tonga is facing a scarcity of land resources coupled with the increasing signs of land resource degradation such as:

- underground water pollution;
- increased soil degradation, which is indicated by the increase in commercial agriculture and the increase in use of fertilizer and pesticide;
- increased pests, weeds and plant diseases;
- loss of native forest and general deforestation;
- loss of habitat, biodiversity and wildlife;
- increasing urban population; and
- problems of increasing waste quantities requiring management.

The state of the land resources, however, is difficult to determine due to the information gaps identified (Section 3.5.2), the lack of appropriate national indicators developed for the purpose of state of environment reporting, and no consistent monitoring to establish reliable trends.

Tonga's land tenure system (ownership system of the land and its uses) has important implications for the government's sustainable development goal. For example, the implications and effects of land ownership and land uses on the country's environment and the long-term sustainability of its development efforts are many and varied. It is useful, however, to draw attention to a few of the issues that are directly relevant to Tonga's land tenure system:

- the non-tradability of land under the existing land tenure system (except leasehold) may contribute to sub-optimal land distribution;
- the shortage of good vacant land for residential purposes in and around the Nuku'alofa urban area has led the large number of urban migrants of recent years to settle in the swampy and low-lying areas of Sopu and Popua, and the mangrove areas of the Fanga'uta lagoon (also discussed in Sections 3.4.1 & 3.4.2 in relation to state of the coastal resources) ;
- the lack of land use planning means the juxtaposition of incompatible land uses, too few parks, lack of recreational and playgrounds and shopping areas, and inability to separate residential from industrial areas.

It might be desirable if the current system of informal 'inducements' to transfer land to somebody (Section 3.3.3.1) else gave way to a more open marketing system. This would mean easier acquisition of suitable lands in the right location, and take the current heavy pressures off reclamation. It would also mean that residents could borrow from the bank to purchase land and improve it. More active involvement by government appears necessary to acquire larger areas so planning can provide for community facilities and environmental considerations.

### **3.5.1.1 Factors Contributing to the Problems Discussed**

#### **Lack of Appropriate Sustainable Development Policies**

It seems that economic growth is the government's overriding development objective. However, the agencies (MAF and MLSNR) that are responsible for economic development of the land (agriculture and land leases/allocations) lack guidelines for maintaining the basis (land) for a sustainable land development. Therefore planning for sustainable land development is absent.

A sustainable development policy for land resources implies that there is coordination among the agencies that are responsible for land (Cicin-Sain, 1993). There is, however, no overarching sustainable development policy to coordinate the activities of government departments that manage land resources. This has resulted in segmented and ad hoc government responses to the land resources issue. All too often the responses are directed by sectoral interests or objectives.

### **Dependency on Donor Funding**

Existing information shows that land resources related research and activities are linked to external funding. For example, water (freshwater) related research was undertaken from the early 1970s to early 1990s, but seemed to diminish until the AusAID project began (Section 3.3.4.4). This suggests that most of the government as well as civil society responses are linked to a donor. When the donor funding ends, the related national activities also stop.

One significant result is the testing of water sources (Section 3.3.3.4) for agricultural chemicals in 1995. The test results showed clear indications (TWB, 1995) that traces of agricultural compounds used in fertilizers and pesticides have reached the water table. Further and regular monitoring is needed to check the level of pollutants considering the increasing use of fertilizers and pesticide in Tonga, however that water testing has not been repeated.

### **Outdated and Lack of Enforcement of Existing Legislation**

Although legislation is the main instrument used in Tonga to protect the environment, some of the existing legislation is old and no longer applicable to the current physical and socio-economic environment of Tonga. (discussed in detail in Chapter. 4, Section 4.5).

### **Lack of Community Awareness**

There are only a few NGOs active in environmental related activities (Section 3.3.5.2). There are often only a few active members in each NGO that are directly involved with running and implementing the program. Most related NGOs work programs in the community are focusing on 'keeping the village clean' or on tree planting. Therefore, awareness programmes NGO carried out were only related to their work programme.

It was also observed that the NGOs work programs, are not determined by the ‘need’ of the communities but rather either by the donor or by an affiliated overseas NGO (per.obs). This thesis argues that Tongan communities might not be aware of how to participate in environmental activities coordinated by NGOs or lack the ‘need’ to participate in such activities.

### **3.5.1.2 Data Gaps – Land Resources**

There is currently insufficient information to establish trends and changes in land resources state or to provide for sound decision making. Much of the statistical data required is unavailable, principally because of the lack of a comprehensive environmental monitoring program. Much of the available information is anecdotal, scattered and there is no clear strategy or path for how such information would reach the decision makers.

Data on agrochemicals, pesticides and fungicides coming into the country are scattered and this makes it very difficult to estimate the total amount used. Also small-scale importers are not licensed.

Data on soil erosion or the effects of commercial agriculture on the soil, and biodiversity, are limited. This suggests that government priorities are focused on economic growth for Tonga from the agricultural sector. There is a lack of conscious effort to maintain that level of economic growth through ‘better’ management of the resources.

There is not enough information on civil society responses to determine the impacts and extent of activities on communities’ environmental attitudes, behaviours and skills. However, civil society’s activities are dependent on external funding and the ability to access those funds (TNAR-WSSD, 2001).

### **3.5.2 Coastal Resources**

The pressures on coastal and marine resources are due to natural phenomena and human activities. Several key marine and coastal issues and problems have been mentioned in this review. It seems that the potential impact of climate change and sea level rise is not yet integrated into any national program as reflected in the lack of related responses identified. As compared with land resource, the amount of information available on the state of coastal and marine resources suggests that government and civil society responses, in



terms of research, projects and awareness programs, are more focused on land resources. This may imply that there is a general lack of awareness of marine coastal issues in Tonga.

Coastal area and wetlands reclamation have caused loss of mangrove areas and littoral forest, especially around Fanga'uta and Fangakakau Lagoon, on the main island of Tongatapu. Reclamation needs to be carefully planned in order to maintain the stability of ecosystems involved; it also needs to be carried out on a larger and better coordinated basis to achieve economies of scale and to allow development to proceed in an environmentally sensitive manner. Since the allocation of coastal wetlands in Tongatapu lagoons have been extensive, it would be more viable and politically acceptable to zone areas for further development where mangroves have already been substantially removed, and seek to protect those areas not yet destroyed (Pelesikoti et al., 2001). This would require political will and commitment at the highest level of government, if further destruction of the coastal areas of Tonga is to be avoided.

A further allocation of coastal foreshore areas for residential and commercial purposes in the southern and eastern coast areas of Tongatapu has led to the destruction of the protective coastal tree belt. This has exposed neighboring plantations to wind that, in the short term, will burn the leaves of the crops, and in the longer term may increase soil salinity via seawater spray. In the very long term, the opening of many such gaps will bring about the possibility of creating "desert" (per. obs), areas, where almost nothing will grow.

Environmental degradation caused by quarrying coral and removing sand from beaches for construction is increasing at an alarming rate. Tonga will have to look for alternative sources, but there is no indication that such a project is underway. Environmental pollution associated with undersea mining and possibly extraction will have to be addressed in the future. However, it is clear that the current management framework and instruments will not be able to effectively address 'new' environmental issues.

Coastal pollution from land-based activities and waste is becoming a major problem in Tonga, for example, siltation from reclamation, solid waste dump sites, potential eutrophication (Zann et al., 1984; Kaly, (1998) and groundwater seepage into the lagoon or coastal waters (Zann et al., 1984; Naidu et al., 1991; Morrison, 1999). However, current responses are piece meal and ad hoc. Similarly, preparedness plans for oil, chemical spill or fires are not yet coordinated.

Although marine reserves have been established as well as a major environmental management plan (Fanga'uta Lagoon Management Plan), there is a lack of commitment for implementation, and this defeats the purpose of establishing the reserves and developing management plans. In order to implement environmental and resource management plans, appropriate institutional arrangements with the capacity and skill to coordinate the work are required. The longer this is delayed, the greater will the environmental damage to the country.

From the few studies that have been concentrated in Tongatapu, coastal fisheries habitats such as seawater quality, mangroves, and seagrass show signs of degradation as a result of development. The impacts of fishing activities have not been fully understood and this will continue to be the case in the absence of a well-organized collection and assessment of fisheries related data. For example, anecdotal evidence has pointed to declining coastal fisheries yet the only protection provided for some coastal and pelagic fisheries is from the *Birds and Fish Preservation (Amendment) Act 1989*, which was based on the original 1934 act.

### **3.5.2.1 Data Gaps – Coastal Resources**

One of the critical issues identified in this section is a perceived decline of coastal fisheries resources (ECAP & GOT (1990); Thaman et al. (1996); Gillet et al. (1998); MOF (2000); Lubbert (2001); Spiller (2001). However, the extent (what species, which areas/part of Tonga, effect of seasons/weather, migration/spawning patterns, fishing technology use, market preference etc.) is not yet fully understood. This could account for the lack of response both from government (apart from some aquaculture projects carried out by MOF) and civil society. In order to effectively address the perceived declining trend of coastal fisheries resources relevant information and data are required including the following:

- regular recording of catches of species that could be perceived to be declining;
- regular monitoring of biophysical conditions of habitat such as coral reefs, seagrass, water quality etc.; and
- information on what methods people use for harvesting fisheries resources, apart from anecdotal evidence.

One of the potential critical issue identified in the state of 'coast and sea' resources in Tonga is pollution infiltration into the ground water and its eventual seepage to coastal

waters (Zann et al., 1984; TWB, 1995; Kaly, 1998; Brown and Morrison, 2000). Comprehensive surveys should (there has been a focus on Nuku'alofa only) need to be done on a regular basis, and the include Vava'u (as the rate of development, including, agriculture in Vava'u is increasing).

Determining the state and trend of the coastal resources is limited as information and data available is from mainly one survey only. Not only that, the lack of national indicators further constrained the effort to determine the state of coastal resources. Typically then, the available data and information were not 'consciously' looking at national indicators rather they only reflected agencies' priorities at the time, what donor funded projects were running in Tonga, and individual researchers' interests. These constraints also apply to land resources. Unless these data gaps are addressed data and information in Tonga would continue to be collected in the usual 'one off and ad hoc' manner, and reporting on the state of the environment would be only be descriptive and incomplete. The translation, therefore, of such incomplete information into sustainable management objectives would also be limited.

### **3.6 Priority Setting**

Despite the incomplete 'picture' of the state of land and coastal resources described by the 'available' information in Tonga, the precautionary principle<sup>23</sup> (Principle 15, 1992 Rio Declaration) is applicable in the context of Tonga. That is, the available information must provide for some preventive actions or priorities (Section 3.6.1.1) for the government and the people Tonga, in order to prevent further environmental degradation.

Lack of information could be interpreted to mean more resources are required for more research and data collection. Although this is a valid interpretation the government should maximise resource allocation by choosing priority areas. Realistically, this thesis argues that for the government to allocate adequate resources for sustainable management of natural resources and the environment, needs to be a continued and a long-term goal for the agencies responsible. However, this thesis also argues that much information could still be collected and used in management decisions even with the existing limited resources.

The method and the type of information/data collected and stored (not all agencies are computerized and some still use the traditional file system) and the agencies' objectives

for collecting those information, could account for the lack of data available on some critical areas identified in this chapter (i.e., soil erosion/degradation, coastal fisheries). It is also argued here that the role of agreed national indicators for sustainable development would address critical/priority areas for Tonga as a whole.

### **3.6.1 Sustainable Resource and Environmental Indicators**

It is well recognised that the key component of state of the environmental reporting is the use of indicators. Indicators provide for amalgamation of raw environmental data which bring together particular aspects thought to be important to ecologically sustainable development, and to obtain a level of understanding that can be used at a policy level to monitor change and to monitor the effectiveness of response strategies (Lloyd, 1996). For the case of Tonga, this thesis argued that the use of agreed indicators would have additional key functions; first to streamline priority areas where limited 'research' resources should be used, second, to develop protocols for data/information collection, storage, analysis and dissemination, and review or follow-up, and third, to provide for the coordination and sharing of resources and skills.

Therefore, as a priority, national indicators for sustainability should be developed. This could be the function of the National Environmental Monitoring Committee (NEMC)<sup>24</sup> approved by Cabinet in 2001 (TEMPP, 2001), in consultation with all stakeholders. The NEMC's first meeting is yet to be convened, a fact which provides impetus to the main aim of this thesis, the development of a new policy framework for sustainable resource and environmental management.

#### **3.6.1.1 Priorities for Action**

As mentioned earlier, the existing information and data available in Tonga and should be used to report on Tonga's state of environment, and to identify priority areas that need immediate and long-term action to prevent further environmental degradation.

#### **Land Resources**

One of the main pressures of land resources degradation is commercial agriculture. Although commercial agriculture is inevitable in Tonga, its high input of agrochemicals, pesticides and machinery tillage is a priority area to be addressed as it leads on to other

land resource problems such as water table pollution, deforestation, erosion etc. Specific area of priorities include the following:

- Management of the ‘lifecycle’ (what is imported, how it is used and how it is disposed) agrochemicals/pesticides;
- Promoting organic farming and agroforestry;
- Investigating markets for organic farming;
- Regular monitoring of groundwater table/establishing number of boreholes for monitoring;
- Solid waste management;
- Biodiversity conservation (addressing important cultural and indigenous fauna and flora); and
- Domestic animals (pigs) scavenging.

### **Coastal Resources**

Pressures on coastal resources are a combination of fishing practices, coastal developments and natural and manmade phenomena (i.e. cyclones, sea level rise associated with global warming etc.) Although there are still many uncertainties as to how coastal ecosystems ‘react’ to each pressure, and also incomplete data and information about Tonga, the following priority areas/needs require immediate and long-term action to prevent further degradation:

- Strict enforcement of prohibited fishing practices (dynamite, ‘wall of death’, fishing nets);
- Regular monitoring of key habitats (coral reefs, mangroves, seagrass);
- Systematic information/data collection of coastal fisheries activities (methods, type of catch and quantity, season variability etc.);
- Development of strategies for sustainable coastal resources management;
- Development of offshore pelagic fishing;

- Infrastructure for removing sludge from septic tanks should be improved, septic tanks should be cleared once a year and not allowed to overflow, and businesses should be desludged more often, about twice a year;
- Environmental codes of practice are needed for businesses (including yacht operators and large boats) to encourage voluntary good environmental ethics and practices; and environmental codes of practice are needed for coastal reclamation to minimize siltation;
- All developments from 15.24 m above high water mark and any major developments for that matter (discussed in Chapter 4) including (aquaculture, wharves, tourist facilities, causeways) should have Environmental Impact Assessments (EIAs), which specifically addresses impacts on the coastal resources;
- Alternative sources of sand need to be located so that the use of beach sand can be eliminated; and
- Consideration for shoreline reforestation/mangroves replanting to minimize loss of sediments, shoreline erosion and salt water sprays.

The issues of land shortages, population growth, and pattern of population settlement, especially in the cities due to rural and outer islands migration, are also important. These all place further pressure on both land and coastal resources. Outer island development should be considered a priority.

### **3.7 Summary**

This chapter aimed at identifying and assessing major environmental issues and problems in Tonga, with regard to the management of the land, marine and coastal resources. Based on the major environmental issues, the chapter identified priorities for actions concerning land resources and coastal resources issues.

The land and coastal issues identified in this chapter (Sections 3.3 & 3.4) are used as the basis for the investigation of the people of Tonga's environmental perceptions (Chapter 5). As Chapter 3 clearly identified a general lack of information on the trends in coastal fisheries and habitats, Chapter 6 reports on investigations of community perceptions on the trends of these resources.

Chapter 4 analyses the existing environmental and resource management framework in Tonga. This is the starting point for the development of a new policy framework which is the main aim of this study.

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<sup>1</sup> Other sources here refer to regional intergovernmental organisations and institutions such as SPREP, FFA, SOPAC, USP etc.

<sup>2</sup> Detailed discussion on nationally developed indicators for the state of the environment reporting can be found in OECD (1994); SCOPE (1995), Lloyd (1996), and Granados & Peterson (1999).

<sup>3</sup> There are several types of estates: The Hereditary Estates are the -- Royal Estates belonging of the King, Royal Family, Estates held jointly by the Royal Family, Estates belonging to the nobles; and *matapules*. Part of The Government Estates, Estates of the Nobles, and *matapules* are subdivided into tax and town allotments, and distributed to the commoners and once registered it becomes hereditary. Land in Tonga is passed on through the legitimate eldest son (paternal) (The Land Act, 1927).

<sup>4</sup> *Matapule* is the Tonga word given to the man (always male) the chief use to do the talking with the chief's 'people' -- those giving land on the chief's estate -- on behalf of the chief. Some of the *matapule* were granted hereditary estates.

<sup>5</sup> Yuncker (1959), Whistler (1991a and 1992), are the best sources of information on the vegetation of Tonga. They provide valuable information about the plants of Tonga and their Latin names, habitat, uses and Tongan names. Also useful in terms of providing habitat information, current scientific and Tongan names, uses, plant descriptions and photographs are Whistler (1980 and 1991b), and Sykes (1978).

Qualitative descriptions of broad vegetation types (including forest types) have been made for Tongatapu (Thaman, 1975), Late (Skykes, 1981), and for 'Eua (Straatmans, 1964). Floristic studies have concentrated on listing and describing plant species, their uses, and general distribution, as well as habitat information, such as in Niuatoputapu (St. John, 1977) and ferns on 'Eua (Sykes, 1978). Woodroffe (1983) provided a detailed account of the impact of Cyclone Isaac in 1982 on the vegetation of Tongatapu and the offshore islands. Wind, flooding, and salt-water intrusion inland caused the damage. Sykes (1978) and Johnstone (1977) provide brief descriptions of the effects of earthquakes on vegetation of 'Eua and 'Ata

<sup>6</sup> There is only about a dozen endemic plant species in Tonga, totaling about 3% of the flora. Of these endemic species, four are found in Kao and Tofua, (*Syzygium crosbyi*, *Guioa lenticifolia*, *Pneumatopteris macroptera*, and *Selaginella yunckeri*) and eight are found in the 'Eua National Park (Whistler, 1989). Kao and Tofua do not have any protection status.

Insects, in general, have not been studied. Only those that have adverse or beneficial effect on agriculture have been studied to some extent and some studied by researchers are unrelated to any identified need in Tonga such as the study of ants by Wetterer (2002) who also referred to other studies of ants in Tonga from 1870s to 1995. Wetterer described eight endemic ant species in Tonga. However his study was limited to the inhabited and easy to access islands of Tonga.

<sup>7</sup> Similar to other small Pacific islands, birds are the major group of vertebrates in Tonga. Tonga has two endemic species, the Tongan megapod (*Malau*), *Megapodius pritchardii*, and the Tongan whistler (*Hengehenga*), *Pachycephala jacquinoti* (Rinke, 1992).

<sup>8</sup> Rinke (1992) also reported on fruit bats and reptiles. Tonga has two species of indigenous mammals, the fruit bat (*Peka*), *Pteropus tonganus*, and the shealth-tailed bat (*Pekepeka*), *Emballonura semicandata*. The fruit bat is common throughout Tonga, while the small bat is declining rapidly. It has already disappeared from many islands (Rinke, et al., 1992).

Reptiles are represented by seven species of skinks, seven species of geckos and one species of iguana (*fokai*), *Brachylophus vitiensis*. One species of gecko (moko), *Lepidodaactylus evaensis* is endemic to the higher parts of 'Eua, where it was discovered in 1986. The distribution of the iguana is poorly documented. It is known with certainty from Vava'u, Tongatapu and 'Eueiki only. It may be an endangered species in Tonga (Rinke et al., 1992).

<sup>9</sup> Examples of Tonga participation in relevant regional and international agreements and instruments included the following :

- As a party for the UN Convention on Conservation of Biological Diversity (CBD), the National Biodiversity Strategic Action Programme (NBSAP) has been under development since 1994;
- Currently (2002 - 2004) collecting baseline information and green house inventory under the enabling activities offered to parties of the United Nations Framework Convention on Climate Change (UNFCCC);
- As a party to the agreement establishing the SPREP, Tonga is participating in almost all of the regional environment program;
- Ha'apai Conservation Area Project, supported by GEF and SPREP, aimed at conservation of biodiversity;
- The South Pacific Regional programme (SPRIG) to improve forest genetic resources;
- FAO, Pacific Plant Protection programme --Tonga was involved in the Related training and capacity building programmes comes with the programmes above;
- Relevant national programme to phase out CFC and other substances that deplete the Ozone Layer as party to the Montreal Protocol;
- Relevant national program initiated in the implementation of the "Agenda 21", such as the UNITAR/UNEP/SPREP program on the Environmentally Sound Management of Toxic Chemicals, including Prevention of Illegal International Traffic in Toxic and Dangerous Products and POPs.

<sup>10</sup> A comprehensive list of government's responses to land development and issues is found in the Tonga National Assessment Report to the World Summit on Sustainable Development (2001), Department of Environment, Nuku'alofa, Tonga. Further discussion on capacity building responses could be found in Thistlethwaite, et al. (1993).

<sup>11</sup> A comprehensive list of civil society's responses to land development and issues is found in the Tonga National Assessment Report to the World Summit on Sustainable Development (2001), Department of Environment, Nuku'alofa, Tonga.

<sup>12</sup> Offshore investigation for alternate sources of sand could be found in Gauss (1980); MOW (1987 and 1999).

<sup>13</sup> Digging, blasting and ripping of foraminiferal and fossil coral from hillsides is the form of mining. When the area is exhausted, a large flattened hole with steep sides is left open. In 1987, more than 70,000 tonnes of limestone were quarried from seven quarries in Tongatapu alone (EPACS & GOT, 1990).

<sup>14</sup> Poisons are used to catch fish. Some of these are highly toxic to corals and small invertebrates and kill all the fish, including the small juveniles. Natural toxins (*kava fisi*) and artificial poisons (bleach, pesticides, herbicides) cause long-term damage to corals and associated flora and fauna. Illegal fish poisoning with agricultural chemicals is suspected and dynamiting is still carried out in some places in Tonga (ESCAP & GOT, 1990).

<sup>15</sup> Further discussion on the Latin names of mangroves species found in Tonga, the various uses of mangroves and the state of mangroves is found in Ellison (1989, 1998 and 1991); Pelesikoti (1992a and 1992b); Whistler (1992).

<sup>16</sup> Few assessments of Tonga coral reefs have been conducted. Descriptions have been made by Dahl (1979) of Tofua and Kao, Late and Vava'u. Chesher (1984, 1985) described areas around Tongatapu, Nomuka, Ha'apai and Vava'u. Zann et al. (1984) and Zann (1994) studied Fanga'uta Lagoon and adjacent coral reefs. Nunn (1993) described the unique algal-ridge forming a fringing reef occurring along the southern coasts of Tongatapu. In 1997, the Marine Parks Centre of Japan (MPCJ) conducted an inventory of the corals, mollusks and fish of Tonga's marine reserves.

<sup>17</sup> Reef gleaning involved of turning of corals or rocks to pick shellfish underneath or using of crow bars to loosen and break open the reef to collect invertebrates and shellfish.

<sup>18</sup> As inshore finfish become scarcer for the Tongatapu market, fishing effort must range further afield. Tu'imatamoana fish market records show a tripling of the amount of fish originating from Ha'apai between 1994 and 1995 (Gillet et al., 1998).

<sup>19</sup> Export data submitted by the main aquarium exports, by composition, were: live fish, 27%; live coral, 29%; soft coral, 27%; invertebrates, 15%; giant clams, 2%. Of the fishes, 54% were Damselfish; 17% Angelfish; 11% Wrasses; 8% Clownfish; 6% Hawkfish; 2% Butterfly fish and 2% Tangs (Matoto et al., 1996).



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<sup>20</sup> Further studies of Tonga's marine plants and animals diversity could be found in Halapua (1980), McKoy (1982), Okamoto (1984), Chesher (1987), Langi & Langi (1987), Mead (1986), Thomas (1987), ESCAP & GOT (1990), Latu & Tuluva (1991 and 1992), and MOF (1991 & 1992).

<sup>21</sup> A giant clams sanctuary is a circle of mature giant clam breeding stock of about 30 to 40 placed close together to aid greater breeding success and reseed the surrounding reefs with new clams.

<sup>22</sup> The Marine Parks are: Hakau Mama'o Reef Reserve; Pangai Motu Reef Reserve; Monuafa Island Park and Reef Reserve; Ha'atafu Beach Reserve; and Malinoa Island Park and Reef Reserve.

<sup>23</sup> Principle 15 of the 1992 Rio Declaration known as the 'Precautionary Principle' means that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation ([www.earthethics.com](http://www.earthethics.com)).

<sup>24</sup> Members of the National Environmental Monitoring are the Director for Environment (Chair), Director for Health, Director for Agriculture and Forestry, Secretary for Fisheries, Director Tonga Visitors Bureau, Secretary for Labour Commerce and Industries, Secretary for Finance, Chief Statistician, Langafonua-a Fefine Tonga (NGO), Tonga Trust (NGO), Director of Works, Director of Marines and Ports, Director of Central Planning and Director of Education.

## **CHAPTER FOUR**

### **THE EXISTING RESOURCE AND ENVIRONMENTAL MANAGEMENT FRAMEWORK IN TONGA**

#### **4.1 Introduction**

The inability of the existing environmental management framework in Tonga to effectively address the increasing environmental and resource degradation, contributes to a need for a major shift in the direction of environmental management towards a framework that is supportive of and promotes a ‘people-oriented’ approach. This ‘shift’ supports the proposition of this study as discussed in (Chapter 1, Sections 1.2.3 and 1.3.1) that Tonga’s sustainable goal will have a better chance of being effective if major efforts are made to develop a new policy framework aiming at achieving sustainable development. This requires in turn an analysis of the nature of the existing institutional and legislative institutional arrangements to manage resources and enforce the protection of the environment in Tonga.

##### **4.1.1 Objectives**

Chapter 4 aims to identify the weaknesses and the constraints created by the existing resource and environmental management framework in pursuing the national goal of sustainable development. Based on this analysis, new legislative and institutional recommendations could be constructed to develop a framework to ensure that the appropriate processes for sustainable development are consistent with the present as well as the future needs of the people of Tonga.

This chapter outlines the evolution and basis of resource management, the decision-making structure and processes, institutional and legal frameworks for resource management, and analyses the performance of these frameworks in the context of implementing the country’s sustainable development objectives. Key development activities (i.e. agriculture and fisheries etc.) are used to analyse the current resource

management regime, and how it affects the ways in which communities view and use the land and marine resources.

## **4.2 Foundation of Environmental Management in Tonga**

Tonga's land and marine tenure is different from other Pacific Islands countries where customary land and marine tenure were in the hands of the people of the same tribe or community (Vuki et al., 1992). Tonga was a customary private property rights system controlled by the chief who restricted<sup>1</sup>, distributed or allowed 'his'<sup>2</sup> people to use the resources as he pleased (as discussed in Chapter 2, Section 2.3.3.1). Basically, the 'traditional or customary' land and marine tenure and resource use practices in Tonga prior to 1850 were not a common property rights system, rather a commoner's blight.

### **4.2.1 Basis of the Modern Land and Marine Tenure**

The Vava'u Code of Laws and the 1875 Constitution established the basis for the 'modern' land and marine tenure in Tonga (discussed in Chapter 2, Section 2.3.3.1). In the Vava'u Code of Laws, the King proclaimed "no person has any title to lands<sup>3</sup> in these islands except by grant from the Government", (Maude et al., 1987). Clause 104 of the 1875 Constitution legalises and reaffirms the principles of land holding established earlier by the Vava'u Codes of Law.

The 1875 Constitution of Tonga then, confirmed the King's liberation<sup>4</sup> of the commoners from the authority of the chiefs and abolished the chiefly privileges; legalised the land tenure (discussed in Chapter 3, Section 3.4.1); and reaffirmed that the people of Tonga could fish 'freely' according to the relevant laws of the country as managed and enforced by the government (Maude et al. 1987).

The *Land Act 1927* prescribes strict rules about the hereditary estates, tax and town allotments, leaseholds and interests in lands of every description. However, these rules provide conditions for land acquisition rather than any management rules. The Minister of Lands is the representative of the Crown in all matters concerning land and sea in the Kingdom (*Land Act 1927*, s.19 (1)). The land and the sea<sup>5</sup> are the property of the Crown (the *Land Act 1927* and the *Territorial Sea and Exclusive Economic Zone Act 1978*).

Therefore, the rights to all natural resources are vested in the Crown (ESCAP & GOT, 1990), and the representative of the crown is the government.

Resource management in Tonga evolved from private ownership to a combination of private and state ownership. Tonga's current environmental and resource management framework is founded in the 1875 Constitution, which set out the constitutional and administrative structure, and establishes the land and marine tenure as practised today. It is apparent, then, that resource management, supporting institutions and management structure in Tonga since the mid-1800s, were based on what was seen as priorities at that time. Although the people of Tonga's 'priorities' have shifted with time, the 'original' institutional arrangement and resource management remains basically the same.

Tonga's modern land and marine tenure can be distinguished from other tenure systems in the Pacific, where the control of land/coastal areas in countries such as Fiji, Cook Islands, and Vanuatu lies in the hands of the family or the community rather than the individual, as is the case of Tonga (Pulea, 1992). Some writers described the marine tenure in Tonga as an open access regime (World Bank, 1999; Malm, 2001) implying 'a free for all' leading to the eventual ruin of the resources. This study, however, argues that it is the failure of the state to implement its management responsibilities as described by the laws of Tonga and its exclusion from management of the people who use the resource daily, that has created the open access situation.

### **4.3 Tonga's Decision Making Structure**

Three decision-making structures and processes are analysed in this section. The first, is the Constitutional and administrative structure and processes that formulate the laws of Tonga. The second is the development approval structure and processes that determine major development projects to be funded and implemented, and the third is the project level structure and process for permits and licences requirements.

#### **4.3.1 Constitutional and Administrative Structure**

Figure 4.1 shows the structure of the three main bodies of Government (refer to Chapter 3, Section 3.3.3.5) in relation to each body's relative level in the hierarchy of the decision-making structure as prescribed by the Constitution. Although the Judiciary plays an

important role in any system, for the purpose of this study, it is not explained in detail. It is, however, included in the structure to give a broad understanding of all the constitutional systems that shape Tonga's decision-making process.

Crucial to any resource management regime is how the decisions are made and who are involved in the decision-making, and what specific powers to make laws that govern resources. Ultimately, it is the King in Council who makes the decisions and approves the laws of the country with the advice of the Parliament or the Cabinet.

(a) The King:

The King gives his sanction and signature to all legislation as it may become law. The King may withhold his sanction to any law passed by the Legislative Assembly and the Constitution then prohibits the Legislative Assembly from discussing that law until the next session (*Constitution of Tonga 1875*, Clause 68). The power to enact laws lies with the King and the Legislative Assembly (*ibid.*, Clause 56).

(b) The King in Council:

The King has the exclusive right to appoint the prime minister, other cabinet ministers and the Governors of Vava'u and Ha'apai. These make up the Cabinet and sit with the King in Council (*ibid.*, Clause 50).

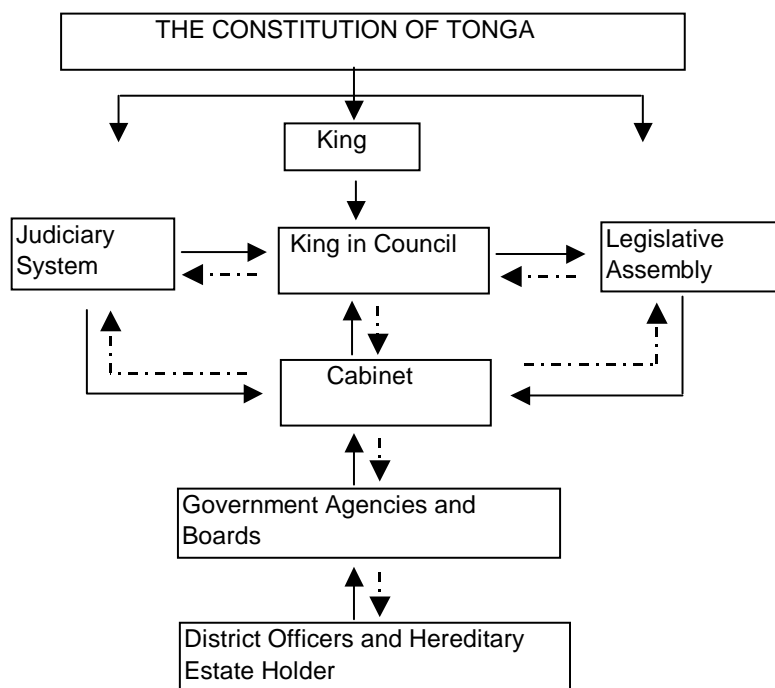
Where the laws are found to be at variance with the Constitution, the Chief Justice is authorised to suspend any such law passed by the Legislative assemble or Privy Council until the next sitting of the House (*ibid.*, Clause 82).

No law can be passed or any important matter decided upon in the Privy Council unless there are three or more members presiding with the King (*ibid.*, Clause 82 s. 3). The King and the Privy Council may between the meetings of the Legislative Assembly, pass Ordinances:

- enacting regulations between meetings of the Legislative Assembly;
- suspending until the next meeting of the Assembly, any law at the request of the Chief Justice;
- giving effect to any Treaty arrangement made by Tonga with foreign countries (*ibid.*, Clause 82 s 7).

Further, under the *Government Act 1903*, The King in Council is the highest executive authority and the Prime Minister is responsible for carrying out the resolutions of the Privy Council (ibid., Clause 55, s 2).

**Figure: 4.1 Constitutional and Administrative Decision Making Structure**



Source: Interpretations based on the Constitution and relevant laws

(c) The Cabinet:

The Prime Minister is the chair of the Cabinet, made up of all Cabinet ministers and the Governors of Vava’u and Ha’apai.

Currently there are ten Cabinet ministers including the prime minister and the two governors. A cabinet minister may hold more than one portfolio. For example the Prime Minister is also the Minister for Foreign Affairs and Defence, Civil Aviation, Prime Minister’s Office and Local Affairs, Statistics, and Central Planning.

(d) The Legislative Assembly:

The Legislative Assembly or Parliament is made up of all cabinet members who sit as nobles (*Constitution of Tonga*, Clause 59), nine representative of the nobles elected by the nobles, and nine representative of the people elected by the people. The King, from the nobles' representatives, appoints the speaker of the House.

Elections for all representatives of the nobles and the people are held once every three years, but the King at his pleasure may dissolve the Legislative Assembly before the expiry of three years and command that new elections be held (*ibid.*, Clause 77).

(e) The Government Ministries and Boards:

A cabinet minister heads each government agency and board.<sup>6</sup>

(f) The District Officers and the Nobles:

The District Officers<sup>7</sup> may make regulations for the governing of village plantations and other necessary matters relating to the welfare of the people of the village (*Government Act 1903*). The regulations will not become law until sanctioned by the Cabinet and confirmed by the signature of the Prime Minister (*ibid.*, s. 26). Any noble holding a hereditary estate is authorised to make regulations for the people who reside on the hereditary estate of the noble, but the regulations must be given to the District Officer of the town in that hereditary estate and the regulations will not become law until sanctioned by the Cabinet and confirmed by the Prime Minister (*ibid.*, s. 27).

#### 4.3.1.1 Constitutional Decision Making Process

The arrows in Fig. 4.1 indicate the flow of the decision-making process. The upward solid arrows represent the general direction of submission or proposal of a policy or a law that is required to go through the process for official endorsement from higher authorities. The downwards and sideways solid arrows could either represent a policy decision or an approval granted. The dotted lines represent 'flow' that requires further discussion, feedback or action.

Most legislation is developed and proposed by the line ministries or boards to Cabinet through their respective Cabinet ministers. A minister may put a case to Cabinet on his intentions to develop a Bill and its proposed objectives. If approved, a policy decision is then made to formulate such a Bill. The line ministry concerned may seek legal assistance from the Crown Law Department or private law firms internally or through a donor if such assistance is required. The Bill has to be approved by a Law Reform Committee<sup>8</sup> and the Cabinet before tabling in Parliament. If rejected from the Law Reform Committee, Cabinet or from Parliament the concerned minister may choose to revise the Bill, and go through the same process again.

The Governors of Vava'u and Ha'apai do not have power to make laws but they are responsible for enforcing the laws in their districts (*Constitution of Tonga*, Clause 55). The people's representatives to Parliament also do not have power to make laws and submit them to the House, although there has been some movement recently to allow this (per. obs.).

An important structure already in place is the role of the noble and district officers (Fig. 4.1) in making regulations with regard to the welfare of the communities. Also this process seems to be shorter as it requires only Cabinet approval and the Prime Ministers signature rather than the process of going through Parliament (Section 4.3.1.1). However, from experience in Tonga, and from official records (Government Gazettes), there have not been any regulations or a record of any such regulations proposed by the district officers or the nobles. This could imply an over reliance on the capacity of the government, or the lack of capacity on the part of the district officers and nobles to develop regulations. Perhaps this is an opportunity for community environmental issues to be addressed but it is not used.

Cabinet Ministers appointed by the King appear to be the key people in the decision making structure. They are in the Council, in Cabinet, in Parliament and in the Ministry and Board levels (Fig 4.1). They are responsible for the formulation of new legislation as well as seeing that it passes through the approval process. Therefore making Cabinet Ministers aware and informed on sustainable environmental and resource use issues is important when sustainable development policies are proposed and considered at all the major decision making levels in Tonga.

Notable from the structure and process explained above is the lack of legal requirement for a Bill to be available for public comments at anytime during the process. There could be



some underlying justification for not allowing for public interests and input for a proposed Bill. It could be assumed that the line ministry concerned may have canvassed public opinion and interests. The government is acting on the best interests of the people or the representatives of the people in Parliament are representing people's opinions. However, from experience in Tonga, the line ministries do not seek public opinion on a Bill, as it is not a legal requirement. It is only in the opinion of the government that they are acting on the best of the people and the Cabinet Ministers and the Nobles always outnumber the people's representatives in Parliament (nine peoples' representatives) against nineteen others).<sup>9</sup>

### **4.3.2 The Policy-Making Procedures**

#### **The Policy-Making Bodies**

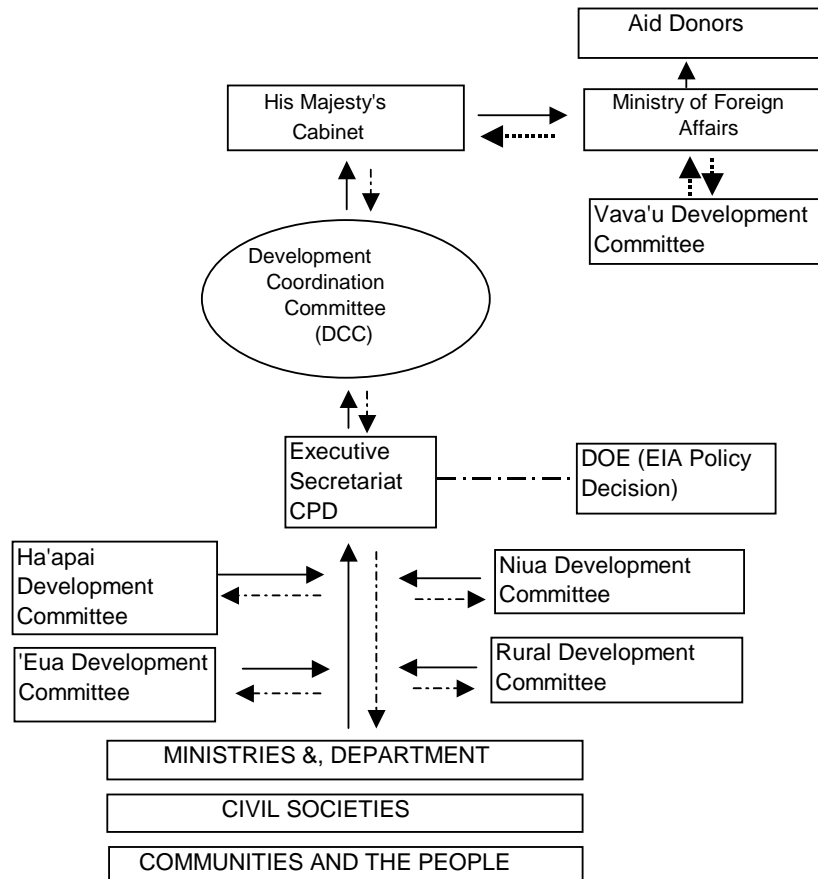
The policy-making bodies in Tonga are Cabinet, a Development Coordination Committee (DCC)<sup>10</sup>, Divisional Development Committees – Vava'u Development Committee (VDC)<sup>11</sup>, Ha'apai Development Committee (HDC)<sup>12</sup>, Niua Development Committee (NDC)<sup>13</sup>, 'Eua Development Committee (EDC)<sup>14</sup>, the Government Departments, and Boards (Fig. 4.2). The Cabinet-established national and divisional development committees are the main policy making bodies, providing policy advice on development issues relating to economic and social development of each main island to Cabinet. However, in reality, these divisional Development Committees main tasks evolve around prioritising development projects that are requesting funding assistance from sources that require government approval or endorsement (Section 4.3.2.1).

#### **The Policy Formulation Process**

National policy is initiated and developed by the Central Planning Department (CPD) through the Strategic Development Plan (SDP) process (Chapter 1, Section 1.2.3). The current SDP formulation process is based on CDP coming up with a draft SDP based on annual reports of government departments and boards, donors interest in Tonga and any existing Cabinet Decisions for the focus of the SDP. The draft SDP is circulated to government departments for comment, the CDP amends the draft in the light of 'any useful' comment, submits to the DCC for consideration and if approved by the DCC, it is

submitted to Cabinet with the DCC's recommendations for a final approval. National policies then are stated and defined in the SDP.

**Figure: 4.2 Development Decision Structure with Divisional Committees**



Source: Adapted from Central Planning Department (CPD), 1999

Apart from the SDP process, there is no other Cabinet Decision to guide the policy formulation processes. Each sector formulates its own policy and submits directly to Cabinet for approval. If the policy is related to any existing laws and prescribed in the law where a Privy Council decision was required, only the approved Cabinet Decision would be submitted to Privy Council for consideration. Otherwise Cabinet makes the final decision to either approve or not approve the proposed policy. The policy is generally stated in a form of a Cabinet Decision, but the document(s) explaining the policy and the proposal for such a policy that was submitted to Cabinet are not circulated unless circulated by the proponent of the policy for comment by other departments, prior to the submission to Cabinet (Fusitu'a, 'E., per. com., 9/10/2001)<sup>15</sup>.

The process suggests that there is a lack of coordination across sectors in policy formulation and there is no input from the civil society. The responsibility, however, for the implementation of the policies, rests with the public. There is no Cabinet Decision or law that restricts government departments from consulting other sectors or the civil society in policy matters. It is entirely at the discretion of each government ministry or sector (Fusitu'a, 'E., per. com., 9/10/2001). It is also noted that there is no requirement in place for policy formulation bodies to seek civil society input.

#### **4.3.2.1 Development Decision Making Structure and Process**

Development decision-making is referring to development projects that required government assistance to secure or approve funding. The sources of fund could be from bilateral, multilateral, international Non Government Organisation (NGO) or local funding from government development funds.

The Central Planning Department (CPD) provides the secretariat services to the each divisional development committees, except the VDC and the National Disaster Preparedness Committee (NDPC) (see Section 4.3.2 and Fig. 4.2). The Ministry of Foreign Affairs (MOFA) and the Ministry of Works (MOW) are the secretariat for the VDC and NDPC respectively. All of the divisional development committees are based in Nuku'alofa. Cabinet also establishes interdepartmental committees to deal with specific projects and have specific term of references, i.e. the Interdepartmental Environmental Committee (IDEC), the Project Coordination Committee (PCC) etc., however, when those projects end, those committees also end.

Each divisional development committee is chaired by a Cabinet Minister and includes the people's or nobles' representatives to the Parliament from that island group as members. The DCC itself, which is also the development committee for Tongatapu, does not have a representative of the people, private sector or the community as a member.

#### **4.3.2.2 Development Decision Process**

The arrows in Fig. 4.2 represent the flow of the decision-making process. The dotted lines represent 'flow' that could be returned for further discussion.

(a) Submission to Central Planning Department (CPD)

Any project seeking funding or technical assistance and requiring government approval has to be submitted first to the CPD.

(b) Project Appraisal

When a proposal is received, the CPD staff who are responsible for the sector area covered by the proposal (i.e. agricultural development, fisheries, tourism etc.) carry out a review. The review takes into account the benefits proposed by the project in relation to achieving the national development objectives, and the requirements and criteria of the potential donor identified by the project. At this stage also, the CPD at its discretion, may wish to consult the proponent or seek advice from other related ministries on matters relating a project.

The Cabinet policy decision No. 217 of 15 February 1985 directed the CPD to submit all new physical development projects for review by the Department of Environment (DOE) for environmental issues and for the DOE to report to CPD on the need for environmental impact assessment. However, in practice it is entirely up to CPD to implement this policy decision as indicated by the dotted line without an arrow between CPD and DOE (Fig. 4.2). This is confirmed by the DOE records where from the year 1997 to 2001, only six projects were referred from CPD to DOE for comments, and those projects were small community based projects proposed by NGOs or village committees (per. obs). There was no record between 1985 and 1997.

(c) DCC Meetings

DCC meetings are usually held on a monthly basis depending on the availability of the Chairman and its members. However, the secretariat could circulate urgent papers among the members of DCC subject to approval by the Chairman.

(d) DCC Outcome

When a project is approved by the DCC it is submitted to Cabinet for the final decision. When a proposal is not approved, it is returned to the proponent through the CPD with relevant comments. The proponent may wish to resubmit through the same process at a later date.

(e) Cabinet Decision

If a project is not approved by the Cabinet, the Prime Ministers' Office (PMO) notifies all relevant parties. The proponent may wish to resubmit the proposal, but the proposal has to go through the DCC again. When Cabinet approves a project, the PMO forwards the Cabinet Decision to the Ministry of Foreign Affairs (MOFA), the proponent and all other related ministries. Foreign Affairs would then notify the potential donor.

(f) Submission to Aid Donors

Project proposals are formally submitted to recommended aid donors by the MOFA. The donors then review the proposal through the donor's own processes. A project may take between a few months up to years before implementation, depending on the size of the project and the amount of funding requested.

(g) Exception to the Established Process

There are several exceptions to this established process in Tonga. These include development projects that go directly to Cabinet and are not channelled through CPD and DCC. Projects proposed from the VDC are an example, although they fall under the criteria of requesting funding and technical assistance, the projects go directly from Foreign Affairs to the Cabinet for consideration and approval.

There are also intergovernmental organisations that require only the approval of their in-country focal points and do not require government approval or endorsement. Therefore, projects in this category go directly to the focal point for approval and from the focal point to the donor. Further, projects that do not require any funding assistance that might entail seeking government approval, or are not subject to any licence or permit approvals (Section 4.3.3), are also not subject to the established process described above.

The examples given above of the projects that do not go through the established process mean that the chances for coordination or for input from DOE or other relevant ministries are extremely limited. Therefore environmental issues are not addressed before the projects are implemented, and many of these 'well-meaning' projects that meet some of the national development objectives have huge environmental (ecological and social) impacts that have been ignored and neglected (per. obs) It can be seen that there is a loophole in the process. Although, the environmental impact appraisal policy is still valid, it is ignored for two reasons. First, the policy is not binding under legislation<sup>16</sup>, and

second, although sustainability objectives are endorsed nationally, government departments who are involved in the process may not have a sustainable development 'culture', or sustainable goal objectives to put into practice (per. obs).

### **Licence Approvals Process**

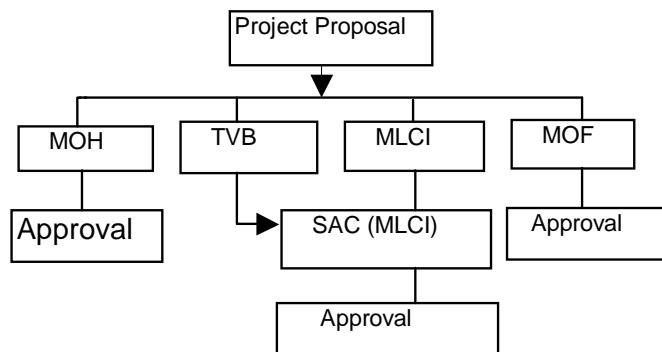
Although some developments that require licences do not use natural resources directly, the output from these developments has potential adverse impacts on natural resources. In cases where a development project is only seeking a particular licence required by the law, the proposal goes directly from the proponent to the ministry/department who controls the licence and if requirements are met a licence is issued (see Fig 4.3). There are also cases where funding assistance is sought that require government approval and the particular licence is also required. Both processes are to be adhered to, in order to obtain the necessary approval and permits (personal communication with the Director of CPD and Secretary for MLCI, August, 2001).

The Ministry of Health (MOH), under the Building Regulations of the Public Health Act, controls the issuance of licences for all new buildings constructed using imported materials. For example, the *Public Health Act 16 (1986) (Building) Regulations* prohibit a building to be erected immediately in front of another building or in such a way as to prevent light and fresh air from entering the other building (*Public Health (Building) Regulation*, Rule 6). Sufficient space must be allowed behind each building for latrines and other conveniences without constituting a nuisance to neighbouring buildings (*ibid.*, rule 8). The medical officer alone determines these rules (*ibid.*, Rule 9).

The Ministry of Labour, Commerce and Industries (MLCI) issues industrial development licences under the *Industrial Development Incentive Act 1978*. Although licences in this category were mainly in small manufacturing businesses such as knitwear, leather garments and concrete blocks, licences approved for the manufacturing of paint, and service stations have potential adverse effects on natural resources such as ground water, or biodiversity. However, in the application form for the development licence, requirement No. 12(d) asks for the "arrangements envisaged in regards to sewerage and effluent disposal" which is the only environmental requirement out of the 16 questions to be answered by the proponent (MLCI, Development Licence Application Form).

The industrial development and the tourist facility licences are considered by a Standing Advisory Committee (SAC) (see Fig. 4.3) chaired by the Minister of Labour, Commerce and Industries who is also the Minister for Tourism. SAC was established by the power of the Minister to make regulations as prescribed by the *Industrial Development Act 1978* and the *Tourist Act 1976*.

**Figure: 4.3 Current Processes for Development Approvals established by Relevant Legislation**



Sources: Interpretations based on the Ministry of Health (MOH), Tonga Visitors Bureau (TVB), Ministry of Labour and Commerce (MLCI), and the Ministry of Fisheries (MOF) licences requirement guidelines prescribed in respective regulations of the *Public Health Act*, *Tourism Act*, *Industrial Development Incentive Act* and the *Fisheries Act*.

The *Tourist Act 1976* prescribes a Tourist Facilities Licence administered by the Tonga Visitors' Bureau (TVB)<sup>17</sup>. Most of the tourist facilities in Tonga, as to be expected, are located by the beaches and have potential impact on coastal resources. However, TVB uses the same form as that used for the application for a development licence.

The Ministry of Fisheries controls the issuance of licences for the exportation of fish and other marine resources, including live fish and coral for aquaria prescribed by the *Fisheries Act 1989*, Regulations, Section 59(1).

### **Monitoring Requirements and Environmental Guidelines for Licences**

The licence approvals process described above lacks environmental guidelines to ensure sustainable development issues are addressed during the consideration of the licence approval. This is indicated by minimal appearance of environmental issues in the industrial development licence and tourist facilities licence application forms. There is no

guideline to specify how certain types of effluent should be treated or any specification, e.g. for the containment of sewage. Likewise for the Building Regulations under the Public Health Act and the Fisheries export licence, there is no established guideline to be followed by developers or exporters with regard to environmental impacts.

Further, none of the licences discussed above prescribe monitoring of permit conditions. Appendix 1 provides a summary of the current site inspection and environmental monitoring activities that are related to environmental and resource management.

## **4.4 Institutional Arrangement for Resource Management**

### **4.4.1 Ministry of Lands, Survey and Natural Resource**

The Ministry of Lands, Survey and Natural Resources (MLSNR) is the main environmental policy making body under the *Parks and Reserves Act 1976*. Responsibilities for environmental matters were concentrated in an Environmental Planning and Conservation Section (EPACS)<sup>18</sup> within the MLSNR. A recent government restructure created a new DOE effective from July 2001, from the Environment Section of the MLSNR (Cabinet Decision No. 76 January 2000), and places the new DOE under the portfolio of the Deputy Prime Minister. While the status of EPACS has been upgraded to become an independent agency from the MLSNR, the Parks and Reserves Act that prescribed its environmental responsibilities is still under the Minister of Lands and the MLSNR, and the new DOE staff came from the abolished EPACS. Therefore the DOE currently exists based on the policy decision with no clear mandate and legislative functions (per.obs).

The DOE still carries on with the following functions: - planning/co-ordination, conservation areas management, conducting hazardous/solid waste awareness and minimisation programs, coordinating regional, global environmental issues and environmental conventions activities in Tonga, managing an environmental information, education and resource centre, and conducting environmental assessment and monitoring (DOE, 2001).

The MLSNR is still charged with the responsibility surveying land for the purposes of allocation, land registration, mapping, granting leases, etc. under its Survey and Cartography Division. The Geological, Mineral and Water Resource Division has the



responsibility for mineral explorations, and for identifying underground water sources for drilling and for monitoring of the drilling of the wells.

#### **4.4.2 The Ministry of Agriculture and Forestry**

Environmental and resource management also lie with other government ministries such as the Ministry of Agriculture and Forestry (MAF). MAF is responsible for the exploitation and conservation of natural resources through the various divisions of:

- Livestock, where the main area of responsibility is to improve nutrition through improved quality of livestock;
- Research, which concentrates on promoting appropriate crop and animal production technology with specific emphasis on biological and pest control programs, the production of disease-free planting materials, and the propagation of viable tree crop species;
- Quarantine and quality management, which concentrates on preventing the introduction of plant pests or diseases from abroad, and the quarantine treatment of commodities;
- Extension, which provides agricultural extension services in the areas outside Nuku'alofa; and
- Forestry, which promotes balanced land use, emphasising the importance of trees for soil and water conservation, wood production, shelter and for other purposes and the promotion of exotic forest plantation on the island of 'Eua (MAF, 2000).

#### **4.4.3 The Ministry of Fisheries**

The Ministry of Fisheries (MOF), created in 1990 as a separate ministry for the MAF, has the responsibility of conservation, management and development of fisheries. The MOF implements these responsibilities through the following divisions:

- Fisheries Management and Development, which focuses on management of fisheries development to ensure the sustainability of fisheries resources;

- Private Sector Development, which concentrates on promoting investment in the fisheries sector and the marketing of fisheries products;
- Fisheries Policies, providing for the development of the ministry's policies, the MOF Strategic Plan;
- Aquaculture, which conducts research and trials on introduced or rare marine species in Tonga (MOF, 1999 & 2000).

## **4.5 Legislation that Governs Resource Use and Environmental Management**

A broad definition of environmental law has been chosen which includes law concerned with the physical environment and natural resources and law which facilitates the sustainable development of natural resources (Pulea, 1992).

Environmental law in Tonga is not codified in one single comprehensive statute. There are currently more than 20 pieces of legislation that contain provisions of environmental importance, some going back more than 50 years. The length of the list of legislation indicates the current inherent difficulty, if not impossibility, of administering environmental controls in a cohesive and co-ordinated way (Thistlewaite et al., 1993). The following sections discuss existing legislation and the sectors for which the legislation provides management rules.

### **4.5.1 Agriculture and Forestry**

There is no single comprehensive piece of legislation which regulates agricultural activities. There are, however, a number of specialised pieces of legislation that has evolved over the years that provide for and regulate specific activities relating to agriculture, e.g., the *Noxious Weed Act 1903*, the *Copra Act 1926*, the *Animal Diseases Act 1979*, the *Plant Quarantine Act 1981*, and the *Pesticide Act 2002*.

The Sixth Development (DP6, 1991-1995) stressed the adoption of preventive measures to avoid environmental damage due to agricultural activities. Support for research into such topics as mapping agro-ecological zones, soil erosion, utilisation of marginal lands, water quality, integrated pest management, maintenance of germ plasm and tissue culture for

genetic conservation and the effects of pesticide use and residue on the environment (DP 6:13), demonstrated the government's interest to strengthen programs for improving environmental protection in the agricultural sector. Such developments would imply considerable change to the existing laws, but there have not been any significant legal changes.

### **Imports of Plants and Animals**

The *Noxious Weeds Act 1903*, as amended, empowers the Minister of Agriculture and Forestry with the consent of the Privy Council, to proclaim, from time to time, any plant to be a noxious weed within the whole or any part of Tonga (ibid., s. 3). Any owner or occupier who fails to eradicate weeds declared to be noxious could be liable to a fine of up to \$T250 (ibid., s. 4).

The *Copra Act 1926*, as amended, regulates the making and sale of copra. Its main provision prohibits the making of copra from nuts which have not fallen naturally from the trees or from nuts which have begun to sprout, or from immature nuts (ibid., s. 3). However, from 1990, the export of copra fell due to the general fall in the copra export market, but coconut products continue to be an important part of agricultural products, particularly for the domestic market.

The *Animal Diseases Act 1979* provides for the control of animal diseases when importing animals. The Minister of Agriculture is empowered to declare, by notice in the Gazette, any land under the Minister's control or, with the consent of the Minister of Lands, any land of the Crown, a quarantine ground for the detention of imported animals. No one is permitted to remove any animal from such grounds without the consent of the Minister (ibid., s. 4). Section 6 provides for the requirement of a permit from the Director of Agriculture for the importation of animal products. Section 7 prescribed the approval required from the Cabinet before certain animals (listed in Section 7) or parts (eggs, semen and carcasses) can be imported, and Section 8 imposes a duty on owners of vessels or aircraft which landed any animal without the permission of an Inspector.

### **Damage caused by Animals**

The *Pounds and Animals Act 1903*, as amended, allows the owner or occupier of any cleared or cultivated land to claim compensation for damage caused by the trespass of cattle from the owner or the person who is in control of the trespassing cattle (ibid., s. 17).

It is an offence for an owner to neglect to enclose cattle within a fence (ibid., s. 16). Where pigs are found at large on a roadway or on public property the Act permits a constable or other police officer to kill them (ibid., s. 18)

One of the main agricultural protection laws in Tonga is the *Plant and Quarantine Act of 1981*. The Act provides for the Minister of Agriculture and Forestry to prohibit by regulations the import generally or specifically of any plant, plant materials, plant pest, soil, insects or garbage from any place specified (ibid., s. 15). However, previous reviews identified that the main constraints lies in the lack of implementing regulations (Thistlethwaite et al., 1993). The effective operation of the Act depends upon regulations expressly detailing the conditions for the entry of plants and plant products. Administration and enforcement of the Act are also a problem. Extension officers are supposed to assist and encourage farmers to increase their output, but in the case of squash and vanilla growers, for example, these extension officers were asked to also undertake the role of quarantine inspection (Fakalata, 1993).

### **Pesticides**

The *Pesticides Act 2002* repealed the *Pesticide Act 1976*. This Act provides for registration of imported pesticides to be imported (s. 3 and s. 6), establishment of a Pesticide Committee (s. 4), the registrar with the advice of the committee may list pesticides banned from importation (s. 9), for the registrar to prescribe guidelines for disposal or destruction of a pesticide (s. 27), the penalties for breaching the provisions of the Act (guilty parties liable on conviction to a fine not exceeding \$T5,000 or to imprisonment for a term not exceeding two years or both (s. 21)).

Thistlethwaite et al. (1993) claimed that the main weakness with most of the legislation in Tonga is the lack of capacity and resources for implementation. Legislation is very old and no longer applies to current situation in Tonga, and communities are not aware of the legislation. The *Pesticide Act 2002* may again fall into these constraints unless the capacity and resources of the Ministry of Agriculture are greatly improved (per.obs).

#### **4.5.1.1 Agricultural Leases**

The system of leasehold aims at encouraging Tongans to develop agriculture for the domestic and export markets. The Minister of Lands, with consent of Cabinet, may grant

leases to any person who is a Tongan subject of full age who does not hold a tax allotment (*Land Act*, s. 89).

On receipt of a lease application the Minister of Lands is required to give the Director of Agriculture the name of the applicant, the particulars of the land held and the land proposed to be leased by the applicant. An authorised Agricultural Officer is to investigate the state of cultivation of the land proposed to be leased and/or the state of cultivation of the statutory allotment (*ibid.*, s. 94). The MAF, however, does not use (see Appendix 1) environmental guidelines in the assessment of agricultural leases, the establishment of agroforestry industries, or intensive farming industries such as squash, commercial vegetable, piggeries and chicken farms (Fryauff & Engleberger, 1984).

At the conclusion of the inspection, the Minister of Lands submits a report of the Director of Agriculture and the application to Cabinet. If the Cabinet is satisfied as to the ability and character of the applicant to comply with Section 74 of the *Land Act*, which relates to planting, a lease will be granted (*ibid.*, s. 95).

The maximum number of allotments a person is entitled to lease is 20 tax allotments and 10 town allotments. The MLSNR issues the lease but may also be arranged privately between two individuals, or between an individual with little or no land with a noble. A lease may also be bought and the lessor will determine the financial arrangements. The cost involved in obtaining a lease nowadays could be quite prohibitive due mainly to the scarcity and the pressure to obtain suitable land (Pulea, 1990).

Notably, there is a lack of specific legal provisions for soil conservation, although the MAF does offer advice on this area. The growing pressure for land indicates a need to address land tenure issues to encourage long term investment instead of short term cropping.

#### **4.5.1.2 Forestry**

The *Forests Act No., 7 1961* is the main statute for forestry management. The main provisions of the Act prescribe that The King in Council may declare a forest reserve (*ibid.*, s. 3). Section 4 prescribes for the Ministers of Agriculture and Forestry to make regulations<sup>19</sup>.

Reviews of the *Forestry Act* carried out by Pulea (1992) and Thistlewaite et al. (1993) pointed out that there is no clear distinction in the *Forests Act* between those categories of forest that are reserved for economic and commercial reasons, and those forests where timber harvesting is prohibited for environmental and conservation reasons.

Part III of the *Forest Act* provides for town and village forest areas. Under this part:

- A district officer may, with approval of the Minister, demarcate a village forest area which shall be registered at the Department of Agriculture;
- Village forest areas shall be governed as prescribed by the Minister;
- Forests officers or police officers may seize and detain any forest produce or property used in taking forest produce; and
- Penalties are provided for offenders.

The *Forest Produce Regulations, 1979* (*Gazette Supplement* 1979) require an export licence for forest produce except for woodcarvings and handicrafts and other semi processes or processed forms of logs, stems or roots. The law also protects 28 native tree species. However, this ‘protection’ is not enforced due to lack of capacity in the MAF (T. Faka’osi, per. com., 13/11/2001).<sup>20</sup>

#### **4.5.2 Fisheries**

The *Fisheries Act 1989* is the main statute governing fishery activities in Tonga. The Act provides for the management<sup>21</sup> and development of fisheries and other related matters. The Minister of Fisheries is empowered to make regulations, among other things, prescribing fisheries management and conservation measures including mesh sizes, gear standards, minimum and maximum species sizes, closed seasons, closed areas (*Fisheries Act 1989*, s. 15(2)) and prohibited fishing methods (*ibid.*, s. 21) and gear (*ibid.*, s. 23). Under 21, prohibited fishing methods are listed as ‘explosive, noxious substances used to kill, stun, disable or catch fish’.

The Act also provides for the Minister to declare, by order published in the Gazette, any area of the fisheries waters to be a reserved area for subsistence fishing, and may specify the types of vessels allowed to fish that area and the fishing methods to be used (*ibid.*, s. 22(1)). Since the enactment of the *Fisheries Act 1989*, there has not been any reserved

area for subsistence fishing gazetted according to s. 22 (1), ('Akau'ola, per. com., 26/6/2001).<sup>22</sup>

The main weaknesses with the *Fisheries Act* involve the lack of implementation of the provisions of the Act and the inadequacies in penalties prescribed (Pulea, 1993; Gillett et al., 1998; Kailola, 1995). Although there is no offence created penalties are provided for following: erecting or using a fish fence without a licence under the Fisheries (Conservation and Management) Regulations 1994<sup>23</sup>; breaching of licence conditions involving the use of a local fishing vessel<sup>24</sup>; carrying on sport fishing activities without a commercial sport fishing licence<sup>25</sup>; use or possession of explosives, poison or other noxious substance<sup>26</sup>; and assault or obstruction and related acts against authorised officers<sup>27</sup> or impersonation of an authorised officer.<sup>28</sup>

Active partnership (community/MOF) in fishery management intervention as envisaged by the *Fisheries Act* is largely absent. In the thirteen years since the *Fisheries Act* became law, there has not been any fishery plans<sup>29</sup> prepared as of date ('Akau'ola, per. com., 26/6/2001). No licensing system is presently occurring, and there appears to have been a lapse in the licensing system for fish fences. With a few notable exceptions, enforcement of the existing laws and regulations has been weak ('Akau'ola, per. com., 26/6/2001). There are many research reports in Tonga that have significant management suggestions upon which little action has been taken (Gillett et al., 1998). Gillett et al. (1998) referred to studies by Preston and Lokani (1990), where these authors recommended several easy-to-implement management actions for beche de mer, none of which were implemented until the beche de mer fishery was at the point of collapse. Similarly, the recommendations given by Kailola (1995) for the sustainable management of beche de mer, lobster, mullet, tridacna, aquarium fish, coral, and octopus as well as seven other inshore resources have not been acted on (Gillett et al., 1998). Further, Udagawa et al., (1996) gave advice on lobster management in Tonga and reviewed "10 years of delay and negligence" in implementing lobster management (Gillett et al., 1998).

Also, it appears that there are important environmental provisions lost with the enactment of *Fisheries Act 1989*. For example, the protection of whales provided by the *Whaling Industry Act* (Acts No. 12, 1935; No. 10, 1979 7 No. 10, 1988); and the wounding, capture, taking or killing of whales of all species prohibited unless approved by the Privy Council in accordance (s. 2) were lost when the new *Fisheries Act 1989* repealed the *Whaling Industry Act*. While there is some potential protection in regulations that may be

made under the regulations of the *Fisheries Act*, those regulations can only be made with respect to prohibiting fishing for whales.

Until recently, there was very little effective control over harvesting of crayfish, clams and other shellfish. The *Fisheries Act* provides for the MOF to formulate regulations controlling the harvesting of these in terms of quantity and size. The issue of drift net fishing for albacore and yellow fin in the waters south of Tonga is currently being addressed at the regional level. The continuation of this type of fishing could seriously undermine the future of the tuna industry. Efforts to prevent this type of fishing need to be maintained, and so too do efforts to stop the use of other damaging fishing methods such as dynamiting, fish poisons, and coral breaking.

There is a need for a strategy for coastal zone development including fisheries, which would be compatible with policies for protecting the coastline and coastal fishery resources, and which would allow different user interests to be reconciled. Such a strategy would have to be based on the concept of sustainable resource use. It is possible that legislation to enforce EIA might improve current approaches to environmental assessment and monitoring. The success of EIA, however, is heavily dependent upon the availability of environmental information, which is easily accessible, and on a nature and scale appropriate to the area studied. Currently this type of information is not available for coastal fishery activities. It also dependent on the ability to predict impacts and then monitor environmental performance against defined standards. In ecological terms, a long-term objective is to ensure that irreversible damage to coastal ecosystems is avoided and the ability of these systems to support important populations and communities of wildlife.

### **4.5.3 Land and Coastal Development**

The provision prescribed the 1875 Constitution of Tonga and enforced by the *Land Act 1903* for land allocation to every male over the age of 16 years (refer to Section 3.4) has put the Minister of Lands under pressure to provide land. This may be contributing to the current major environmental problems (Fielakepa, per.com., 22/08/2001).<sup>30</sup> The Minister's legislative responsibility was to distribute and allocate land (*Land Act*, s 7), however, environmental considerations, as an integral part of this responsibility was not considered. As a result, encroachment of tax and allotments upon the national parks as in the case in 'Eua National Park, Mt. Talau National Park and government reserve<sup>31</sup> are common.



Environmentally sensitive and ecologically important lands such as swampy and low lying areas, mangrove area, and wetlands are inevitably subdivided for other purposes (Fielakepa, per.com., 22/08/2001).

Only a small percentage of land is locked under the Royal estates, and most of the royal and nobles' estates land that has not been allocated, is in long (50-99 years) term leases to churches, government or to business. Tonga has acute land shortage problems for future development and the only unallocated crown land left is on remote and uninhabited islands (Fielakepa, per.com., 22/08/2001).

The Minister of Lands, controls development in coastal areas, including allocation of protected areas and leasing of coastal areas for the purpose of aquaculture. Section 113 of the *Land Act* prescribes the following power of the Minister of Lands, Survey and Natural Resources:

- to grant allotments, anywhere, to Tongans entitled under the law;
- to grant leases and permits, including marine or coastal area leases, with the consent of Cabinet;
- to issue permits for foreigners to reside on the premises of a Tonga subject;
- to act as Registrar General of all land titles;
- to authorise all surveys and order the opening of all new roads but not close any roads without the permission of the Cabinet;
- to grant permits to erect stores, wharves or jetties on the coastal area or grant a lease for these purposes; and
- to grant permits to 'mine' sand from beaches.

None of the powers of the Minister of Lands, however, is subject to any environmental assessment.

The *Land (Removal of Sand) Regulations 1936* prohibits the taking or the removal of sand, however, the fine is only up to T\$100. Contradictory to this provision, the MLSNR mines sand and available records do not show anyone having been fined for illegal removal of sand although this goes on (per. obs).

The control of other types of coastal developments is found in the *Tourist Act, 1976* as amended, where the Minister responsible for tourism is empowered to license, regulate

and control accommodation, restaurants and other tourist facilities (ibid., s. 6(j)). A tourist facility is defined to include beach operators, boat hirers, entertainment or sporting complexes and any other attraction or facility used by tourists (ibid., s. 2).

#### **4.5.3.1 Biodiversity and Wildlife Conservation**

Biodiversity and habitat conservation is one of the most difficult environmental issues facing small island countries, as it often poses choices between environmental protection and economic development, between ‘food or income’ for today and the notion of ‘selective harvesting’ for a sustained supply in a longer time frame. The conflict between landowner rights and the government’s growing role in its stewardship responsibilities is also apparent. Tonga is party to the United Nations Convention on Biological Diversity (CBD), but appropriate national policies and legislations are absent to meet the requirement of the CBD.

The *Parks and Reserves Act 1976 & 1988* ((Acts Nos. 11 of 1976 & 20 of 1988)), “provides for the Establishment of a Park and Reserves Authority and the Establishment, Preservation and Administration of Parks and Reserves”. The Act provides for the setting up of both Land and Marine Parks and Reserves, or combinations of the two (refer to Sections 3.4.4.2 and 3.6.3.1).

The Parks and Reserves Authority<sup>32</sup> was established in 1996 with the consent of Privy Council. Prior to the establishment of the Authority, the Minister of Lands was the Authority, (*Parks and Reserves Act 1976*, s. 5). From 1996-2002, the Authority met only once (per. obs). This is yet another example of the lack of implementation of the existing legislation.

The Act authorises the Authority (or the Minister of Lands) to make regulations, but to date however, no such regulations appear to have been made according to s. 5 of the Act:

- prescribing conditions and restrictions the Authority considers necessary for the protection, preservation and maintenance of natural, historic, scientific and other valuable feature of any Park and Reserve;
- prescribing fees and charges for admission;
- providing for employment of patrons from any purpose which the Authority may consider necessary; and

- providing such other matters as are contemplated by or necessary for giving full effect to this Act and for its due administration.

Early attempts in diversity and wildlife conservation are reflected in the *Birds and Fish Preservation (Amendment) Act 1989* originally enacted in 1915 (*The Birds and Fish Preservation Act* {Acts Nos 1 of 1915; 13 of 1916; 13 of 1934; 24 of 1974; 21 of 1988, 46 of 1988}). Prior to the coming into force of the *Fisheries Act 1989* the *Birds and Fish Preservation Act* was described as “An Act to make Provisions for the Preservation of Wild Birds and Fish”. The Act has a list of the birds that are rare or endangered, and provides for the protection of those birds and their habitats. The *Birds and Fish Preservation (Amendment) Act 1989* which came into force the same day as the *Fisheries Act 1989* has however, deleted the word ‘fish’. Thus the various references throughout the Act and Schedules relating to fish are repealed or deleted (Pulea, 1992).

Another form of protection that disappeared with the repealed sections of the *Birds and Fish Preservation Act* was the list of protected turtles which were protected during the breeding season. It appears that the intention was to transfer that protection to regulations made under the *Fisheries Act 1989*, but a regulation for the protection of turtles has not been established (‘Akau’ola, per. com., 26/6/2001).

There has not been any revision of the rare or endangered birds at this stage, apart from the list made by the *Birds and Fish Preservation Act in 1934* (ESCAP & GOT 1990). Further, this Act did not achieve its intended potential, as it was never enforced. None of the three most relevant ministries (MLSNR, MAF and MOF) have the capacity to enforce the Act (Hon. Fielakepa, per. com., 22/08/2001). For example, the *Birds and Fish Preservation Act 1913* listed the whole of Fangakakau and Fanga’uta Lagoon as the first protected area in Tonga, most probably for the area’s important habitat for birds and spawning areas for fish. Yet, major parts of the mangrove area and foreshore of the lagoon have been allocated and reclaimed (Pelesikoti, 1992; Ellison, 1999).

#### **4.5.3.2 Water Resources**

Water resources here refer to the sources of fresh water for human use and how these are being managed. The two main sources of water in Tonga are the rainwater collected from rooftops into water tanks, and the water from underground fresh water lens. The rainwater

collection is not managed under any regulation, whereas ground water is managed under several statutes.

A number of institutions is responsible for managing the public water supplies in Tonga; MOH is responsible for the water supplied in the rural areas in conjunction with the Village Water Committee in each village, (*Public Health Act* ss. 38-45). The Tonga Water Board (TWB) is responsible for water supply and distribution in the four urban areas of Nuku'alofa, Pangai, Neiafu and 'Eua (*TWB Act*, Acts Nos 18 of 1966 and 19 of 1974). The MLSNR by a Cabinet directive is responsible for monitoring of the groundwater resources. In general, the MOH develops policies and programs for improvements to water supply and sanitation, while the MLSNR is responsible for managing the groundwater source by controlling the drilling of wells, and monitoring, testing and maintaining the quality of the water, (CPD, 1987 as in ESCAP & GOT 1990).

The Water Supply Regulations set out the various functions of the TWB. The regulations stipulate that the selling of water is prohibited, as is the wasteful use of water. Fouling or damaging of public water supplies is also prohibited, but the penalties for breaching these measures are inadequate. Thus anyone convicted under regulation 18 (i.e. for selling of water without authorisation or wasting water) is liable to a maximum fine of \$T20 and a further fine of \$T10 for each day the offence continues. The penalty for fouling or damaging public water supplies is \$T20.

Although the careful use of the limited water resources is critical to the development of Tonga, at present the MOH and TWB seem to deal only with supply and distribution issues. Specifically, the Water Board Act mainly deals with the establishment of Tonga Water Board; it contains nothing about water conservation, water management (other than the constitution of the Board and its financial responsibilities) or protection of water resources.

#### **4.5.3.3 Environmental Health, Waste Disposal and Pollution**

The Public Health Division (PHD) of the MOH is responsible for environmental health, waste management and pollution as prescribed by the *Public Health Act 1913*, the *Garbage Act 1949*, and the *Public Health (Refuse Dumping Ground) Regulations*.

## **Solid Waste**

The *Garbage Act, 1949*, as amended, the *Public Health Act 1913*, as amended, and the *Public Health (Refuse Dumping Ground) Regulations* require every owner or occupier of premises to keep garbage cans covered, clean, in good repair, and easily accessible. Rubbish should not be deposited on roadways, vacant land, foreshore, streams or creeks. These measures are not as effective as they should be because they are often not enforced, and, if enforced, the penalty for non-compliance is a maximum of \$T40, or up to a maximum period of three months' imprisonment (Rule 10).

The *Public Health (Refuse Dumping Ground) Regulations* provide for the Minister of Health, with the consent of Cabinet, from time to time declare certain areas or places to be dumping grounds for refuse (Rule 3). The MOH is in charge of municipal solid waste management, including waste pick-up, dumping and maintenance of the dumpsite. The authority to set aside/allocate land for public purposes is, however, vested in the Minister of Lands. Without agreement of the Minister of Lands, the Minister of Health cannot carry out his responsibilities under this Act. Further, the regulations do not require an environmental assessment to be completed before the declaration is made for any site.

Section 94 of the *Garbage Act 1949*, empowers the Minister of Health to specify what are to be regarded as toxic or hazardous wastes, and how these may be transported, stored or disposed. As this provision now stands, it is not mandatory for the Minister to action the activities envisaged by this Section (Pulea, 1992).

## **Litter**

There is no specific law to control or regulate the disposal of litter in public places such as on the streets, shopping areas, markets, except for those provisions on litter found in the *Parks and Reserves Act 1976*. Section 11(c) of the Act makes it an offence to “deposit, throw or leave any rubbish or anything in a park or reserve except in a place or receptacle provided for the purpose”. Most parks and reserves such as the Ha'atafu and Pangaimotu Reserves, which are popular recreational sites, suffer from litter problems (per.obs).

## **Hazardous Waste**

There appears to be no specific regulations dealing with the disposal of hazardous waste apart from the provisions prescribed for agricultural chemicals and pesticides by the *Pesticide Act 2002*.

## **Sanitation**

Sewage in Tonga is disposed of by latrines (wet and dry) or septic tanks. This includes sewage from public toilets, hotels and public buildings, industrial sites and households. Section 32 of the *Public Health Act* prescribes that approval of the type or pattern and number of latrines is required from the Ministry of Health as part of the Building Regulation licence requirement.

## **Pollution**

The *Petroleum Mining Act 1969* provides for the controls of importation, handling and sale of all petroleum and products. His Majesty in Council may issue exploration licences (s. 7(1)), and may make, vary, alter, amend revoke or cancel regulations. This Act has significant environmental conditions that prevent or minimize pollution and require the reduction of waste associated with petroleum exploration and production (*Petroleum Mining Regulation* (G.S. 107/85)). The regulation specifically deals with safety aspects of carriage, loading and unloading of petroleum and storage.

The Petroleum Mining regulations require any company exploring for petroleum to adopt all practical precautions to prevent pollution of the high seas or coastal water by oil, mud, or other flued substances which might contaminate the sea water or shoreline or which might cause harm or destruction to the marine life. The Company responsible is required to take all specified measures in its petroleum agreement to remove the pollution and minimise the damage to the environment.

The *Harbours Act 1903*, as amended, makes it an offence for any person to build a wharf, stage, jetty, landing place into the harbour or deposit/throw rubbish (ballast water, stones, earth, sand etc.) in the harbour without the permission in writing of the Controller of Customs (s. 27). Anyone who throws rubbish into the harbour without the permission of the Harbour Master can be liable on conviction to a fine of \$T20 or one month imprisonment in default. In addition, the Harbour Master may perform the task at the expense of the offender (s. 17). The use of explosives such as dynamite within the limits of any harbour is prohibited except with the permission of the Harbour Master (s. 15).

The *Continental Shelf Act 1970* contains provisions for the protection, exploration and exploitation of the continental shelf and to prevent pollution resulting from such works

(s. 7(1)). Both the *Harbours Act*, and the *Continental Shelf Act* however, have not developed relevant regulations.

#### **4.5.3.4 Proposed Bills**

Two important proposed Bills relevant to the sustainable development goals are the 1999 Environmental Impact Assessment and the 1992 Marine Pollution Bills are not yet enacted. The slowness in enactment of these bills suggests that timely legislative enactment is dependent on decision makers' commitment, and in the case of Tonga, Cabinet Ministers responsible for the bill and the Cabinet. The two bills have gone through the required process (as in Section 4.3.1.1 -- i.e. approved from Cabinet to be drafted, and both drafts have been also approved from the Law Reform Committee, but deferred by Cabinet with suggested amendments).

#### **EIA Bill**

The EIA Bill's central focus has arisen from recognition of the need for more effective decisions regarding development activities in Tonga. Decision makers need to be properly informed of the potential for and likelihood of proposed activities giving rise to adverse environmental effects. This is to assist in developing appropriate ways of mitigating those potential adverse effects, so that developments can proceed without being a future environmental cost or burden to Tonga -- or at least so that those potential costs can be included and considered as part of the decision making process.

The EIA Bill does not replace or reduce the existing development decision making authority system of Government or Ministries; it inserts an additional advisory step to ensure that the environmental implications of any development are fully described and assessed, and any relevant conditions are attached to reduce possible environmental impacts. Some of the key features of the Bill include the following:

- The main object of the Bill is the achievement of sustainable development (s. 3);
- Environment is defined to include all natural and physical resources as well as ecological, social and economic well-being (s. 2);
- Section 7 establishes the two classes of assessment, one for significant development projects requiring a major assessment and one for minor activities assessment. The criteria for this classification are also left for definition by

Regulation. Through out the Regulations it is envisaged the trigger levels for capturing projects will be set -- otherwise every single development activity in the Kingdom will require some form of assessment and that would be both unworkable and inefficient;

- Significant development projects are defined either as those creating certain class of effect [which allows an interpretative discretion or those belonging to a certain class of activity which are generally known to create such effects (s. 8 and s. 9)];
- Section 16 establishes the Environmental Assessment Committee (EAC) and sets out its membership (made up of the authorities concerned with the issuing of the relevant licences). It also allows the Chairman to co-opt more members to assist in the discussions of various projects as required;
- Section 21 sets out that the Regulations may allow for public participation in the process; and
- Section 28 sets out the development activities of government agencies will be subject to the Bill.

The *EIA Bill* provides a framework for development planning which aims to prevent the making of arbitrary land, marine and coastal areas and resources use decision. The proposed Bill is fundamentally sound; however, Sections 16 and 21 could be amended to provide for stronger and more effective public participation. For example, the power of the chair to co-opt more members to assist in the discussions of various projects, as required, implies that the chair may co-opt members either from the public or from the potentially affected communities, or from the government sector. To avoid this ‘community consultation loophole’ and to make sure that communities are represented in the EIA process, a permanent member of key communities or NGOs could be included in the core membership of the EAC or prescribed that the chair must co-opt members from any communities that are directly affected by a proposed development under discussion.

Section 21 also provides another opportunity for public participation in the EIA process. However, the flexibility of language use in the section, i.e. “...that the regulation may allow...” implies that it would be up to the Minister for Environment to either require a public participation in the EIA process or not. This could be strengthened by regulations to prescribe public participation in the form of a hearing on the assessment report, and



comments from the public hearing are in the final report to the EAC. This is to include similar to what is being included in EIA processes in other countries.

The enactment of the EIA Bill should also require amendments to relevant sections of existing legislation such as the *Tourism Act*, the *Development Licence Act*, the *Building Regulations*, and the *Fisheries Act* – aquaculture sections to the effect that prior to the approval of licences required by the above mentioned Acts, the requirements of the EIA Bill are to be met. Similarly, amendments to the *Public Health Act* – Waste and Hazardous sections, should specify that proposed landfill sites and any sites holding hazardous waste or inflammable and toxic substances, such as oil depots and warehouses for pesticides and chemicals, should subject to the requirements of the EIA Bill.

### **Marine Pollution Bill**

The purpose of the Marine Pollution Bill (MPB), drafted in 1992, was to prevent the actual release or threat of hazardous substances, such as oil and other pollutants, sewage and other waste matters, into the marine environment. The Bill would also meet Tonga's international obligations under the following Conventions:

- Convention for the Prevention of Pollution from Ships, 1973;
- Convention on the Protection of the Natural Resources and Environment of the South Pacific Region, 1986;
- Convention on the Transboundary Movement of Hazardous Waste in the Pacific Regions (Waigani Convention); and
- Any other international agreement for the prevention of marine pollution or the protection of the marine environment.

“Pollutant” is defined in the Bill to mean any substance, or any substance that is part of a substance, or any form of energy, declared by the Minister to be a pollutant and includes any water contaminated by any such substance or form of energy and may also include untreated ballast water, mixtures of pollutant with water or any other substance or form of energy (s. 2).

Part II of the Bill deals with the prevention of pollution in and outside of Tongan waters. Part IV of the Bill sets out the powers of the Minister to deal with marine casualties and powers to make regulations to deal with the more detailed aspects of marine pollution.

Any person found liable under the Bill can be fined on conviction up to \$T100,000. This is the first Bill where the fine may reflect the severity of the offence. One of the common problems of other 'environmental legislation' is that the fines are negligible.

## 4.6 Discussion

### 4.6.1 Legislative Constraints

The broad constraints and defects of the legislation discussed above are discussed in this section. Although one can find evidence of environmental concern from the large body of laws promulgated, there are deep-seated obstacles to promoting sustainable environmental resource management. One of those obstacles stems primarily from the fact that national (government) priorities have 'little' to do with sustainable resource management, i.e. reducing unemployment, curbing inflation, reducing balance of trade deficit or raising GDP.

The other constraint is that environmental legislation, as an autonomous component within the statutory law, is fairly recent. Legislation dealing with environmental issues has for too long been segmented and covered under sectoral themes such as agriculture, forestry, fisheries, health, and lands. As a consequence, the approach to the enforcing and implementing of the legislation is very sectoral with little co-ordination among the agencies concerned. Development of new legislation seems to also follow the existing process and lacks prior consultation among relevant sectors, let alone consultation with the public.

There seems to be very little updating<sup>33</sup> to outmoded legislation that no longer applies to the situation in Tonga, such as in the *Land Act*. Even where amendment has occurred, this is not acted upon or significant environmental provision is lost. An example is in the *Fisheries Act* with regard to the protections of whales. Further, most of the old legislation is based on models from other countries (British, New Zealand, Australia, Canada etc.) which do not reflect the circumstances of Tonga. Further, Tonga does not have the capacity and level of environmental awareness (of those developed countries whose legislation is used as models) to implement the legislation. A Summary of Existing Legislation, by sector, strengths and weaknesses, and action needed is given in Appendix 2.

Law enforcement has been difficult, as resources in terms of finance, tools/equipment and manpower for enforcement have not been provided. For example, since the *Forestry Act 1961*, there has not been any ‘village forest’ reserved. Section 22 of the *Land Act* prohibits cutting of trees within the 15.24 m of the high water mark, yet this is the area where the collection of medicinal plant resources, firewood and wood for light construction purposes has been carried out. Although existing regulations such as in the *Town Regulations* and *Public Health Act (Building) Regulations* prescribe criteria for house location, town cleanliness, planting, cutting of trees, pig and goat control and littering in public places, these activities have become major environmental hazards throughout Tonga. Most of the legislation that has provisions for environmental protection and conservation is either no longer appropriate to emerging issues such as climate change and sea level rise, transboundary movement of hazardous waste, solid waste and sewage, and protection of biodiversity, land and marine resource degradation among others, or, is in urgent need of revision.

Three of most important pieces of ‘environmental’ legislation namely the *Parks and Reserves Act 1976*, the *Birds and Fish Preservation Act (Amended), 1989* and the new *Pesticide Act 2002* have no associated regulation yet, and their application is therefore pending. This lack of regulation is common in the laws of Tonga.

The existing legislation also lacks requirements for environmental provisions and considerations as reflected in the existing development decision-making process where there are effects on the environment and natural resources (Figs 4.2 and 4.3). The government does not seem committed to implementing or enforcing its own policies, i.e., the Town Planning Policies, the functions of the Parks and Reserves Authority, and the 1985 EIA policy.

#### **4.6.1.1 Lack of Provisions for Public Participation**

Although some of Tonga’s legislation provides for public participation, the laws all implicitly provide for the management of the environment natural resources through a central authority. In such a ‘command and control’ approach to management, the control authority determines the terms and conditions of involvement of principal actors in a given activity, based on the information it possesses or has been made available to it (Ruddle, 1994; Fisher, 1995).

Although the 7 Strategic Development Plan (SDP 7) , calls for resource based government institutions, such as MOF, MAF, MLSNR (SDP 7, 2001), to be facilitators of an environment conducive to private sector involvement, and to encourage public involvement and support for sustainable development. This has not happened. This ‘facilitators’ policy seems, however, to have been developed without prior understanding from the ministries concerned on how to effectively implement the policy. The policy has not been translated into law. As expected, therefore, the institutions responsible for implementing the public participation policy fail. However, when there is participation, it may be limited to soliciting of views and advice, merely to satisfy the requirement that there was some form of participation.

The *Fisheries Act 1989* provides limited stakeholder participation in Sections 3<sup>34</sup> and 7<sup>35</sup>. The Act empowers the Director of Fisheries, under the direction of the Minister, to establish local committees from professional fishermen (of the fisheries concerned), to consult and advise him or her regarding the number of fishing vessels to be allowed to fish in certain areas or fisheries, and the allocation of licences (s. 7). Section 3 provides for the preparation of fisheries management plans. It is expected that conservation measures, the protection of endangered species, and the zoning of special sensitive areas would be included in fishery plans. In the preparation and review of each fishery plan, the Director of Fisheries is required to consult with any local government authority and with local fishermen (s. 3 (3)). However, this consultation has not occurred, as there have not been any formal fishery plans ever prepared or reviewed (AusAID & FAO, 1997).

The power of a District Officer (see Section 4.5.1.2) to demarcate a village forest area (*Forestry Act No. 7, 1961* s 8) has not ever been put to practice. From the records and various reports of the MAF and from anecdotal evidence, there have not been any village forest areas established since the enactment of the Act.

Another possibility for community ‘participation’ is provided by the *Parks and Reserves Act 1976*, where it allows the Parks and Reserves Authority to enter into agreements or arrangements with any person or persons or Government departments for the purpose of carrying into effect any objective or any purpose of the Act (s. 6 (e)).

The existing *Fisheries Act*, the *Forestry Act* and the *Parks and Reserves Act* all have opportunities for effective public participation; however, appropriate amendments are required in each legislation.

## 4.6.2 Institutional Constraints

### 4.6.2.1 Overlapping and Unclear Management Powers

The Minister of Lands can authorise certain activities by issuing leases in specified marine and terrestrial areas. He also has the powers for conservation and management of marine and national parks, and in all government land (*Parks and Reserves Act* and the *Land Act*). This creates the potential for a conflict with the regulation of fishing by the Minister of Fisheries in accordance with a fishery plan, licensing regime or declaration of a reserve (s 22) for subsistence fishing under the *Fisheries Act*.

The lack of implementation of the *Fish and Birds Preservation Act* is an example of 'unclear' management power. The *Fish and Birds Preservation Act* is considered the most important piece of legislation in Tonga to conserve biodiversity and wildlife (GOT & ESCAP, 1990) yet the MOF, MAF and MLSNR, are not sure who is supposed to implement the Act.

The power of the Minister of Agriculture and Forestry under the *Forestry Act 1961* to declare community forests, the power of the Minister of Fisheries under the *Fisheries Act 1989* to establish community fishing areas and fisheries reserves, and the provision in the *Fish and Birds Preservation Act 1915*, as amended, to establish 'protected areas' for biodiversity or wildlife conservation seem to overlap. Further, these powers prescribed in respective legislation depend on the consent of the Minister of Lands, not for any environmental considerations, but through the power of the Minister of Lands to issue leases. Land allocated for public use or for a public cause is to be approved and leased from the Minister of Lands.

Historical evolution of the laws of Tonga closely reflects the institutions that were established at the time of enactment, such as MLSNR and the MOH. Though issues have changed, e.g. environmental and health issues, the old institutional structure and management traditions still continue, despite obvious constraints. For example, there is no more 'available' land for subdivision and allocation, the remaining coastal/wet lands and forest areas require environmental consideration which the MLSNR considers not to be a priority, and waste management issues have grown beyond the capacity of the Public Health Division of the MOH.

#### **4.6.2.2 Lack of Government Commitment for Sustainable Development**

Policy decisions in the form of Privy Council or Cabinet Decisions are in place with the intention of ensuring that environmental considerations are incorporated into the development programs. However, these are not always acted upon, unless the Cabinet Minister responsible follows through with appropriate implementation. Another problem is that these policy decisions often fall short of recommending relevant legislative amendments, as the new policy may be in conflict with existing legislation or lack legal backing. Although environmental issues and challenges in Tonga now are very different from those of two decades ago, the commitment accorded by the Government, in terms of resources is negligible.

For example for the last past five years, the MLSNR holds approximately 1.5% of the total government recurrent expenditures. This budget stands to decrease in the future with Government trying to curb its expenditure. Prior to 2001, EPACS had about 0.2% of the total MLSNR budget, and the new DOE still has a 0.2 % of the MLSNR's budget (GOT, Budget Statements, 2000/2001). This budget covers mainly staff salaries with negligible operating funds.

Where the law does not specify enforcement officers, the Ministry of Police is the prosecutor of the laws in Tonga. However, environmental provisions of the laws are 'new areas' to the police force e.g., prosecution of illegal fishing in Marine Parks. The Police force does not normally patrol these areas, or have the resources to patrol these areas, resulting in offenders continuing illegal activities. There is an element of appropriate education and awareness raising needed with the police force, together with building joint enforcement strategies with Ministry of Police, and other agencies to improve enforcement by sharing resources and information.

#### **4.6.2.3 Lack of Appropriate Policies**

Although sustainable development is a national goal, there is a lack of appropriate national environmental and sustainable development policies. National macro-economic policies and decision-making processes are not integrated across sectors, and environmental considerations do not always feature in these processes. Classic examples are sustainable development being a national goal and an agency was established to promote this goal yet the instrument (i.e. EIA legislation, environment criteria for existing development licence

requirements and a EIA policy) was neglected. A government restructure in 2001 (Section 4.4.1) lacks appropriate policy supports. These few examples suggest that there is a lack of overall 'good planning skills' in the government.

Existing measures had been formulated in response to each sector/agency's particular problems and circumstances rather than as responses to overall national concerns; thus the sectoral perspectives and objectives, rather than national ones have been the underlying parameters guiding the formulation of the existing measures. As long as the environment is accorded low priority by the Government, and as long as there is no machinery in place to ensure consultation and co-ordination among relevant government institutions and the general public, measures to protect the environment will continue to be sector-based, fragmented, and in many cases ineffective.

It is not surprising, as existing institutional structures had been built pragmatically in response to particular issues as perceived by the government at the time. Education, Health, Economic growth (Agriculture, Fisheries, Industries and Trade and Treasury) and land subdivision (Lands and Survey) were the main focus. Even so, the absence of a comprehensive arrangement for integrated policy development among decision makers of these key institutions, presents a barrier to a sustainability approach in policy or management.

To overcome some of the major defects and to ensure that environmental measures to protect the environment are integrated at the national level and become more effective, the following deserve serious consideration:

- clear national guidelines on the environment need to be formulated, based on contributions from all official sectors and institutions, the private sector, and the general public; and
- a clear and unequivocal national policy on the environment, backed up by full commitment from the Government should be drawn up, and publicised as widely as possible.

The government is supposed to act in the best interests of the people. Current policies on sustainable environmental and resource management issues are sourced from within the government system as a response to events outside Tonga. This is reflected in the policy decisions that are made related to donor-funded projects. Therefore activities are project based, which means that sustainability of project activities after the donor departed is one

of the main problems occurring in Tonga (per. obs.). This study argues that if policies were based on national and community priorities there is a better chance of those activities being continued. The government seems to justify this practice of assuming that it is acting on behalf of the people's interests and priorities but in fact, there is no mechanism to assess what the public priorities are.

## 4.7 Summary

Several weaknesses of the current resource and environmental management framework identified in this analysis include lack of political commitment to implement sustainable development objectives, lack of legal provisions for public participation in policy and decisions making relevant to sustainable development, outdated legislation, lack of enforcement of existing regulations and policies, lack of integrated planning and implementation among sectors and institutions responsible for sustainable development, and slowness in enactment of the EIA Bill and the Marine Pollution Bill.

The information presented in this chapter is integrated as a part of further investigation in Chapters 5 and 6 and used in chapter 7 for developing a new policy framework for resource and environmental management in Tonga. Chapter 5 investigates the general environmental perceptions of the people of Tonga, the identification of community priorities and views of the existing environmental and resource management framework.

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<sup>1</sup> The chiefs would declare certain food as 'taboos' – or '*eiki*' status – reserved for the chief only. Commoners were not allowed to eat these foods however commoners may grow and fish for these to be given to the chief for his consumption.

<sup>2</sup> People were regarded as the property of the chief (Latukeyu, 1947).

<sup>3</sup> 'Lands' as interpreted in the Vava'u Code of Laws mean the land and the sea including land and sea resources. Land and sea resources were seen as interlinking with each other (Maude, 1965).

<sup>4</sup> A new Code of Laws (1862) stated the following: 'All chiefs and people are to all intents and purposes set at liberty from serfdom, and all vassalage, from the institution of his law; and it shall not be lawful for any chief or person, to seize, or take by force, or beg authoritatively, in Tongan fashion, anything from any one' (1862 Code of Laws, Clause XXIV 2; *ibid.* 247).

<sup>5</sup> The 'sea' as interpreted in the Land Act refers to sea water, sea bed and all marine life and resources.

<sup>6</sup> There are three boards that are owned by the Government – The Tonga Water Board; The Tonga Broadcasting Commission, and the Tonga Telecommunication Cooperation.



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<sup>7</sup> For administration purposes, the main island groups of Tonga (Tongatapu, 'Eua, Vava'u, Ha'apai and Niua) are each further divided into districts and within each district are villages or towns. The district boundaries are not political or cultural rather it is according to geographic locations for ease of administrative purposes such as census, cyclone relief program or health vaccination program. For example Tongatapu has three districts known as the Western, Eastern and Central Districts. While both of Vava'u and Ha'apai have main island districts, west, east or central and outlying islands' districts are grouped according to the locations of the outlying islands. Niua and 'Eua have two districts each known as the town and bush districts. Each district, then, has a District Officer elected by the people of the district once every three years and each village or Town has a Town Officer elected by the people of the village for a term of three years. District and Town Officers are under the Prime Minister's Office and they are the official contact and link of the government to the communities.

A district could be made up of hereditary estates or government land or a combination of the two. Where there are hereditary estates then there are nobles.

<sup>8</sup> Members of the Law Reform Committee are Chief Justice, Minister of Crown Law (Chair), Minister of Police, Minister of Lands, Survey and Natural Resource, Chief Secretary and Secretary to Cabinet and the Ministry of Crown Law provides secretariat. The Committee may co-opt an officer from the line Ministry who was responsible for the formulation of a particular Bill.

<sup>9</sup> Nine people's representatives are made up of three from Tongatapu, two from Vava'u, two from Ha'apai, one from 'Eua and one from the Niua. 'Others' (19) are currently ten Cabinet Ministers, and nine nobles representatives. The nobles and the government traditionally support each others.

<sup>10</sup> DCC's members are the Prime Minister (Chairman), Minister of Finance, Minister of Labour, Commerce & Industries, Chief Secretary & Secretary to Cabinet, Secretary for Foreign Affairs, Chief Establishment Officer, Solicitor General and Director of Planning.

<sup>11</sup> The members of the Vava'u Development Committee are Prime Minister (Chair), Minister of Works, Minister of Health, Minister of Finance, Governor of Vava'u, No.1 Nobles' Representative to Parliament from Vava'u, No.2 Nobles' Representative from Vava'u, No.1 People's Representative to Parliament from Vava'u, No.2 Peoples Representative to Parliament from Vava'u, Secretary for Finance, Secretary for Foreign Affairs (secretariat)

<sup>12</sup> The members of the Ha'apai Development are the Minister of Police (Chair), the Governor of Ha'apai, the two people's representative to Parliament from Ha'apai, the Minister of Health, and the Secretary for Foreign Affairs, the Director of Tourism, the Director of Central Planning and an Economist, from Central Planning Department.

<sup>13</sup> The Niua Development Committee members are the Minister of Works (Chairman), Representative of the Noble for Niuatoputapu and Niuafu'ou, Permanent member of NDC (a Nobel), NZ Deputy High Commissioner, People's Representative to Parliament for Niua, Government Representative for Niuatoputapu, Govt rep for Niuafu'ou, Director of Works, Deputy Secretary for Finance, Deputy Director of CPD, Deputy Director of Works, Central Planning (secretariat).

<sup>14</sup> The 'Eua Development Committee members are the Minister for Labour, Commerce & Industries (Chairman), Minister of Health, People's Representative to Parliament for 'Eua, Government Representative for 'Eua, Secretary for Foreign Affairs, Secretary for Lands and Survey, Deputy Director of Tourism, Deputy Director of Agriculture and Forestry, Deputy Director of Central Planning (secretariat), Deputy Secretary for Finance, Director of Environment, and Senior Assistant Secretary, Labour & Commerce.

<sup>15</sup> 'E. Fusitu'a, is the Chief Secretary and Secretary to Cabinet

<sup>16</sup> Good environmental practices do not always require legislation; voluntary practice is widely used and is very effective, through the use of code of practices, code of conducts or environmental principles. However, this case is often the 'excuse' given in Tonga (per.obs.).

<sup>17</sup> Tonga Visitors Bureau (TVB) is a department under the Ministry of Labour Commerce and Industries.

<sup>18</sup> EPACS - Environment Planning and Conservation Section, within the MLSNR is the old name of DOE (this is the section that implements the environmental functions of the MLSNR).

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<sup>19</sup> The Forestry Act 1961 provides for Minister of Agriculture the power to make the following regulations:

- (a) protect, control and manage forest reserve;
- (b) foster and encourage growth of forest produce;
- (c) prohibit and regulate, the felling, burning, or removing of any forest produce;
- (d) camping, building of huts or livestock enclosures;
- (e) the depasturing of livestock;
- (f) the cultivation of land;
- (g) the entering of the forest reserve
- (h) the killing and taking of animals, birds, insects, fish or any eggs or spawns;
- (i) any activity that is likely to cause fire;
- (j) or prescribe fees and royalties for the felling of trees or the collecting and removing of any forest produce;
- (k) grant licences and permits for forest produce;
- (l) prescribe conditions for licences to take, sell or export forest produce;
- (m) provide for licence holders to render returns of forest produce received;
- (n) establish nurseries;
- (o) provide for survey and demarcation from forest reserve and reserved areas; and
- (p) or appoint and control forest guards (s. 4).

<sup>20</sup> Faka'osi, T., is the head of the Department of Forestry, Ministry of Agriculture and Forestry (2001)

<sup>21</sup> "Fisheries Management" is not defined in the Act. The interpretation of the 'management' functions of the Ministry of Fisheries, however, ranges from 'control of fishing effort' to much broader interventions in support of objectives, which have been set for fishery.

<sup>22</sup> 'Akau'ola is the Secretary for Fisheries, Ministry for Fisheries (2001).

<sup>23</sup> Fisheries Act, 1989, Section 24 and Section 30, which apply to breach of conditions of licences but not to the absence of fish fence licence.

<sup>24</sup> Ibid., Section 5(5).

<sup>25</sup> Ibid., Section 8 (6).

<sup>26</sup> Ibid., Section 21.

<sup>27</sup> Ibid., Section 34.

<sup>28</sup> Ibid., Section 35.

<sup>29</sup> The Fisheries Act (1989) states: "Each fishery plan shall indicate the present state of exploitation of the fishery, the objectives to be achieved in the management and development of the fishery, the management, licensing and development of measures to be applied, the statistical and other information to be gathered on the fishery, and the amount of fishing, if any, to be allowed to foreign vessels"

<sup>30</sup> Hon. Fielakepa is the Minister for Lands, Survey and Natural Resources (2001).

<sup>31</sup> Land reserved for government development such as schools, teachers' allotments (s. 55), and hospitals etc.

<sup>32</sup> The members of the Parks and Reserves Authority are Minister for Lands, Survey and Natural Resources – Chair, Secretary, MLSNR, Director, MAF, Director, TVB, Secretary, MOF; and the Director DOE as the secretariat

<sup>33</sup> Pulea, 1992, reviewed the 'Environmental Laws' of Tonga and identified gaps, overlapping and conflicts of legal responsibilities and gave recommendations. These recommendations have not been acted upon.

<sup>34</sup> Currently, stakeholder participation may occur only in the preparation and review of fishery plans (Fishery Act Section 3).

<sup>35</sup> Stakeholder participation under Section 7 of the Fishery Act cannot occur if local fishing vessel licences are not being issued.

## **CHAPTER FIVE**

### **ENVIRONMENTAL ATTITUDES, SKILLS, KNOWLEDGE AND BEHAVIOUR OF THE PEOPLE OF TONGA**

#### **5.1 Introduction**

People's environmental attitudes, skills, knowledge and behaviour are crucial for developing a policy framework for sustainable environmental management in Tonga. Two theoretical paradigms are investigated here. The first is based on social change theory (Chapter 2) -- the need for government's environmental policies to be responsive to people's perceptions is investigated here. As sustainable development goals are new, appropriate policies are required to encourage 'good environmental behaviour or skills' and to change unsustainable behaviour. Second, community participation in policy formulation and decision-making has been negligible in Tonga, and this investigation provides a forum for the integration of community priorities into the policy making process.

Although the opinions of the population of a country or community are viewed by many researchers (Absher, 1986; Keys Young, 1994; Gebhardt & Lindsey, 1995; Zimmerman, 1996; Sonquist & Dunkelberg, 1997; Cantrill et al., 2000) as pivotal components in any drive toward sustainability, very little data has hitherto been collected in Tonga. Relevant policies and decision-making processes have, therefore, largely lacked direct input from the general population.

#### **5.1.1 Objectives**

The main objectives of this chapter are to:

- (a) collect baseline information required for the development of this study's aim – a policy framework for sustainable environmental and resource management for Tonga - through a comprehensive data acquisition exercise on community perceptions towards environmental issues, resource-use practices, and conservations needs;

- (b) identify community resource and environmental priority issues as the basis for relevant policy development; and
- (c) canvass communally acceptable approaches to environmental and resource management.

## **5.2 Methods**

The methods used in this chapter involved four phases:

- development of a questionnaire;
- sampling methods and pilot survey;
- quantitative face-to-face surveys with a sample of the population of Tonga; and
- data management and analysis.

### **5.2.1 Development of a Questionnaire**

The empirical investigation in this chapter relies primarily on a survey of a representative sample of the adult population of Tonga nationwide. A survey questionnaire (see Annex 3) is considered appropriate to quickly collect and generate an appropriate amount baseline information required for the purpose of this study. Rating scales such as the Likert type of scale<sup>1</sup>, frequently used by a large majority of researchers to measure attributes of people, are the format of choice in this study (Absher, 1986; Keys Young, 1994; Gebhardt & Lindsey, 1995; Zimmerman, 1996; Sonquist & Dunkelberg, 1997; Cantrill et al., 2000). The questionnaire format employed in this study was adapted from Keys and Young (1994).

Key environmental issues identified in Chapters 3 and 4, together with the researcher's experience in Tonga, were used to draft the survey questions. Although the first draft was prepared outside the study area without inputs from the people to be studied, there were advantages of doing this. The draft had extensive inputs from experts<sup>2</sup> at the University of Wollongong (UOW) who have experience in environmental management issues in the Pacific Islands and in developing survey questionnaires. The draft was also submitted to the UOW Ethics Committee, and approval was obtained in December 2000.

The draft questionnaire went through three revision sessions in Tonga in the first quarter of 2001. The first revision session was carried out with the staff of the Department of Environment, before the whole questionnaire was translated into the Tongan language. The translated questionnaire was further discussed during a one day focus group workshop with the Langafonua 'a Fefine Tonga<sup>3</sup> (LFT). LFT was selected, as it is the main non-governmental organisation (NGO) involved in environmental activities nationwide. The workshop was in the form of working groups with representatives of the same district or the same organization making up the groups. There were two groups representing different churches (Catholics and Free Wesleyan representatives) and a further three groups representing different districts. Questionnaires were distributed the day before the workshop to give participants enough time to read the content. The key questions that guided working groups discussions were as follows:

- what are the main environmental issues in Tonga?
- are the issues in the draft questionnaires relevant, easy to understand?
- what are the definitions of key terms used such as 'environment', 'environmental quality' 'public participation' and 'sustainable development'?
- what questions that can be added, improved, or eliminated?
- what are the general feelings of participants to the questionnaire? and
- who should participate in the survey?

The third revision involved a pilot run of the whole revised questionnaire involving 10 households in Nuku'alofa. Difficult questions to ask and to understand were deleted or rephrased. After further edits, the actual survey started in May 2001.

The questions were arranged to start with very general and relatively 'easy' questions building up to more specific and 'in-depth' issues. The technique is expected to build an easy rapport at the beginning, and gain the confidence of those being interviewed. Open-ended questions were also included to allow respondents to express their ideas in their own words. Respondents also provided interval survey data, which permits a comparison between respondents' commitment, for instance, to 'good' environmental behaviour, the factors influencing any changes in behaviour, etc. That is, respondents were requested to complete a series of Likert scale runs, for example:

- *Strongly Agree to Strongly Disagree*, to reflect their opinion of their current environmental priorities in their village;

- their opinion of state of the environment in Tonga (using a *Much Better* to *Much Worse* scale); and
- their opinion of the management role of the government (through *True* and *False*) etc.

### 5.2.2 The Sample

The sampling frame for this study was Tongan people living in Tonga at the time of the survey, aged between 19-73 (based in the 1996 Census results). The following criteria were established to guide the selection of the sample population with the advice of the Tonga Statistics Department:

- the sample is to represent a nation-wide survey;
- the resources and time available to conduct the survey; and
- a viable and manageable sample size.

The total population of Tonga is 97,784; the total number of people aged from 19-73 is 50,517, which is 52 % of the total population, (1996 Census). Fifty-two per cent of the total households<sup>4</sup> (16,194) is 8,421, divided by selected 17 census districts is approximately 500. A maximum sample size of 500 households was considered manageable considering the criteria used. The census blocks and maps were used as the base to select the survey sample. For the purposes of this study, Tonga was divided into four main divisions (see Table 5.2.1). The divisions were further divided into census districts (CDs). Seventeen CDs were randomly selected (from a total of 23 CDs) with probability proportional to the number of households in each division. For example, the CDs with higher numbers of households were more likely to be selected to participate in this study than the CDs with smaller number of households. The possible maximum number of households to be surveyed in each CD was proportional to the district's total number of households. The 500 respondents were selected from CDs in proportion to the number of people aged 19-73 in the district.

**Table 5.2.1: Households (HH), (in # & %) by Divisions and Survey Districts; Target Maximum # of Surveys and Actual Number of Interviews Completed**

<sup>1</sup>Urban towns, and <sup>2</sup>Rural villages of Tongatapu; <sup>3</sup> Urban towns, and <sup>4</sup>Rural villages of Vava'u; <sup>5</sup>Urban towns and <sup>6</sup> Rural villages of Ha'apai; <sup>a</sup> Main island Vava'u only; <sup>b</sup> Main island Ha'apai only

Division/Census Districts	Total #HH	% of HH sample in CD	Maximum number of interviews	Actual # of interviews completed
<b>1. Tongatapu</b>				
Kolofo'ou <sup>1</sup>	1501	31	100	92
Kolomotu'a <sup>1</sup>	1246	26	80	76
Vaini <sup>2</sup>	423	9	25	25
Tatakamotonga <sup>2</sup>	282	6	15	15
Lapaha <sup>2</sup>	299	6	13	13
Nukunuku <sup>2</sup>	718	15	40	35
Kolovai <sup>2</sup>	377	8	26	22
<b>Tongatapu Total</b>	<b>4846</b>	<b>100</b>	<b>299</b>	<b>278</b>
<b>2. Vava'u<sup>a</sup></b>				
Neiafu <sup>3</sup>	1169	51	40	37
Pangaimotu <sup>4</sup>	325	14	8	8
Ha'alaufulu <sup>4</sup>	221	10	14	12
Leimatu'a <sup>4</sup>	563	25	25	18
<b>Vava'u Total</b>	<b>2278</b>	<b>100</b>	<b>87</b>	<b>75</b>
<b>3. Ha'apai<sup>b</sup></b>				
Pangai <sup>5</sup>	244	51	40	33
Foa <sup>6</sup>	234	49	30	25
<b>Ha'apai Total</b>	<b>478</b>	<b>100</b>	<b>70</b>	<b>58</b>
<b>4. Outer Islands</b>				
<b>'Eua</b>				
'Ohonua	208	75	20	18
Angaha	69	25	18	10
<b>'Eua Total</b>	<b>277</b>	<b>100</b>	<b>28</b>	<b>28</b>
<b>Niuas</b>				
Vaipoa	52	63	12	6
'Esia	30	37	9	3
<b>Niua Total</b>	<b>82</b>	<b>100</b>	<b>21</b>	<b>9</b>
			<b>505</b>	<b>447</b>

Generated from the 1996 Census of Tonga

### 5.2.2.1 The Survey Sampling

In order to ensure as high a response rate as possible, a four-stage approach was adopted as in Keys and Young (1994) using the following sequence:

- First, the maximum number of interviews to be obtained through face to face contact to a maximum number of households in a CD was determined.

For example, a maximum number of interviews, for instance, of 100 was to be obtained through face to face contact to a maximum of 200 households (100 x 2) randomly selected from the percentage of the household sample in that district. For example, in Kolomotu'a,

31% of the Kolomotu'a number of household is 465. The maximum number of interviews for Kolomotu'a was 100, to be obtained through contacting to a maximum of 200 households (100 x 2).

- Second, the 465 households (using the example above – Kolomotu'a) in a randomised fashion, using a grid reference.

The Department of Statistics census maps were used to randomly mark the 465 households and a starting point in each CD in such a way that all households in the CD were passed once.

- Third, the 200 households to be contacted were then randomly marked from the preselected 465 households.
- The fourth approach applied to the resident to be interviewed at each household, which was determined in a random fashion by a use of a grid technique.

The age group ranges used in the survey (refer Appendix 3, Q. 21) were randomly allocated to the 200 households to be contacted. If the age group range allocated to a household was not present in the household, the next age group range was considered. Further, the 'out of scope' households (i.e. unoccupied or where there was no usual resident aged 19-73) were not counted.

Survey protocols<sup>5</sup> were established, according to Sallant & Dillman (1994), as follows:

- only one respondent from each selected household was interviewed;
- if the resident who was selected could not to be interviewed at the first visit, at least two further calls were made at different times to secure an interview with him/her;
- if a selected household was unoccupied or where there was no usual resident aged 19-73, that household was 'out of scope' and was not counted; the number of interviews are made up from the 'reserve households'; and
- in every CD, a maximum of 15 'reserve households' were also randomly marked to make up the number of interviews, if needed.



### 5.2.3 The Survey

Face-to-face interviews were chosen due to unreliability of the mail service to the outer islands and not every household has a telephone. The average interview time in a call was approximately one hour. The Prime Minister's Office (which gives permits for research conducted in Tonga) approved the survey. The approval letter was delivered to District and Town Officers in each CD and they were the first point of contact. The purpose of the survey was explained, the Town Officers then announced in the village '*fono*' (meeting) – every Monday morning, that the survey will be conducted in the village, who to expect, possible times, etc.

In selected households, after the greetings, each interview began with a brief overview of the research and its purpose (for academic purposes), the confidentiality of their answers, the nature of questions to be asked, and names of respondents were recorded only for the purpose of follow up visits by the researcher if required. Each interviewee was encouraged to ask questions at anytime during or after the survey and was free to refuse to continue with the survey at any time. After these preliminaries, the selected respondent was asked if he/she had time and would be willing to participate in the survey. If the respondent was willing and had time, the survey started.

In cases when the respondent was busy, a mutually arranged time was arranged for the interview. An average of four to five questionnaires was completed in a day. A staff member from the Department of the Environment accompanied the researcher to every household due to cultural expectations and preferences<sup>6</sup>. Interviews on Tongatapu were conducted first, followed by 'Eua, Vava'u, and Ha'apai. Due to logistical travel difficulties to the northern most islands of the Niuas, and in consultation with the principal of Niuva High School, the questionnaire was posted to Niuva for the principal to conduct the interviews.

Although a lot of planning went into the preparation of the survey to address 'any foreseeable problems', problems did occur. A few respondents who agreed to participate later could not be reached or cancelled participation (generally citing a lack of time), especially in the Nuku'alofa area. The cost involved for the survey was underestimated, especially for internal and inter-islands transport and related expenses, etc., and the survey was slowed down awaiting funds availability. Often respondents remarked that the questionnaire was too long yet they were quite happy to talk about 'other things' for hours, which cannot be avoided in Tonga. Further, interviewees had to be reassured that

the researcher was not conducting the research in any official capacity to 'allow ease of exchange of opinions' in some of the questions regarded as 'sensitive', especially when talking about the government's management role. Manpower to conduct the survey, however, was the main constraint, thus the target of 500 respondents was not achieved.

### **5.2.3.1 Response Rates**

From the target 505 respondents, only 447 interviews were completed, which represents 89% of the target sample size and 88% of the aggregating figures for the total households in the CDs to be included in the sample (out of scope households were excluded). In 9% of households where contact was made, it was not possible to interview the randomly selected respondent and 3% where interviews started but the questionnaire was not completed, as respondents did not have enough time.

However, out of the total 7,961 households (Table 5.2.1) in the CDs selected to participate in the survey, the 447 interviewed represent 6 % of that total. Further, out of the total 50,517 people aged from 19-73, the 447 interviewed only represent 1 % of those 'eligible' to be surveyed. The 1 % may seem to be not representative, but the survey protocol established (Section 5.2.2.1) only allows for one respondent from each household. There is a high possibility that a large number of 'eligible' people may live in one household (the average Tongan family in Tonga number is 7.5-8 (1996 Census)). Therefore, only one person in a household is eligible.

## **5.2.4 Data Management and Analysis**

The completed questionnaires in a day were immediately translated back to English assisted by the staff of the Department and cross-checked by the researcher before being entered into a Microsoft Access database. Narrative responses that expounded on a particular choice with the questionnaire or answered questions were grouped into categories before entering into the database.

Actual data analysis was carried out in the UOW with advice from the Statistics Consulting Service of the university. The analysis was eventually completed using SAS 8.1 for Windows.

#### **5.2.4.1 Demographic Categories**

In addition to gender, and residence, the age groups were regrouped into four groups only, as respondents aged 19-23, 24-33, 34-53 and respondents aged 54 and above. Further regrouping was also applied to the level of education, such as those who did not complete secondary school, those who completed secondary school and some technical/trade training, and those who obtained a university degree or diploma. Similar categories were given to the level of household income; lower income bracket covers those respondents with an annual total income of \$T5,000 and below, the middle income bracket covers respondents from households income between \$T5,001 and \$T20,000 and the upper income bracket are those from households earning \$T20,001 and above per year.

#### **5.2.4.2 Weighting**

The survey results presented are weighted figures, derived from the raw survey results. The UOW Statistical Consulting Service advised on the weighting procedures to be followed. The purpose of the statistical adjustments was to adjust the raw responses to estimate results based on every member of the Tonga population aged 19-73 having an equal chance of selection in the sample. Overall results do not vary greatly from the unadjusted figures.

Weighting took account of four factors:

- a) Household weights: CDs, which were used as a basic sampling unit, contain unequal numbers of households. The weights applied to correct for this unequal numbers in between CDs;
- b) Person weights: Only one person per household was interviewed, people living in small households had a greater chance of being interviewed than people in larger households. The person weights applied to address this issue changed for each household;
- c) Divisions weights: Since the ratio of respondents to eligible population varied from division to division, the weights applied an independent estimate of the number of 19-72 year olds resident in each division at the 1996 Census;
- d) Non-response: A non-response factor was introduced to allow for different levels of non-response; these weights changed only between the divisions.

The application of these procedures generates population proportions, not counts.

### **5.2.4.3 Logistic Regression Analysis**

Selected key questions were subject to further statistical analysis through techniques of logistic regression to determine whether a relationship exists between two nominal variables or between combinations of variables. SAS chi-square test for independence was used to see which combinations responses or group of responses had more or less observations that would be expected if the two variables were independent. The hypothesis of independence states that the likelihood of an observation falling into one group for one variable is independent of any other group that observation falls into (Gregory, 1963). A low chi-square value and high probability ( $p$  value) indicates acceptance of the null hypothesis. A large chi-square value, on the other hand, and a corresponding low probability, suggests rejection of the null hypothesis (Abacus Concept, 1996). Therefore, a conventional significance level of 0.05 was used as the as the cutoff point. A significance level of more than 0.05 indicated the null hypothesis is valid and therefore there is no significant relationship or correlation in the data set. A significance level of less than 0.05 indicated the null hypothesis is not valid and therefore there is a significant relationship or correlation in the data set.

## **5.3 Survey Results**

Demographically, 62.2 % of the total respondents were in Tongatapu with 16.7 % in Vava'u, and 13.0 %, 6.3 % and 2.0 % in Ha'apai, 'Eua and Niua respectively. These percentages mean that 53.9 % of the total respondents were from urban areas, 38.0 % from rural areas and the remaining 8.1 % were from the outer islands. Almost the same number of females (51 %) and males (49 %) were interviewed. Other demographic characteristics and the breakdown of these characteristics according to the questions asked such as age, education, and place of residence are given in Appendices 4-18.

The survey results are presented under the headings Priorities, Knowledge, Attitudes and Opinions on Environmental Issues, Skills and Behaviour.

## 5.3.1 Priorities

### 5.3.1.1 Priorities for Government Attention

Respondents were asked to nominate, from a list of ten items, the two most important issues for attention by the Government at present and in ten years time. Overall, education was nominated as the most important issue for government's attention at present (44%) followed by infrastructure development (25%). The environment ranked sixth (16%) behind education, infrastructure development, combating crime, farming/agriculture and health. However, for the most important issue for government's attention in ten years time; environment ranked third (40%) behind health (45%) and education (44%).

By looking at the results by division, respondents in Vava'u differed from the overall two in the most important issues for government attention by nominating education and farming/agriculture as the most important issues at present; and in ten years' time health issues and the environment were nominated. Tongatapu and Ha'apai respondents selected the same priorities inline with the overall results for government attention at present (i.e., education and infrastructure development), but, the most important issues in ten years time, were health and education, and education and the environment respectively. The outer islands respondents nominated education and environment, as the most important issues at present and for the future, the most important issues nominated were crime and government attention to unemployment problems (see Tables 5.3.1 and 5.3.2.).

The priorities for government attention at present and in the future by level of education, levels of household income and by gender were as follows (see Tables 5.3.1 and 5.3.2):

- Education was the most important issue for all ages at present and health was the priority issue for government's attention in the future for all ages, apart from the 19-23 age group which still had education as the most important future issue. Younger respondents nominated the environment as a priority, both now and in the future, more often than older respondents. For example, 16% of respondents aged 19-23 and aged 24-33 nominated the environment as the most important priority issue in ten years time;
- Respondents who had completed secondary school prioritised education, followed by farming/agriculture, and those with university degrees and diplomas nominated education and health as the priority issues at present. However, for priorities in ten

years time, those who completed secondary school rated health followed by environment as the two most important issues, while those with degrees and diplomas rated the environment as the most important issue followed by education for government's attention;

- Upper income respondents prioritised education followed by health for government attention at present. Respondents in the low income and the middle income brackets nominated the environment as a priority, both now and in the future, more often than higher household income respondents did; and
- There was no difference between male and female respondents in the level of priority given to the environment (i.e. environment was ranked 7<sup>th</sup>) at present and in the future (environment was ranked 3<sup>rd</sup>). More females (26%), however, nominated environment more often than males (18%) as a priority for the future.

**Table 5.3.1: Priorities for Government Attention at Present**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt N=278 %	Vv n=75 %	Hp N=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Education	44.3	18.8	25.5	14.1	16.8	12.2	1.4	22.0	12.3	5.8	4.3	18.8	17.9	7.4	16.1	22.2	6.1
Infrastructure Development	25.0	10.8	14.2	9.7	7.4	7.2	0.7	15.0	4.0	4.5	1.4	14.8	8.3	1.8	12.5	10.9	1.4
Crime	23.0	12.1	10.8	7.2	10.3	5.2	0.2	13.9	3.6	3.4	2.2	13.2	7.6	2.0	11.3	10.2	1.4
Farming and Agriculture	20.8	11.4	9.4	6.5	9.0	4.3	0.9	11.9	4.5	3.4	1.7	10.1	8.5	2.0	8.6	10.2	2.3
Health	20.6	10.5	10.1	6.8	7.4	5.6	0.9	14.8	1.6	2.7	1.6	5.6	7.6	7.4	6.8	8.9	5.4
The Environment	16.4	8.5	7.9	5.2	6.5	4.3	0.2	12.3	1.1	0.5	2.5	5.8	7.2	3.4	6.8	7.3	2.3
Unemployment	14.5	6.3	8.1	4.7	6.1	3.4	0.2	7.9	3.2	3.4	-	7.6	5.2	1.6	8.2	5.5	0.5
Fisheries	13.4	10.3	3.1	4.3	4.9	3.6	0.7	9.2	0.5	2.5	1.3	8.7	2.9	1.8	7.2	4.8	1.1
Alcohol and other drugs	12.1	5.6	6.5	6.1	4.1	2.0	-	8.1	2.7	0.2	1.2	5.4	4.7	2.0	5.5	5.5	1.4
Bilateral and multilateral relations (AID)	7.1	3.4	3.8	1.8	2.9	2.0	0.5	7.0	0.2	-	-	5.0	1.4	0.9	4.5	2.1	0.7
Not sure	2.0	1.4	0.7	1.1	0.5	0.2	0.2	2.0	-	-	-	1.4	0.6	-	1.6	0.5	-

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands

A – Did not complete secondary school, B – Completed secondary school/tech/trade training

C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

**Table 5.3.2: Priorities for Government Attention in Ten Years Time**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Health	44.7	22.9	21.8	15.3	15.5	12.8	1.1	28.0	10.3	3.1	3.4	21.3	18.0	5.4	20.2	20.9	4.1
Education	43.5	22.9	20.6	16.0	15.1	11.9	0.7	29.6	4.7	6.1	3.4	19.3	16.8	7.4	18.6	19.3	5.7
The Environment	40.1	17.9	22.5	15.8	16.1	9.1	1.4	25.0	8.7	5.2	1.8	16.3	16.1	7.9	14.9	18.1	7.1
Combating crime	33.1	14.2	18.9	10.8	11.5	9.5	1.3	19.6	6.5	2.5	4.5	16.9	11.0	5.2	15.5	14.6	2.7
Unemployment	28.4	12.4	16.0	10.4	10.9	6.3	0.7	16.2	6.5	2.0	3.7	13.3	11.3	3.8	12.1	13.5	3.0
Alcohol and other drugs	27.7	15.2	12.5	11.4	9.3	5.2	1.6	15.9	6.4	5.2	0.2	13.7	10.5	4.1	13.5	11.7	2.3
Farming and Agriculture	18.6	8.7	9.9	5.2	8.3	4.7	0.5	14.1	0.9	2.0	1.6	10.3	4.7	3.4	7.5	8.4	2.7
Infrastructure Development	18.5	9.7	8.8	5.2	7.9	4.5	0.9	10.9	3.2	3.2	1.4	9.5	6.8	2.3	10.7	5.5	2.3
Fisheries	18.2	11.7	6.5	5.0	6.3	6.3	0.7	11.5	1.2	1.8	3.8	8.8	7.0	2.3	7.1	9.3	1.8
Bilateral and multilateral relations (AID)	15.7	7.5	8.2	5.5	8.0	2.3	-	8.2	1.1	5.5	0.9	10.0	4.1	1.4	9.6	6.0	0.23
Not sure	9.8	5.7	4.1	2.7	4.6	2.3	0.2	0.7	6.4	2.7	-	6.4	2.1	1.4	4.7	4.4	1.4

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands

A – Did not complete secondary school, B – Completed secondary school/tech/trade training

C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket



### 5.3.1.2 Priorities Among Environmental Issues

#### Environmental Priorities in Tonga Today

Those interviewed were asked (unprompted) to state the single most important environmental issue in Tonga today. The largest numbers of respondents referred to:

- Pollution – solid waste (29 %)
- Coastal/Marine degradation (20 %)
- Land degradation (17 %)
- Climate change & sea level rise (13 %)
- Pollution–others (sewage, waste oil, water source pollution) (10 %)
- Inappropriate environmental legislation and policies (8 %)

The details of the results by categories are presented in Table 5.3.3. Relatively small percentages of respondents (4.7 %) raised a number of other issues including lack of awareness, lack of alternatives for generating income (i.e., alternative employment or business opportunities), and poverty.

**Table 5.3.3: Ranking of the Most Important Environmental Issue in Tonga Today (Unprompted)**

Issue	Percentage of Respondents
<b>Pollution – solid waste</b>	
Litter and dumping of rubbish in public places	10.2
Household rubbish and garbage	8.4
Plastic bags and diapers	7.0
Old discarded vehicles and second hand ‘goods’	3.0
	<b>28.6</b>
<b>Coastal/Marine degradation</b>	
Overfishing of coastal resources	6.1
Sand mining	5.2
Coastal deforestation	3.1
Coastal reclamation and removal of mangroves	3.1

<b>Issue</b>	<b>Percentage of Respondents</b>	
Destructive fishing techniques	2.0	<b>19.5</b>
<b>Land degradation</b>		
Deforestation	6.1	
Excessive use of pesticides and fertilizers	5.1	
Pigs and other domestic animals	5.0	
Sea sprays (associated with cyclones)	1.0	<b>17.2</b>
<b>Climate change and sea level rise</b>		
Sea level rise	6.2	
Coastal inundation/erosion	6.3	<b>12.5</b>
<b>Pollution – others</b>		
Sewage	3.2	
Water pollution	3.1	
Waste Oil	2.0	
Batteries	1.3	<b>9.6</b>
<b>Environmental Legislation and Policies</b>		
Lack of enforcement	4.5	
Inappropriate and outdated environmental legislation and policies	3.3	<b>7.8</b>
<b>Others</b>		
Lack of alternatives for income generating activities	3.5	
Poverty	1.4	<b>4.9</b>

### **Priorities among Specified Environmental Issues**

The respondents were then shown a list of twenty environmental issues and asked which of these they regarded as the two most important issues in Tonga today. The results were:

- Litter and dumping of rubbish in public places      41.9% (of respondents)
- Waste from business and service stations            20.9%
- Pollution of coastal and marine areas                    19.7%
- Soil erosion and land degradation                        18.8%
- Coastal erosion/inundation/sea level rise                18.8%
- Household rubbish and garbage                            18.4%
- Loss of forest and culturally important trees            17.9%
- Poor living conditions in low lying areas                17.3%

- Uneven development  
(between islands and between urban/rural areas) 15.5%
- Problems with domestic animals 15.5%
- Wasteful packaging 14.8%
- Loss of coastal forest and mangroves 11.7%
- Overfishing in coastal areas 11.2%
- Sanitation and waste water 11.0%
- Improper and excessive use of pesticide and  
agro-chemicals 8.7%
- Noise from night clubs in residential areas 7.8%
- Transport and storage of dangerous chemicals 6.7%
- Salt water intrusion into the water source 6.5%
- Damages to reefs 6.5%
- Sand mining 6.3%
- Others 2.7%

Issues relating to pollution – solid waste (litter and dumping of rubbish in public places, solid waste – discarded vehicles parts, containers, tyres, household rubbish and garbage, wasteful packaging); land degradation (soil erosion & land degradation, loss of forest and culturally important trees, inappropriate use of pesticides and agro-chemicals); sea level rise and associated problems (coastal erosion/ inundation) and coastal/marine degradation (over fishing and diminishing of coastal fisheries, loss of coastal forest and mangroves, poor living conditions in low lying areas, sand mining, damages to reefs) were frequently regarded as the important environment issues. Similar trends were shown in the responses from the various divisions and subgroups within the sample, for example:

- All issues in relation to pollution (pollution of coastal and ocean, litter, household garbage, waste from business and service station, wasteful packaging, sanitation

and waste water) were slightly more important environmental issues for urban respondents than rural respondents;

- Poor living conditions in low-lying areas, loss of coastal forest and mangroves, and free ranging pigs were much more important issues for urban and rural respondents than for outer islands respondents; and
- Litter and rubbish was the most important environmental issue for both male and female, although a higher priority for female respondents (17.3% and 25.0% respectively), followed by pollution of coastal areas and the oceans where male respondents ratings were higher than female (11% and 9%), while coastal erosion/inundation/sea level rise were equally rated by both male and female respondents (9.4%).

### 5.3.1.3 Local Environmental Concerns

The respondents were then invited to nominate an environmental issue or problem affecting their own local area that particularly concerned them. The issues most often mentioned are presented in Table 5.3.4.

**Table 5.3.4: Environmental Concerns in Local Area**

Issue	Percentage of Respondents
<b>Land degradation</b>	
Deforestation	6.1
Loss of wildlife	5.5
Excessive use of pesticides and fertilizers	5.1
Problems with pigs and other domestic animals	5.0
Sea sprays (associated with cyclones)	1.1
	<b>22.8</b>
<b>Pollution – solid waste</b>	
Litter and dumping of rubbish in public places	8.2
Household rubbish and garbage	6.4
Plastic bags and diapers	2.0
Old discarded vehicles and second hand 'goods'	2.0
	<b>18.6</b>
<b>Coastal/Marine degradation</b>	
Overfishing of coastal resources	6.0
Sand mining	5.0

<b>Issue</b>	<b>Percentage of Respondents</b>	
Coastal reclamation and removal of mangroves	3.0	
Run-off into the harbour	1.3	
Destructive fishing techniques	1.0	16.3
<b>Climate change and sea level rise/storm surges</b>		
Coastal inundation	7.2	
Coastal erosion	7.6	<b>14.8</b>
<b>Pollution -- others</b>		
Sewage	5.2	
Water pollution	3.1	
Waste Oil	3.0	
Batteries	2.1	<b>13.4</b>
<b>Others</b>		
Lack of alternatives for income generating activities	7.2	
Poverty	2.0	<b>9.2</b>
<b>Environmental Legislation and Policies</b>		
Lack of enforcement	2.5	
Inappropriate and outdated environmental legislation and policies	2.9	<b>4.9</b>

There was some variation in the responses for the various subgroups within the sample (see Appendix 4). For example:

- Land degradation was mentioned as a local concern by relatively a high number of respondents in the rural areas of Tongatapu (16 %) and Ha’apai (12%);
- Others -- lack of alternative income generating activities and poverty were a relatively high concern (39%) for respondents in the outer islands (Eua/Niua), 11% for the respondents in both Vava’u and in Ha’apai, but was less of an issue for respondents in Tongatapu (4%);
- Solid waste pollution was a high priority for 17% of Nuku’alofa (Urban Tongatapu) respondents and 15% of Neiafu respondents (Urban Vava’u), but for fewer people elsewhere in Tonga (e.g. 3% in the outer islands and 7% from Ha’apai);

- Run-off into the harbour was mentioned as a local concern by 8 % of the urban respondents in Vava’u, but not an issue elsewhere;
- Problems related to climate change, sea level rise and storm surges were high priority local concerns for a large number of respondents from all divisions (Tongatapu, Vava’u, Ha’apai and Outer Islands) and in all urban and rural areas, though highest in urban Vava’u (Neiafu – 25%); and
- Coastal/marine degradation was mentioned as a high priority local concern by 28% of the Ha’apai respondents, 16% of the Vava’u respondents, and 14 % of the Tongatapu respondents, but none from the outer islands.

#### 5.3.1.4 Views on Environmental Priorities for Action by the Government

Respondents were asked for their opinion as to the single most important thing that the Government of Tonga could do to protect the environment over the next few years. Table 5.3.5 shows the results.

**Table 5.3.5: Single Most Important Environmental Initiative for Government Action Over the Next Few Years.**

Action	Percentage of respondents
<b>Attention to law enforcement problems</b>	
Address lack of enforcement of existing regulations	13.1
Provide required resources for enforcement	10.2
Coordinate enforcement capacity of government	6.1
Improve enforcement capacity of District/Town Officers	4.0
Fine on the spot and higher penalties	2.0
	<b>35.4</b>
<b>More public participation</b>	
Provide resources for public participation in national development projects	6.2
Consult and improve public participation in regional development	5.0
Provide assistance to village committees and NGOs	5.0
Provide for better awareness and distribution of assistance to all of Tonga	3.5
	<b>19.7</b>

Action	Percentage of respondents
<b>Provide for more effective and sustained awareness and education programme on environmental issues to the public</b>	
Provide appropriate awareness and education campaigns	9.5
Sponsor village competitions	5.3
Promote tree planting	4.0 <b>18.8</b>
<b>Deal with pollution issues</b>	
Improve solid waste services and management	7.3
Provide assistance to recycling programmes	3.2
Deal with problems relating to hazardous waste	4.2 <b>14.7</b>
<b>Enactment of appropriate legislation and policies</b>	
Develop appropriate legislation and policies	6.1
Provide resources to promote awareness of the legislation to the public	5.3 <b>11.4</b>

A very large proportion (75%) of respondents from the outer islands considered that attention to law enforcement should be the priority issue for government's action to protect the environment in the next few years. Also, relatively high responses were seen from the urban respondents of Tongatapu (26%), and Ha'apai (28%) in relation to respondents from Vava'u and rural Ha'apai. Attention to more public participation was the priority issue for respondents in urban Vava'u and rural Ha'apai, (see Table 5.3.6 and Appendix 5).

To a large extent, people's views on priorities for government action to protect the environment thus confirmed the lack of enforcement and implementations of existing environmental regulations and policies as discussed in Chapters 3 and 4 (Sections 3.5.1.4 and 4.6.1). Of significance, however, people's views on the priority issues for government attention could be related to their views in key environmental concerns. For example, lack of enforcement of existing regulations and policies related to the issues of solid waste, land and coastal/marine resources management, largely contributed to these issues becoming key environmental concerns.

**Table 5.3.6: Priority Environmental Issues for Government Action to Protect the Environment of Tonga in the Next Few Years (by Division)**

	Total n=447 %	Residence						
		Tt		Vv		Hp		OT
		Urban n=154 %	Rural n=124 %	Urban n=29 %	Rural n=46 %	Urban n=17 %	Rural n=41 %	n=36 %
Attention to law enforcement problems	35.4	26.3	16.6	10.7	10.7	27.6	8.6	75.0
More public participation	20.0	6.8	7.9	16.0	5.3	20.7	20.7	19.4
Increased and improve environmental awareness and education	19.0	12.6	10.0	16.0	4.0	10.3	-	-
Deal with pollution issues	15.0	3.6	5.0	8.0	12.0	-	-	5.6
Enactment of appropriate legislations and policies	11.4	6.1	5.4	10.7	6.7	12.1	-	-

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands (Eua/Niua)

### 5.3.1.5 Summary

- Overall, education was ranked as the current most important issue for government attention at present, and in ten years time. The environment ranked sixth. The environment, however, ranked third, behind health and education as the most important perceived issues for government attention in ten years time.
- Younger respondents tended to attribute greater importance to the environment as an issue for government attention, now and in ten years time. Older respondents, the well-educated and high household income level respondents, however, attributed greater importance to education and infrastructure development at present, and to health, environment and combating crime and other issues in the future.
- Respondents in Vava'u, Ha'apai and in the outer islands attributed greater importance to environmental issues, both at present and in the future, than respondents in Tongatapu.



- People's perceptions of the most important environmental issues in Tonga today were dominated by concerns about land resources degradation, solid waste pollution and coastal/marine degradation. When respondents were offered a list of specific environmental issues for comment, substantial numbers also gave high priority to solid waste pollution, coastal/marine degradation, land resources degradation, especially the loss of forest and culturally important trees, and poor living conditions in low lying areas.
- Land resources degradation and solid waste pollution were also frequently identified as major local environmental concerns followed by concerns for coastal/marine degradation and problems associated with sea level rise. For respondents in urban Vava'u, run-off into the harbour was an important local issue. Respondents in the outer islands and in Ha'apai emphasised lack of awareness, lack of alternative income generating activities, and poverty as local concerns.
- The top environmental priorities suggested for government action were to deal with lack of enforcement issues, to improve public participation in decision making, to provide effective environmental awareness and education programs, to enact appropriate legislation and policies and deal with pollution problems and management of hazardous waste.
- Results from logistic regression analysis (see Section 5.4.1.2 below) showed that where respondents lived significantly affected their views on the 'environment' as a priority (p-value of 0.0011). For example, significantly more people in Tongatapu and the outer islands had the environment as a priority.

## **5.3.2 Knowledge**

### **5.3.2.1 Respondents' Knowledge on National Environmental Issues**

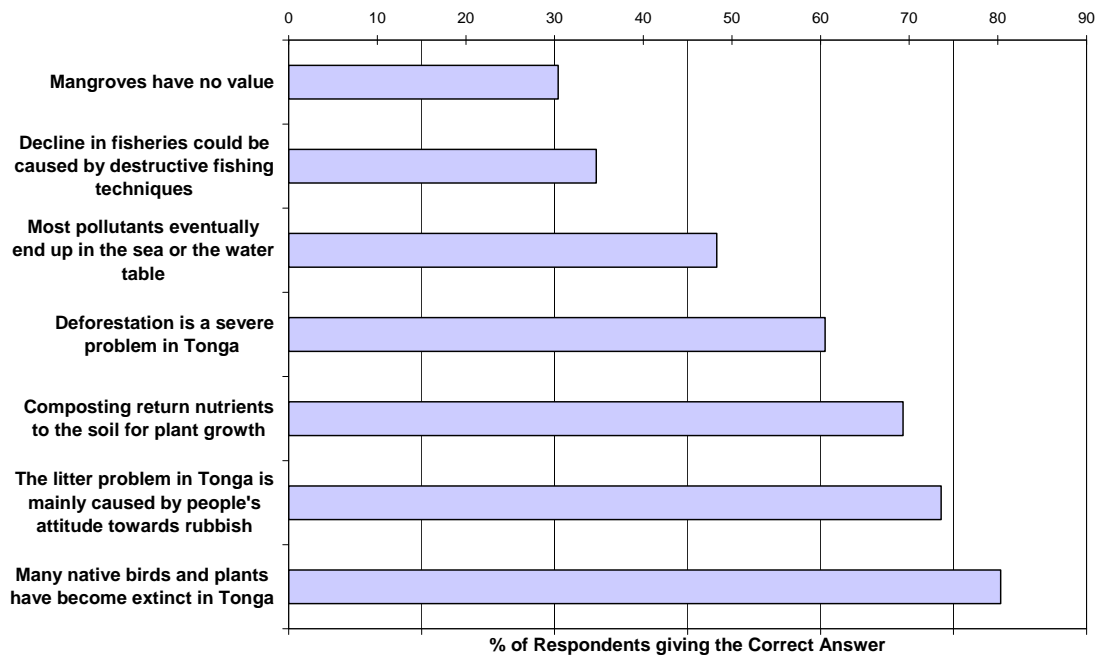
The respondents were shown a set of seven statements on environmental matters, and asked to say whether each statement was true or false. These statements were selected with the assistance of a NGO to cover a variety of national environmental issues that

members of the general public might realistically be expected to know something about. The proportions of respondents who gave 'correct' answers varied considerably from statement to statement. For example, 80% correctly confirmed that many native birds and plants have become extinct in Tonga. By contrast, only 30% correctly denied that mangroves have no values (see Figure 5.1 & Appendix 5.1).

In order to determine the level of knowledge between different categories (age, gender, level of education and area of residence) within the survey sample, each respondent was given a total "knowledge score" reflecting the accuracy or otherwise of his/her responses to these seven statements. Possible scores ranged from 0 points (seven wrong answers) and 14 points (seven correct answers); a "not sure" answer scored one point. Each respondent was placed in one of three groups – Least knowledgeable (0-5 points), Medium knowledge (6-10 points), and Most knowledgeable (11-14 points). The Least knowledgeable category included 26% of all respondents, the Medium knowledge category 28 % and the Most knowledgeable category was 46% (see Table 5.3.7).

The results tended to vary with level of education. For example, 63% of those respondents who held university or diploma qualification fell into the Most knowledgeable category. This was true for 50% of those respondents who had completed secondary school or held technical qualification, and for 38% of those who had not completed secondary school. A similar trend was apparent in relation to increasing levels of household income. For example, 64% of those respondents who are in the upper income bracket fell into the Most knowledgeable category; this was true for only 48% of those respondents from the middle-income bracket and for 40 % of those who were from the lower income bracket. There is, however, a marked difference by gender. Fifty-two percent of male respondents and 41% of females belonged to the Most knowledgeable group. There was relatively little difference in knowledge scores by age groups, although low scores (Least knowledgeable, 0-5) were most frequent among people in the oldest group, those aged 54 or over. More than 50% of the respondents in Tongatapu (54 %) were in the Most knowledgeable category, and only 39% and 33% from Vava'u and Ha'apai were in the Most knowledgeable category. Only 19% of the respondents from the outer island were in this category.

**Figure 5.1: Correct Responses to Seven True/False Statements on Environmental Issues**



### **Logistic Analysis**

The knowledge scores were further examined through use of logistic regression analysis, a statistical technique, which allows the effect of several variables to be considered simultaneously. In this instance the dependent variable was whether or not the respondent had a knowledge score in the Most knowledgeable (highest) category, 11-14 points. The independent variables were:

- gender;
- age (19-23, 24-33, 34-53, 54 or over);
- whether the respondent lived in the main island of Tongatapu, Vava'u, Ha'apai or in the outer islands;
- education (whether or not the respondent had a University qualification); and
- annual household income (\$T5,000 or less, \$T5,001-\$T20,000, or over \$T20,000).

The test showed significant relationships in being represented in the highest knowledge score category in the following variables only:

- gender – more males than females had high knowledge scores (p-value of 0.0236);
- level of education – those who had University/Dip qualification were strongly represented among those with high knowledge scores (p-value of 0.0132); and
- place of residence – Tongatapu respondents were strongly represented in the high knowledgeable scores (p-value of 0.0014).

**Table 5.3.7: Knowledge Score (Range 0-14)**

	Total n=447 %	Gender		Age Group				Residence				Education			Level of Household Income		
		M n=221 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Least knowledgeable (score 0-5)	26.4	20.4	32.3	27.8	24.3	27.0	33.3	23.4	23.0	41.4	33.3	36.6	18.5	13.2	32.7	25.0	10.0
Medium knowledge (score 6-10)	27.5	28.1	27.0	29.1	26.0	28.8	20.0	22.3	39.0	26.0	47.2	25.9	31.5	23.5	27.6	27.6	26.0
Most knowledgeable (score 11-14)	46.1	51.6	40.7	43.1	49.7	44.1	46.7	54.3	39.0	33.0	19.4	37.5	50.0	63.2	39.8	47.5	64.0
	100.0	100.0	100.0	100.0	100.0	100.0	100	100	100	100	100	100.0	100.0	100.0	100.0	100.0	100.0

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands  
A – Did not complete secondary school, B – Completed secondary school/tech/trade training  
C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

### **5.3.3 Attitudes and Opinions on Environmental and Management Issues**

#### **5.3.3.1 General Level of Concern about Environmental Problems**

Respondents were asked how concerned they were in general about environmental problems. Seventy-two of the respondents said that they were concerned a great deal, while a further 24% said they were concerned a fair amount--a total of 96%. Four per cent said they were not concerned very much, and 1% not at all (see Table 5.3.8).

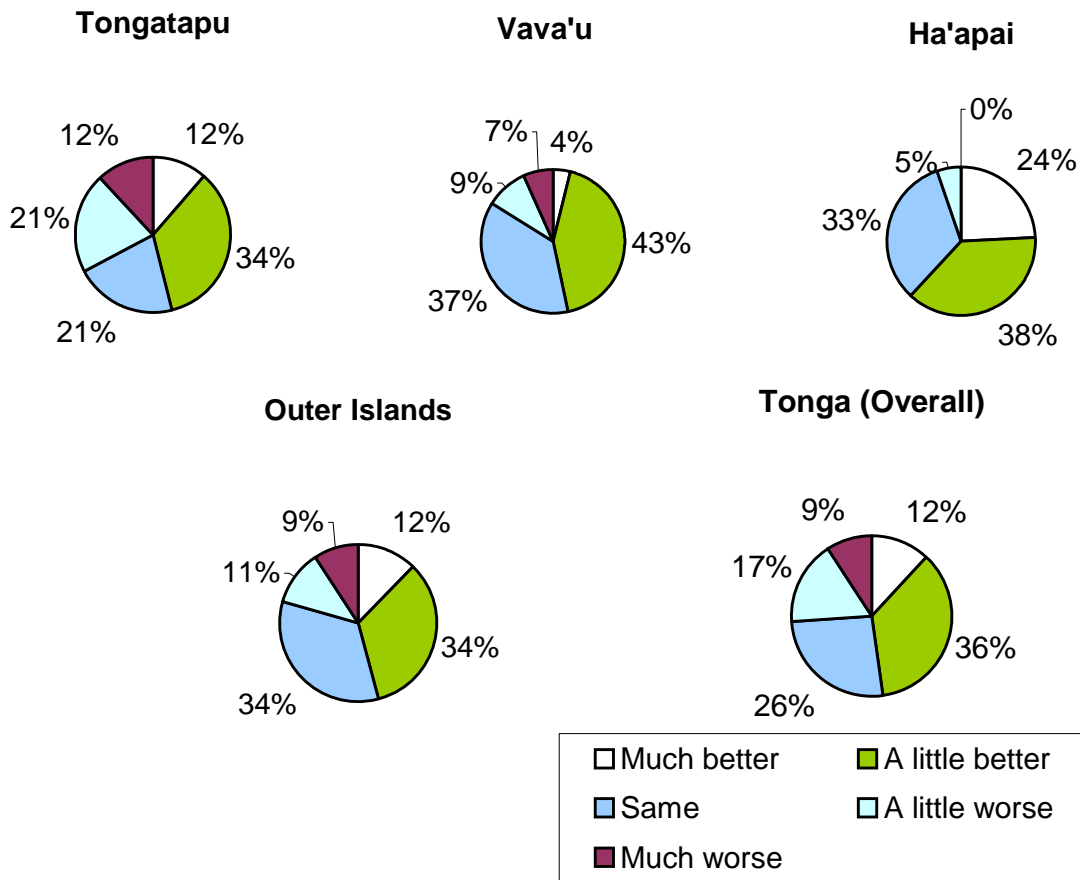
Although there were slight variations in responses within the subgroups, high levels of concern for environmental problems were apparent from all categories, (i.e., gender, age groups, level of education and level of household income).

#### **5.3.3.2 Assessments of the Quality of the Environment in Tonga (as a whole), in the Divisions by Islands and in the Respondents' Local Area**

Respondents were asked to rate the quality of the environment in Tonga as compared to 5-10 years ago as either much better, a little better, same, a little worse, much worse or not sure. Overall, 14.3% said that the environment in Tonga is much better; 36.2% voted for a little better, which adds up to 51%; however, 26% said the quality of the environment in Tonga is the same. Thirteen point two percent and 9.8% chose the response of a little worse and much worse respectively, which adds up to 23%. Only 0.2% of the respondents were not sure. There was only a slight difference between urban respondents (4% nominated much better and 13% nominated a little better) and rural respondents (5% nominated much better and 11% nominated a little better). The difference was bigger, however, in the urban/rural nominations for little worse and much worse quality of the environment in Tonga. For example a total of 23% of respondents from urban areas thought that the quality of the environment in Tonga is either a little worse or much worse, in comparison to 10.7% from the rural areas who have the same opinion. There was very little difference in the nominations from the outer islands (see Figure 5.2 and Appendix 5.2).



**Figure 5.2 Assessment of the Quality of the Environment in each Island Group and in Tonga as a Whole**



### 5.3.3.3 Recent Environmental Changes in Tonga

Questions were asked about perceived environmental changes in Tonga over recent years. Responses are presented in Table 5.3.9. In relation to the environment as a whole, only 41 % of respondents believed that, over the last five years, the situation in Tonga had become better or much better, while 18 % believed that there had been little or no changes; and 40 % believed that things had become worse (see Table 5.3.9). This result is consistent with the results in Section 5.3.3.2 (Appendix 5.2), For example, there is fairly a high number of respondents who believed that the environmental quality in Tonga is generally much worse now (40 %-49 %).



**Table 5.3.9: Views on Environmental Improvement or Deterioration in Tonga (Over the Past Five Years)**

	<b>Much Better</b>	<b>Better</b>	<b>Little or no change</b>	<b>Worse</b>	<b>Much worse</b>	<b>Not sure</b>
	<b>%</b>	<b>%</b>	<b>%</b>	<b>%</b>	<b>%</b>	<b>%</b>
Fresh water source quality	45.0	32.2	11.1	5.0	2.5	0.5
Cooperation on environmental issue with other villages/district, islands	26.4	46.7	17.5	7.6	1.6	0.2
Cleanliness of beaches and coastal areas	20.9	33.6	30.5	9.2	5.6	0.2
Protection and conservation of culturally useful trees (medicinal plants & cultural trees)	21.5	31.1	32.0	11.6	4.0	0.2
Dealing with free roaming pigs and other domestic animals	15.9	21.3	18.1	13.2	25.7	5.8
Dealing with the general litter problem (rubbish)	13.1	20.9	16.6	24.7	25.6	-
The environment in general	11.2	29.3	18.1	25.1	14.5	1.8
Protection of endangered plants and animals (wild life)	10.4	21.7	22.6	26.0	17.4	2.0
Dealing with household waste	4.8	20.2	13.4	37.3	23.9	0.5
Abundance and quality of coastal fisheries	3.4	7.6	22.4	30.7	34.3	1.6
Transport, storage and disposal of dangerous chemicals	2.3	26.6	44.0	18.5	6.3	2.3
Protection of soil and soil quality	2.2	27.0	30.6	33.0	5.8	1.4
Dealing with waste from companies and business	1.6	10.6	33.8	37.2	12.2	4.7

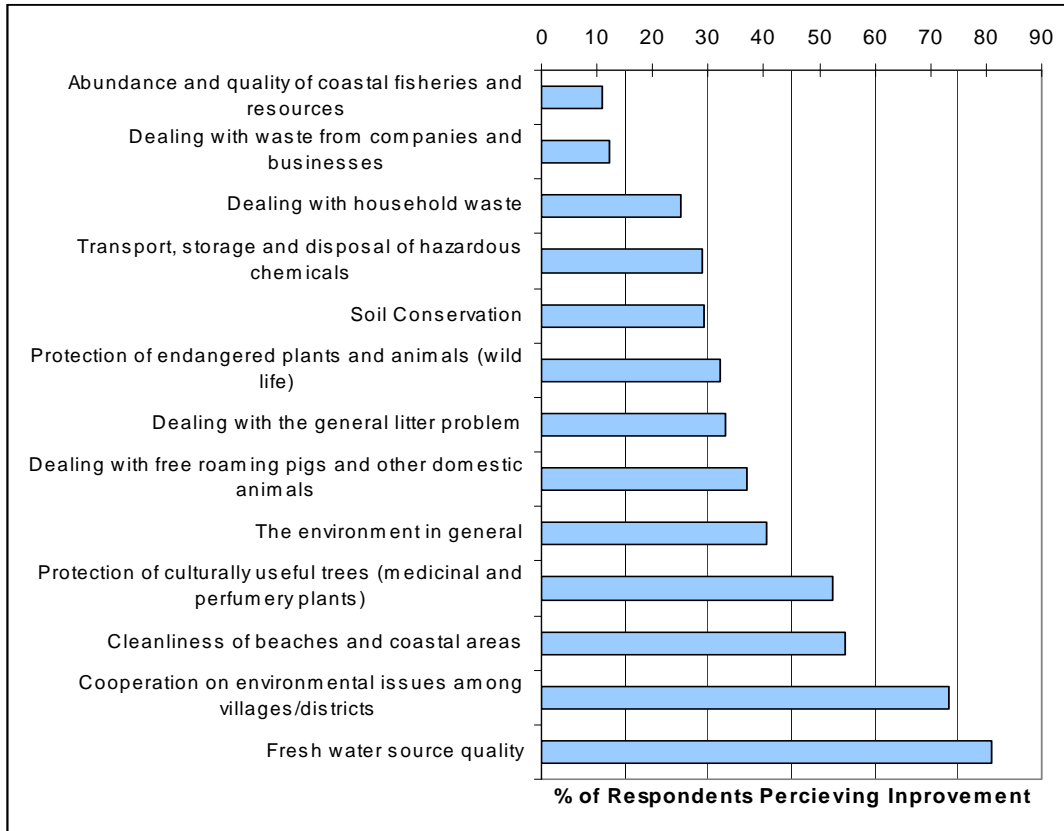
Relatively large numbers of respondents thought that things in Tonga had become either worse, much worse or little or no change at all in relation to:

- The abundance and quality of coastal fisheries and resources 87%
- Dealing with waste from companies and businesses 83%
- Management of household waste 75%
- Transport, storage and disposal of hazardous chemicals 69%
- Attention to soil conservation 69%
- Dealing with the litter problem in general 67%
- Protection of endangered plants and animals (wildlife) 66%
- Dealing with the problems of free roaming domestic animals 57%

By contrast, fresh water quality, cooperation on environmental issues with other villages/districts, cleanliness of beaches and coastal areas, conservation of culturally

useful trees (for medicines and for oil making) and the environment in general were believed to have become better or much better (see Figure 5.3)

**Figure 5.3 Perceptions of Improvement in Various Aspects of the Tonga's Environment Over The Past Five Years**



In relation to Tonga's environment in general, only 13% of the respondents in age group 54<sup>+</sup> perceived improvement over the past five years, whereas younger respondents perceived a higher percentage of improvements (see Appendix 6). Dealing with waste from companies and businesses, low percentages of all age groups perceived improvement, with a lowest of 8% from respondents between the ages of 24-33. Similarly, perceived improvements in the abundance of quality of coastal fisheries and resources were relatively low within all subgroups.

Only 19% of the respondents in Ha'apai perceived some improvement in the environment over the past five years in contrast to the higher percentage of perceived improvement from respondents in Tongatapu (43%), Vava'u (39%) and (64%) from the outer islands. In relation to transport, storage and disposal of hazardous chemicals, respondents that hold

university degrees or diplomas perceived the lowest in improvement (only 18%) in comparison to the other two levels of education.

### 5.3.3.4 Reliability of Environmental Information from Various Sources

Those surveyed were asked for their views on the reliability or otherwise of environmental information from a variety of possible sources (Table 5.3.10).

**Table 5.3.10: Tonga Community Views on the Reliability of Environmental Information from Various Sources**

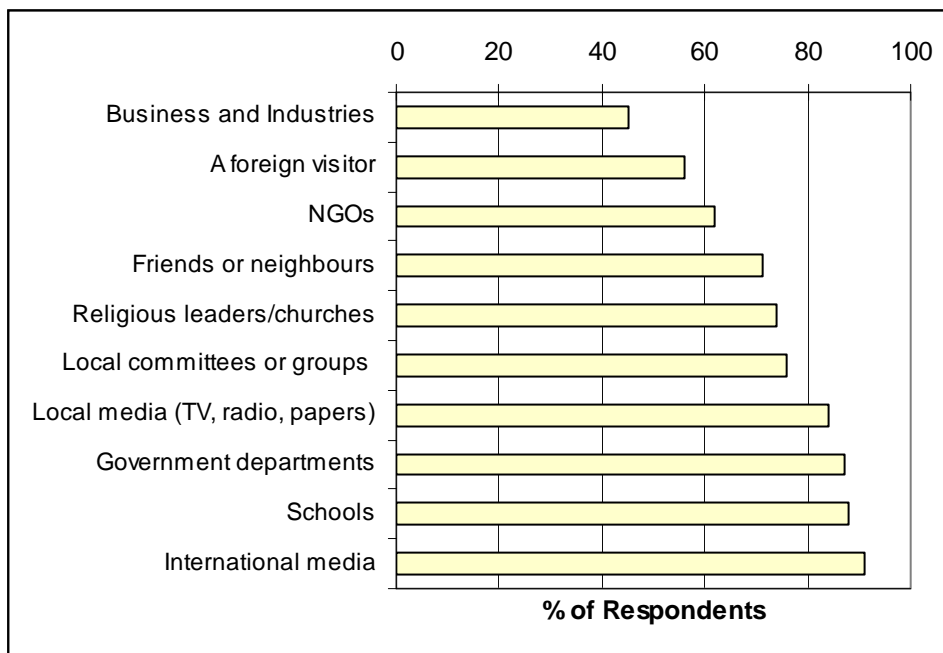
	Very reliable %	Fairly reliable %	Hard to say %	Fairly unreliable %	Very unreliable %
Schools	44.0	44.2	12.1	-	-
International media	40.0	50.9	7.6	1.4	0.2
Local media (TV, radio, papers)	39.7	44.5	14.7	1.3	-
Government departments	34.1	52.5	10.0	4.0	-
Local committees or groups	30.5	45.4	21.2	1.1	2.0
Religious leaders/churches	50.0	42.0	27.0	2.0	-
Friends or neighbours	27.5	40.0	30.2	2.0	0.7
NGOs	17.5	56.1	25.3	0.9	0.2
Business and Industries	17.0	28.1	45.0	10.0	0.7
A foreign visitor	16.6	39.5	39.0	4.8	0.5

Environmental information from all sources received a fairly large percentage of very reliable or fairly reliable views (see Figure 5.4). Respondents saw either schools or both international and local media as likely to provide reliable information on environmental matters. However, environmental information provided by business and industries or received from foreign visitors was regarded as less reliable than from the other sources.

The general pattern of opinion on the reliability of environmental information from various sources was similar within various subgroups of respondents (see Appendix 7). For example, very high percentages of respondents with a university degree or diploma considered information from schools, government departments, local and international

media reliable; relatively low percentages of these respondents, however, placed reliance on information from business and industries, from friends and neighbours and from NGOs. Similarly, large numbers of those aged 54 or over regarded information from schools, from government departments and from the local and international media as reliable.

**Figure 5.4 Percentage Believing that Environmental Information from Various Sources is Very/Fairly Reliable**



### 5.3.3.5 Causes of Environmental Problems

The survey also sought people's views on the extent to which ten possible causes of environmental problems actually contribute to the problems experienced in Tonga. All ten possible causes of environmental problems were perceived, by a very large percentage of the respondents, to contribute a great deal or a fair amount to the environmental problems in Tonga (see Table 5.3.11). None of the respondents nominated 'Not sure'. However, poor government systems or services such as waste management were regarded most frequently as contributing a great deal to environmental problems in Tonga, followed by a contributing factor that the environment is not a priority for the government.

**Table 5.3.11: Tongan Community Views on Causes Contributing to Environmental Problems in Tonga**

	<b>Contributes a great deal</b>	<b>Contributes a fair amount</b>	<b>Contributes not very much</b>	<b>Contributes not at all</b>
	<b>%</b>	<b>%</b>	<b>%</b>	<b>%</b>
Government services such as waste management are very inefficient	70.5	26.0	3.1	0.5
Government does not place enough emphasis on protecting the environment in pace with development	65.8	27.7	5.2	1.3
People's perceptions of development and what is seen as 'progress/being developed' – using plastic bags, diapers are signs of being developed, etc., without considering the consequences/cost of disposing of rubbish or the expense involved.	61.5	31.7	5.2	1.6
Lack of awareness and education-people just do not know what to do to protect the environment	60.4	32.4	4.3	2.9
Overpopulation--there are too many people using up resources	54.1	36.1	14.8	4.0
Business and industry are allowed to litter and pollute the environment	56.4	40.3	2.9	0.5
Lack of alternative sources of 'livelihood'	52.1	34.0	11.9	2.0
Not enough land for Government to distribute	51.9	28.0	17.0	3.1
Peoples attitudes towards the environment-'things to be used'--resources are self corrected or reproduced easily	51.7	37.0	10.1	1.3
Lack of enforcement of existing legislation	50.8	42.1	6.7	0.5

### 5.3.3.6 Views on the Appropriateness of Environmental Regulations

The questionnaire sought opinions as to whether environmental regulations affecting various sectors of the community were too strict, too lax or about right. The results were summarised as follows:

	<b>Too strict</b>	<b>About right</b>	<b>Too lax</b>	<b>Not sure</b>
Leasehold land	11.2	26.2	57.7	2.9
Littering in public places	10.6	4.4	84.4	0.7
Tourism industry	10.1	13.7	75.0	1.4
Protected areas	7.1	22.1	69.9	0.9
Fisheries industry/fisheries management	13.3	22.7	63.4	0.7
Sand mining	14.5	10.4	75.0	0.5
Forestry management	7.7	11.6	80.0	0.7
Agriculture/Farmers	10.3	13.3	76.1	0.2

Those who thought that regulations were too lax consistently outnumbered by a very large margin those who thought them too strict. Further results, by categories are set out in Table 5.3.12. More than three-quarters of respondents regarded regulations prohibiting littering in public places, regulations affecting the tourism industry, protected areas, sand mining, forestry and agriculture/farmers as too lax. As far as particular subgroups in the sample were concerned:

- In all eight sectors, to a large extent, it was respondents in Ha’apai and in the outer islands who most often considered environmental regulations as too lax;
- There was a tendency for older respondents to describe environmental regulations as too lax in five of the cases; and
- The largest proportions of respondents regarding environmental regulations relating to of leasehold land as too lax were found in the outer islands (92 %).

**Table 5.3.12: Respondents’ Views on Appropriateness of Environmental Regulations, by Groups**

Regulation of:	Percentage who regard environmental regulations as too lax								
	Total	Age Group				Residence			
	n=447 %	19-23 n=151 %	24-33 n=169 %	34-53 n=111 %	54+ n=15 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %
Leasehold land	59.7	60.3	50.8	72.1	60.0	59.4	49.3	53.5	91.7
Littering in public places	84.4	85.1	82.1	85.7	92.9	78.7	91.9	100	86.0
Tourism Industry	74.8	76.7	75.7	70.9	73.3	64.0	86.7	100	94.0
Protected areas	69.9	66.0	70.3	72.0	87.0	68.8	48.0	98.1	81.8
Fisheries industry and fisheries management	63.4	64.0	63.3	60.0	80.0	62.0	72.0	79.3	33.3
Sand mining	75.0	74.0	82.2	68.0	73.3	70.0	78.7	100	61.1
Forestry management	80.0	74.3	83.8	80.0	93.3	75.4	91.4	90.0	77.8
Agriculture/Farmers	76.1	75.8	74.1	77.1	93.0	78.6	78.5	48.3	97.2

### 5.3.3.7 Opinions on Specific Environmental Propositions

The questionnaire sought respondent’s views on a series of agree/disagree statements on various environmental issues not directly covered elsewhere. The results are summarised in Appendix 8. The main findings are as follows:

- There was high level of agreement with the following propositions:
  - there is a lot that I, as an individual, can do to help protect the environment (83%);
  - I do what I can do to improve the quality of my land as it is going to be inherited by my children (89%); and
  - media campaigns (e.g. lobster man) do a lot to encourage people to do the right thing to protect the environment (84%).
- Three of the statements dealt with issues relating to environmental information. Some respondents (29%) agreed that it is easy to obtain reliable environmental information in Tonga. Only 12% of respondents agreed that there is a lot of environmental information provided by the Tonga media. On the other hand, 44% agreed with the statement that 'I feel quite confused by all the different information and claims I hear about environmental issues'. The extent of agreement with the latter tended to fall as age increased, as the level of education rose and, also, as the level of household income increased.
- With the proposition that, in Tonga, we are doing too little, too late, to protect the environment, 45% agreed, but, 36% disagreed and 10% were not sure. Forty-seven percent and 48% of respondents who agreed were from Tongatapu and Vava'u respectively.
- There was a high level of agreement (73.2%) with the proposition that Tongans can no longer afford to ignore environmental problems as hard earned economic growth will be spent correcting the environmental resources that provide for the economic growth; a larger number of respondents were 54 years old or above.

#### **5.3.3.8 Views on the Relationship between the Economy and the Environment**

Two further questions were asked in a form that required those surveyed in each case to choose between two contrasting statements. When asked to decide between the propositions that:

- A: Tongans will increasingly have to make hard choices between economic growth and protection of the environment; and

- B: It is quite possible to have both a prosperous economy and a healthy environment.

Thirty-five percent of the respondents agreed more with statement A, while 64 % agreed more with B (Table 5.3.13). A high percentage of males (75%) believed that economic growth and environmental protection can be complementary, compared to only 52% of female respondents. Only 40% of the respondents from the 54 and over age group agreed with statement B.

### **5.3.3.9 Views on the Responsibility of the Individual in Environmental Protection**

A second pair of statements asked for respondents' views regarding the role of individual in environmental protection:

- A: Each of us, as an individual, must take responsibility for doing all that we can to protect and improve the environment; and
- B: You cannot expect the individual to take environmental issues seriously when the Government and businesses are ineffective or irresponsible.

Thirty-four percent of the respondents agreed more with statement A, while 93% agreed more with statement B (see Table 5.3.14 for more details). A very large percentage (98%) of the respondents from Ha'apai agreed more with statement B compared to respondents from the rest of Tonga. In all of the subgroups, agreement with statement B exceeded agreement with statement A.



**Table 5.3.13: Respondents' Views on the Relationship between the Economy and the Environment**

Proposition A: Tongans will increasingly have to make hard choices between economic growth and protection of the environment.

Proposition B: It is quite possible to have both a prosperous economy and a healthy environment

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ N=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Agree More with A	34.9	24.0	45.6	36.4	32.5	34.2	53.3	41.0	21.3	22.4	36.1	37.5	31.5	35.3	37.8	35.8	24.0
Agree More with B	63.5	75.1	52.2	62.9	66.3	63.1	40.0	56.5	78.7	77.6	64.0	61.6	65.4	64.7	60.7	62.2	76.0
Hard to say/Not sure	1.6	0.9	2.2	0.7	1.2	2.7	6.7	2.5	-	-	-	0.9	3.1	-	1.5	2.0	-

**Table 5.3.14: Respondents' Views on the Responsibility of the Individual in Environmental Protection**

Proposition A: Each of us as an individual must take responsibility for doing all that we can to protect the environment

Proposition B: You can't expect the individual to take environmental issues seriously when the government and business are ineffective or irresponsible

	Total N=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Agree More with A	33.8	31.2	36.3	39.1	31.4	29.3	33.3	42.7	37.8	1.7	36.1	30.6	36.4	36.7	29.1	37.7	40.0
Agree More with B	62.9	67.0	58.9	60.3	65.7	62.2	66.7	56.8	57.3	98.3	63.9	66.7	59.9	58.8	69.4	57.1	56.0
Hard to say	3.4	1.8	4.9	0.7	3.0	8.1	-	5.4	-	-	-	2.8	3.7	4.4	1.5	5.1	4.0

Key :- Tongatapu; Vv – Vava'u; Hp – Ha'apai; OI – Outer Islands; A – Did not complete secondary school; B – Completed secondary school/tech qualification; C – University degree or diploma; D – Lower income bracket; E – Middle income bracket; and F – Upper income bracket.

### 5.3.3.10 Attitude and Opinion on Environmental Management Role and Capacity of Communities and the Government

Those surveyed were asked to nominate whether they agreed strongly, agreed, not sure, disagreed or disagreed strongly with five propositions regarding the capacity of the government and the community to manage certain aspects of the environment. A large number of respondents strongly agreed and agreed with the statements that community groups can do a lot to conserve community resources and that Town and District officers have important environmental management roles. More respondents disagree or strongly disagree with the proposition that the government of Tonga has the capacity to implement sustainable development policies than those who agreed (Table 5.3.15).

**Table 5.3.15: Agreement/Disagreement with Propositions Regarding Environmental Management Role and Capacity of Communities and the Government**

<sup>1</sup> Government as used in this table (and other related discussion to this table) refers to the state existing resource and environmental management regime of the government of Tonga.

	<b>Strongly agree</b> %	<b>Agree</b> %	<b>Not sure</b> %	<b>Disagree</b> %	<b>Strongly disagree</b> %
Community groups can do a lot in the community to conserve community resources	41.0	40.6	14.0	4.0	0.7
Town and District Officers have important environmental management roles	26.0	51.2	14.3	6.9	1.6
Communities have the capacity to manage communities' resources	22.3	32.0	18.5	14.0	14.0
The government <sup>1</sup> of Tonga has the capacity to implement sustainable development policies throughout Tonga	14.3	10.0	14.8	33.0	29.0
Government has set clear sustainable development policies	11.0	34.2	16.4	33.7	5.0

The results were further analysed according to categories, and the following emphasis per category can be seen:

- A very high number of respondents within all subgroups agreed with the statement that community groups could do a lot in the community to conserve community resources. For example, an average of 81% from all subgroups agreed with the statement (see Appendix 9);

- There were more male respondents (62%) agreeing with the statement that government has very clear sustainable development policies than there were females 46%; for the other four statements there were more females agreeing than males; and
- There were more younger respondents than older, agreeing to statements that communities have the capacity to manage communities' resources.

### **5.3.3.11 Summary**

- Ninety-six percent of respondents said that they were concerned either a great deal or a fair amount about environmental problems. Those with a university degree or diploma expressed a very high level of concern and those with high household incomes and younger respondents were slightly more concerned about environmental problems than older respondents;
- Fifty-one percent of respondents rated the quality of the environment in Tonga as either very good or fairly good. The other 49% of respondents rated the quality of the environment in Tonga as the same, (no change), a little worse or much worse, or not sure;
- In total, only 48% of respondents assessed the quality of their local environment as either very good or fairly good. There was also a high percentage of respondents rating the change in quality of the environment in their local area as in the range from no change to much worse or not sure;
- When asked about perceived changes in the environment of Tonga over the past five years, 41% thought that the environment in general had improved, 18% saw little or no change, and 25% thought that the situation had become worse; 2% were unsure. Many respondents perceived an improvement with regard to water quality (77%), and community cooperation in environmental issues (73%). Just over half thought there had been improvement in relation to looking after beaches and coastal areas (55%) and to the protection and conservation of culturally important trees (53%). On the other hand most respondents believed that dealing with waste from business and protection of soil had become worse, and there were also

concerns about transport/storage/disposal of dangerous chemicals and the quality of coastal fisheries and resources;

- Respondents were asked for their views on the reliability of environmental information from various sources. The sources regarded most highly were schools (88% of respondents seeing information from schools as reliable), international and national media (91% and 84% respectively) and government departments and local committees or groups (87% and 76%). Only 45% regarded information from business and industry as reliable;
- From a list of possible causes of Tonga's environmental problems, 71% identified inefficient government services regarding waste management as contributing a great deal to such problems. Sixty-six percent identified the low priority the government places on the environment. While 62% believed it was the attitude of people to what they perceived as 'development' was contributing a great deal to environmental problems, 60% claimed it was the lack of awareness and education that contributed a great deal to the environmental problems in Tonga;
- More than three-quarters of respondents took the view that environmental regulations relating to littering in public places, the tourism industry, sand mining, forestry management and agriculture/farmers were too slack; 70% thought this was true of regulations for protected areas, and in relation to the fisheries industry and management the figure was 63%. Fifty-eight percent thought that regulations affecting leasehold land are too slack. On all the eight issues considered, those who thought the regulations too lax outnumbered those who thought them too strict;
- A small number of respondents agreed that it is easy to obtain reliable environmental information in Tonga (29%) and only 12% of respondents agreed that there is a lot of environmental information provided by the Tongan media;
- Forty-eight per cent of the respondents believed that in Tonga we are doing too little, too late, to protect the environment, and 73% said that Tongans can no longer afford to ignore environmental problems as hard earned economic growth will be spent repairing the environmental resources that provide for the economic growth;

- Eighty-three percent of respondents believed that ‘there is a lot that I as an individual can do to help protect the environment’; 89% said that the reason for improving ones land quality was that the land was to be inherited by their children;
- Some 84% of respondents said that media campaigns (e.g. lobster man) do much to encourage people to do the right thing to protect the environment;
- Thirty-five percent of respondents agreed with the statement that Tongans will increasingly have to make hard choices between economic growth and protection of the environment;
- Sixty-three percent agreed with the statement that it is quite possible to have both a prosperous economy and a healthy environment;
- Thirty-four percent agreed with the statement that ‘each of us as an individual must take responsibility for doing all that we can to protect the environment and improve the environment’;
- When asked to comment on the their role as caretaker of the environment while government and companies/businesses are ineffective or irresponsible, a majority believed that it would be difficult to continue their caretaker role; and
- There was a high level of agreement with the statements that community groups can do a lot to conserve community resources and that Town and District officers have important environmental management roles, (81% and 77% respectively). Slightly over half of the respondents (54%) agreed that with the statement that ‘communities have the capacity to manage community resources’, while 45% agreed that ‘the government of Tonga has the capacity to implement sustainable development policies throughout Tonga’.

### **Further Statistical Analysis**

a) The relationships of ‘level of concern about the environment’ with socio-demographic characteristics (age, gender, education level, economic level and place of residence) used in the survey were further statistically analysed to investigate which category of socio-demographic has the most respondents that are concerned about the environment ‘a great

deal' or 'a fair amount'. The results showed no significant relationship for all tests except for:

- Significantly, more males (p-value of 0.0279) than females were concerned 'a great deal' about the environment issues;

b) The relationship of perceived environmental quality with the socio-demographic characteristics categories (used in the survey) was analysed. Perceived environmental quality refers to respondents who believed that the environmental quality in Tonga, in their island or village (local area) is much better now, improved, or a little better as compared to 5-10 years ago. Significant relationship were:

(i) Quality of environment in Tonga:

- respondents aged 54 and over had the smallest proportion of people saying that the quality of environment in Tonga as a whole has improved (p-value of <0.0001);

(ii) Quality of the environment in the Island Division they live in (Tongatapu, Vava'u, Ha'apai and 'Eua/Niua):

- the highest proportion of people who thought that the quality of the environment of their island of residence has improved came from the low income category of Tongatapu (p-value of 0.00497);
- females had a lower proportion of people saying that the quality of the environment of the island that they live in has improved (p-value of 0.0178); and
- respondents aged 54 and above had the smallest proportion of people saying that the quality of the environment of the island they live in has improved (p-value of <0.0001);

(iii) Quality of the environment of respondents local area (village):

- respondents aged 54 and above had the smallest proportion of people saying that the quality of the environment of their village has improved (p-value of <0.0001);

c) The relationship of socio-demographic characteristics with people's opinions on specific environmental management roles was further statistically analysed to examine which independent variable or combination of variables are significantly related to the following management roles:

(i) Agreeing with the statement that the government of Tonga has clear sustainable development policies. The following relationships were found to be significant:

- significantly more males (p-value of 0.0212) than females believed that the government has clear sustainable development policies;
- the majority of people who agreed with the statement above comes from the age group (24-33) and did not complete secondary school (p-value 0.0168); and
- the majority of people who agreed with the above statement lives in Tongatapu and are from the low income (\$5,000 and below) category; and

(ii) Relationship of 'agreeing that community groups can do a lot in the community to conserve community resources' with the socio-demographic characteristics:

- the tests showed no relationship between the representations of respondents 'agreeing' that community groups can do a lot in the community to sustainably manage community resources with gender, age, place of residence, level of education and level of household income;

(iii) Relationship of agreeing with the statement that Town Officers and District Officers have important environmental management roles, which could be strengthened. The following socio-demographic characteristics were significantly represented in agreeing with the statement:

- significant number of females from low income households agreed with the above statement (p-value of 0.0118);
- more females (aged between 24 - 33) agreed with the above the above statement than any other age group (p-value of 0.0169);



- females who live in Tongatapu (p-value of <0.0001); and
- respondents aged between 24-33 and living in Tongatapu (p-value of 0.0266).

Therefore the statistical analysis test results, shows that a significant of the females respondents aged 24-33, from low-income households and lives in Tongatapu believed that town officers and district officers have important environmental management roles;

d) The number of respondents who ('agreeing strongly and agree') with that statement that sustainable development is a priority to the government of Tonga was statistically analysed to investigate if there is any significant relationship of 'agreeing' with the above statement and with socio-demographic characteristics used in the survey. The analysis showed the following significant results:

- respondents in Tongatapu and Ha'apai significantly agree with the above statement (p-value of 0.0002);
- people aged 34-53 agreed more with the above statement (p-value of (0.0126);
- the majority of females from the middle income households agreed with the above statement (p-value of 0.0168); and

e) Further statistical analysis was conducted on the relationship of agreeing (agreeing strongly and agreeing) that the government of Tonga has the capacity to implement sustainable development policies throughout Tonga with the socio-demographic characteristics. There was only one significant relationship:

- More females respondents from low income households in Tongatapu agree with the above statement (p-value of 0.0127).

### **5.3.4 Skills**

Those interviewed were also asked to describe their own level of skill in relation to three environmentally related of activities -- conservative methods of reef gleaning, composting, and ability to find advice for application and disposal of pesticides and agricultural

chemicals. The results are set out in Appendices 10 - 12; Figure 5.6 summarises the responses from male and from female respondents.

#### **5.3.4.1 Safer and Conservative Method of Reef Gleaning**

Twenty-one percent of the respondents said that they would definitely know how to reef glean safely (i.e. turning of coral to take shell fish from underneath and placing coral face down afterwards), while a further 33% said they would have a fair idea how to do so (54% in total). Male respondents were more confident about reef gleaning than female, and so were the older respondents. Respondents in Tongatapu and in the outer islands were more confident than respondents from Vava'u and Ha'apai (Appendix 10).

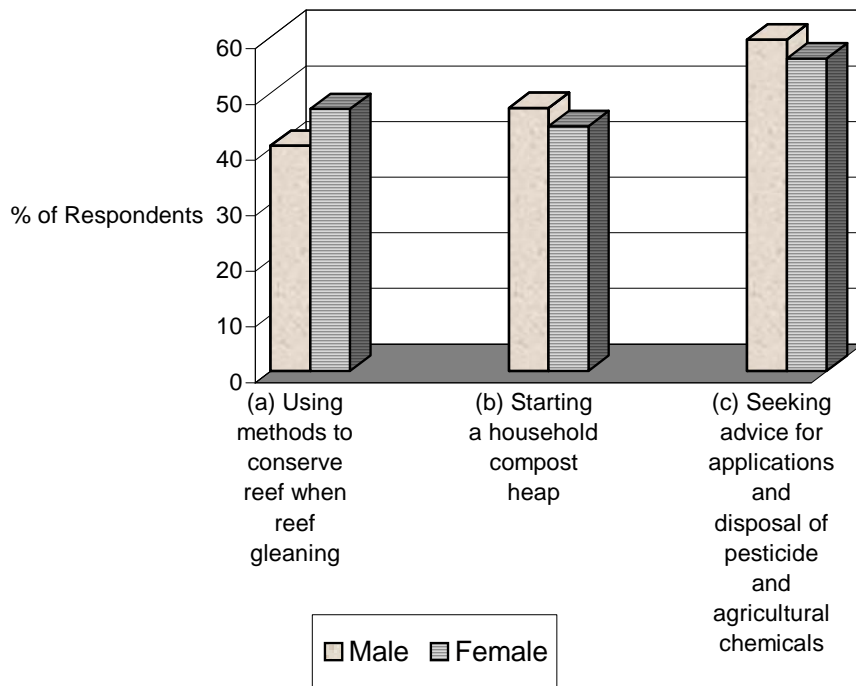
#### **5.3.4.2 Composting**

Some 19% of the respondents believed that they would definitely know how to start a household compost heap, while a further 29% said they would have a fair idea how to do so – a total of 48%. The levels of confidence were similar for male and female respondents (47% to 44%); respondents aged 54 and over were also much more confident about composting, as were respondents in Tongatapu (Appendix 11).

#### **5.3.4.3 Seeking Technical Advice for Pesticide and Agricultural Chemical Applications and Disposals**

On knowing how and where to seek advice for the use of pesticide and agricultural chemicals, 35% of respondents believed that they definitely knew how to do this, while a further 23% said they had a fair idea how to do so (a total of 58%). (See Appendix 12.) Respondents aged 54 or over were more confident than the younger respondents; Tongatapu and Vava'u respondents were also more confident; male respondents were more confident about seeking advice in the area of agricultural chemicals and pesticide application and safe disposal than female respondents. The level of confidence increased with the level of education (Fig. 5.6).

**Figure 5.6: Reported Levels of Environmental Skills (Males and Females)**



Note: In relation to items (a), (b), and (c), the graph (Fig. 5.6) shows the total percentage of respondents who said they 'definitely' knew or had 'a fair idea' how to do this.

#### **5.3.4.4 Belonging to an Environmental Group/Committee**

Respondents were then asked if they were members of any community group/committee whose main concern is to protect the environment. The results were as follows:

- 34% of the total respondents were members of environmental committees while 66% were not in any environmental groups;
- 18% of those who were members were females, 16 % for male respondents;
- the largest membership was from respondents aged 24-33 (16%);
- there was a larger tendency for respondents who hold a university degree or diploma (34%) and those from higher household income levels (33%) to be members of environmental groups.

### **Logistic Analysis**

Further logistic regression analysis was carried out to test the effects of the independent variables on the level of confidence in performing the three environmental related skills reported above. Respondents' answers were further categorised into being 'confident' to do a given task and 'not confident' to do a given task. Significant relationships were found as follows:

a) Being confident in reef gleaning using conservative methods to protect coral reefs:

- more respondents from the 54 and above age group were in the confident category (p-value of <.0001);
- people with an university degree/diploma qualification were more confident (p-value of 0.0222); and
- more females from the lower household income groups were more confident ( p-value of 0.0139) to reef glean; and

b) Being confident in starting a household compost:

- a number of people in the 54 and over age group were more confident (p-value of <.0001);
- people from the low income households were more confident to start a household compost (p-value of 0.0335);
- a significant number of those who completed secondary school and from the outer islands were more confident (p-value of 0.0275); and

c) Being confident in seeking advice regarding safe use of agrochemicals and pesticide:

- a significant number of respondents aged 54 and over were more confident (p-value of <.0001);
- people with a university qualification were more confident in seeking advice on the safe use of agrochemicals and pesticides (p-value of 0.0039); and
- people from low income households (\$5,000 and below) and from Tongatapu were more confident (p-value of 0.0006).

### **Relationships of Skills Levels and Knowledge Scores with Socio-Demographic Characteristics**

Further logistic regression analysis was used to examine any relationship between levels skills and knowledge score. The dependent variables were the level of skills and knowledge scores. The only significant relationship found was found:

- respondents both the most knowledgeable and the least knowledgeable categories were significantly represented in the more confident group to reef glean using conservation methods (p-value of 0.0208).

This result implies two significant resource use behaviours. First 'reef gleaning skills' are common and are passed on through social interactions and not through 'learning from any education level', and second, reef gleaning implies that this skill (of resource use) also 'considers and conserves' the environment.

### **Relationships of 'Improved or Not Improved' Responses to the Quality of the Environment with the Level of Skills (Confident and Not Confident)**

Chi-square tests used to ascertain if there was a relationship between the responses to two different questions (i.e. the question in relation to the quality of the environment and the question in relation to skills). The only significant relationships were found in the following combinations:

- there was a relationship between the respondents who agreed that the environment of Tonga has not improved and their being confident to reef glean using conservation methods (p-value of 0.0074);
- there was a relationship between the respondents who agreed that the environment of Tonga has not improved and their being confident to start a household compost heap (p-value of 0.0074);
- there was a relationship between the respondents who agreed that the environment of Tonga has not improved and their being confident to seek advice on agrochemical and pesticide use (p-value of <.0001); and
- there was a relationship between agreeing that the environmental quality in the island divisions (Tongatapu, Vava'u, Ha'apai and Outer Islands) has improved and not being confident to do all the three tasks given (p-values of 0.0125, 0.0011 and <.0001 respectively).

Therefore, the chi-square tests show that there is a significant relationship between those who were confident in how to do to the tasks given (know how to reef glean, know how to start a household compost and know how to seek advise on how to use agrochemicals) and those who perceived that the environmental quality in Tonga as a whole and in the individual island divisions has not improved. The test result could be interpreted to suggest that if people were confident with the 'environmental task/activity' they do they would tend to do it more often, thus improving the quality of the environment.

### 5.3.5 Behaviour

The questionnaire included a range of questions about changes in behaviour relating to environmental issues.

#### 5.3.5.1 Changes Reported

The respondents were asked whether they had made changes in their usual behaviour for environmental reasons in the past year. Their responses are summarised in Table 5. 3.16. Only a very small number (7.1%) of those surveyed did not identify any relevant changes in their behaviour or claimed that they had made earlier changes, but not in the last year.

The specific changes in behaviour most often reported were as follows:

- participating more in clean up campaigns (beaches, public areas, community cemetery/meeting areas, etc.) 43%
- keeping their own properties clean and free from harmful insects 39%
- conserving water 37%
- replanting more and saving a variety of trees 36%

There were very few people who reported changes in behaviour in the following:

- sorting of rubbish before burning 11.0%
- joining environmental groups 10.0%
- mangroves conservation 2.5%
- modifying farming practices for environmental reasons 1.0%

**Table 5.3.16: Respondents Reported Changes Made for Environmental Reasons in the Past Year**

	Total n=447 %	Gender		Education		
		M n=221 %	F n=226 %	Didn't complete secondar n=216 %	Completed secondary/ tech qual. n=162 %	University/ Dip. n=68 %
Participating more in clean up campaigns (i.e., beaches, public places, village cemetery/meeting area etc.)	43.4	47.0	40.3	36.0	44.0	66.2
Keep properties clean and free from harmful insects	38.5	41.2	36.0	33.0	43.2	46.0
Conserving water	37.4	38.0	37.0	38.0	40.1	29.4
Replanting more plants and saving variety of trees	36.2	29.0	43.4	36.0	36.0	38.2
Taking care of disposing of oil, paints and batteries	27.1	27.2	27.0	27.0	28.0	25.0
Fencing of pigs	26.4	30.3	22.6	31.0	22.0	25.0
More aware in using agricultural chemicals and pesticides (reading instruction, wear protective clothes)	25.0	25.3	24.3	27.0	18.0	35.3
Reducing destruction of medicinal plants as not to destroy the plant (i.e. few required leaves rather than a whole branch)	24.0	24.4	23.5	25.5	30.0	6.0
Conserving use of energy (electricity or firewood)	21.0	20.0	22.1	17.1	23.5	26.5
Modifying fishing habits for conservation purposes	21.0	25.0	17.0	31.0	11.1	12.0
Taking own shopping bag	16.3	19.0	14.2	21.0	11.1	15.0
Starting to recycle more/reuse	15.0	18.0	12.0	13.4	15.0	18.0
Reducing use of vehicles (cars)	16.1	17.0	15.5	19.0	16.1	9.0
Sorting rubbish	11.0	14.0	8.4	9.3	11.1	16.2
Join environmental groups	10.0	8.0	12.0	8.0	14.0	6.0
Saving mangroves (replanting and conservation)	2.5	2.3	2.7	3.2	1.2	3.0
Modifying farming practices for environmental reasons	1.0	0.5	1.3	1.0	1.2	-
Other	0.2	0.5	-	-	0.6	-
Made earlier changes but none in the past year	2.0	0.5	3.1	1.0	3.7	-
No, can't think of changes I've made	2.5	1.0	4.0	4.4	2.5	2.0

In relation to level of education, the data (Appendix 13) indicated that on the matters included in the survey, those with a university or diploma qualification reported slightly more changes in behaviour. There were more males than females who reported changes in

their behaviour for environmental reasons in the past year (see Appendix 13); specifically, the areas that males made more changes in their behaviour were:

- Fencing the pigs (30% males, 23% females)
- Modifying fishing habits for conservation purposes (25% males, 17% females)
- Starting to recycle more (18% males, 12% females)
- Sorting out rubbish (14% males, 8% females)

In a number of cases the frequency with which environmentally appropriate changes in behaviour was reported varied with household income level. For example, participating in clean up campaigns was reported by 36% of those living in households with annual gross income of \$5,000 or less (lower income bracket), by 44% of those with annual gross incomes in the range of \$5,001-\$20,000, and by 66 % of those with household incomes over \$20,000 (see Appendix 14).

In relation to area of residence, reported changes in behaviour varied from island to island and from case to case, though respondents in Tongatapu reported slightly more changes in more cases than the rest of Tonga. For example:

a) Tongatapu had the highest percentage of reported changes in behaviour for environmental reasons in the following cases:

- Keeping properties clean and free of harmful insects 42%
- Fencing of pigs 33%
- Modify ways of fishing 27%
- Energy conservation 22%

However, of those who made earlier change but not in the past year, or did not report any changes made, 63% were from Tongatapu.

b) Respondents in Vava'u reported major changes in behaviour in the following cases:

- Participating in clean-up campaigns 53%
- Reducing use of vehicles 27%



- c) Ha’apai reported more changes in the following cases:
- Water conservation 60%
  - More aware of the impacts of the wrong use agricultural chemicals and pesticides 45%
  - More aware of wildlife conservation 45%
- d) The Outer Islands (Niua/Eua) reported relatively large changes of behaviour in the following cases:
- More aware of safe disposal of oil, paints, batteries etc. 56%
  - Reduce destruction of medicinal plants 47%

### 5.3.5.2 People who Influenced Changes

Those respondents who had reported any changes (which were almost all respondents) in environment-related behaviour were next asked to identify any particular people or types of people who had influenced them. A very large number of respondents (77%) identified the government departments as having a big influence in changing their behaviour, village committees (74%) and non-government organizations (72%), (Table 5.3.17). There were slightly more males than females who identified people or a group of people influencing their behaviour from the list given. This trend did not change much with the level of education, area of residence and level of household income (see Appendix 15).

**Table 5.3.17: People who have Influenced Changes in Behaviour Relating to the Environment**

	Total n=447 %	Gender		Age Group			
		M n=221 %	F n=226 %	19-23 n=151 %	24-33 n=169 %	34-53 n=111 %	54+ n=15 %
Government departments	77.0	78.0	76.0	73.0	79.0	78.4	80.0
Village committees	74.3	75.1	73.5	73.0	76.3	73.0	80.0
NGOs, environmental groups	72.0	74.0	70.4	70.2	73.4	73.0	73.3
The media and media personalities	59.0	61.0	57.0	56.0	61.0	60.4	53.3
School teachers and church leaders	57.3	57.0	58.0	56.0	61.0	57.0	40.0

	Total n=447 %	Gender		Age Group			
		M n=221 %	F n=226 %	19-23 n=151 %	24-33 n=169 %	34-53 n=111 %	54+ n=15 %
Prominent public figures	40.5	43.0	38.1	41.2	40.0	43.2	27.0
Friends, neighbours	32.2	33.0	31.4	32.0	35.0	29.0	33.3
A consultant/visitor	26.0	27.0	24.3	26.0	25.4	26.1	13.3
(Family members) Grandparents, parents, children	11.4	15.0	8.0	14.0	10.1	11.0	7.0
Other	11.0	12.2	9.3	14.0	11.0	8.11	-
No body in particular	8.0	8.1	7.1	7.3	7.1	9.0	7.0
Not sure/not stated	4.3	5.0	4.0	4.6	4.1	5.0	-

### 5.3.5.3 Reasons for Changing Behaviour

The respondents who had reported some change(s) in behaviour were further asked to assess the importance, for them, of a list of possible reasons for those changes. The responses were as follows (see Appendix 16):

- I read a book or magazine or I saw films or TV programs that made an impression on me (91%);
- I felt I could not leave it to other people; I had to do my bit (90%);
- A number of my friends, relatives, neighbours or colleagues were doing these sorts of things (90% very important or fairly important);
- It became easier now, for example, there are rubbish bins available (87% said this was very important or fairly important for them);
- I began to understand clearly what the environmental consequences of my actions really were (84 %); and
- I was influenced by a government training/program (82%).

All six possible reasons for changes to a more environmentally favourable behaviour were emphasised by a large number of respondents from all subgroups.

When asked whether there was anything else, which was important in leading them to make such changes, 29 % of those who had made changes said 'yes'. The other influences that were mentioned were:

- Behaviour learned from living abroad (62%);
- Village competitions (18%); and
- Women's development groups (13%).

#### **5.3.5.4 Environmental Damaging Behaviour by Individuals**

##### **Identifying Environmentally Damaging Behaviour**

All respondents were asked to identify the most environmentally damaging aspects of their behaviour and way of life. Issues relating to the respondents' habit of littering, careless dumping of rubbish (41%), unsafe disposal of batteries, oil, paints, medical supplies (41%) and burning of green waste (40%) were the most frequently mentioned damaging environmental behaviour (see Table 5.3.18). As Table 5.3.18 shows, only 7% of the respondents failed to identify any particular aspect of their behaviour or way of life as environmentally damaging. Among both males and females it was the issues relating to littering, unsafe disposal of batteries, oil, paints, medical supplies, etc., and burning of green waste, which were most frequently identified as environmentally damaging behaviour. However, more females (45%) than males (38%) gave littering behaviour; and more males (42%) than females (38%) burned 'green' waste.

Capacity to identify any damaging aspects of one's own behaviour slightly increased with level of education. A similar trend was apparent in relation to household income, with identification of damaging behaviour increasing from the lowest to the highest household income category. Twenty-seven per cent of those in the age group 54 or over were unable or unwilling to identify any relevant matter; by contrast, this was true of only 2% of those aged 19-23, 6% of those aged 24-33 and 9% of those aged 33-53 (see Appendix 17).

Overall, the respondents who failed to identify any damaging behaviour, most had not completed secondary school, and were from the low household income bracket and lived in Tongatapu.

**Table 5.3.18: Respondent’s Own Most Environmentally Damaging Behaviour**

	Total n=447 %	Gender		Education		
		M n=221 %	F n=226 %	Didn’t complete secondary n=216 %	Completed secondary/ tech qual n=162 %	University/ Dip. n=68 %
Habit of littering, dumping anywhere “available”	41.2	38.0	45.1	39.4	44.0	43.0
Unsafe disposal of batteries, oil, paints, medical supplies etc.	41.2	41.6	41.2	35.0	48.0	47.1
Burning of ‘green’ waste	40.0	42.1	38.0	47.0	38.3	22.1
Misuse/overuse of forest resources and plants	36.0	33.0	39.0	36.1	30.3	47.1
Buying/ and excessive using of non/slow degradable products (diapers, plastic bags etc)	33.3	34.0	33.0	32.4	30.0	44.1
Haphazard use of a lot of toxic chemicals, herbicides, pesticides	28.2	37.0	20.0	21.6	26.5	33.8
Letting domestic animals (pigs) free/unattended	27.7	24.0	31.0	29.0	27.2	26.4
Destructive use of coastal forest/mangroves and wildlife habitats	25.7	29.0	23.0	21.0	26.0	28.0
Failure to recycle (enough in all situation)	24.4	21.3	27.4	18.0	26.5	32.1
The way I fish (all sizes, using techniques that might be damaging etc.)	20.8	19.0	22.6	20.0	21.3	22.0
Lack of water conservation (wasteful use of water)	19.5	15.0	24.0	16.2	16.7	22.7
Ways land is being managed/use and its resources (ploughing, clearing of forest, fertilizers etc.)	18.3	25.0	12.0	13.2	15.0	23.0
Not replanting enough trees	17.0	16.0	17.3	8.3	24.1	25.0
Failure to save energy	12.1	10.0	14.2	10.0	12.0	13.3
Aspects of my work/sort of work I do	4.3	4.2	4.0	5.6	4.3	-
Other	5.0	4.5	3.5	2.3	5.7	4.4
Not sure, can’t identify anything	7.0	7.0	5.0	7.0	6.0	4.0

### **Perceived Reasons for Environmentally Damaging Behaviour**

The respondents were next asked to say why they themselves did things that could be environmentally damaging. The reasons that respondents most often gave for the fact that they themselves did things that were environmentally damaging were as follows:

- More concerned with cost 39.4%
- Don't clearly understand what is and is not harmful 35.8%
- Don't have time 28.9%
- More convenient/faster/less messy 24.6%
- Lack of interest 21.9%
- Necessity no practical alternative 19.2%
- Ignorance/lack of awareness 11.2%
- Don't want to be different 11.0%
- Don't like to be told what to do 3.4%
- The only way known 3.1%
- Not sure 0.2%
- Not applicable 0.5%

More females than males were concerned with the cost of doing the right thing. This was also true for respondents aged 54 and above. Regarding the lack of understanding of what is and is not harmful, more male than female respondents said that this was the main reason for their doing things that were environmentally damaging. This was true for younger respondents and for those who did not complete secondary school (see Appendix 18).

#### **5.3.5.5 Basic Reasons for Seeking to Protect the Environment**

When the respondents were asked what was the point of doing things that may help to protect the environment, the reasons given most often for protecting the environment were (see also Table 5.3.19):

- We owe it to our children/future generation (68.5%)
- Socio-economics reasons – so we can sustain our sources of livelihood (33%)
- Quality of life/enjoyment; clean water, fish to catch, fresh air etc. (33%)
- Protecting people's health and safety (31%)

**Table 5.3.19: The Point of Doing Things to Protect the Environment**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Owe it to our children/future generation	68.5	75.0	62.8	67.0	70.8	67.2	53.3	60.0	73.3	98.3	77.8	67.6	68.4	72.1	62.6	73.5	70.0
Socio-economics reasons – so we can sustain the sources of livelihoods	33.0	32.0	35.0	36.2	30.2	33.3	33.3	31.9	17.3	47.0	53.0	34.7	34.4	25.0	32.8	34.4	28.0
Quality of life/enjoyment; clean water, fish to catch, fresh air etc.	33.0	31.0	35.4	33.5	30.8	36.0	33.3	37.0	33.3	22.4	19.4	31.5	31.2	42.7	39.0	26.1	38.0
Protecting people's health and safety	31.0	31.0	31.0	27.3	33.2	31.5	40.0	30.7	29.3	33.0	33.3	36.6	28.0	21.0	41.5	23.0	22.0
Survival of the planet/life as we know it	18.0	17.0	19.0	18.6	21.4	9.9	26.7	18.4	36.0	-	2.9	14.8	22.4	16.2	13.3	20.9	22.0
We have a duty to look after things; it's the right thing to do	10.0	9.1	10.2	10.7	7.8	9.9	13.3	13.4	8.0	-	-	5.1	11.9	17.7	8.7	10.3	12.0
The law requires us to conserve and protect the environment	5.4	5.9	4.5	6.7	4.1	6.3	-	6.2	2.7	-	13.9	8.3	3.1	1.5	1.5	10.3	2.0
Other	1.6	0.5	2.7	1.8	3.6	-	-	2.5	-	-	-	1.4	0.6	4.4	0.5	1.5	6.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands  
A – Did not complete secondary school, B – Completed secondary school/tech qualification  
C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

### 5.3.5.6 Summary

- Ninety-five per cent of those surveyed identified changes in behaviour that they had made for environmental reasons in the past year. People more often reported changes with higher levels of education and with higher household incomes; more men than women reported making changes in their behaviour for environmental reasons.
- The changes in behaviour most often reported were:

- participating and joining clean up campaigns	43%
- keeping properties clean and free from harmful insects	39%
- conserving water	37%
- replanting more trees	36%
- taking care of the disposing of oil, paints and batteries	27%
- fencing of pigs	26%
- More aware in using agricultural chemicals and pesticides (reading instruction, wear protective clothes)	25%
- Reducing destruction of medicinal plants as not to destroy the plant (i.e. few required leaves rather than a whole branch)	24%
- Conserving use of energy (electricity or firewood)	21%
- Modifying fishing habits for conservation purposes	21%
- Taking own shopping bag	16%
- Reducing use of vehicles (cars)	16%
- Starting to recycle more/reuse	15%
- Sorting rubbish	11%
- Among those who had made changes in behaviour, 77% identified the government as having influenced them in this regard, followed closely by village committees and NGOs;



- Ninety-one percent of respondents stated that they were influenced to change by reading a magazine, newspaper or by a TV program. Corresponding percentages were -- 90% felt that they could not leave it to other people, and 90% were influenced by what their friends, neighbours or colleagues were doing. However, when asked if there was anything else that may have influenced them to change, 62% reported that they had learned and saw the changes they have made when visiting overseas;
- When respondents were asked to identify environmentally damaging aspects of their own behaviour or way of life, younger respondents, those with a university or diploma qualification and those living in the main island of Tongatapu were more likely than other respondents to identify damaging aspects of their own behaviour;
- The aspects of people's behaviour or way of life that were most often identified as environmentally damaging were:
  - the habit of littering, dumping of anywhere "available";
  - unsafe disposal of batteries, oil, paints, medical supplies etc.; and
  - burning of 'green' waste;
- The dominant explanations that people offered for the fact that they themselves did some environmentally damaging things were: more concerned with cost (39% of respondents), do not clearly understand what is and is not harmful (36%); and do not have time (29%); and
- The basic reasons why people thought it was important to do things to protect the environment were responsibility to children/grandchildren/future generation; socio-economic reasons--so we can sustain sources of livelihoods; and quality and enjoyment of life.

## **5.4 Discussion**

Given the methodological process and research products described in the previous sections, it seems reasonable to conclude that this survey is reliable for generalisation to the whole of Tonga. Although there have not been any previous national surveys, for comparison purposes, and the results represented only what the respondents themselves

have said, it is considered that the methodological approach adopted in the survey is adequate and appropriate in the context of Tonga, and that therefore the results are reasonably reliable. The survey identified people's own set of environmental issues and priorities, which should have due weight in planning and decision-making process. These were, in fact important elements (that have been missing) which feed into the decision-making processes, legitimise environmental policies and promote public support, and improve the robustness and responsiveness of strategies dealing with sustainable development challenges confronting Tonga.

The results have many implications about what has been happening in Tonga (and in the Pacific Region for that matter) in the last fifteen to twenty years. For example, a number of programs and projects leading up to the 1992 United Nations Conference on Environment and Development (UNCED), as well as the relevant programmes ten years after UNCED, was either developed and implemented in Tonga or Tonga, was party to a member of international and regional organisations. One would expect that general environmental awareness, skills, behaviour, knowledge and the perceived quality of the environment would be much better. Contrary to this expectation, the survey results showed otherwise. Although, the 'environmental issues' are at the top of the global agenda, and funds for environmental projects and programs have trickled down to Tonga, it seems that the most important target to influence (i.e. the people) has been missed (per.obs).

The general lack of environmental awareness depicted by the results reported in this chapter, however, is interpreted by this thesis to be a reflection of the failure of the current resource and environmental management framework to integrate and tailor global and regional initiatives to address community issues, and the lack of an established mechanism for effective community consultation and participation in relevant resource and environmental initiatives.

Some 96% of respondents who stated that they were concerned either a great deal or a fair amount about environmental problems, showed an overall indication that there is quite a high degree of interest and concern about environmental issues in Tonga. The environment is likely to increase in importance in the future as an issue for Government attention. This high level of concern is further shown by almost all of the respondents stating that they had made changes in their behaviour for environmental reasons during the year prior to the survey.

However, the high level of concern about environmental problems shown by the survey could be explained in two ways. First, it is because people are concerned by the declining quality of environment, nationwide and in the local communities (only 14% stated that the quality of environment in Tonga nation wide is much better, with a further 36% stated a little better). Second, although people are highly concerned about environmental issues, when asked for the main reasons why they themselves do things that are bad for the environment, 39% stated that they were concerned with cost involved and a further 36% claimed that they do not understand what is and is not harmful (i.e. not knowing what to do, or lack of awareness). In other words, transforming that ‘concern’ into environmentally positive actions was not possible for various reasons (Sections 5.3.3.1-5.3.3.3).

The reported changes of behaviour were highest in participating in cleaning-up campaigns, and keeping properties clean and free from insects, which in Tonga have become high profile public activities, such as competitions, village pride initiatives and winning of prizes. A member of the royal family is usually involved, and politicians and businesses donate prizes, which could account for the many respondents stating that these are the changes that they have made. The small number of respondents that made other changes in other areas (see Table 5.3.16) could be due to a lack of understanding of the issues.

#### **5.4.1 The Causes of Environmental Problems**

Several underlying reasons for the causes of Tonga’s environmental problems and declining environmental quality that could be drawn from the survey results are:

- First, there is a large number of Tongan people who believe that environmental management is not their responsibility, i.e. it is government’s responsibility. This is further confirmed by 63% of respondents believing that individuals could not be expected to take environmental issues seriously when government and business are ineffective (contrasts with only 34% who believed that each individual must take responsibility to protect the environment). This result could imply that the Tongan people believed that the responsibilities to minimise or correct a behaviour that is detrimental to the environment are not their problem, ‘somebody else’ should deal with it. This view became apparent in the following:

-- the waste from all sources, individuals' habits of littering, and pigs, were identified by a very large number of respondents as problems that have changed as either worse, much worse or no change at all (Table 5.3.9). It was then not surprising that 71% of the respondents claimed that necessary services like waste management were not efficient or not available and government did not place enough emphasis on protecting the environment (66%) were the main causes of environmental problem;

- Second, there is a general lack of environmental awareness and lack of environmental knowledge as indicated by only 46% of the respondents falling into the most knowledgeable category. Also, some 60% of the respondents said that lack of awareness and education (people just do not know what to do) is a cause contributing to environmental problems;
- Third, there is a tendency for the people of Tonga to believe that a shift from using local materials and food to using imported consumer goods is a sign of personal sophistication or 'being developed' (62% of the respondents nominated this issue as the cause contributing to environmental problems in Tonga). This could relieve the pressure on the natural resources (i.e. demands for forest products), but associated problems such as solid waste, litter etc. (old cars, plastic bags, bottles, cans etc.) was something new that the people of Tonga or the government for that matter, are not prepared to deal with; and
- Fourth, the fact that only 29% of respondents agreed that it is easy to obtain reliable environmental information and 12% claimed that there is not enough environmental information provided by the Tonga media. These claims are valid; for example, local TV stations and programs are only viewable in Tongatapu. Radio and weekly newspapers are the forms of media that reach the outer islands including Vava'u and Ha'apai. Environmental news sources are mainly from the government departments, but the issues of media access to good information and the 'environmental awareness' of media personnel, and their understanding of usually technical information, and their reporting, could be deterrents to the amount of environmental information that is being reported. Although some departments and NGOs produce TV, radio programs or environmental newsletters, these efforts are usually linked to donor-funded projects, and these programs usually end when the aid funds dry up.

There is, however, a window of opportunity to address these causes of environmental problems; for example, 82% of respondents claimed that there is a lot an individual could do to help protect the environment and 45% agreed that in Tonga we are doing too little, too late, to protect the environment. This shows that people still believe that a lot could and should be done to minimise environmental problems, thus, reversing the decline in environmental quality.

There was little difference between the levels of environmental concern shown by male and female respondents, but males appeared to be more knowledgeable (with a higher knowledge score) and more aware than women (Section 5.3.2). Also, contrary to common belief in Tonga, men more often reported making changes in their behaviour for environmental reasons than women. This result suggests that men should be involved more in resource and environmental management as they provide the necessary influence for adopting environmental friendly behaviours. Culturally, environmental and resource conservation activities are regarded as the role of women in Tonga – the results of this survey suggests that more involvement of men might improve environmental awareness in Tonga in areas where women seem to have failed.

Respondents in the age group from 19-33 were more concerned, as were the people with university qualifications. Major concerns for environmental issues were also apparent from all the island groups. The standard of education showed a close relationship with changes in environmental behaviour, and those from lower household incomes reported fewer changes in behaviour for environmental reasons than those in high-income levels.

Perceptions about national and local environmental issues were similar, though with a slightly different emphasis. The four most important environmental issues both nationally and locally were, pollution – solid waste, coastal/marine degradation, land degradation, and problems associated with free ranging domestic animals (pigs). There is a possibility of developing a nationwide environmental program and action plan to address these issues that would apply to all of Tonga with locally specific activities, e.g. to address the runoff problems into the harbour in Vava'u. Of particular importance, is that these are the issues where government should focus its environmental strategies in the next few years.

Environmental regulations were seen as being generally too lax in all of the sectors covered in the survey. As expected, 35% of respondents stated that the single most

important environmental initiative for Government action over the next few years should be attention to law enforcement problems, and a further 11% nominated attention to enactment of appropriate legislation and policies. At the same time, there was a need (stated by respondents) for the government to facilitate and allow for more public participation in environmental matters (20%). Nineteen per cent of the respondents would like to see more effective and sustained awareness and education programs on environmental issues for the public, while 15% of the respondents would like the government to deal effectively with the pollution problem.

What may appear to be an obvious call for more public participation in environmental management issues becomes more important when a large number of respondents (82%) strongly agreed or agreed that community groups can do a lot to conserve community resources. A further 77% strongly agreed and agreed that Town and District Officers<sup>7</sup> have important environmental management role.

Those surveyed did not regard all likely sources of environmental information as equally reliable. Schools, both local and international media and government departments were seen by about eighty per cent of respondents as either very reliable or fairly reliable sources of environmental information. Yet, only 29% and 12% of respondents respectively stated that it is easy to obtain reliable environmental information and that there is a lot of environmental information provided by the Tonga media. This view could be explained by problems accessing reliable environmental information; for example, although people regarded environmental information from government as reliable, such information, however, is not readily available to the public or not in a form that could be easily understood by the people and the media.

The respondents described government departments, village committees, environmental groups and non government organisations as important influences on change in behaviour; the media and media personalities, school teachers and church leaders were also seen as influential. The availability of a facility or a system that would make changes in behaviour easier or practical was seen as playing a dominant role in decisions about such changes. For example, the availability of rubbish bins made it easier for people to reduce littering. Showing good examples were very important too, such as seeing what friends and colleagues are doing, learning from relevant government training and awareness program and media influences. Interestingly, 62% of the respondents claimed that visiting overseas

influenced their personal changes in behaviour. Both government and non-government organizations could use what media is available in Tonga to promote environmental awareness. It is important to note that 18% stated that village competitions (i.e. competitions for the most beautiful village, clean and green, with certain number medicinal trees/fruit trees, etc., with pig fencing – these kinds of competitions have monetary prizes that help community projects) were an important influence for them.

## **5.4.2 Implications for Environmental Management – Planning Strategies Input**

Based on the main results of the survey, the following implications –detailed in the below sub -- sections can be drawn. In general they make a contribution to Tonga’s environmental policy via informed decision making and the facilitation of public involvement.

Wild and Marshall’s (1999) keys to local participation in the decision-making process, which are applicable in the case of Tonga, are:

- the importance of the commitment of key community and public sector representatives; and
- the need for participation to be an ongoing commitment with a preparedness to begin with ‘where people are at’ rather than to set aspirations too high.

### **5.4.2.1 Priority issues Identified for Policy Development**

#### **Pollution-Waste Management**

Pollution and waste management were identified as major issues throughout Tonga, specifically in relation to solid waste, hazardous waste, waste from businesses, sanitation and sewage, and old vehicles. Solid waste management and minimisation objectives would include:

- to reduce waste generated;
- to treat waste at source;
- to investigate opportunities for recycling;

- to improve waste management services;
- to differentiate and establish appropriate fees and fines for businesses, for residential homes and for littering;
- to improve enforcement of existing regulations and review old regulations to bring more in line with the nature and magnitude of the problem;
- to build capacity of community groups and NGOs to facilitate waste management programs in the communities; and
- to educate the public on waste minimizing (including safe handling and disposal of hazardous waste) techniques i.e. composting, less packaging, etc.

### **Land Degradation**

Priority land degradation problems identified were deforestation, damage caused by domestic animals, especially pigs, issues related to the use or disposal of agricultural chemicals and pesticides, and poor living conditions in low lying areas. Land degradation prevention objectives would include:

- to promote nationwide reforestation;
- to establish community forests to be managed by the community;
- to ban pigs in the main towns of Tonga and encourage/assist in building low/cost and low maintenance pig pens and conduct research on viable pig food;
- to investigate options for community regulations on domestic animals and empower Town and District officers to enforce these regulations;
- to establish forest conservation areas as habitat for wild life;
- to educate farmers and the general public on the use or disposal of agricultural chemicals and the impacts on human health and wildlife health; and
- to integrate conservation and education programs with respect to every major commercial crop in relation to land management, and soil conservation, i.e. squash, water melon and vegetables.



### **Coastal/Marine Degradation**

Coastal and marine degradation problems are very important in the context of small islands as land related issues contribute significantly to coastal and marine problems at a faster rate than that in larger land mass countries. Priority issues identified were overfishing of coastal resources, sand mining, coastal reclamation and destruction of mangroves, run-off into the harbour (in the high islands), and the use of destructive fishing techniques. Objectives for the prevention of coastal/ marine degradation would include:

- to minimise land-based sources of pollution;
- to encourage Town and District Officers to enforce existing community regulations;
- to establish community management/conservation mangrove areas;
- to educate fishers on conservation methods and principles of fisheries and marine habitat conservation;
- to ban coastal sand mining and to implement other options that have been investigated in the past in Tonga (as discussed in Chapter 3, Section 3.5.1.3); and
- to enforce the requirement for impact assessment for every major coastal development.

### **Environmental Education, Awareness and Information**

Generally the survey results indicated that there is a need for major environmental education and awareness programs at all levels including the environmental decision makers. Initiatives should include the addressing of broader issues of sustainable development in the context of Tonga. Environmental information should be made available to the general public in a form and language that can be understood by the public. Environmental education and awareness objectives should include:

- to integrate environmental education into appropriate national programs and provide resources to facilitate that integration;
- to provide resources to the optimum use of media for environmental education and awareness;
- to build the capacity of the government sectors, community groups and the media in disseminating environmental information to the public; and

- to link and educate the people of Tonga on relations between population growth, economic development and environmental issues.

One concern raised that does not fit in any of the above categories is the need, identified by the outer islands respondents, for alternative sources of income to relieve pressure on the natural resources. However, this could be one of the root causes of environmental degradation in the outer islands. Sustainable development strategies have to consider communities sources of livelihood as an integral component.

## **5.5 Conclusions**

The priority resource and environmental issues identified in this chapter are similar to the priority issues for action identified in the Chapter 3, Section 3.7.1.1. This suggests that the survey results are reliable. Therefore, this chapter according to its objectives, has reported accurate baseline information that has been lacking in the natural resource and environmental management planning in Tonga, i.e. a lack of community input into the management planning process. Community resource and environmental priority issues have been identified using appropriate research methodology that has been established and used in previous studies (Chapter 2), and which can be repeated in Tonga to investigate changes in community perceptions.

Given that the development of a responsive environmental management framework to facilitate the process for sustainable development in Tonga is a worthwhile initiative, it seems reasonable to suggest that this survey should be replicated as part of the national census in Tonga. Once every 10 years could realistically allow for survey preparation, fund raising, analysis and input into other national planning processes. This would also allow an opportunity to assess if there were changes in people's attitude, practices and priorities. However, if resources were available, smaller scale surveys could be conducted at the island (Tongatapu only or Vava'u only) or at village levels in shorter time interval (i.e. once in every two or three years or annually, depending on a clear objectives for the need for such surveys).

The qualitative nature of this research, and the type of data it generates, also indicates that additional studies should be conducted in parallel. For example, state of environmental reporting is important in confirming what people say and what the actual state of the

environment is. A state of environment report would provide some form of verification of reported behaviour or any improved knowledge for instance.

The socio-economic significance of coastal resources in the context of Tonga has been established in the earlier chapters (Chapters 1 and 3), and coastal resources degradation was identified as a community priority issues (Chapter 5, Section 5.4.2.1). For the aim of this study, however, there is lack of information on community coastal resources trends and management perceptions. Chapter 6 specifically addresses this information gap.

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<sup>1</sup> Researchers favour Likert type scales as the scales are often treated as yielding interval data, and hence allow the use of parametric statistical tests, which are considered more powerful than non-parametric test in determining statistical significance when all the assumptions about distribution of parametric data have been met.

<sup>2</sup> Dr Greg Hampton and Professor John Morrison, both of the University of Wollongong.

<sup>3</sup> Langafonua 'a Fefine Tonga is the umbrella women's non government organisation in Tonga where all women's village committees, women's organisations and women's churches groups are members.

<sup>4</sup> Household in the context of Tonga means the people who normally have evening meals together (1996 Cnesus). In a 'home' or one town allotment, there would be many houses with different families, if they eat together then they are one household. If they don't eat together then there is more one household in that town allotment.

<sup>5</sup> Salant and Dillman survey protocol is to ensure the validity and the accuracy of the survey and making sure that all necessary materials required for the survey are ready.

<sup>6</sup> A staff member of the Department of Environment accompanies the researcher to every household for security purposes (both the researcher and the household) and to ease any the 'awkwardness' of a female researcher approaching households alone (the same applies if the researcher is a male) and to gain confidence and rapport with male respondents.

<sup>7</sup> The people elect Town and District Officers every three years and they are the official point of contact for the government to the community and community matters. They are, however, not political figures.

## **CHAPTER SIX**

### **COMMUNITY PERCEPTIONS OF TRENDS AND FACTORS AFFECTING COASTAL RESOURCES AND THE CONDITIONS OF KEY HABITATS**

#### **6.1 Introduction**

Coastal areas and resources are very important to all countries, particularly for small islands, where the total land mass and ocean are closely intertwined. Considering Tonga's limited land resources (as discussed in Chapter 3), Tongans will continue to depend heavily on the marine life in the coastal waters for food and income. Much of the culture of the Tonga archipelago – its way of life, traditions and recreation – is inevitably linked to the coastal areas and their resources. These areas and resources are now facing many pressures and are most vulnerable to man-made and natural disasters.

The definition of coastal area and coastal resources used here is as defined in Chapter 3, Section 3.5. Only living resources, however, and their habitats are included in the investigations of this chapter.

Two aspects of coastal resources management are considered in this chapter. The first aspect is community perceptions of the trends in key coastal resources selected by the communities studied, and factors affecting the use of these resources. The second aspect is a comparison of what communities perceived concerning the general biophysical conditions or reality of the coastal habitats surveyed.

##### **6.1.1 The Rationale for the Focus**

Understanding the socio-economic context of coastal resources stakeholders is essential for assessing, predicting and managing coastal resources as there is a close link between how people use coastal resources and their socio-economic background (Bunce et al., 2000). Ideally, one of the key requirements for sustainable coastal resource management is a comprehensive knowledge base of community perceptions of the resource and

biophysical state. To obtain this can often be both a costly and lengthy process. For this reason, management decisions are often based on minimal empirical information from the area and people concerned, and this is the case in Tonga.

For the purpose of this study, the socio-economic assessment in this section is focused on community perceptions, however, the community perceptions are divided into two parts. The first is a process and participatory oriented assessment. That is, the process of collecting information is as important as the resultant learning from the process and the information collected (Bunce et al., 2000). The second part is the investigation of biophysical conditions of the resources for comparison with community perceptions.

#### **6.1.1.1 Community Perceptions**

Lubbert (2001) listed three main reasons why community perceptions and input into community resource management frameworks are important:

- local people have their own sets of issues and priorities, which need to receive due weight in the planning and decision-making process;
- local communities have considerable knowledge, which, if understood and used by environmental management agents, can greatly improve the results; and
- effective community participation in resource management requires a learning and action process, not only in identifying problems and possible solutions, but also actually taking part in practical actions to solve the problems.

#### **6.1.1.2 General Biophysical Status of Coastal Habitats**

In order to develop any sustainable management framework of any natural resources, one needs to know about the status of the resources or the areas to be managed (Bunce et al., 2000). While the focus of this study is community perceptions which is essential for national policies, they do not necessarily reflect the real status of coastal resources at particular sites. Therefore it is important to complement the results of community perceptions with ecological assessment (World Bank, 1999). This could serve two purposes: first, it would validate community perceptions of local resource trends; second, it would allow a better targeting of awareness efforts in sites or on resources where

community perceptions were found to differ from ecological reality (Warner, 1997; World Bank, 1999).

Further, since approaching sustainable development from the perspective of only one discipline (economic or social or ecological – Chapter 2, Section 2.2.1) has significant shortcomings, it will be necessary to investigate the ecological status of the resources studies in this study. This will permit decision makers and society to make better choices (Munaisnghe et al., 1995).

Chapter 6, therefore, is divided into two parts:

- Part 1: Community perceptions of coastal resources trends and management; and
- Part 2: Biophysical conditions at selected coastal habitats and a comparison with community perceptions.

## **6.2 Objectives**

The general aim of this chapter is to establish a socio-economic assessment program and a monitoring program for Tonga for the collection of the baseline information and data for the development of the new framework for sustainable development. Specific objectives are as follows:

Part 1:

- to establish a methodical process appropriate (cost and time effective, socially acceptable, can be repeated, promotes awareness of and learning about environmental issues) for Tonga, for acquiring community perceptions of coastal resource and habitat trends;
- to investigate community management practices and preferred management options; and
- to identify factors most likely to affect sustainable coastal resource management;

Part 2:

- to establish a program for biophysical conditions baseline surveys appropriate for Tonga;
- to identify ecological characteristics and conditions that should be considered in management; and

- to compare the biophysical status of the resource with community perceptions to promote a 'holistic' sustainable management regime.

## **6.3 Methods**

### **6.3.1 Survey Site Selection**

Certain criteria were established to guide the site selection process. According to the focus of this chapter, it was necessary to select communities that are mainly dependent on coastal fishery resources for subsistence as well as on commercial sources of income. Sites selected were also considered to represent the three main island groups of Tonga, to be accessible, to have been omitted from other recent studies, or and not to have been directly involved in any donor funded environmental projects during the past five years. The latter criterion was considered relevant so as not to overburden<sup>1</sup> the community and keep the disruption of daily activities to a minimum. Further, another consideration for the site selection was a conscious selecting of areas that are 'heavily impacted' and areas that are 'low impacted'. Using these criteria, Manuka was selected in Tongatapu, Taunga from the Vava'u Group; and Felemea from the Ha'apai Group. Parts 1 and 2 of this part of the study were conducted at the same sites.

#### **6.3.1.1 Survey Area**

Manuka village is located 28 km northeast of Nuku'alofa (Table 6.1.1 and Fig 6.1). Manuka's northern coast is part of an important mullet spawning grounds (Pelesikoti et al., 2001). Taunga is an island with only one village, also called Taunga, south of mainland Vava'u (Table 6.1.1 and Fig. 6.2). Felemea is one of the two villages located on the island of 'Uiha, south of Lifuka, the main island of the Ha'apai Group (Table 6.1.1 and Fig. 6.3). 'Uiha is separated from the main island of Lifuka by the 'Auhangamea Passage<sup>2</sup>.

#### **Logistics**

The Town Officer of Manuka was contacted directly as the office is located in Tongatapu. Town Officers of Taunga and Felemea were contacted through the Governor's Office in Vava'u and Ha'apai and those two offices assisted in the fieldwork logistics. The

researcher resided in Taunga and Felemea for the duration of the fieldwork in those two islands but commuted daily from Nuku'alofa to Manuka. This was to allow the researcher to consult with potential participants at any time convenient to the participants.

All fieldwork was conducted in 2001. The Manuka survey took the whole month of October. Taunga, was from 6-9 August, and Felemea from 15 - 25 September. The weather and tide were also determining factors for the timing of the survey. In August to October, the weather in Tonga starts to get warmer but it is not yet the wet and hurricane season. However, there were patches of unexpected bad weather that determined the time at which the surveys were carried out.

### **6.3.2 Part 1: Community Perceptions**

Part 1 relied primarily on community perceptions of trends in the conditions of coastal resources and factors affecting coastal resource management at the village level. A participatory learning appraisal (PLA) method commonly known as the Delphi survey method was used.

#### **6.3.2.1 The Delphi Technique**

The Delphi technique is based on utilising group information in order to make reasoned predictions of uncertain future events based on the past and present trends. The basic format of a Delphi survey, based on pioneering work of scholars such as Helmer, Brown, Rochaberg and Brown (Dalkey et al., 1972; Linstone & Turoff, 1975; Adler & Ziglio, 1996), generally takes three forms:

- Background information – Background information is disseminated to participants prior to and during a Delphi survey. For example, usually relevant documentation, tables or graphs are distributed to participants to assist in their knowledge and familiarity with the topic surveyed.
- Individual views – These views are collected from the individuals who received the background information and who are willing to participate in a Delphi survey. Participants are usually selected due to their skills and expertise in relevant to the purpose of the survey i.e., local coastal resources and fishery. This process is repeated a number of times, usually four, although there is no theoretical basis for any particular



number of repetitions. This is to allow participants to confirm or amend their earlier views (Adler & Ziglio, 1996).

- Group opinion – This comprises the aggregated results of each round used to collect the individual view. Individual views, however, were not linked to any person<sup>3</sup>. Group opinions do not necessarily represent a consensus. Diverging opinions and a lack of consensus provide useful information. That uncertainty exists is in itself important (Adler & Ziglio, 1996).

Although the Delphi method is only one of the many possible approaches to investigate human nature and social processes, it was used in this study because it is considered to be a rapid and relatively efficient way to “cream the tops of the heads” of a group of knowledgeable people (Dalkey et al., 1972). In general, it involves much less effort for a participant to respond to a well-designed questionnaire than, for example, to participate in a workshop or a meeting. The use of systematic procedures lends an air of objectivity to the outcomes that may or may not be spurious, but which is at least reassuring. Also anonymity and group responses allow a sharing of responsibility that releases the respondents from social inhibitions (Dalkey et al., 1972). These features of a Delphi survey are desirable, especially if the exercise is conducted in the context of policy formulation, where group acceptance is an important consideration, as was the case in this study. Specifically, the Delphi method was considered appropriate for the following reasons (adapted from Dalkey et al., 1972):

- it canvasses perceptions of local “experts” in the area of fishery and coastal resources management;
- the technique allows achievement of study objectives within the time and resources available;
- the technique is conducive to narrowing the views of a group, as well as enabling the true views of the group to be established without open confrontation;
- it gleans some ‘better understanding’ of the future of sustainable coastal resources management where required information and data are lacking; and
- the knowledge of the group as a whole is considered to encompass at least as much (and usually more) information than any single member’s perspectives on community coastal fishery resources and related management issues.

**Table 6.1.1 Study Sites Characteristics**

Study Site	General location.	Physical characteristics	Area (sq. km)	Total Pop.	Pop. Density/ (sq.km)	Number of Households	Conservati on Site?	No. of Tax allotments	Source of Energy	Ease of marketing of Fisheries Products	Main source(s) of income
Manuka (Tongatapu)	North east of Nuku'alofa (Fig 6.1)	Coastal village, flat and swampy - North shores of Manuka is low with muddy and soft bottom floor -Sandy soil to the coast and clay inland -Remnant of primary forest left but vulnerable to population pressure	0.38	312	821.1	50 (52 were counted during this study)	No	11	Electricity (diesel)	Easy	Fisheries Some white collar jobs Remittance from family overseas
Taunga (Vava'u)	An island south of Neiafu Approx. 18° 45' S and 174° 01' W (Fig. 6.2).	High limestone island - Slightly elevated on the eastern side, highest elevation is 10 m asl -Sandy soil -Almost all secondary forest	0.57	77	135.1	19 (only 15 counted during this study)	No	none	Solar for lights only	Medium	Fisheries Women's handicrafts (fine mats) Remittance from family/relatives in the capital towns of Tonga and overseas
Felemea (Ha'apai)	Located in 'Uiha, south east of Lifuka Approx. 19° 54' S and 174° 24' W (Fig. 6.3)	High limestone island - Slightly elevated on the south eastern coast, highest elevation is 10 m asl -Sandy soil -Still have some primary forest to the south-east coast of the village (wind ward side)	1.96	210	107.1	42 (only 38 counted during this study)	No	46 (mainly sandy and loamy soil and considered by many to be infertile)	Still dependent on firewood for cooking and kerosene for lights	Difficult	As in Taunga

Sources: ESCAP & GOT, 1990; *Tonga 1996 Census*, Department of Statistics; Ministry of Lands, Survey and Natural Resources Land Registry Records and Field observations and reconnaissance; Household numbers were based on 1996 Census and the number counted during this study; Total population is based on 1996 Census.

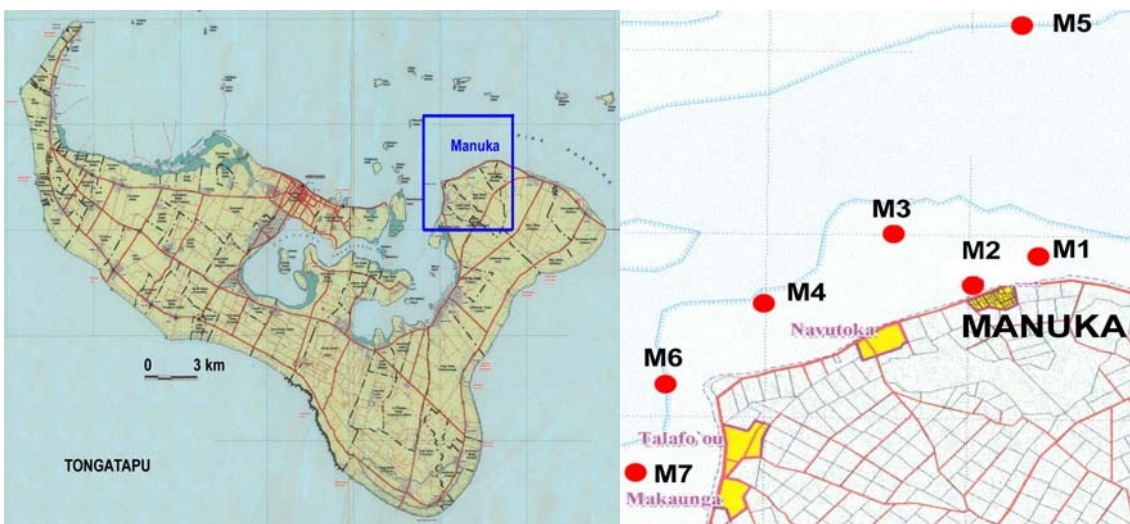
### 6.3.2.2 The Modified Delphi Technique used in this Study

The basic theory behind a Delphi survey was maintained (Section 6.3.2.1) but the method was slightly modified for use in Tonga (see Table 6.3.1). For example, the following steps were modified:

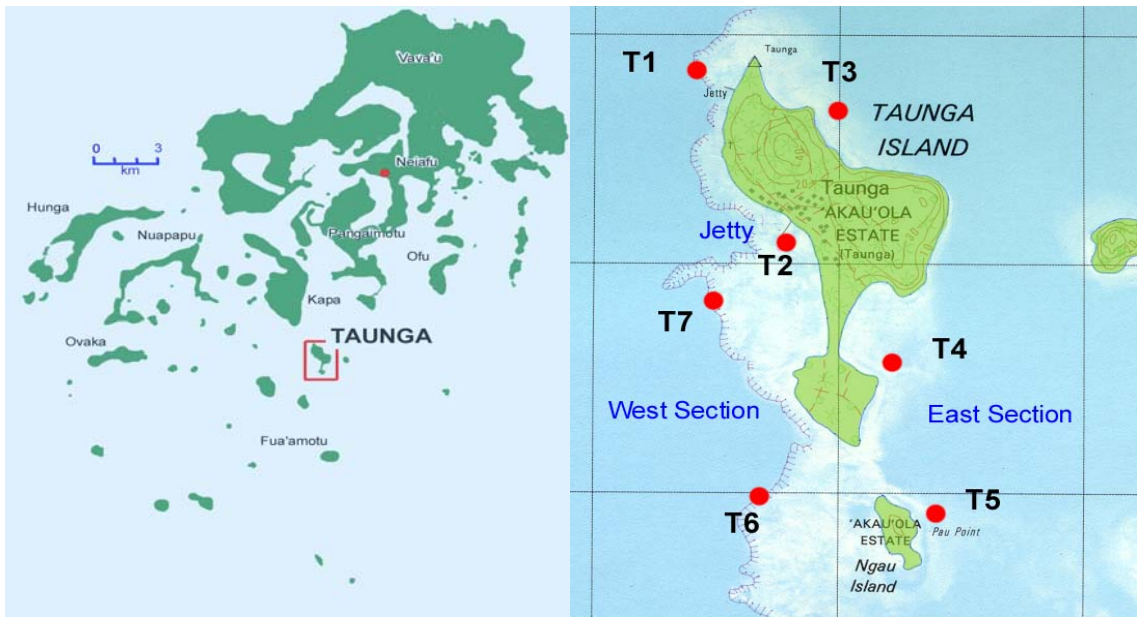
- by way of “dissemination” of relevant background material, initial meetings and dialogue were held with key local people in each study area, instead of distributing written material;
- instead of relying on the questionnaire and repeatedly requesting participants, usually after several rounds of discussions, to answer the questionnaires on several occasions to confirm or amend their earlier views, the questionnaire at the first round was used only to collect information to be used as the focus of group discussions in round two.

This modification was necessary for the case of Tonga, especially in rural areas and in the outer islands, where reading of print materials without prior knowledge of the communities’ capacity to read could slow down the process.

**Figure 6.1: Location Map of Manuka within the Main Island of Tongatapu and the Position of all Sampling Sites and the Community of Manuka**

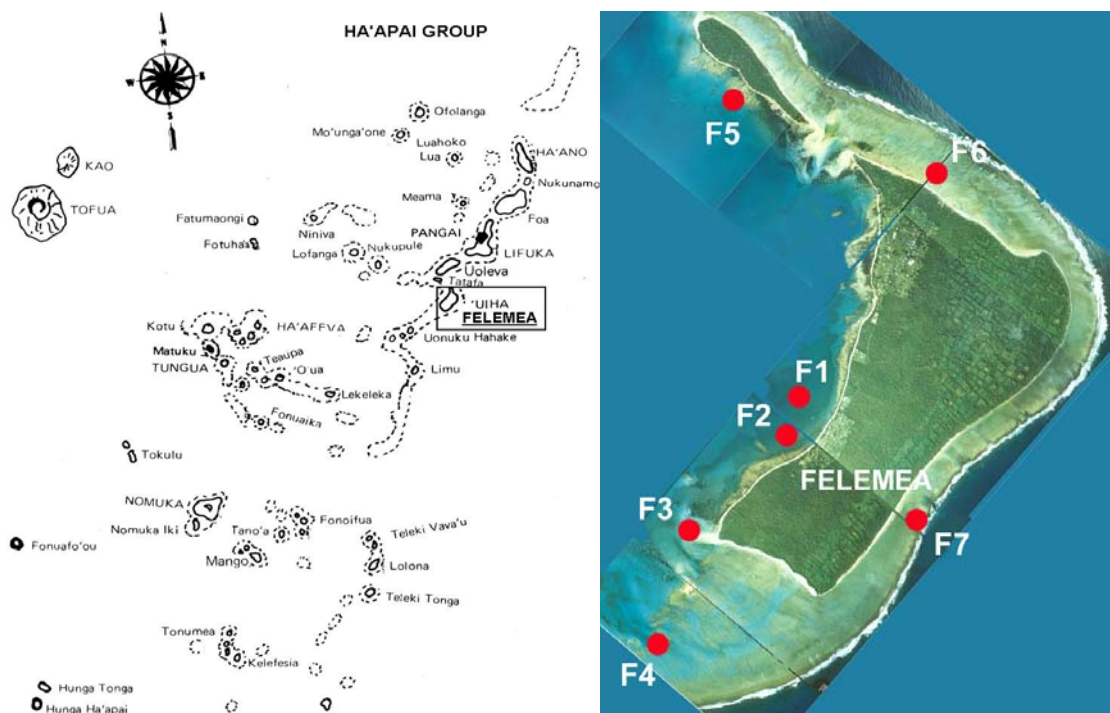


**Figure 6.2: Location Map of Taunga within the Vava'u Group and the Position of all Sampling Sites and the Community of Taunga.**



Note: In Figures 6.1, 6.2, 6.3, north is at the top of the figure

**Figure 6.3: Location Map of Felemea within the Ha'apai Group and the Position of all Sampling Sites and the Community of Felemea.**



**Identifying Fishery Expert Groups**

Key persons in the community, such as the Town Officers, church ministers, teachers in the local schools, and elders of the village, were initially invited to a meeting to discuss the purpose of the survey and our presence in their community, to identify the main environmental issues in the community, and to identify and list the fishery experts. These key people are not only the ‘leaders’ in the communities in their respective areas, but they are also considered as ‘the experts and advisors’ at the community level.

The fishers in the village are regarded the ‘experts’, not only in fishing, but also in coastal area management issues. Lists of the fishing experts were made according to type of fishing used (i.e., long liners, divers, reef fishers, those using fishing nets, fish traps, etc.). Table 6.3.2 shows the number of local fisheries experts per study area, and this is also the number of people who participated in the survey.

**Table 6.3.1 Basic Steps of a Delphi Survey and the Method used in this Study**

Basic Delphi Survey Steps	Background Information Dissemination	Individual Views	Group Opinion
Modified Delphi Used in this Study	<b>Reconnaissance Survey</b> - secondary data  - meeting with key local persons  - identifying local experts  - onsite reconnaissance  - selection of key habitat indicators	<b>Expert views</b>  - semi structured questionnaire distributed to each expert  - focus group discussions	<b>Community validation</b>  - community workshop

**Table 6.3.2 Number of Experts per Study Area**

Study Area	Number of Fishery Experts <sup>1</sup>					Total
	Gill netters	Hand liners	Divers	Fish Fencing	Women Fisher <sup>2</sup>	
Manuka	8	8	15	2	10	43
Taunga	2	4	5	-	3	14
Felemea	3	9	10	-	4	25
Total	13	21	30	2	17	82

<sup>1</sup> All of the people in the community fish for subsistence at one time or occasionally, the number of experts in Table 6.3.2 are those who always fish (considered in the village as the full time fishers) either for subsistence or for commercial or for both.

<sup>2</sup> Usually as reef and lagoonal fisher during low tide.

### **Individual Views**

After having compiled a list of local experts, each was approached by the researcher to see if they wanted and had time to participate in the survey. If they were willing, an open-ended questionnaire was distributed (see Appendix 19). The timetable for the survey was dictated by the need to run it concurrently with the community workshop. Therefore, in relation to the aims of this study, three themes were developed:

- perceived trend in fisheries;
- perception of habitat trends; and
- community fishery management issues.

In Manuka, as more time was available and the number of participants was larger, the questionnaire was with participants for five days before collection. While in Taunga and Felemea, participants were asked to complete the questionnaire in two days, after which the questionnaires were collected and the results compiled in wall charts and matrices for presentation and discussion during focus group meetings.

### **Focus Group Meetings**

The local experts were then grouped according to gender<sup>4</sup> and area of fishing expertise. There were two reasons for the grouping:

- to facilitate ease of discussion; and
- fishers were available at different times, i.e., some divers were available during the early afternoon only, and fishing activities are controlled by the tide and condition of the sea, therefore the research time had to fit with when fishers were available.

Three main groups were arranged and established, one group of women fishers, and two groups of males – the divers, and all other fishers. Three different focus group meetings were arranged at different times to present the views expressed in the questionnaire. The groups were then allowed to discuss the issues raised in the questionnaire and the answers provided. The focus group meetings were very informal and held in conjunction with local activities, to avoid taking people ‘away’ from their daily activities. The researcher (female) consulted and assisted the female focus group during the *toulalanga*<sup>5</sup>, while the male members of the research team met the male fishers during the ‘*kava*’<sup>6</sup> sessions in the evenings, or at prearranged times with those who were out fishing in the evening or at night.

In these group meetings, the results of the individual perceptions from the questionnaire were presented although answers were not linked to any individuals. The techniques used during the focus group meetings were:

- individual views were written on small cards, which were displayed on a wall and rearranged by participants under each theme to eliminate duplicates and to initiate discussion within the group;
- participants were asked to discuss and answer, as a group, the questionnaire again irrespective of what was on the wall; and
- if different views eventuated, all views were recorded as long as the group agreed that each view was valid or important to them.

The results from the focus group meetings were compiled in wall charts and matrices for presentation to the community workshop.

### **Validation of Perceptions – Community Workshop**

The views collected from the previous two rounds were presented to a community workshop, attended by both males and females, held in the village hall. Open discussions were used and all points raised were recorded on wall charts for participants to see and to prompt further discussion.

Throughout the whole exercise, it was made clear to the fishers that they were the experts on local fishing management issues, and that the researcher had come to listen and to learn from the fishers' perceptions and viewpoints.

### **The Analysis**

The information and data obtained were primarily qualitative or conceptual and, therefore, not subject to statistical analysis.

### **6.3.3 Part 2: Biophysical Conditions**

At the same time as the on-site Delphi survey, and at the same coastal communities, biophysical measurements were conducted in each study area. A reconnaissance survey of secondary data available in Tonga, preliminary talk with key stakeholders in the

community (Section 6.3.2.2), and a pilot survey of the biophysical conditions of the study areas were carried out to determine the parameters to be examined.

### 6.3.3.1 Survey Design and Methods

#### Survey Design

Surveys of the abundance and percentage cover of benthic organisms and physical features were undertaken in the coastal areas of the three study areas. The survey was designed to compare what communities perceived as ‘high impact areas’ and ‘low impact areas’ between locations and within locations. The purpose of the design was to identify ecosystem conditions at each location and differences between the locations. Seven sites were randomly selected around each study area (location), (see Figures 6.1, 6. 2 and 6. 3). Between one and five replications, depending on the variables sampled were randomly selected at each site. The sites were labelled uniquely throughout the three study areas (Table 6.3.3).

**Table 6.3.3 GPS Location for all Survey Sites**

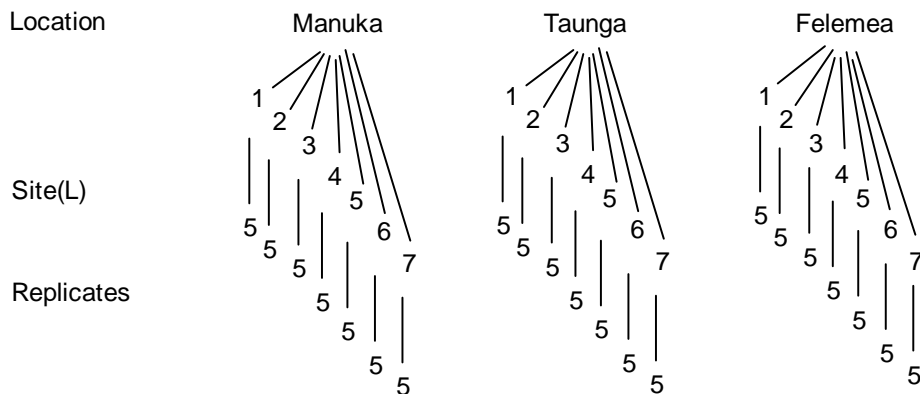
Study Areas	Section Name	Latitude (°S)	Longitude (°W)	Section Name	Latitude (°S)	Longitude (°W)
<b>Manuka</b>	<b>M-1</b>	21.07.03	175.05.73			
	<b>M-2</b>	21.07.01	175.05.87	<b>M-5</b>	21.05.60	175.06.02
	<b>M-3</b>	21.07.15	175.06.15	<b>M-6</b>	21.08.70	175.07.60
	<b>M-4</b>	21.07.55	175.07.00	<b>M-7</b>	21.08.58	175.07.90
<b>Taunga</b>	<b>T-1</b>	18.44.69	174.00.80			
	<b>T-2</b>	18.44.69	174.00.80	<b>T-5</b>	18.79.45	174.00.46
	<b>T-3</b>	18.44.33	174.00.69	<b>T-6</b>	18.45.20	174.00.73
	<b>T-4</b>	18.45.03	174.00.60	<b>T-7</b>	18.44.84	174.01.01
<b>Felemea</b>	<b>F-1</b>	19.55.75	174.25.63			
	<b>F-2</b>	19.55.45	174.25.88	<b>F-5</b>	19.57.98	174.28.39
	<b>F-3</b>	19.55.36	174.26.05	<b>F-6</b>	19.54.42	174.24.73
	<b>F-4</b>	19.52.86	174.24.97	<b>F-7</b>	19.55.35	174.26.69

#### Sampling Design Tree

Figure 6.4 shows the structure of the sampling program. In all three locations, there was a five sites design for water quality and a seven sites design for the corals and seagrasses.



**Figure 6.4: Sampling Design Tree for the Study.**



### **Indicators Selected**

As explained in Section 6.3.3, the indicators selected were determined the reconnaissance and the pilot survey conducted prior to the ‘real survey’. The selection of the parameters to examine therefore was based on the findings of the reconnaissance and pilot surveys. Generally, the coastal area reconnaissance survey identified the main coastal variables that are of ‘significance’ (e.g. water quality is considered an indicator as it is responsive to both to human or natural activities (Ward & Jacoby, 1992)), and also those that are of a ‘concern’ to the target communities.

A point intercept transects method was used for the pilot survey of benthic communities and coastal marine communities which were recorded along the fixed transect (discussed in “survey methods” below). Based on the result of the pilot survey, coral reef and seagrass communities were considered an important focus, if present in the randomly placed transects. Trends in the coral reef and seagrass communities were not only major concerns for the communities surveyed but also they could give some preliminary indication of the condition coastal resources (Ward & Jacoby, 1992). Therefore, the four classes of indicator groups that were the focus of the survey and the analysis during this study were:

- Water quality – physical measures and faecal coliforms
- Water chemistry – nutrients
- Coral reef communities - % cover by coral type
- Seagrass communities - % cover by seagrasses, epiphytes on seagrasses and algae.

### **Water Quality and Water Chemistry**

Surveying water quality has been historically concerned with the risk to human health. With time, the risk to the aquatic environment was recognised and the water emission and quality standards have been expanded to cover criteria for protection of aquatic ecosystems (ANZECC, 1992 & 2000). There are two main categories of water monitoring undertaken, effluent discharge monitoring and water body quality monitoring. For the purpose of this study, the latter was used. Another consideration is the ease of collecting and analysing samples, and the existence of standards that enable survey results to be compared with recognised criteria.

Seven variables of water quality were examined, including salinity, temperature, pH, dissolved oxygen, turbidity, depth and faecal coliform (at different depths -- Table 6.3.4), and four indicators of water chemistry were monitored, phosphate and three forms of dissolved nitrogen (nitrate, nitrite and ammonia).

### **Coral Reef and Seagrass Communities**

Patches of corals, coral reefs and seagrass communities are a key component of coastal ecosystems throughout the world (information on location can be found in ([www.coral.noaa.gov/](http://www.coral.noaa.gov/))). They are important for millions of people worldwide as sources of protein, medicinal and cultural products. They also provide raw materials for dwellings along the coast, and protect fragile shorelines from storm damage and erosion. Many economies are also dependent on reefs and their products. Coral reefs and the white sand beaches they produce, are worth hundreds of millions of dollars in tourism to some tropical countries, and are the mainstay of many small island developing states (Wilkinson 1998). Coral reefs are also of great value to the world at large as they are the hotspots of marine biodiversity ([www.icriforum.org/](http://www.icriforum.org/); [www.crc.org.au](http://www.crc.org.au); Maragos et al., 1996).

Seagrasses, apart from their intrinsic value, also provide food, habitat and shelter for many commercially important species of fish and crustaceans (Clarke et al., 1989; Poiner et al., 1989; Gray et al., 1989). They contribute to detrital food chains by means of their high rates of primary production (King 1981), and may also trap and stabilise sediment, thus contributing to the quality of marine and estuarine waters (Zimmerman 1987, Gambi et al. 1990).

The coral and seagrass survey was limited to coverage and species abundance and types only. For coral, seagrass and algae communities, a total of 23 indicator variables were used including cover by each species (See Appendix 20).

**Table 6.3.4 Description of Units, Positions in the Water and Number of Replicated for Water Quality and Chemistry Indicators Measured**

Position refers to location of the sample in the water column; Surf=10cm below the surface; Bott=5 metres down from the surface; Diff = difference between surface and bottom which was calculated either as Surface – Bottom (S-B) or Bottom – Surface (B-S). Differences were usually calculated for Surface – Bottom because it was expected that temperature, DO, pH and Clarity would be greater in surface waters, implying a +ve gradient. For Salinity, it was expected that surface waters might be less saline, so the direction of a +ve gradient was reversed.

	<b>Variable</b>	<b>Units</b>	<b>Position</b>	<b>Replicates</b>
Water Quality	Salinity	Ppt	Surf, Bott, Diff = (B-S)	5
	Temperature	C	Surf, Bott, Diff = (S-B)	5
	Dissolved Oxygen (DO)	mg/L	Surf, Bott, Diff = (S-B)	5
	pH		Surf, Bott, Diff = (S-B)	5
	Clarity: (Turbidity tube)	M	Surf, Bott Diff=(S-B)	
	(Secchi disc)	M	-	5
	Depth	M	-	5
	Faecal coliforms	#/100ml	Surf	1-2
Water Chemistry	Nitrate	µg/L	Surf	1
	Nitrite	µg/L	Surf	1
	Ammonia	µg/L	Surf	1
	Phosphate	µg/L	Surf	1

## **Survey Methods**

### **Water Quality**

Measurements of pH, temperature, salinity and DO, were taken using two probes (TPS Ltd, Brisbane, Australia -- WP 84 and WP 91). Probes were calibrated before use, using the manufacturer's instructions. Measurements were taken at two different depths in the water (surface readings were taken at 10 cm depth and subsurface readings at approximately 5 m depth). Water clarity (turbidity) was measured using two techniques. Surface and bottom clarity were measured separately using a turbidity tube and a Secchi disk (Kaly et al., 2001b). Depth at each site was measured using a drop line made of measuring tape and dive weight.

Two replicate water samples for faecal coliform counts were collected at each site. Samples were collected in 150 ml plastic sample containers from 10 cm below the surface of the water. These were stored in an esky on ice until they could be delivered to the laboratory for analysis. Either TWB or MOH, using standards methods (APHA-AWWA-WPCF 1995) carried out the analyses. Faecal coliforms were analysed using the membrane filtration technique at TWB and the most probable number (MPN) method at MOH (Morrison, 1999).

### **Water Chemistry**

A single one-litre water sample was collected from each site for chemical analysis. These were placed in an esky on ice before being frozen for later analysis. Laboratory analysis of the samples was carried out by MAF using the standard methods (APHA-AWWA-WPCF, 1995). For ammonia this was the indophenol blue method, for phosphate, the molybdenum blue method, and for nitrite, production of a red azo compound. Nitrate used the same method as nitrite, after it had been reduced using a cadmium column.

In Felemea, the faecal coliform and water chemistry were not tested due to the logistical difficulties of keeping the samples cool with no electricity or other form of cooling facilities, and the difficulties in transporting the samples from the isolated for laboratory analysis.

### **Coral, Seagrasses and Algal Communities**

For coral, seagrasses and algal communities, point intercept transects were used. At each site, five replicates of 30 metres length were laid out. The replicate transects were located randomly. The 30 metre tapes were marked randomly with 100 points, which were used directly to provide % cover estimates for all variables. Life forms encountered beneath the points were recorded on an underwater slate.

### **Limitations of the Design**

Although the communities surveyed raised concerns with declining trends in CPUE of some coastal fisheries (Section 6.4.1.2), the time and resources available for this study did not allow for any fish stock assessment to be carried. Therefore, these variables were not included in the design of Part 2 of this study. The design also, did not include out of reach areas from human use (unimpacted sites) as it would have been more costly to reach

coastal sites that have not been visited or ‘fished’. Table 6.3.5 summaries the main factors and design logic used in this study and other sources use in this section.

**Table 6.3.5 Summary of Design Logic for the Biophysical Survey and other Sources used in this Study**

Key Components	This study	Other Sources
Sampling Objective	Objectives were set with the assistant of the stakeholders of this study. The stakeholders were the communities of the area studied	
Ecosystem Analysis	Field observations	Review of previous ecological studies in Tonga (Zann, 1981; Naidu et al., 1989; Aalbersberg et al., 1992; Kaly e. al., 2000; & Kaly et al., 2001b)
Sampling Design	Refer – Sections 6.3.3 & 6.3.3.2	Kaly et al., (2001b)
use of statistics	Two Factor ANOVA	
the question being examined	the ecological condition of each study locations as shown by the parameters sampled	
Survey - field and laboratory methods	Water quality biota – Sections 6.3.3.2 & 6.3.3.3	ANZECC, (1992).
Interpretations of Results	Section 6.4.2	
Review of Program		Future Studies

### 6.3.3.2 Survey Design and Field Technique Considerations based on Previous Studies

The use of water quality, seagrass and benthic corals, and other marine resources, as indicators of marine/coastal or estuarine conditions is not new. Many studies have been conducted with respect to monitoring methodology and parameters used for sampling or surveying marine systems. The selection of techniques/parameters is, however, determined by the questions asked and the purpose of the survey, along with other considerations, such as the availability of equipment, laboratory support, costs, the time frame, manpower skills etc. Discussions of factors to be considered in designing a monitoring or a baseline study program are found in Green’s Rules, cited in Kaly et al., 1997; Green, 1979, as reported in Osenberg & Schmitt, 1996; Maher & Norris 1994.

Given the diversity of techniques available to sample and analyse water quality, and the often operational dependent nature of the results obtained, there is an obvious need to adopt uniform methods for physico-chemical water quality monitoring (ANZECC, 1992). Notwithstanding the water sampling protocols set by the ANZECC (1992); APHA (1991); and USEPA (1990), among others, a major consideration adopted in this study was the use of a protocol that ensures some national consistency in the sampling methods, physico-chemical and biological indicators selected, analytical methods, and quality control used in previous studies in Tonga.

Assessing coral or seagrass health can be done using remote sensing (Larkum and West, 1990; Short et al., 1996; Lally & Berkelmans, 1999), modelling (Kinsman et al., 1977; Oliver et al., 1992; Atkinson, 1992) and *in situ* techniques (Kinsman et al., 1977; West, 1990; Abal & Dennison, 1996; Kaly, 1998 and 1999; Crosby and Reese, 1996; Samoily, 1998; and Baird, 1999). Each of these techniques has both advantages and disadvantages according to the purpose of each study. For example, in Tonga, the available remote sensing data is not suitable for this study as it is difficult to detect in detail the area of seagrass or corals due to the small scale of the study areas in comparison to the scale of the aerial photographs. For example, the only two aerial photograph series available in Tonga were taken at a scale of 1:25 000 to 1:50 000 in 1967 and 1994. Modelling was considered beyond the skills and resources of the present study.

Therefore *in situ* techniques were adopted in this study due to the following considerations:

- physical sampling of beds yields quick results and short processing times;
- they can detect small-scale changes quickly; rapid output to be obtained and may be acted on accordingly; and
- they can give an indication of bed patchiness and size plus, in the case of seagrass, can quickly give an indication of the presence of epiphytes or algae (West, 1990; Abal & Dennison, 1996; Kaly, 1998 and 1999; Crosby and Reese, 1996; Samoily, 1998).

GPS locations of sampling sites were used to secure the permanency of sites for future studies in order to facilitate comparison with this study to determine any changes that might have happened. Surveying the status of both seagrass and corals requires description of specific parameters. The parameters that have been used to detect small-scale changes quickly include biomass, density, percentage cover and productivity (Kirkman, 1996;

Kaly, 1998; Kaly et al., 1999). The parameters used in this study were percentage cover and species diversity, and abundance as these can be quickly and easily estimated from the water surface or by snorkelling (King & Barclay, 1986; King 1988; Heidelbaugh & Nelson, 1996).

### **Deciding When Ecosystems are Showing Stress**

There are no national water quality standards in Tonga. The MOH in Tonga is using the WHO standards for drinking water (WHO, 1984) and the DOE has been using the ANZECC/AWRC guidelines for the protection of the aquatic ecosystems – marine waters (ANZECC, 1992). Australia and New Zealand guidelines for the protection of aquatic ecosystems are based on the ecologically sustainable development philosophy<sup>7</sup>, and the goal is to protect biological diversity and maintain ecological processes and systems, thus maintaining ‘ecological integrity’<sup>8</sup> (ANZECC, 1992). The range of values specified in the ANZECC (1992) have been used.

Water Quality Guidelines (ANZECC, 1992) for other<sup>9</sup> physico-chemical indicators for coastal water quality was the benchmark for ecological integrity (Table 6.4.7) adopted in this study (the recently revised ANZECC (2000) guidelines were considered to involve resources well beyond those available in Tonga at the time of this study).

There are no international standards established for what constitutes a ‘normal’ or ‘healthy’ cover by seagrasses, algae or corals. In most cases, monitoring of corals and seagrasses seeks to establish baseline conditions and monitor deviations from them to detect change. In this study, the purpose was to identify large deviations from the average conditions found in other studies, which were used as a proxy-baseline where no baseline information existed.

### **6.3.3.3 Statistical Methods**

Data were recorded in a Microsoft Excel spreadsheet. Not all data were analysed, for example, rare species (recorded with a zero) were omitted; this was done by taking out all the zero values by using the spreadsheet functions. The recalculated numbers were aggregated into measures of total % cover and species richness for analysis. This was necessary as there were no single species abundant enough to analyse on its own. Faecal coliforms were not analysed using ANOVA – these were examined using graphs.

Data were imported into Statsoft Statistica 4.5 for analysis. Data were analysed separately in individual ANOVAs. The data for each variable were first tested for normality and for homogeneity of variances, using normality plots, plots of means vs. variances (“trumpet plot”) and Cochran’s test. If data were found to be heterogenous, they were transformed to either  $\sqrt{(x+1)}$  or  $\ln(x+1)$  and the transformed data used in the ANOVA. If transformation did not stabilise the data, analysis proceeded with the original data.

Data were analysed using a two factor ANOVA for water quality and coral type variables, with main effects being Location and Sites nested in Location (Table 6.3.6). The probability level for all analyses (ANOVAs and Cochran’s Tests) was set at  $p=0.05$ . Results of the ANOVAs were interpreted from the F-tests and graphs of means +/- SE (Standard Errors).

**Table 6.3.6: Summary of the ANOVA Design used for Analysing 2-Factor Survey Results**

<b>Factor</b>	<b>Fixed/Random</b>	<b>Nesting</b>
Location	Fixed	
Sites(Location)	Random	Nested in Location

### **Interpretation**

The analyses were interpreted only in so far as they applied to the question being examined in this section (see Table 6.3.5) -- concerning the overall ecological conditions that support each community studied, and for the comparison of the ecological conditions or reality with community perceptions.

## **6.4 Results**

### **6.4.1 Part 1: Results of Community Perceptions Surveys**

The results presented here represent the general views (but not necessary a consensus) of participants at each community workshop.



### 6.4.1.1 Main Environmental Issues

The initial meetings in each study area with key community people identified the main environmental issues as perceived by each community. The main issues obtained from all study areas were very similar in identifying coastal areas and their degradation related to the use of the resources (see Table 6.4.1). Manuka participants, however, identified coastal management issues at the initial meeting as lack of enforcement and response from the Ministry of Fisheries (MOF), and the participants believed that they do not know which government ministry is dealing with coastal areas issues such as pollution, loss of mangroves, reclamation, deforestation etc., (Table 6.4.1).

Water resources issues were raised in Taunga and Felemea, whereas poor roads, swampy lands, lack of land and pig food problems were raised in Manuka as land issues. Socio-economic issues were again very similar in all locations with additional issues in Manuka.

**Table 6.4.1 Key Environmental Issues Identified by Study Area**

Key Community Issues	Manuka	Taunga	Felemea
Coastal Issues	<ul style="list-style-type: none"> <li>- Depleted coastal resources</li> <li>- Pollution</li> <li>- Destructive fishing methods</li> <li>- Increased commercial fishing (too many fishers)</li> <li>- Lack of enforcement and response from the Ministry of Fisheries</li> <li>- Do not know which government ministry to approach for coastal areas issues (i.e., pollution, loss of mangroves, reclamation, fishing ground/marine leasing, deforestation, etc.)</li> <li>- Unsatisfactory coastal leasing arrangement which has created problems for fishers and the general community</li> <li>- Fisheries resources are declining</li> <li>- Sea wall built seems to be low after the January 2000 cyclone as the foreshore was ruined and stones ended up on the main road</li> </ul>	<ul style="list-style-type: none"> <li>- Coastal erosion</li> <li>- Destructive fishing methods used by 'outside' fishers</li> <li>- Important fisheries resources are declining</li> </ul>	<ul style="list-style-type: none"> <li>- Coastal erosion</li> <li>- Destructive fishing methods still used by fishermen from other islands</li> <li>- Commercial fishers from Tongatapu with better gear fishing indiscriminately</li> <li>- Fisheries resources are declining</li> </ul>
Land Issues	<ul style="list-style-type: none"> <li>- Swampy areas</li> <li>- Need to improve roads in the village</li> <li>- Lack of land for planting crops</li> <li>- Lack of food for domestic animals, such as for pigs and dogs, therefore the pigs and dogs are left to roam freely</li> </ul>	<ul style="list-style-type: none"> <li>- Water shortage during droughts as dependent on rain water</li> </ul>	<ul style="list-style-type: none"> <li>- Water shortage during droughts as dependent on rain water</li> </ul>
Socio-Economic Issues	<ul style="list-style-type: none"> <li>- Income from fisheries is dependent of weather and good fishing gear and equipment</li> <li>- Lack of money to buy good fishing gear</li> <li>- Lack of alternative sources of income</li> <li>- Fishers in Manuka should participate in seaweed farming or any other aquaculture that might be introduced in Manuka</li> <li>- High unemployment especially among young people</li> <li>- Young people prefer to find a job in Nuku'alofa</li> </ul>	<ul style="list-style-type: none"> <li>- Difficult to market fishery products</li> <li>- Lack of alternative sources of income</li> <li>- High out-migration rate</li> </ul>	<ul style="list-style-type: none"> <li>- Difficult to market fishery products</li> <li>- Lack of alternative sources of income</li> <li>- High out-migration rate</li> </ul>

### 6.4.1.2 Perceived Trends in key Fisheries Resources

Although participants were unable to give specific figures, fishers described a general decline in CPUE for most coastal resources identified during the study. The focus group meetings and community workshops in each study area supported individual views. Table 6.4.2 gives a summary of the perceptions of trend in CPUE and reasons stated. Appendix 21 gives the Tongan, common English and scientific names of important coastal (fisheries) resources identified by the study.

The majority of the responses where perceptions that CPUE is increasing were due to seasonal appearance for some species, such as, seaweed in Felemea and to expanding fishing to ‘new or further’ fishing grounds, improving and better fishing gear, so that fishers could go further and operate for longer (i.e., divers with underwater torches, gas, ice etc.). This is an indication, however, of an increased fishing effort by local fishermen compared to previous times and that fish are caught and depleted faster by the fishing methods now used. An example is the increasing use of gillnets that are capable of catching a wider range of fish species, from minute to very large. From all the study areas, there was a consensus that commercial fishermen from outside the village use modern fishing methods and local fishermen could not afford such modern fishing gear.

**Table 6.4.2 Trend in CPUE for Key Species**

Study Site	Resource	Trend	Reasons Stated for Improving or Declining Trends in CPUE
Manuka	finfish	declining	- too many fishers - have to go further and for longer period of time now.
	mullet	declining	- the use of long gill net and fish traps has increased in the last few years - there are simply too many people fishing - the use of explosives is still common though prohibited by law - there has been a lot of reclamation destroying mullet spawning areas, such as mangroves, and contributed to increased siltation
	beche-dermer	declining	- excessively harvested for export - better fishing gear available (diving using gas, faster boats) therefore, even the stock from the deep and distant areas are harvested.

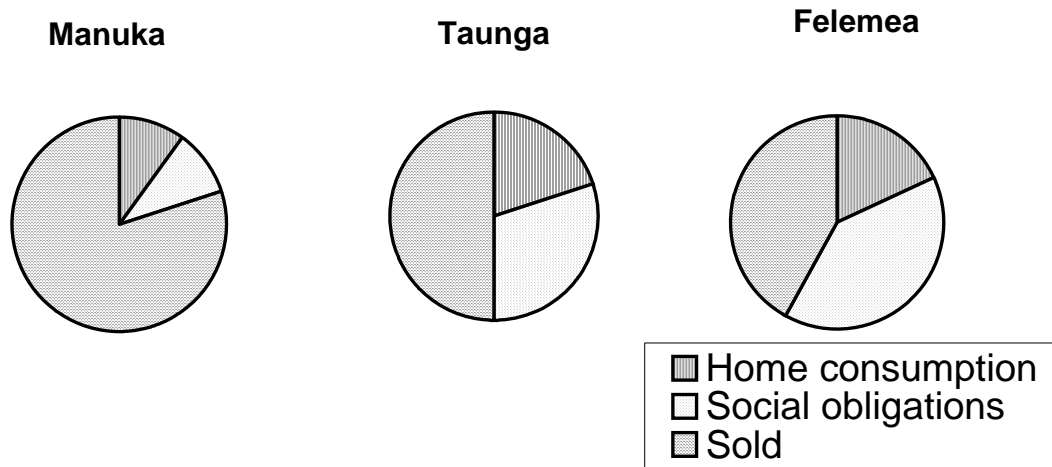
Study Site	Resource	Trend	Reasons Stated for Improving or Declining Trends in CPUE
	generally considered to applied to all other coastal resources	declining	<ul style="list-style-type: none"> <li>- quantity and quality of fish and shellfish in the catchment is declining rapidly. In the past the estimated average number of fish strings<sup>10</sup> caught were more then seven per fishing trip made. Currently it would be a good trip if three strings were obtained. In a string of fish there is about 5 to 10 fish depending on the type of fish and size.</li> <li>- fishermen from other areas. They seem to be responsible for the continued dynamiting, using the wall of death nets and 'aukava' (fish poisoning) activities.</li> <li>- those with canoes perceive those with outboard motors as a threat to the catchment.</li> <li>- hand liners perceive the divers as a threat to the resources</li> <li>- water debris has obviously increased evident in the amount of litter, fishermen have to remove from their fish fences weekly.</li> <li>- increased pollution in the area may have destroyed the shellfish as the colour of the sea in the lagoon changes and at times there is a strong foul smell and the water has a lot of foamy substance.</li> <li>- fishing equipment costs on the rise have meant that fishing effort to cover these costs have inevitably increased as well.</li> <li>- wall of death nets though prohibited by fishery legislation are still in use.</li> </ul>
<b>Taunga</b>	finfish	declining	<ul style="list-style-type: none"> <li>- declining in close-by fishing grounds as frequently visited by many fishers</li> <li>- although Taunga is a small community, and 'our' fishing grounds always provide our needs, we are now not the only people fishing in 'our' fishing grounds</li> </ul>
		increasing	<ul style="list-style-type: none"> <li>- those who have boats can go to further reefs and can catch a lot</li> </ul>
	turtle	declining	<ul style="list-style-type: none"> <li>- easier now to catch turtles in nets, thus contributing to their decline</li> <li>- turtle eggs are a delicacy thus decreasing the numbers that could survive</li> </ul>
	emperor	increasing	<ul style="list-style-type: none"> <li>- expanding to new fishing areas</li> </ul>
	lobster	declining	<ul style="list-style-type: none"> <li>- due to increasing number of commercial fishers, especially from Nuku'alofa that have good and modern fishing gears (torches, ice, scuba diving, etc.)</li> </ul>
	giant clams	decreasing	<ul style="list-style-type: none"> <li>- good diving gear means giant clams are easily fished to extinction, divers have to go further to find any</li> </ul>
	shellfish (all kinds)	declining	<ul style="list-style-type: none"> <li>- overfished at every low tide</li> </ul>
<b>Felemea</b>	octopus	decreasing	<ul style="list-style-type: none"> <li>- fishing method used destroyed octopus habitat in near-by reefs</li> <li>- marketing of dried octopus in Nuku'alofa has contributed to its overfishing</li> </ul>
	giant clams	decreasing	<ul style="list-style-type: none"> <li>- good diving gear means fished giant clams are easily fished to extinction, divers have to go further to find any</li> </ul>
	seaweed	increasing	<ul style="list-style-type: none"> <li>- it is seasonal</li> </ul>
	sea urchins	decreasing	<ul style="list-style-type: none"> <li>- reason not know but could be caused by overfishing</li> </ul>

Study Site	Resource	Trend	Reasons Stated for Improving or Declining Trends in CPUE
	shellfish (ark clams)	decreasing	- especially in size as it is being sold to the Nuku'alofa market in sack loads
	parrotfish	decreasing	- increase in commercial fishing with modern fishing gear
	seaperch	decreasing	- increase in commercial fishing and with better fishing gear too many fishers
	emperor	decreasing	- increase in commercial fishing and with better fishing gear
	surgeon fish	increasing	- mainly for local (village) consumption not a favourable fish to buyers

### **Importance of Fisheries Resources**

Fishers reported that fisheries are the most important resource to the community for home consumption, for churches and social ceremonial gatherings and for cash. Fishers explained that other sources of income such as remittances from relatives overseas or from the capital (Table 6.1.1) are irregular and too small to cover their needs and expenses. Fisheries are the source of the livelihoods. With decline in CPUE, fishers stated that they would prefer to sell their catch as the price increases but sometimes getting to the market is difficult especially in Taunga and Felemea. Figure 6.5 shows the relative quantities of fisheries sold, used for home consumption, or used for socio-cultural obligations, such as donations<sup>11</sup> to extended family functions, church or village ceremonies. Manuka fish, on the other hand, are sold by the roadside in Manuka, or taken directly to Nuku'alofa and sold. The fisheries catches in Taunga and Felemea are being sold in the island division capitals of Neiafu and Pangai respectively, either to the general public, to small retail shops, or to traders who then market the catch in Nuku'alofa.

**Figure 6.5: Relative Uses of Fisheries in each Study Site (2001).**



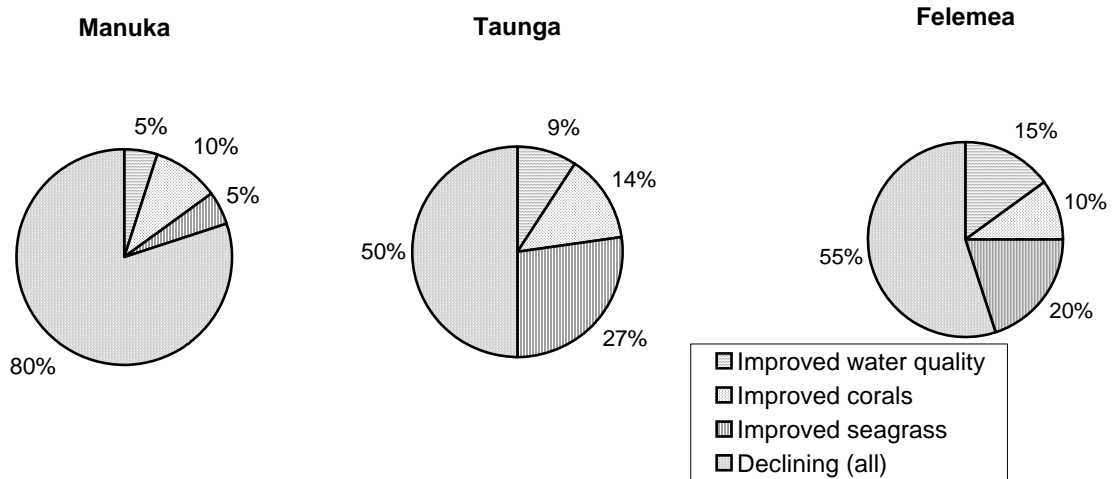
#### **6.4.1.3 Perceived Trends in Three Coastal Habitats**

The most common perception noted was that the observable conditions of water quality, corals and seagrass are declining, in all three locations. Decline in localised water clarity in all three locations was accounted for by local reasons such as effects of foreshore development (reclamation for seawall construction) and loss of mangroves in Manuka. Digging of the seafloor at Taunga for shellfish, and pigs scavenging at low tide in Felemea.

The reasons given for perceived decline in corals were related to fishing pressures, such as increasing commercial fishing and destructive fishing methods usually believed to be caused by fishers from outside the study areas and an increase in coastal pollution. Participants from all the three locations claimed that seagrass seems to “appear and disappear” and they do not know the reasons for this (see Table 6.4.3). At all three locations, there were more people perceiving a decline than those who thought that there is no change or conditions are improving in each of the habitats (Figure 6.6). The most common reason given by those who said that water quality, corals and seagrass conditions are improving was due to natural occurrences, or belief that resources will recover or is recovering as “Tonga is blessed and looked after by God”.

**Figure 6.6: Relative Distribution of Community Perceptions for Improved Water Quality Clarity, Improved Corals Coverage and Species Abundance, and Improved Seagrass Coverage and Health in all Locations in 2001**

The relative distribution of community perceptions of declining habitat quality, coverage and abundance represent those who believed that water clarity, coral coverage and abundance and seagrass coverage in each location were all declining in 2001 (at the time of the survey).



**Table 6.4.3 Stated Perceptions of Habitat Trends**

Study Site	Habitats and Reasons Stated for the Perceived Decline or Increase					
	Water Clarity	Reasons Stated for the Perceived Decline and Increase in Water Clarity	Coral Coverage and Diversity <sup>1</sup>	Reasons Stated for the Perceived Decline and Increase in Coral Coverage and Diversity	Seagrass Coverage and Health <sup>2</sup>	Reasons Stated for the Perceived Decline and Increase in Seagrass Coverage and Health
<b>Manuka</b>	- water clarity in front of the village and to the lagoon side has declined a lot	- after building the seawall, water clarity seem to decrease and mangroves were destroyed and sand disappeared - sea floor has changed to soft and muddy bottom which could contribute to the clarity problem	- live coral coverage is declining although in some areas there are signs of new growth - different types of coral in different shapes now as compared to a decade ago	- coral extraction for aquarium export has destroyed a lot of our reefs - we have seen an increased in crown of thorns around the reefs	- seagrass seems patchy , could be seasonal - sometimes they seem to be abundance and disappear at times	(as above)
<b>Taunga</b>	- water clarity in the jetty area has declined and visibility is poor - clarity and water colour changes after a storm - it seems there is increased litter in the water as compared to 10 years ago	- coastal deforestation could contribute to the decline in water clarity as there is increased coastal erosion - after high seas and rough weather, the waters turn brown - fishing for some baits and shellfish involves digging at low tide and a lot of the fine sediments are easily dispersed - after building the village jetty, there seems to be a decline in water clarity	- reef flats close to the village are practically dead - there are signs of coral damage in the outer reefs (coral breakage)  - different coral types seem to increase in some areas	- destructive fishing methods have taken a toll (dynamiting, reef gleaning, coral smashing, boat anchorage etc.)  - new coral growth appears in undisturbed areas	- seagrass seems to appear for a period of time and than disappear - sometimes it appears in areas where there was just bare sand before - the boat area is completely covered with seagrass now, where it was not the case before - the seagrass seems healthy enough	- do not know the reason why seagrass appear and disappear or grow at places where they were not any seagrass before
<b>Felemea</b>	- water clarity in the jetty area has declined a lot - increasing litter in the coast and lagoon - the colour changes to brown after a storm	- coastal erosion could contribute to the decline in water clarity as a lot of the big trees by the shore were destroyed by the 1982 and more recent cyclones - sediments are disturbed by pigs scavenging at low tide	- live coral coverage in the outer reefs has decreased. - there are signs of coral breakage, big holes and some discolouration - increasingly different coral types in some areas	(as above)	- seagrass seems to appear and disappear - seagrass seems to be healthy enough	- do not know the reasons  - could be caused by some natural phenomena

<sup>1</sup> Could be easily observable by the different shapes or sometimes colour of the coral, <sup>2</sup> Observable in the appearance of the seagrass

#### 6.4.1.4 Community Management

##### Existing Community Committees involved in Management

Participants were asked to identify any existing community fishery or coastal management and any general development committees and their perceived concern for sustainability issues (Table 6.4.4). The three locations studied did not have existing fishery community committees or coastal management committees. All existing community committees in the study locations were perceived to be ‘weak’ in their concern for sustainability. The most common reason given for the perceived weak concern for marine resource sustainability was that sustainability has never been an issue and that “it was always considered that nature would be able to provide for the future”. This attitude was common in all study areas, although when asked about the trend in CPUE and habitats, they were all aware and talked about resource and habitat degradation now, as compared to a decade ago.

The Women’s Development Committee in Manuka claimed that they benefited from participating in environmental education and awareness programs coordinated by government departments and NGOs in Nuku’alofa and conducted in the village (i.e., tree planting, village clean up, etc.).

**Table 6.4.4 Community Management**

Study Area	Existing Community Committees and Committees’ Goal	Concerns for Resource Sustainability Issues
<b>Manuka</b>	As all of the above with the exception of the Manuka Women’s Development Committee Manuka Women’s Development Committee – Environmental issues are part of their agenda, but address land issues only, such as, town cleanliness and inspections, especially issues concerning health and sanitation, tree planting and anti-litter campaigns	<b>strong</b>
<b>Taunga</b>	A general community development committee that has membership of both women and men and looks after community health, sanitation, and general community obligations especially to the noble or to the government, etc. Women’s groups that are involved in handicrafts and marketing of handicrafts in Nuku’alofa and overseas and sometimes involved in environmental related activities such as tree planting. All churches have various committees that are for religious purposes	<b>weak</b> <b>weak</b> <b>weak</b>
<b>Felemea</b>	Committees as in Taunga (above)	<b>weak in all</b>



### **Definition of ‘Sustainable Resource Use’**

Expanding from this general view that “it was always considered that nature would be able to provide for the future”, participants were further asked the following questions:

- would nature always provide resources for the future or God would always provide;
- would that mean that management of resources is not required in their community;
- what is the meaning of ‘sustainability’;
- would sustainable resource management (sustainable development) lead to a ‘better quality life’ or would community welfare be better if coastal resources were sustainably managed;
- is community action necessary to bring about sustainable development?

In Taunga and Felemea, more participants (60 % and 55 % respectively) agreed that “nature would still provide” than in Manuka (40 %). Taunga and Felemea residents believed if “their coastal resources” were for their own communities use alone, management would not be required. Manuka, residents (60 %), however, “would like to see coastal resources being managed, and for the people of Manuka to be more involved in management”.

There is no one single word in Tongan that means ‘sustainability’ but sustainability could be defined by a phrase to show its meaning in the context of coastal (natural) resource use. The translation into English of ‘sustainable resource use’, as defined by the communities studied (*ke ngaau fakapotopoto ‘aki e koloa fakaenatula, ke mahino ‘oku lahi ma’u pe ki he fiema’u ‘a e ngaahi kolo.*) -- generally means, “wise use of resources so that its level of availability to communities is not lowered at any time”.

Participants were further questioned about their opinions on the statement “if resources were sustainably managed would that lead to a better life<sup>12</sup> than they have now”. Fishers from the three locations reported total agreement with the idea that if resources were sustainably managed, they would have a better quality of life (see Section 6.4.1.5). Fishers in all study locations, however, believed that action by their own communities alone would not lead to sustainable resource management as coastal resources are for common use, so collective actions are needed to be taken at the community, division and national levels to achieve sustainable resource use, and thus a better quality of life for all (see Table 6.4.5).

### **Communities Management Options**

Participants were further asked to identify and rank management priorities they believed would lead to sustainable or successful coastal resource management. Similar management priorities were identified in all locations with some slight variations (see Table 6.4.5). For example, Manuka fishers preferred more “management responsibility” to be given to the community of Manuka, as they reported that “the MOF and other government departments do not have the capacity to address our local issues”. Taunga and Felemea participants were also concerned about the high out migration in general, and that there would be fewer people left in the islands to manage the resources if management responsibility was given to the community.

The management priorities given by participants at each location further confirmed the earlier views that the decline in coastal resources is caused by “other fishers” (as in Tables 6.4.2 & 6.4.3). For example, Felemea and Manuka participants raised and considered restriction of ‘outside’ fishers and fishing boats from community fishing areas as a very important priority, but this was not raised as an issue in Taunga. Allocation of exclusive community fishing areas was identified and considered as a very important management priority at all locations, plus the need to be more involved in decision making regarding community resources. Table 6.4.5 gives a summary of the management priorities identified.

#### **6.4.1.5 Other Field Observations**

It was also noted that most fishermen from the three study areas are not socially and economically well off. Marine products are generally taken to the capital town or Neiafu or Pangai (in the case of Taunga and Felemea) if the weather permits, or sold off in strings by the roadside in Manuka. The meagre returns, in most cases, are the only regular household income. This is used to pay off all bills such as the children’s school fees. When these marine resources are scarce, families are faced with difficult times.

Coastal erosion in the leeward side of Taunga and Felemea was very obvious where the littoral forest is very thin with patches of grass and tussock grass in between trees. Large trees and coconut trees are standing in the water at high tide and exposed at low tide. The effect of salt spray on the windward side was also evident with stunted growth trees that would normally grow large and lush in other parts of Tonga. The remaining mangrove in

Manuka are very small less than three patches of standing mangroves – 20 m<sup>2</sup> each – are left compared to villages with no sea wall.

Floating debris and rubbish such as plastic bags, cans, bottles, were very common in the coastal area of Taunga, some old fishing nets and ropes were observed in Felemea and in Manuka, including iron bars left behind from a seaweed farm in Manuka.

In some areas of the reefs in Manuka and Felemea, large holes surrounded by dead coral were observed. When asked villages members claimed that they were old sites where dynamiting was carried out.

**Table 6.4.5 Management Priorities Identified, and Ranking of Perceived Importance of each Option during Community Workshops In each Location**

Management Priorities	Community Ranking		
	Manuka	Taunga	Felemea
We need to know what relevant laws are there to protect the resources and what is required of us by the law	***	***	***
There is total lack of enforcement therefore timely enforcement of existing regulations is very much needed;	***	***	***
Need for appropriate legislation that takes care of communities issues	***	***	***
Need more education and awareness programme to reach the outer islands and the rural areas	***	***	***
Restrict 'outside' fishers and boats from community fishing area	***		
Need to be involved in decisions on the management of communities resources	***	***	***
Need to establish community sustainable development committees or strengthen existing committees to be able to address such issues in the community	***	***	***
Allocate exclusive community fishing areas	*** <sup>3</sup>	*** <sup>1</sup>	*** <sup>2</sup>
Leasing of community fishing grounds, especially close to the village, to private companies should be prohibited	***		
Need for development assistance to the communities to improve fish marketing, identify alternative sources of income, and to learn sustainable resource management skills	***	***	***
We need to see relevant officers (i.e. fisheries officers) in the communities	*	***	***
To introduce tougher penalties for using dynamiting and fish poisons	***	***	***
To promote and encourage coastal tree planting by providing relevant awareness programme and seedlings	**	***	***
To establish community marine protected areas for nursery purposes to supplement nearby areas and for the communities to involve in its management	***	***	

\*\*\* – most important; \*\* – important; \* – could be a good idea; blanks – not raised.

<sup>1</sup> This management option was raised in Taunga, however, the rate of out-migration also concerned participants as the population of Taunga is decreasing every year and leaving behind mostly middle age to old people

<sup>2</sup> Participants in Felemea were concerned with people from other islands and villages fishing right in front of the lagoon in Felemea. They would like to designate areas close by to the village exclusively for their women and children fishers and for the village recreational activities

<sup>3</sup> In Manuka this was a major concern and a favoured option, but, at the same time participants in Manuka were concerned how 'community fishing areas would be allocated, in relation to neighbouring villages where they are fishing in the same areas

## 6.4.2 Part 2: Results of Ecological Surveys

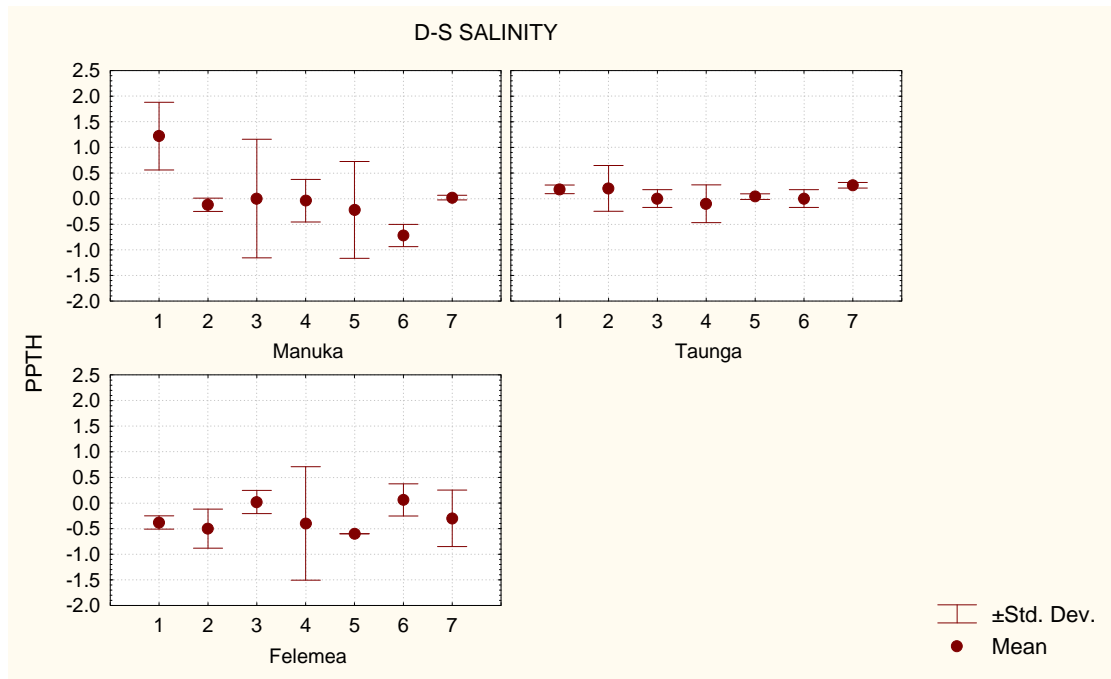
### 6.4.2.1 Water Quality

A total of seven variables for water quality were sampled and analysed in this study. However, the water quality variances could not be stabilised, therefore the results given below have been interpreted directly from the untransformed data. Full analyses and graphs are given in Appendices 6.4.

#### Salinity (Surface, Bottom, Difference as B-S)

Surface and bottom salinities varied between 27 and 33 ppt at the three study locations over the sampling periods. Surface and bottom salinities were generally lower in Taunga as compared to Felemea and Manuka (Appendix 22). There were no significant differences between surface and bottom salinity in the three locations (see Table 6.4.6), but Manuka and Felemea showed negative values for the difference between surface and subsurface salinities at one site (Fig. 6.7).

**Figure 6.7: Graph of Differences between Bottom and Surface Salinity (B-S) at all Sites and Locations. Data are means +/-SE and units are parts per thousand.**



### **Temperature (Surface, Bottom, Difference as S-B)**

Water temperatures at all three locations varied between 23 and 29° C with a maximum difference between surface and bottom values of around 1.5° C (Appendix 22). There were significant differences in surface and bottom temperatures among the three locations (Table 6.4.6), with the highest surface temperatures found at Felemea. There was, however, no evidence of temperature stratification at any location (Appendix 22).

### **Dissolved Oxygen (DO) (Surface, Bottom, Difference as S-B)**

There was a problem with the dissolved oxygen readings obtained for Manuka and Felemea, which returned values near zero, and were considered suspect, except for two locations in Manuka. The dissolved oxygen levels varied between 6.4 and 8.9 mg/L in surface and bottom waters at Taunga, with a maximum difference (S-B) between them of 0.6 mg/L (Table 6.4.6 and Appendix 22).

### **pH (Surface, Bottom, Differences as S-B)**

Surface pH for all locations ranged between 6.0 and 8.4 pH units, and bottom pH ranged from 4.2 to 7.9 pH units in all locations. This is very unusual in Tonga as most coastal sites from other studies have pH values of approximately 8-8.2. The difference in pH between surface and bottom waters varied the most in Taunga, but was near-zero at the remaining locations (Manuka and Felemea), (Appendix 22).

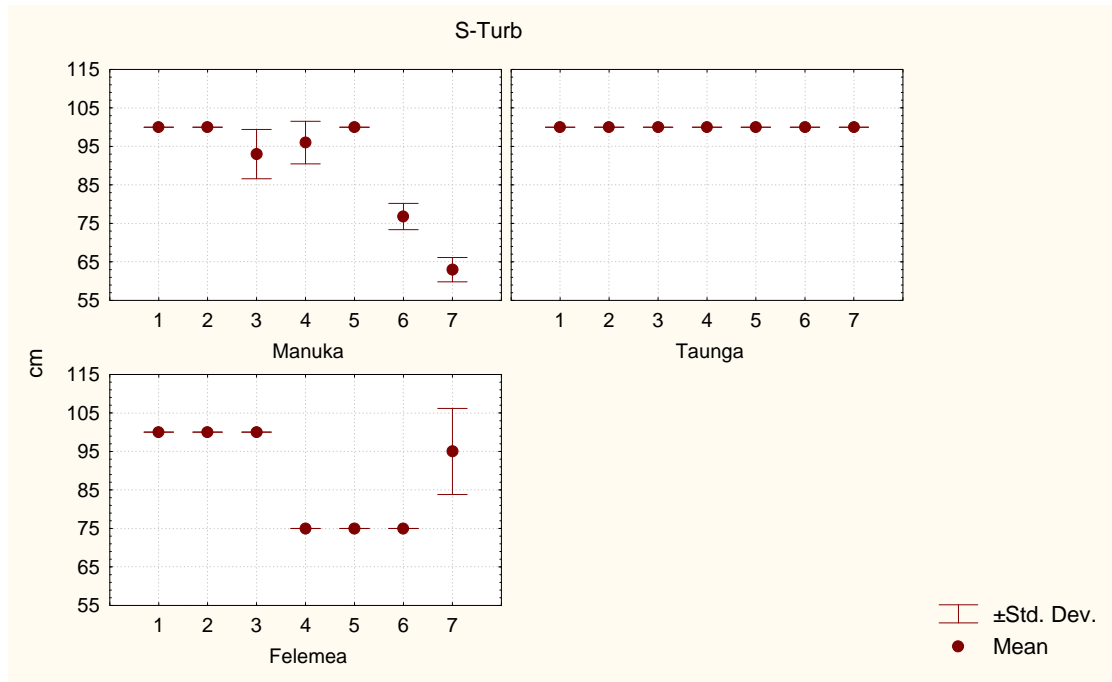
### **Water Clarity (Surface, Bottom & Differences as B-S Turbidity Tube, & Secchi Disc)**

#### **Turbidity Tube**

Water clarity was generally good at all locations and positions in the water column, with values ranging between 75 and 100 cm in the turbidity tube column. Surface turbidity differed significantly among locations. At Taunga water clarity was uniformly 100 cm or better, with some higher turbidity being detected at Mauka and Felemea (Figure 6.8). The bottom turbidity did not differ significantly among locations, with all locations also exceeding 100 cm. Differences between bottom and surface (B-S) turbidity were significant among locations, with the greatest differences being observed at Felemea (Table 6.4.6 and Appendix 22).

**Figure 6.8: Results of Turbidity Tube Measurements, of Surface Turbidity, at the Three Study Locations.**

Values are mean heights in the turbidity tube column (cm) +/-SE. Note that a maximum of 100 cm was possible using this technique, with 100 indicating good water clarity, and lower values indicating increasing turbidity.



**Secchi Disk**

Secchi disc readings also differed significantly among locations and varied between 1.23 and 2.49 m. Water clarity as measured by the Secchi disc was lowest in Manuka and highest in Felemea (Fig.6.9).

**Table 6.4.6 Summary of ANOVA results for Water Quality Variables**

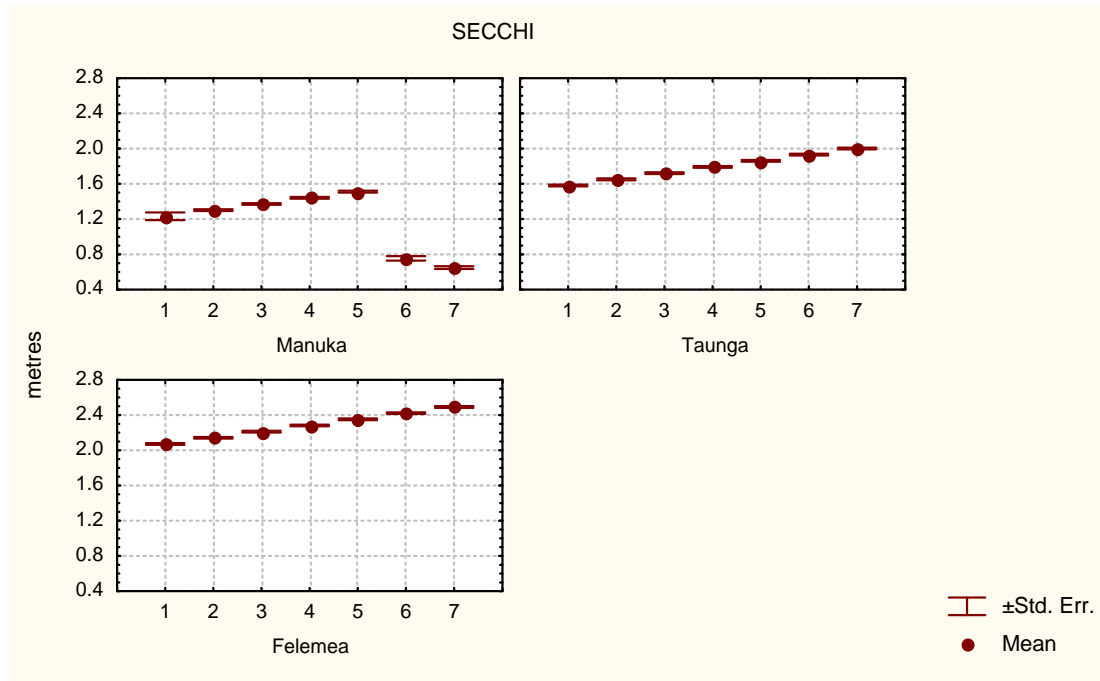
The significance level used was  $p= 0.05$ , where • indicates a significant effect and “NS” indicates no significant difference among the levels of the factor(s) being tested. These results were interpreted from graphs. S=Surface, B=Subsurface, D=Difference.

<sup>1</sup>DO value is of suspect value here as well due to the results given by Felemea and Manuka

Factor	Salinity			Temperature			DO <sup>1</sup>			pH			Clarity	
	S	B	D	S	B	D	S	B	D	S	B	D		
Location	•	•	NS	NS	•	•	•	•	NS	•	NS	•	•	
Site(Location)	•	•	•	•	•	•	•	•	NS	•	•	•	•	

**Figure 6.9: Results of Turbidity Measurements as estimated using a Secchi Disc at the Three Study Locations.**

Values are mean depths at which the Secchi disc quadrants become indivisible (m) +/-SE. Note that higher values indicate clearer waters.



### **Faecal Coliforms (Manuka and Taunga)**

Faecal coliform values obtained at Taunga and Manuka were all below the ANZECC standards for both seafood and direct contact (swimming) (Table 6.4.7). The values obtained from a total of 14 samples varied between 0 and 16 colonies per 100 ml of collected seawater in Taunga and 0 and 13 colonies per 100 ml of collected seawater in Manuka.

### **Nutrients (Phosphorus, Ammonia, Nitrite, Nitrate (Manuka and Taunga))**

The levels of nutrients in the waters around Taunga and Manuka were generally low, and where ANZECC standards exist, did not exceed them (Table 6.4.7).

**Table 6.4.7 Summary of Maximum and Minimum Values for the Main Water Quality Variables examined in this Study.**

Values are compared with the ANZECC (1992) Standard, and results obtained from the Neiafu, Vava'u Study (Kaly et al., 2001a) and the Fanga'uta Lagoon, Tongatapu (Kaly et. al., 1998-2000), NG – no guideline available.

Variable Sampled	ANZECC Standard (1992)	Fanga'uta Study 1998-2000	Neiafu Monitoring Study 2001	This Study 2000-2002	
Faecal coliforms (colonies/100ml)	Seafood 14 median MPN / 100ml, <10% samples >43 MPN/100ml	0-240	0-104	Manuka	0-13
				Taunga	0-16
Phosphorus (PO <sub>3</sub> ) (µmols/L)	Swimming 150 median MPN / 100ml, with 4/5 samples <600 / ml	<0.1-44.7	<0.1	Manuka	<0.1
				Taunga	<0.1
Ammonia (NH <sub>3</sub> ) (µmols/L)	NG	<0.1-31.7	0.11-0.13	Manuka	<0.1
				Taunga	<0.1-0.24
Nitrite (NO <sub>2</sub> ) (µmols/L)	NG	<0.1-0.74	<0.05	Manuka	<0.05
				Taunga	<0.05
Nitrate (NO <sub>3</sub> ) (µmols/L)	Swimming 0.16-1.6	<0.1-7.6	1.45-4.72	Manuka	<0.1-1.32
				Taunga	.1.72-2.82
Salinity (ppth)		12.3-40	25.9-30.4	Manuka	28.8-31.1
				Taunga	27.9-29.3
				Felemea	31.0-33.1
Temperature (C)	15-35 (Range)	22.5-39	22.9-27.5	Manuka	24.2-26.8
				Taunga	25.9-27.2
				Felemea	23.4-28.8
DO (mg/l)		0.1-11.6	5.1-9.9	Manuka	-
				Taunga	6.5-8.9
				Felemea	-
pH	5.0-9.0 (ideal 7.4)	2.4-9.1	4.8-8.1	Manuka	6.1-7.2
				Taunga	4.3-7.8
				Felemea	6.2-8.3
Turbidity (cm)		7-98	>100	Manuka	93 - > 100
				Taunga	> 100
				Felemea	75 - > 100
Secchi (m)	1.6 (Minimum)	0.3-0.7	3.7-20.6	Manuka	1.2-1.5
				Taunga	1.6-2.0
				Felemea	2.1-2.5

### 6.4.2.2 Seagrasses, Corals and Algae

Seven summarised variables covering seagrasses, corals and algae were analysed by formal MANOVA/ANOVA and in graphs (Appendix 23). Individual species were not analysed because their distributions were discontinuous, and many species were in low abundance. The MANOVA results, used to determine whether species assemblages differed among the study locations confirmed this observation, with a significant difference among locations being detected (Table 6.4.8).



**Table 6.4.8 Multivariate Analysis of Variance for Benthic Seagrass, Coral and Algal Communities.**

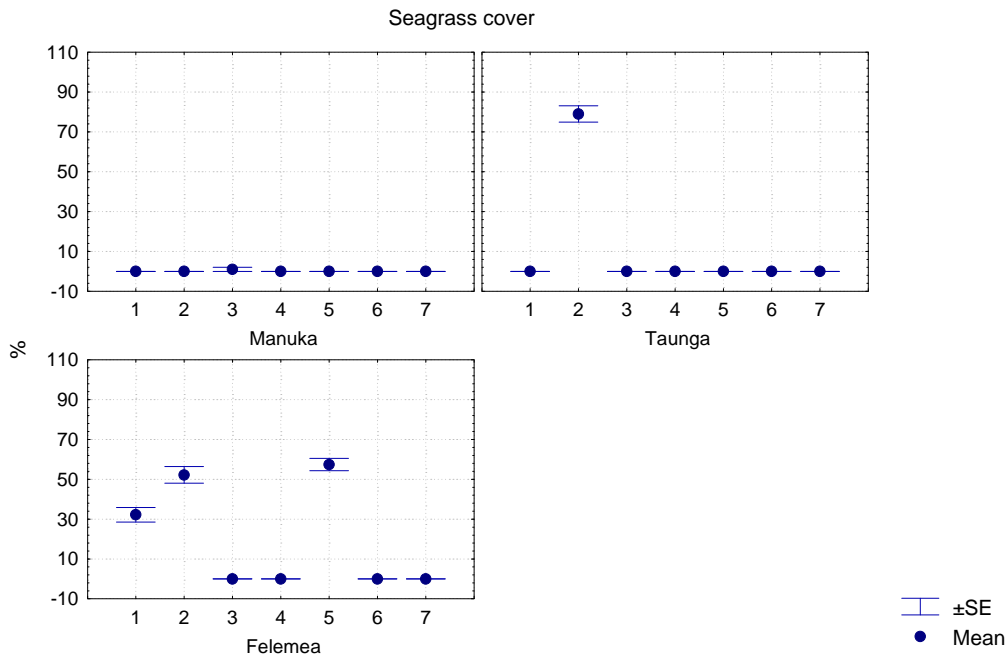
	Wilk's Lambda	Rao's R	df 1	df 2	P-level	Significance
L	0.188	2.24	14	24	0.04	*
S(L)	~0.00	20.00	126	522	0	*

**Seagrasses and their Epiphytes (two variables)**

Seagrasses were relatively rare in the studied locations, with beds being found at only one site in Taunga and three of the sampling sites at Felemea. Seagrass cover in Felemea varied between 30 and 55% where present, while almost 80% cover was recorded at the jetty site (T2) in Taunga (Figure 6.10). Seagrass cover in Felemea, however, varied from less than ten percent to sixty percent.

Seagrasses, where present, were generally free of epiphytes at all of the three study locations, except at the jetty site (T2) in Taunga. At that site, 76% (+/-4.89 SE) of seagrass had epiphyte coverage (Appendix 23).

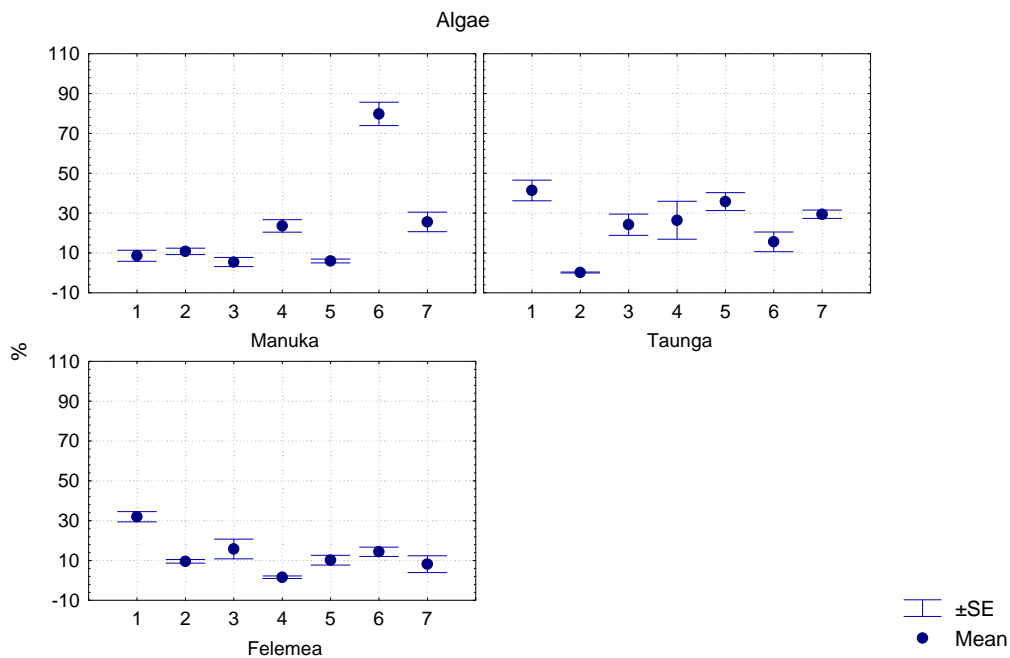
**Figure 6.10: Percent cover by Seagrasses (all species) at the Three Study Locations. Values are mean % cover +/-SE.**



**Algae (two variables: percent cover and diversity)**

There was no significant difference in the cover by algae in the three study locations (Figure 6.11, Table 6.4.9, Appendix 23), with cover varying between 0 and 94%. Most of the variation in algal cover occurred among the sites at each location (Figure 6.11). The highest cover by algae was found at Manuka (S6). A similar pattern was found for algal diversity, with no significant difference being detected across locations. In this case, however, most variation in algal diversity was recorded at Taunga (Appendix 23).

**Figure 6.11: Percent cover by Benthic Algae (all species) at the Three Study locations. Values are mean % cover +/-SE.**



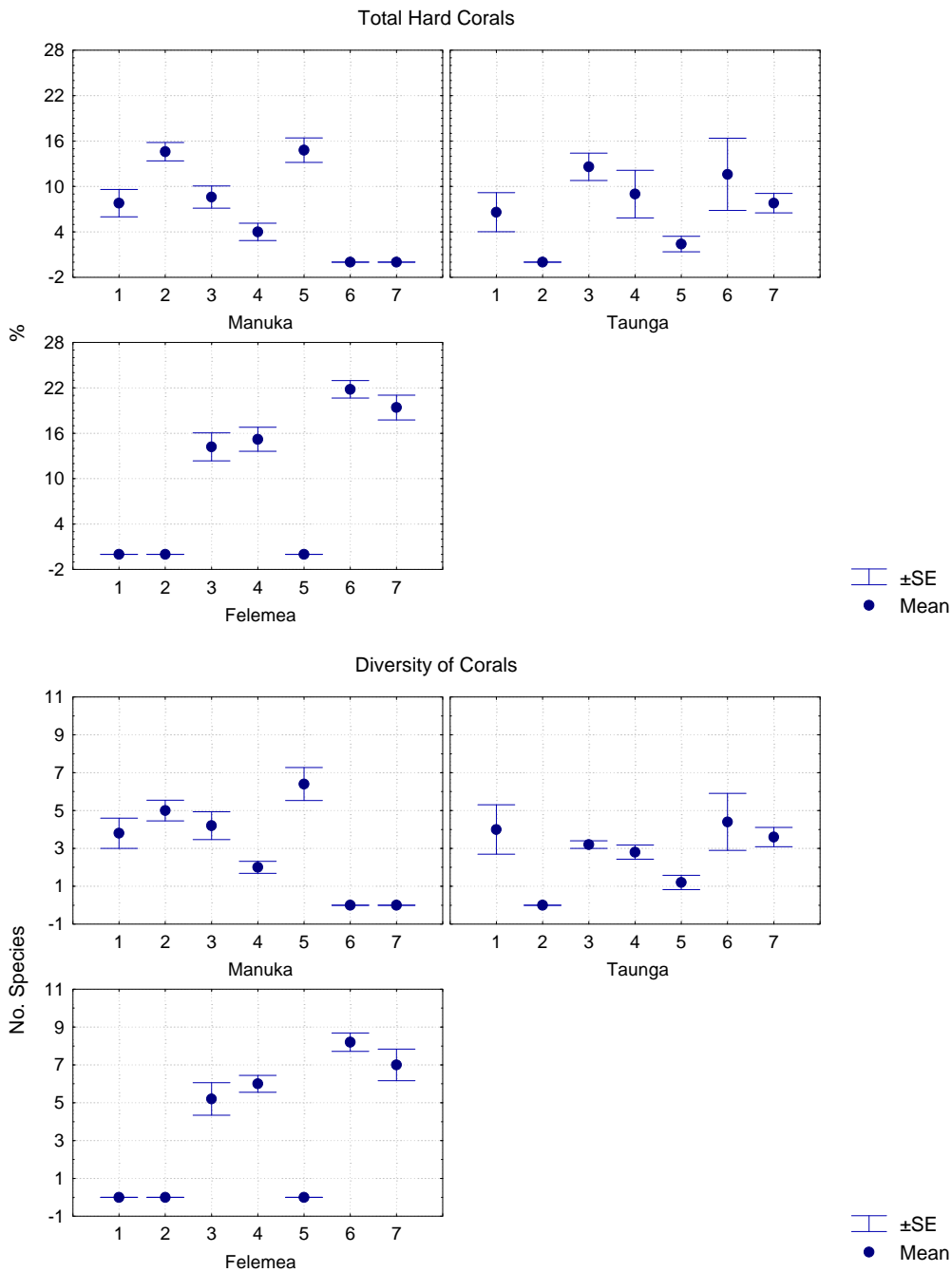
**Corals (Three variables: Soft Corals, Hard corals and Diversity of Hard Corals)**

Soft coral cover was generally low at all locations, varying between 0 and 10% cover and with no significant difference among locations (Table 6.4.9, Appendix 23). The highest values for soft coral cover were at two of the Felemea sites.

Total cover of all hard corals ranged between 0 and 29% of the substratum, with no significant difference being found among locations (Table 6.4.9). It appeared that most of the variation in hard coral cover is found at the level of sites within locations (not the focus of this study).

The diversity of hard coral types was generally low at all three locations, with a maximum of 10 species/types being recorded throughout the study. Six of the sites sampled throughout the study had no coral cover/diversity, and at least one of these was present at each location (Figure 6.12).

**Figure 6.12: Percent cover by all Hard Corals, and Diversity of Corals at the Three Study Locations. Values are mean % cover or Number of Species +/- SE.**



**Table 6.4.9 Summary of ANOVA Results for Coral and Algae Communities**

Full results of analyses, with transformations, are available in Appendix 23. The significance level used was  $p =$  or  $< 0.05$ , where • indicates a significant effect and “NS” indicates no significant difference among the levels of the factor being tested.

Factor	%	%	%	%	Number of	%	Number of
	Seagrass	Seagrass epiphytes	Soft corals	Algal	Algal diversity	Total hard corals	Diversity of hard corals
Location	NS	NS	NS	NS	NS	NS	NS
Site(Loc)	•	•	•	•	•	•	•

## 6.5 Discussion: Community Perceptions, Ecological Conditions and Comparison of Communities Perception versus Ecological Reality

### 6.5.1 Community Perceptions

This study is based on the assumption that stated perceptions reflect the true perceptions of the communities surveyed. From experience in the field and comparison of results, it appears that this is generally true, indicating that the methodology accurately captured communities’ perceptions of coastal resource and ecological trends.

Two of the most overwhelming perceptions from all locations was that coastal resources and habitat were declining and that there was lack of coastal management interventions in all locations. However, the fact that all respondents at the survey locations believed that many of the causes cited for CPUE and habitat declines – such as pollution, destructive fishing, lack of enforcement, lack of community involvement etc. – can be effectively addressed through community action has important implications for future coastal management in Tonga. This suggests that the central government responses have been misplaced so far, and that people are willing to actively participate in management. Many other threats however, are beyond the control of communities and cannot be handled through community based fisheries management alone. This indicates that more needs to be done to assist local communities – particularly in addressing land-based threats, infrastructure projects (causeways and wharfs), alternative income generating activities, outside fishers, climate change, sea level rise issues, and natural disasters.

### **6.5.1.1 Major Environmental Issues**

The observations of fishers in Taunga and Felemea that coastal erosion is a major environmental issue is supported by field observations and reconnaissance where coastal forest is sparse, mature trees are standing in the water, and wave action has dug into the land. Marine area leasing, pollution and reclamation were important threats to resources and their habitats in Manuka, and perceived by Manuka residents as major environmental issues whereas they were not in Taunga and Felemea. This was to be expected due to Manuka's close proximity to Nuku'alofa (capital) and several heavily populated villages along the eastern coast of Nuku'alofa (Tongatapu). The northern and eastern coastline are also very low in elevation, and in some areas, it is only 2–5 m above sea level. Reclamation of the coastal areas and seawalls are common features throughout the northern and eastern coastline.

#### **Perceived Trend of CPUE of Coastal Resources and Trend of selected Habitats**

Study results showed that perceived declining trend of coastal resources and habitat were related to the people of Tonga's resource use behaviour and the inability of the current management framework to deliver its responsibilities. Of significance, however, is the fact that the perceptions from the three areas were similar indicating that the perceived declining trend is a true reflection of what is actually happening. Similar problems are likely to be occurring in other areas of Tonga.

The reasons perceived for the declining trend in CPUE of fisheries resources and conditions of coastal habitats were overfishing and destructive fishing methods. Fishers from the three study areas did not see themselves as overfishing or practising destructive fishing, rather it was perceived that fishers from other villages and from the other islands of Tonga were causing the most damaging impacts.

Further, the Manuka community provided a very strong critique of the leasing of some of "their lagoon". This was leased without their being consulted and problems have arisen between the community of Manuka and the company when usual fishing grounds and boat routes were closed. For example, fishing boat propellers were caught in the nets used to farm seaweed or the boat ran into submerged iron rods left by the seaweed company. According to fishers of Manuka, when they remove these things they are accused of stealing and some are facing court cases. This conflict between fishers and the seaweed

farming company further demonstrates that communities affected by developments such as aquaculture, are not being consulted or involved in the planning for that development, let alone in the coastal lagoon leasing that is new in Tonga.

### **Views on Sustainable Resource Management and Quality of Life**

Fishers in the study locations were aware of the benefits, to their quality of life, of sustainable resource use and management, but, opinions from the three study locations pointed to a need for collective action at community, district and national levels in order to achieve sustainable resource management. This opinion further confirmed the community views that the coastal resources decline in both in fisheries and habitat, are caused by fishers from outside the study locations and the incapability of the existing management framework (the government) to effectively implement its sustainability objectives at the community level.

Sustainable resource use, from the perspective of the communities studied (Section 6.4.1.4), reflects a concern for resources availability at all times, but there is a very weak link to the management role of those who are using the resources daily (i.e., the communities themselves) apart from ‘perceiving’ that resources should be abundant for their use. It seems that if a community is concerned about being dependent on a single resource for livelihood, as is the case in the communities studied, it may lead also to a concern for better management. However, the concern for the future may be influenced by another overriding community perception that “nature would always provide” (Section 6.4.1.4). This is an example of what Rees (1990) described as society’s understanding of reality is shaped by unconscious facts, assumptions and beliefs. This perception that “God controls nature therefore will provide as God blessed Tonga” may result in poor or non-response to resource degradation, as was evident from the responses and discussions in all three study locations.

### **Community Management and Future Management Options**

Existing community committees were perceived to have little concern for ‘sustainability issues’. It was also surprising that for communities who rely on coastal resources as a means of livelihood, none of the existing committees were concerned with the community’s source of livelihood nor were coastal resources issues a focus of any committee. What was also unexpected is that although communities are aware that coastal

resources are declining, there seemed to be a general lack of appropriate responses to address that decline. This would appear to confirm that a lack of community involvement in the current management framework is influencing community views about their management role relating to local resources (i.e., it is not 'our role'). However, the lack of existing community management might be due to a lack of awareness of what could be done as a group to reverse the declining trends in coastal resources.

The Women's Development Committee in Manuka was considered to be strong in its concern for resource sustainability issues, but the activities that are currently undertaken by the women's committees focus on the 'human/urban environment', not on the natural environment and resources that support their welfare. Communities seem to be unaware that different management rules, skills and efforts apply when working with different types of environments. Further, it shows that environmental and resource awareness programs, promoted in the villages by the government or NGOs, may not be the most pressing issues in the community. The finding of this section suggests that the most pressing issue is coastal resource degradation.

The management option most preferred in all study locations is more community involvement and participation in resource management. For example, there were generally more participants in each location preferring greater involvement in the management of the coastal resources (as compared to their existing non involvement); establishment of 'an exclusive community fishing area'; and to restrict 'outsiders' from these areas. However, the extent of their involvement, the role of Manuka's neighbouring villages and other villages in Tongatapu, the future role of the government were identified at all locations as important issues to be addressed. Communities also identified the need for more relevant community awareness programs, better and more timely enforcement of existing legislation, tougher penalties for dynamiting, and the establishment of community conservation areas as management options. Assessments of community opinions like those found in this study are very limited in Tonga. This information is important for the development of any new management framework.

The people of Taunga were, nevertheless cautious of the high out migration rate and its possible effect on their capacity to manage coastal resources. This is a common problem observed in relevant national reports regarding the high out migration rate from the outer islands of the Vava'u and Ha'apai Groups. The 1996 Census recorded a - 0.9 % of average annual population growth rate between 1986-1996 for the Ha'apai group and

0.4 for the Vava'u group. However, Tuanga displayed a – 12.2 % and Felemea a –17.9 % average annual growth between 1986 and 1996 (GOT 1996 Census).

Manuka fishers raised a preference for an 'exclusive community fishing area' for the people of Manuka. This is a new concept for Tonga, and the concern raised by fishers showed that they were aware that it could lead to potential conflicts. Although communities are separated according to administration purposes, i.e., the census districts or a noble's estate, a noble's estate may spread over several districts, into urban and rural areas and over both main island and outlying islands. Marking legal boundaries therefore, for an exclusive fishing area for one 'community' has not been undertaken in Tonga. There is a need for in-depth community consultation and careful thinking about all aspects of this issue in Tonga. This study has shown, clear indications from the communities concerned that they are prepared and willing to be responsible for the management of the resources that provide for their livelihoods, and their general dissatisfaction with the effectiveness of the current management regime.

## **6.5.2 Condition of Coastal Habitats and Resources**

### **6.5.2.1 Water Quality**

The results obtained for faecal coliforms and nutrients at Taunga and Manuka (phosphorus, ammonia, nitrite and nitrate) are generally within accepted standards for seafood growing and recreational waters (in this case, primary contact such as swimming) as described in ANZECC (1992). While no standards were available for ammonia or nitrite, these could not be assessed in relation to international standards, so the values were assessed in general terms. Faecal coliforms and nutrients found at Taunga and Manuka were also generally low in relation to locations included in other studies carried out in Tonga (Table 6.4.9; Kaly et al., 2001a; Kaly et. al., 1998-2000). It is not clear whether these results would be similar for Felemea because the sites could not be sampled due to logistical limitations identified in Section 6.3.3.2.

Standard oceanic seawater has a salinity of about 35 ppt. The values of between 28 and 33 ppt found at the three study locations would be considered slightly low, but well within the range of normal coastal areas subject to rain and the proximity of freshwater inputs from land. The low salinities at Manuka are not surprising since the area is located close to Fanga'uta Lagoon in Tongatapu where salinities varied between 12 and 40 ppt over the



three years of a study (Table 6.4.9; Kaly et al., 1998-2000). The low values recorded at Taunga could be due to the effect of the heavy rain during the week of the survey or to tidal influence at the time of sampling. Rain and tidal influence are likely to lower salinity (Mosley and Aalbersberg, 2002). In general there was no sign of major stratification in the water as might be shown by differences in salinity between surface and bottom, and no evidence that any of the sites may be under unusual stress from nearby land areas that could affect coral and fish communities. Similar patterns and conclusions could be drawn from the results obtained for water temperature.

pH values are similarly difficult to assess for indications of overall ecosystem health because international standards have not been established. Despite this, the values obtained during this study were generally not extreme (i.e., most between pH 6 and 8) and would be considered within the natural range for coastal ecosystems. There was a slightly acidic condition recorded at Taunga where at one site a value as low as 4.3 was recorded. Compared with other locations examined during other studies, those obtained at Manuka, Taunga and Felemea compare favourably.

In terms of water clarity, the measurements made during this study show that the waters around the three study locations are of moderate clarity and within the range often found in lagoonal and waters near substantial landmasses or islands (Table 6.4.7). Given that Taunga and Felemea are small, and located in lagoonal areas open to the ocean, the values obtained here are surprising and indicate waters more turbid than would be expected. At Felemea the local fishers collect worms, shellfish and other fauna in the shallow nearshore habitats by digging. It is possible that this activity results in sediments being resuspended and in increased turbidity. Taunga and Felemea are also subject to disturbances caused by domestic pigs that forage in the nearshore environments during low tide (some of the sites at Taunga and Felemea were within 50m from the shore). Coastal erosion was also observed in Taunga and Felemea.

### **6.5.2.2 Seagrasses, Algae and Corals**

Seagrass was not present at many of the sites surveyed in all three locations. The presence of a heavy load of epiphytes at Taunga (76%) was considered indicative of stress. Most of the remaining seagrasses surveyed during this study were free of epiphytes (algae and other organisms) and appeared to be in good condition. The main seagrass species found during this study is given in Table 6.5.1.

Both the cover and diversity of algae, and cover soft corals recorded in this study seem comparable to studies in other similar coastal ecosystems in the Pacific (i.e., in Tuvalu and Fiji), (Kaly et al., 1996; Nunn et al., 1994). This may not be the case for the cover and diversity of hard corals (Table 6.5.1). An average cover of hard corals of 10% and a total diversity of around 10 species/types appears low for the habitats surveyed. In other studies carried out in similar habitats, percent cover is usually from 0 to 76 % and diversity of hard corals ranging from 0-13 species per transect (Kaly et al., 1999). This is not a definitive indicator because sites can vary greatly even under pristine conditions, but may suggest that the ecosystems may be under stress however, more evidence is required.

**Table 6.5.1 Main Seagrass, Algae and Coral Species Identified at All Locations Surveyed**

<b>Seagrass/Algae</b>	<b>Corals</b>
<i>Halodule uninevis</i>	<i>Diplofavus hiliopora</i>
<i>Halophila ovalis</i>	<i>Porites spp.</i>
<i>Halimeda spp. (segmented green algal)</i>	<i>Acorora spp.</i>
<i>Caulerpa spp.</i>	<i>Sarcophyton elegans (soft coral)</i>
	<i>Fungia spp.</i>

### **6.5.3 Comparing Community Perceptions with Measured Ecological Conditions**

The study found strong consistency in the perceptions of the three communities and the biophysical variables surveyed. The strong consistency suggests that the methods use for surveying coastal habitats condition accurately give indicative and baseline information at the time of the survey which could be the basis for further monitoring.

#### **6.5.3.1 Water Quality**

In terms of water quality, the people at Taunga generally felt that their water quality was good, but that it was lowered at the jetty in front of the village (Table 6.5.2). During the ecological survey it was found that water clarity may have been slightly lower than expected for an ecosystem of this type (open to oceanic waters) with secchi disc values of between 1.6-2m. It is possible that the overall water clarity in the area is influenced by southerly current and not by local conditions in the area. A strong tidal current was

observed running between the Vava'u mainland and Tuanga during this survey and confirmed by the Tonga Tidal Currents Chart (1980).

The ecological survey results also supported a community perception of lower water clarity near the jetty. Higher turbidity was recorded at the jetty and on the northwestern tip of the island (T1, T2). Other indicators of water quality from the ecological survey, such as coliform counts and nutrient levels indicated that liquid pollution is not an issue, yet. The islanders did not raise problems with liquid pollution at the time of the survey. The community did identify an emerging problem with solid wastes, particularly near the jetty area, and this was confirmed in the field observations.

The Felemea community considered their waters to be in good condition apart from the jetty area where visibility was perceived to decline over the last decade. Felemea also reported that after storms, the colour of the water changes (Table 6.5.2). The surface turbidity tube reading ranges from 75–100 cm with the lowest around the jetty at (F2) and (F3 and F4) (common fishing areas). More surveys are required at different seasons to establish patterns of water quality. A community perception of an emerging problem with solid waste was also confirmed in field observations.

Water quality at the village area and to the lagoon side (west of Manuka) was perceived by the community of Manuka to have declined markedly over the last decade. During the ecological survey it was found out that water clarity varied between 1.2 and 1.5 m (secchi values), the lowest from all locations surveyed in this study (see Table 6.5.2).

### **6.5.3.2 Seagrasses**

The communities of the three study locations have similar observations that seagrasses seem to appear and disappear over time. When they appear, they may grow in areas where they were not observed before, and seem to be healthy. The ecological survey of seagrass at all locations found that seagrass was patchy as well (Table 6.5.2). There is a need for ongoing surveys to determine the pattern of seagrass growth. Seagrass patches change over time and maybe unrelated to human activities, Another consideration could be related to the presence and nature of grazing animals (Bell and Pollard, 1989). Site (T2) at Taunga has a very high percentage of epiphytes cover, whereas epiphyte loads were near zero in Felemea at the time of the survey.

### 6.5.3.3 Corals

Communities of the study locations reported signs of coral damage and perceived that coral coverage has declined (Table 6.5.2). The people of Felemea reported that dynamiting still occurs and there are areas with signs of dynamiting (large holes in the reef). Coral diversity at all locations was perceived to be abundance. However, the ecological survey recorded in all locations an approximate total hard coral cover ranging from 3–22 % with at least one site in each location having no hard coral cover. In coral diversity, the highest was recorded in Felemea (nine species), seven species in Manuka and five in Taunga.

**Table 6.5.2 Public Concerns and Conditions Observed during the Study**

<b>Study Area</b>	<b>Issue</b>	<b>Public Concerns and Perceptions</b>	<b>Biophysical Conditions Observed during This Study</b>
Taunga	Water Clarity	<ul style="list-style-type: none"> <li>- Very clear apart from jetty area</li> <li>- increasing litter</li> </ul>	<ul style="list-style-type: none"> <li>- Water clarity was moderate (1.6-2m by secchi disc and uniformly 100+cm by turbidity tube). The secchi readings are not as high as expected for the conditions at this location. Using the turbidity tube, waters at the jetty area were the same as elsewhere, but by secchi disc, clarity was lower at the jetty and the northwestern corner of the island (T2 and T1).</li> <li>- Faecal coliforms were low and within the accepted standard and, however it could be a concern in the future</li> <li>Nutrients levels were low.</li> <li>Litter was observed intertidally and subtidally in the jetty area (T2).</li> </ul>
	Seagrass Coverage and Health	<ul style="list-style-type: none"> <li>-Seagrass seems to appear at areas where there were sand before over a period of time</li> <li>-The boat area is completely covered with seagrass now where it was not the case before</li> <li>- Seagrass seems to be healthy</li> </ul>	<ul style="list-style-type: none"> <li>- Abundant only at the jetty site</li> <li>- Patterns in the distribution of seagrass tend to be long term (20-30 years) and may have no connection with human activities, but alternate in occupying space with sandy areas dominated by holothurians</li> <li>- Heavily loaded with epiphytes, which may indicate stress also many species are known to vary greatly between years and may be grazed (Clarke et al., 1989; Bell and Pollard, 1989)</li> </ul>
	Coral Coverage and Diversity	<ul style="list-style-type: none"> <li>Reef flat close to the village is practically dead</li> <li>- different coral types seems to increase in some areas.</li> </ul>	<ul style="list-style-type: none"> <li>- Hard coral cover and diversity may be low as compared to similar conditions in other areas.</li> <li>- signs of coral damage (i.e. coral breakage and dead coral) was observed</li> <li>- some new growth was observed but of the same species as of the existing coral species present</li> <li>- perceived community increased could be accounted by the soft corals and sponges observed where community regarded those as coral diversity and increases in coverage</li> </ul>
Felemea	Water Clarity	<ul style="list-style-type: none"> <li>-Water clarity in the boat area has declined a lot</li> <li>- After heavy rains the water colour changes brown</li> <li>- solid waste seems to increase</li> </ul>	<ul style="list-style-type: none"> <li>- Water clarity was low in surface waters at sites F2, F3, F4 on the south-western (close to the village)</li> <li>- Bottom waters were clear at all sites</li> <li>- Secchi disc results show good overall water clarity of 2.2m + .</li> </ul>
	Seagrass Coverage and Health	<ul style="list-style-type: none"> <li>-Seagrass appear and disappear</li> <li>- Seagrass seems to be healthy</li> </ul>	<ul style="list-style-type: none"> <li>- Seagrass cover was between 30-55% at three sites at Felemea (F1, F2, F5) and zero at other sites.</li> <li>- Epiphyte loads were near-zero.</li> </ul>

<b>Study Area</b>	<b>Issue</b>	<b>Public Concerns and Perceptions</b>	<b>Biophysical Conditions Observed during This Study</b>
	Coral Coverage and Diversity	<ul style="list-style-type: none"> <li>- Signs of coral damage are increasing (breakage, big holes, and some changes in colour)</li> <li>- Live coral coverage seems to be decreasing in some areas</li> <li>- There are many different coral types that can be seen (different shapes)</li> </ul>	<ul style="list-style-type: none"> <li>- Hard coral cover and diversity may be low for the conditions at the island.</li> <li>- Evidence of dynamite fishing was observed.</li> <li>- Perceived increase in coral types could be due to the same condition in Taunga.</li> </ul>
Manuka	Water Clarity	<ul style="list-style-type: none"> <li>- Water clarity in front of the village and towards the lagoon side has declined significantly</li> </ul>	<ul style="list-style-type: none"> <li>- This location is near eastern side of Fanga'uta Lagoon for which low clarity and water quality has been well-established (Pelesikoti et al., 2001).</li> <li>- Water clarity by turbidity tube was slightly lower at M3 and M4, and by secchi disc, clarity varied between 1.2 and 1.6m, the lowest of all locations surveyed.</li> </ul>
	Seagrass Coverage and Health	<ul style="list-style-type: none"> <li>- Seagrass seems to be patchy and appear and disappear</li> <li>- When they appear they seems healthy enough</li> </ul>	<ul style="list-style-type: none"> <li>- No seagrasses recorded at surveyed sites at this location. It could be due to seasonal variations.</li> </ul>
	Coral Coverage and Diversity	<ul style="list-style-type: none"> <li>- Live coral coverage is declining as compared to the last decade</li> <li>- The same types of corals in different shapes as before</li> </ul>	<ul style="list-style-type: none"> <li>- Low to moderate cover (0-15%) and diversity of up to 7 species/types.</li> </ul>

#### **6.5.3.4 Communities' Perception of Coastal Resources as a Basis for Future Management**

The results showed reasonable consistency between community perceptions of habitat trends and the conditions found and observed during the ecological survey in each study location.

Although this study is a singular survey only and the first to establish such data and information in Tonga, the following observations were made:

- communities perceived coastal fisheries resources to be declining;
- biophysical conditions in all locations at the time of the survey indicated some agreement between community perceptions and the observations made;
- communities are very aware of the general changes that occur in coastal resources;
- communities perceptions of ' increased coral diversity' differ with the findings of the ecological surveys where coral diversity at all sites was found to lesser than in other similar sites (Sections 6.5.2.2 & 6.5.3.3).

- based on the discussions with communities, there is a possibility of establishing a community monitoring program to assess changes in key habitats and resources;
- there is a need for long term monitoring of biophysical conditions of coastal resources to establish relationships between community perceptions and biophysical conditions for management purposes;
- there is a need for community awareness of the impacts of communities resource use pattern and behaviour concerning the habitat/resources biophysical conditions;
- there seems to be a lack of appropriate responses from the part of the communities' to the perceived decline in coastal fisheries resources;
- sustainable resources coastal management seems to be a low priority within existing community committees;
- the communities surveyed are aware of their lack of involvement in coastal resources management and are keen and showed interest, but need some assistance in how to go about it.

### **Priorities for Community Sustainable Resource Management**

The suggestions made by the communities themselves to improve the condition of coastal resources should be included in any future national management framework. In the three study locations, people, whose livelihoods depended on the exploitation of coastal resources preferred more involvement in management, stricter enforcement of existing rules, and appropriate community awareness and education programs. The views of communities studied that the existing management regime is incapable of delivering the required management is indicated by the managers' lack of presence, contact or response at the community level. Communities, therefore, want to be responsible for the management of the resources that provide for their livelihoods (Table 6.4.5). Generally, the management priorities recommended by the communities can be summarised as:

- Community information – the study shows that the communities are not aware of the existing legislation, who to contact in government agencies, and the processes to follow. This is a reflection of the weakness in current management, where the information that community should know is not reaching them;
- Stricter enforcement – the study indicates that destructive fishing methods is one of the most important threats to coastal area. For example, if existing regulations regarding dynamiting, fishing net sizes, closed season for some species etc., are not

enforced consistently, this will continue to undermine efforts to nurture and conserve resources;

- Community management – the observations of fishers in all study locations that community committees have a limited concern for sustainability issues is supported by the lack of community committees or any other arrangement to address coastal resource management issues, and by the lack of appropriate government programmes at the community level. The most suitable management option for sustainable coastal resource management will involve more community input and participation in relevant policy decisions, which would lead to support, and actual involvement in the implementation, on the grounds of those decisions.

### **Site-Specific Characteristics that should be Considered in Management**

Based on the results of Part 1 and Part 2 of this chapter, site-specific characteristics to consider in management could be divided into two groups: socio-economic and ecological.

#### **Socio-economic Characteristics**

Several socio-economic characteristics were identified during the course of the community survey. High out-migration was a concern raised in Taunga and the survey team observed numbers in households in Felemea had decreased since the last census, whereas Manuka seems to be increasing in population (Table 6.1.1). Any management framework developed should consider population movement and distribution in the outer islands and the main islands of Tonga.

The lack of alternative sources of income could mean that there is pressure on coastal resources resulting in resource degradation, or contributing to the high out-migration rates. Handicrafts, especially the weaving of fine mats, appear to have potential in Taunga and Felemea. Attention to the status of the resource i.e., pandanus<sup>13</sup>-- *Pandanus whitmeanus*, is needed early to ensure sustained harvesting and replanting schemes. Other forms of income generating opportunities should be investigated.

There seems generally to be a high level of 'dependence', either on the government or on 'nature', to provide a management role or to mitigate resource degradation. This general 'mind set' could be common throughout Tonga and may be linked to the widespread indications of environmental and resource degradation. It is important for any new policy framework to consider empowering the communities through various mechanisms

appropriate to Tonga. If the communities are aware of the issues, have reliable information and the right skills, they would be confident to act.

Solid waste appears to be a concern in all study locations. Participants complained about increased amounts of rubbish finding their way into the coastal areas. It was also observed to be a problem, and appropriate waste minimization habits at the household level should be considered.

Leasing of community fishing grounds to a commercial aquaculture company was an issue in Manuka, leading to social conflicts. Aquaculture opportunities and the involvement of the communities is important, and could be considered as a means to relieve pressure on other already heavily fished resources, providing alternative income to the community. The potential ecological impacts of aquaculture, however, need to be carefully considered.

### **Ecological Characteristics**

It is clear from the ecological survey carried out that there is an urgent need for longer term monitoring, leading to formulation of appropriate action programs at the community level, and provision of reliable information to decision makers. However, monitoring has to be related to community priorities and issues with a clear aim of contributing to addressing these priorities or issues and to justify the resources requested to be spent in monitoring.

Impact of different marine activities on corals and seagrass (i.e. fishing landings and methods in all locations, live coral export and aquaculture in Manuka) are to be monitored to provide an information base for the development of appropriate management plans at the community and national level.

The species assemblages and any associated and changes of 'grazing animals' is an important factor to monitor to gain better understanding of fish assemblages and fisheries associated with coral reefs and seagrasses, and the distribution and changes in their biophysical conditions.

The ecological value of coral diversity should be the focus of a 'community awareness program' together with coral health, coral coverage and threats to coral reefs in Tonga. This appears to be relevant to the communities' understanding of the interrelationships of coastal ecosystems and coastal fisheries.



Monitoring of ‘unimpacted’ (pristine areas not fished) sites as control sites is important to determine the impacts of climate change; sea level and extreme weather (natural phenomena – cyclones, increase temperature etc.) would be useful for management purposes at the local level.

Loss of mangrove areas was identified as an important issue in Manuka. Mangrove replanting schemes could be considered for Manuka. Similarly, coastal erosion was considered an important issue at all locations. Coastal reforestation and protection programs developed at the community level for the community could address this issue.

Field observations (Table 6.1.1) and community ‘preferred management priorities (Table 6.4.5) suggest that setting up community protected or conservation areas could address problems identified such as lack of involvement in management, loss of fisheries resources (conservation or protected areas could provide a breeding area and shelter for marine species). This would lead to biodiversity conservation.

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<sup>1</sup> With the experience of the researcher in Tonga, communities have often talked about being weary with community surveys after community surveys and at times have little time to do their own activities. Some have developed sceptical view and always refuse to participate or others have developed expectations that there would be fee paid to them to participate in surveys usually when they know that non Tongans are in the survey team or conducted by non Tongans altogether.

<sup>2</sup> From an ecological perspective ‘Auhangamea Passage and numerous other passages in the Ha’apai group create a situation where the planktonic eggs or larvae emanating from spawning or a wide range of marine organisms, in or near the passages, could settle virtually anywhere in the Ha’apai group due to the movement of currents in the passages. If, however, flows through such passages are blocked or impeded, there could be a very negative impact on the replenishment of a wide range of marine species, something that local communities of Felemea believed to happened after the construction, in the mid-1970s, of the causeway over the ‘Ahanga passage linking Lifuka and Foa. The causeway was destroyed by the 1982 cyclone Issac.

<sup>3</sup> In this way, the discussion is kept at a objective level and not being unnecessarily influenced by a ‘dominant figures’ single view.

<sup>4</sup> Male and female fishers usually fish at different times, using different techniques and tend to fish among themselves (i.e., females fish together and males tend to have their own male group fishers). In some cases female and male fishers may go in the same boat to a reef or island to fish but when they get there, they separate into male and female groups, or the husband may dive while the wife glean the reef (pers. obs)

<sup>5</sup> ‘*Toulalanga*’ is a Tongan word for when women get together to weave fine mats. This is usually done in groups of 5 to 10.

<sup>6</sup> *Kava* is a traditional drink where men sit around in a circle and drink while discussing any issues of interest to them in the evenings or even have a community or church meeting while drinking *kava*.

<sup>7</sup> The ecological sustainable development philosophy for the protection of aquatic ecosystems suggested that, ideally, it should be that level that guarantees the future evolutionary potential of species and ecosystems. All development is likely to cause some loss of genetic component of biodiversity, to reduce overall populations of some species, and to interfere to greater or lesser extent with the ecosystem processes.

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Protection of biodiversity means ensuring that these factors do not threaten the integrity of ecosystems or the conservation of species (Biodiversity Working Party (1991) cited in ANZECC, 1992).

<sup>8</sup> Pearch et al. (1989) cited in ANZECC (1992) suggested that... “ecological integrity is maintained when the productivity, stability and resilience of the system are sustained, that is, when the system is ‘ecologically healthy’ and has the capacity to perform all essential ecological processes. A system has ecological integrity when it has the ability to maintain evolutionary potential in the long term. When the ecological integrity of a natural system is reduced, the capacity of that system (and species within it) to survive change is also reduced. An indicator of ecological integrity is the degree to which ecosystems have been altered from their natural state. However, defining ‘natural state’ is problematic” (p.2).

<sup>9</sup> Physico-chemical water quality guidelines are necessary to protect ecosystems, to facilitate discharge controls and to identify problem contaminants in water. The Australian Water Quality Guidelines have separated physico-chemicals indicators into two groups: toxic and bioaccumulated chemicals and other physico-chemical indicators. The latter is used in this study.

<sup>10</sup> Fish are sold in Tonga in strings – that is the fish or lobster is strung in a piece of string or wire and depending on the size of the fish, a string could have 8-10 or more fish if it is small fishes (about 16 cm and less from head to tail) or less for the bigger ones (above 16 cm). The price of one string then depends of the type of fish and the size of the fish. Mullet is a favourite fish, therefore a string of two large mullets (about 30 cm each in length or more) would be \$T20.

<sup>11</sup> “Free” here means fisheries resources are not sold for money to the relatives as it is considered “bad manners or foreign manners” if you sold things to your relatives at times of celebrations (weddings, birthdays etc) or in grieving (funerals). However, you also expect your relatives to do the same by returning the same favour to you and your family.

<sup>12</sup> “Better life” was defined in the community workshops as being able to regularly have fresh seafood in daily meals, having money to pay children’s school fees, and meet church and community obligations, being able to save money from marketing of fisheries to buy a fishing boat, to build a better house, and in general to have money to be able to have choices in life.

<sup>13</sup> In Tonga fine mats play a very important part in all cultural ceremonies and celebrations. There are different species of pandanus and those species have hierarchy according to the type of mats they are made into. There are mats for chiefly occasions for instance, and only certain type of pandanus are used etc.

## **CHAPTER SEVEN**

### **A POLICY FRAMEWORK FOR SUSTAINABLE RESOURCE AND ENVIRONMENTAL MANAGEMENT FOR TONGA**

#### **7.1 Introductions and Aim**

Tonga is a small archipelago with densely populated islands. Its economy depends on the primary use of limited land, coastal and marine resources. These factors, among others, have led to major pressures on the environment. The earlier sections of this study concluded that the existing environmental protection measures, based on regulatory control and the capacity of the government, had largely failed to achieve a national goal of sustainable development first presented in Development Plan Six (1991-1995).

The new Policy Framework for Sustainable Environmental and Resource Management developed in this study is a national strategy for the environment, which aims to achieve sustainable development in Tonga. It establishes key environmental management themes, and strategies to ensure that objectives are achieved. The policy framework is characterised by a management approach to environmental problems, involving:

- the adoption of sustainable development as a general target;
- the integration of the environment into decision making by all sectors;
- formalising effective community participation in the policy development process;
- clear identification of responsibility for actions;
- new legislation and amendments to existing laws;
- institutional reforms;
- a commitment to reshaping of community attitudes; and
- a recognition of Tonga's dependence on international cooperation and action.

WCED (1987) established the need for appropriate assistance from the international community to assist small island states to achieve the national objectives and those of Agenda 21 (chapter 2, Section 2.2.1).

The aim of this chapter is to present a new policy framework for sustainable environmental and resource management for Tonga. The new policy framework established here not only addresses national sustainable development issues but it should better prepare Tonga for effectively addressing the objectives of Agenda 21, the Barbados Action Plan, and the recent WSSD.

### **7.1.1 The Process for Establishing the New Policy Framework**

The earlier sections of this study provide the basis for developing and establishing the new policy framework. Chapter 2 provided the theoretical basis for environmental policy and management improvement through coordinating the effort of various stakeholders and communities. The section dealing with the state of the environment of Tonga (Chapter 3) described the pressures and the activities that cause environmental problems in Tonga (a summary of the problems can be found in Appendix 24), and Chapter 4 analysed the current management framework. The findings of these chapters were incorporated into community surveys to canvass community environmental and resource use practices, perceptions, problems, priorities, and management preferences and options (Chapters 5 and 6).

Community environmental priorities and problems (identified in the previous chapters) have been grouped (Table 7.1.1) according to the sources of the issues or problems. These groupings of environmental problems form the sustainable management themes for the new policy framework. This study considered that addressing environmental problems at their source is more efficient and effective than attempting to mitigate the complex and inter-related environmental impacts which result from human activities and natural phenomena. This study also considered that such an approach makes clear who is responsible (target groups) for the necessary action, and enables environmental actors (policy makers, businesses, communities) to focus on environmental protection measures or sources of pollution and degradation rather than on their multiple environmental impacts. This approach is considered more appropriate for Tonga, considering its limited

financial and skilled manpower capacity. A 'time scale' and 'resources required' for implementation are also considered.

'Target groups', as used in this study, refers to a range of key groups in the context of the 'source' addressed. It refers to groups causing resource depletion that is commercial farmers and fishers or polluters (e.g. coastal dwellers or manufacturers). Target groups may include a community that has raised a particular issue as having high priority a group, with specific environmental skills, a government agency having legal responsibility to manage a particular resource or pollutant as a result of resource use, or a non government organisation (NGO) that is active, has skills and interest in environmental activities that may lead to environmental problems.

'Time scale' is an indication of timely actions necessary for strategy implementation. The time scale proposed also considers the likely delay between taking action and adequate addressing of the environmental themes. 'Phased' targets, allow the people of Tonga time to understand the policies, and provide milestones to monitor progress. 'Resources required' considers skilled manpower, financial, and technology resources needed.

### **7.1.2 Sustainable Management Themes**

The 'sustainable management themes', or priority areas, are further divided into policy goals, management objectives and action strategies to address the source of environmental problems under each theme (Table 7.1.1 and Figure 7.1). The strategies define the action required to achieve the objectives and identify the target group responsible for implementing the strategies. These themes are the key to the policy development process; they help to identify what policy to develop, the actors, the appropriate policy instrument needed, and how to enforce the policy.

It is noted that one 'source' could cause several environmental problems and an environmental problem could originate from several sources. In order to avoid repetition, a source is only discussed once. An environmental problem is also only addressed once in the theme most closely related to the problem.

**Table 7.1.1 Summary of Key Sustainable Resource and Environmental Management Themes and Identified Priority Problems Addressed under each Theme**

Environmental Themes	Problems	Summary of Key Findings of the earlier Chapters of this Study
<b>Policy Planning Process</b>	<ul style="list-style-type: none"> <li>• Lack of a sustainable development policy</li> <li>• Lack of consistency, transparency and coordination in policy making</li> <li>• Policies are based on what is assumed by policy makers</li> <li>• Lack of public input to the policy process</li> <li>• Policy making is based on project activities and the policy ends with the life of the project</li> <li>• Policy making bodies are duplicating each others functions</li> </ul>	<ul style="list-style-type: none"> <li>• Identified as the major weakness in Chapter 3 and 4</li> <li>• Only 45 % of respondents strongly agree and agree that government has set clear sustainable development policies while 50 % strongly disagree and disagree and 16 % are not sure</li> <li>• Only 24 % of respondents strongly agree and agree that government has the capacity to implement sustainable development policies throughout Tonga while 62 % strongly disagree and disagree and 15 % were not sure</li> <li>• (Refer bullet points on legislation)</li> </ul>
<b>Legislation</b>	<ul style="list-style-type: none"> <li>• Old/irrelevant legislation</li> <li>• Lack of enforcement/ lack of resources for enforcement/no clear roles for enforcement officers/departments</li> <li>• Lack of environmental protection requirement</li> <li>• Penalties and fines are too small in most cases</li> <li>• Lack of awareness of the legislation</li> </ul>	<ul style="list-style-type: none"> <li>• Identified as a major weakness in Chapter 3 &amp; 4</li> <li>• 5 % of respondents perceived that there is lack of enforcement and inappropriate and outdated environmental legislation and policies</li> <li>• 35 % of respondents prioritised attention to legislation related problems as the single most important initiative for government's attention</li> <li>• 11 % of respondents call for enactment of appropriate legislation and policies</li> <li>• 51 % perceived lack of enforcement of existing legislation as the cause of environmental problems in Tonga</li> <li>• More than 60 % perceived that legislation regarding land leases, littering, tourism, protected areas, fisheries, sand mining, forestry and agriculture was too lax</li> <li>• Larger proportion of respondents from the outer islands regard existing legislation as too lax, which confirmed the concentration of the central government activities in the capital and in the main island of Tongatapu</li> </ul>
<b>Waste Disposal</b>	<ul style="list-style-type: none"> <li>• Litter</li> <li>• Solid waste/sewage pollution</li> <li>• Hazardous waste disposal (medical waste, waste oil, batteries)</li> <li>• Transboundary movement of hazardous waste</li> <li>• Lack of monitoring of the impact of waste and pollution on the environment and on health</li> </ul>	<ul style="list-style-type: none"> <li>• 29 % of respondents ranked solid waste as the most important environmental issue in Tonga today</li> <li>• A further 10 % ranked other sources of pollution (sewage, waste oil, water pollution, batteries) as the most important environmental issue in Tonga today</li> <li>• 42 % of respondents ranked litter and dumping of rubbish in public places as the priority environmental problems among specified environmental problems, a further 21 % prioritised waste from business and service stations, a further 18 % prioritised household rubbish and garbage, a further 15 % prioritised wasteful packaging, and a further 11 % prioritised sanitation and waste water</li> <li>• Waste and related problems were identified as high priority problems by respondents from Nuku'alofa and Neiafu</li> <li>• 15 % of respondents believed that the single most important environmental initiative for government action over the next few years should be to deal with pollution problems</li> <li>• There is a very high number of respondents (74 %) who believed that litter problems in Tonga are mainly caused by people's attitude towards rubbish</li> <li>• Only 5 % of respondents believed that management of household waste has improved over the past five years; while 83 % of respondents believed that dealing with waste from companies/ businesses has become either worse or much worse; similarly 75 % believed that household waste has become worse</li> </ul>

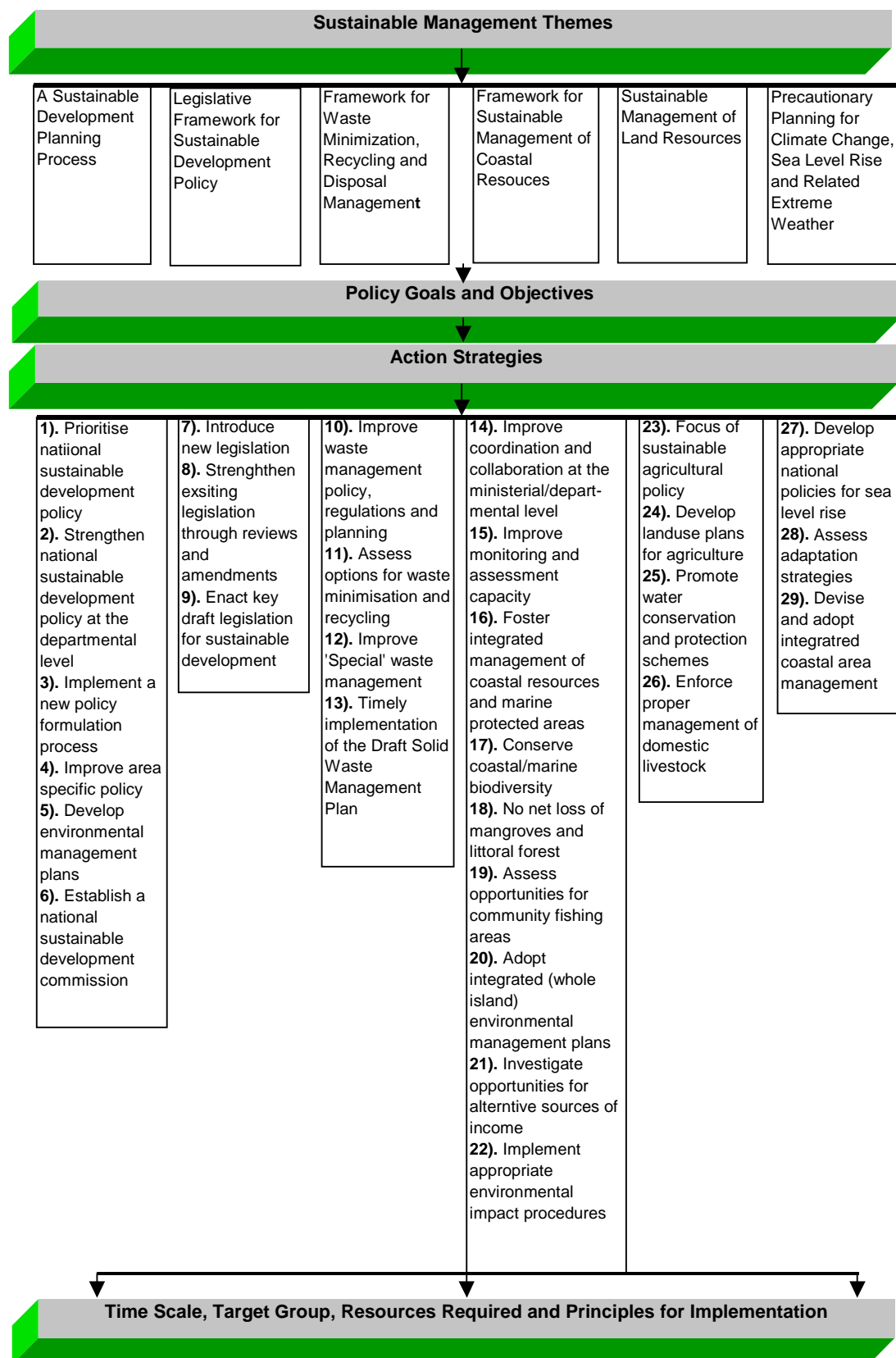
Environmental Themes	Problems	Summary of Key Findings of the earlier Chapters of this Study
		<p>and 67 % of respondents believed that dealing with the litter problem in general has become much worse.</p> <ul style="list-style-type: none"> <li>• A fairly low percentage of respondents (19 %) believed that they would definitely know how to start a compost heap.</li> <li>• Tunga, Felemea and Manuka study areas all identified pollution and waste related problems as a main problem related to coastal areas</li> </ul>
<b>Coastal Resources Depletion</b>	<ul style="list-style-type: none"> <li>• Lack of reliable information and data collection to assist decision making</li> <li>• Diminishing coastal fisheries</li> <li>• Habitat destruction,</li> <li>• Coastal pollution</li> <li>• Reclaiming mangroves areas and wetlands</li> <li>• Commercial fishing and destructive fishing methods/techniques (dynamiting)</li> <li>• Fishing area leasing, aquarium export of live species</li> <li>• Lack of community participation in coastal fisheries management</li> <li>• Lack of exclusive community fishing areas</li> <li>• Lack of marine protected areas</li> <li>• Lack of resources to manage existing marine protected areas</li> </ul>	<ul style="list-style-type: none"> <li>• Establishing trends of the state of coastal resources was difficult due to the lack of reliable data</li> <li>• 20 % of respondents survey ranked coastal/marine degradation as the most important environmental issue in Tonga today</li> <li>• Among specified environmental problems, 20 % ranked pollution of coastal and marine areas as one of the two most important issues in Tonga today, while 12 % nominated loss of coastal forest and mangroves, 11 % nominated over fishing, 7 % nominated damages to coral reefs and 6 % nominated sand mining as on the two most important issues in Tonga today respectively</li> <li>• Coastal/marine degradation was mentioned as a high priority local concern by 28 % of respondents from Ha'apai, 16 % from Vava'u and 14 % from Tongatapu</li> <li>• A relatively high percentage of respondents (70%) perceived that mangroves do not have any value</li> <li>• A fairly low (about 11) % of respondents believed that the abundance and quality of coastal fisheries and resources have improved</li> <li>• Run-off into the harbour was a major problem identified in Vava'u</li> <li>• All the three communities (Manuka, Taunga &amp; Felemea) surveyed in this study perceived the CPUE of key coastal fishery to be declining as compared to the last decade and the conditions of coastal habitat to be also declining</li> <li>• Coastal deforestation was also observed to be a problem in Taunga, Felemea and Manuka</li> <li>• Destructive fishing methods such as dynamiting was perceived as a major threat to coastal resources and habitats in Taunga, Felemea and Manuka</li> <li>• Although 33 % of respondents claimed that they have changed their behaviour and fenced their pigs, a high percentage still claimed that roaming pigs is a major problem</li> </ul>
<b>Land and Water Degradation</b>	<ul style="list-style-type: none"> <li>• Lack of monitoring and data collection in the outer islands. Most surveys are concentrated in Tongatapu</li> <li>• Soil structure breakdown</li> <li>• Soil erosion</li> <li>• Deforestation</li> <li>• Loss of medicinal and culturally important plants</li> <li>• Excessive use of pesticides and fertilizers</li> <li>• Ground water pollution</li> <li>• Lack of community forest</li> <li>• Loss of habitat and wildlife</li> <li>• Mechanisation/commercial agriculture</li> <li>• Uncontrolled domestic animals (pigs, etc.)</li> <li>• Lack of land use planning</li> </ul>	<ul style="list-style-type: none"> <li>• State of the Environment reporting requires systematic monitoring</li> <li>• 17 % of those interviewed stated that land degradation is the most single important environmental issue in Tonga today</li> <li>• 19 % of respondents regarded soil erosion and land degradation as one of the two most important issues in Tonga today among specified list of environmental problems, while a further 18 % regarded loss of forest and culturally important trees as one of the two most important issues, a further 17 % believed that poor living conditions in low lying areas and a further 16 % believed that problems with domestic animals are among the two most important environmental issues in Tonga today, and 9 % regarded improper and excessive use of pesticide and agro-chemicals as one of the two most important environmental issue in Tonga</li> <li>• Land degradation was the overall highest environmental issue identified in local areas and also the highest from Tongatapu and Ha'apai</li> <li>• 80 % of respondents believed that many of native birds and plants in Tonga have become extinct</li> <li>• 69 % of respondents are aware that composting provides good nutrients for plant growth</li> <li>• 61 % of respondents believe that deforestation is a severe problem in Tonga</li> <li>• A very high percentage of respondents believed that the fresh water quality is much better as compared</li> </ul>

Environmental Themes	Problems	Summary of Key Findings of the earlier Chapters of this Study
	<p>Note: transport, storage, disposal of hazardous chemicals could also affect coastal resources</p>	<p>with five years ago</p> <ul style="list-style-type: none"> <li>• Transport, storage and disposal of hazardous chemicals were perceived by 69 % of respondents to be much worse now as compared with five years ago</li> <li>• 69 % of respondents viewed that attention to soil conservation is much worse or worse</li> <li>• 66 % perceived that protection of engendered plants and animals (wildlife) is much worse or worse</li> <li>• 57 % believed that dealing with the problems of free roaming domestic animals is much worse or worse</li> <li>• 7 % of respondents regarded salt water intrusion into the water source as a problem</li> <li>• 52 % of respondents believed that one of the main causes of environmental problems in Tonga is that there is not enough land for the government to distribute</li> </ul>
<p><b>Climate change/ sea level rise and extreme climatic conditions</b></p>	<ul style="list-style-type: none"> <li>• Inundation</li> <li>• Sea spray</li> <li>• Salt water intrusion</li> <li>• Storm surges</li> <li>• Coastal erosion</li> <li>• Droughts</li> <li>• Increased frequency and intensity of cyclones</li> </ul>	<ul style="list-style-type: none"> <li>• 44 % of respondents nominated infrastructure development as the second most important priority for government's attention that implies taking into consideration sea level rise scenarios when building coastal infrastructures</li> <li>• 13 % of those interviewed stated that climate change and sea level rise and associated problems are the most important environmental issue in Tonga today</li> <li>• 7 % regarded climate change, sea level rise and associated problems as a priority problem in the local area in all study locations (Tongatapu, Vava'u, Ha'apai and the outer islands)</li> </ul>

Source: Summarised from this study's Chapters 3, 4, 5 & 6



**Figure 7.1 A Policy Framework for Sustainable Resource and Environmental Management for Tonga**



## **7.2 The Policy Framework for Sustainable Resource and Environmental Management**

The following discussion is based on the policy framework for sustainable environment and resource management (Fig. 7.1) Figure 7.1 was derived from Table 7.1 and the process explained in Sections 7.1.1 and 7.1.2.

### **7.2.1 Theme One – A Sustainable Development Policy Planning Process**

The sustainable development policy theme embraces the weakness in the current policy planning process, inconsistencies in government policy, lack of sustainable development policies and inappropriate policy instruments. Sixty six percent of the people interviewed (Chapter 5, Section 5.5.8) believe that one of the possible causes of environmental problems in Tonga is due to the low priority government is giving to the environment. As a result, planning and implementation of sustainable development policies and measures are not a priority, remain uncoordinated, and are invariably fragmented (as discussed in Chapter 4, Section 4.3.2).

Two major themes provided the underlying rationale for the practical application of effective and constructive stakeholders' dialogue, consultation and participation in policy making for sustainable environmental and environmental management in Tonga. These are the perspectives that effective policy making be based on constructive dialogues (Chapter 2, Section 2.5.2) (ANOP, (1991); Marsh, (1995); and Papadakis, (1999) and the theory on participatory management approaches (Chapter 2, Section 2.3.2). The communities form the society support base for sustainable development policies. It is they who should largely determine how ambitious the policy should be and which measures are acceptable. The communities are also resource users, consumers and generators of litter or pollution; therefore, the public as a group, contributes to several of the environmental themes (Imperial, 1999).

#### **Policy Goals:**

- ❖ Establish a framework for the improvement of the policy making process for sustainable resource and environmental management (sustainable development) in Tonga; and

- ❖ Restore, conserve and develop the specific natural resources properties of given areas.

### **Objectives**

The main objective of environmental policy is to improve the well-being and living standards of a community, society, or country (Agenda 21). ‘Sustainable development’ as defined by the draft EIA Bill of Tonga (Chapter 2, Section 2.2.1.1) and the communities in Tonga (Chapter 6, Section 6.4.1.4) have common elements of concern for maintaining the quality of the environment and maintaining the supply of resources for present and future generations. The Tonga definition of sustainable development, which mirrors the Brundtland Report definition (WCED, 1987) suggests that to improve the well-being and living standards of the people of Tonga, the quality of the environment and availability of resources must be maintained or improved.

The objectives of the new policy process, based on the problems defined in this study, and emphasised in the new framework, are to:

- gather public support for sustainable development policy through open consultation in policy making;
- improve the process of decision making through devolution of decision making to divisional committees and communities affected by each decision;
- strengthen mechanisms for putting ‘matters of public concern’ on the agenda through the development of divisional environmental plans; and
- improve inter-ministerial coordination at the national level.

#### **7.2.1.1 Action Strategies**

##### **Strategy 1: Prioritise National Sustainable Development Policy**

There are several underlying problems with the existing policymaking process as described in Chapter 4, Section 4.3.2.1, Figure 4.2 and summarised in Table 7.1.1. The following strategies are developed to ensure that the objectives (stated above) are achieved.

Sustainable development outcomes will not be realised if there is no sustainable development policy. The Tonga 7 Strategic Development Plan (Chapter 1, Section 1.2.3) showed that between DP 6 (1991-1995) to the current Plan, sustainable development is stated as a fourth ranked national goal following the goals of increased economic growth, generating more employment, raising health standards and improving the education system.

Despite having economic growth as national priority goal ever since the first Development Plan (1960s), Tonga's economic growth has been on a downward trend since the early 1990s (Chapter 3, Section 3.3.3.4). It has been difficult, however, for the government to acknowledge that this downward trend also reflected the condition of the resource base that provides the basis for Tonga's economy (apart from remittances from Tongans overseas which are also declining). Booms and busts of the commercial agriculture sector are not totally controlled by the overseas market, they are also related to diseases and pests of the bananas, vegetables, and now pumpkin exports and soil degradation. Tonga's economic growth in real terms is short-lived as such growth also produces environmental pressures. Tonga's sustainable development policy then, should aim at sustainable economic growth while environmental pressures are reduced or remain constant.

This strategy requires a shift in the Tonga's development paradigm or mindset – from economic growth to sustainable economic growth or sustainable development. Ample lessons should be learned from the negative economic growth of the last decade (still happening) and from the obvious signs of environmental degradation in Tonga (Chapters 3, 5 and 6). Twenty-six percent of the adult population of Tonga believed that the environmental quality in Tonga is a little worse or much worse compared with 5-10 years ago. Another 26% believed that the environmental quality is the same, i.e. no improvement from 5-10 years ago (Fig 5.3). Similarly, the three communities surveyed on perceptions of coastal resources and habitat trends believed that coastal resources and habitats have declined when compared with the last decade (Chapter 6, Sections 6.4.1.2 and 6.4.1.3).

#### **Strategy 2: Strengthen National Sustainable Development Policy at the Departmental Level**

As a response to the national sustainable policy government, agencies vital for the implementation of this policy should also have a sustainable development policy. This is to allow the government agencies to translate the national policy into appropriate actions.

Although national sustainable development policy has been established since 1991(DP 6) these policies were not incorporated into the annual work program of the relevant government departments and boards. Each ministry and department pursues its own work program according to sector interests and priorities.

Therefore, it is crucial that the National SDP objectives are implemented and pursued in the annual work plan of government agencies and for this to happen, government departments should have the same priorities and objectives as those of the SDP. A national policy of sustainable development, established by the SDP, should also be reflected in the ministry/department level policies and objectives.

The government, as a priority, should specifically target the integration of national development policy considerations into sectoral ministries policies and work plans. Government agencies should have in place, mechanisms to review their own policies against the national objectives stated by the SDP. The objective is to identify strengths and weaknesses at every stage of the policy process, from first concepts to instruments, actions and enforcement.

If ministerial and departmental objectives are to form part of a cohesive policy framework, it is essential for government agencies to put sustainable development objectives in relative order of priority in terms of what each agency aim to do to achieve the national development policy. It is also necessary to define objectives in terms of indicators, which can be used to measure progress towards the achievement of each objective. These indicators should be defined in terms of the quantity, quality and time, and should be objectively verifiable. It is important that indicators have certain qualities, which increase their ease of use and effectiveness, considering Tonga's lack of skilled manpower and resources. Indicators should:

- be simple to understand;
- be easy to measure;
- be as objective as possible;
- measure something which is important;
- be sensitive enough to measure change; and
- measure something specific and not be too pervasive.

(OECD,1994; Harvard, 1996; Campbell, 1996; Granados & Peterson, 1999).

### **Strategy 3: Implement A New Policy Formulation Process**

Based on the problems faced with the existing process (described in Chapter 4, Section 4.3.2), a new process is recommended. There is a need to review the terms of reference of each Development Committee to emphasise their policy formulation and advice to Cabinet roles. A national policy on sustainable development could still be the responsibility of DCC and CDP, but Divisional Development Committees (VDC, HDC, NDC & EDU) should concentrate on developing division specific (area specific) policies that should allow for a more specific approach taking into account local and divisional differences in the causes and effects of environmental problems (*Strategy 1*). Currently, Divisional Development Committees duplicate DCC functions. A new process for national<sup>1</sup> policy formulation is recommended as:

- Cabinet to establish a new process for the SDP process (CDP is to be responsible for the Cabinet Paper);
- The new process is required to formalise an open planning process with target groups, such as the agricultural product export companies, the tourism industry, the manufacturing industry, motor vehicle services businesses, communities and the government sectors;
- Consultation and negotiations are central to the initial planning phase of the SDP preparation. Consultation and negotiations are important to mobilising a cooperative effort and can lead to a greater sense of involvement and commitment by all parties; and
- The planning process for the SDP, including the consultation process and the target groups consulted, should be an integral component of the SDP. DCC must not approve the SDP and recommend it to Cabinet, if the new planning process is not clearly shown to be implemented in the SDP.

This new approach, however, should be legally formalised as a long-term plan to ensure that the open planning process and community consultation are integrated into the government's planning processes. For the time being, each agency should adopt and practice an 'open planning process and community consultation' as part of its strategic planning process.

#### **Strategy 4: Improve Area Specific Policy**

Under the umbrella of the national sustainable development policy, the divisional committees<sup>2</sup> would concentrate on developing local area specific sustainable development plans of each island group. This will minimise the current practice of ad hoc development, provide an opportunity to decentralise policy to better reflect the priorities of each island division, and involve the communities of the outer islands in the policy making process. The community surveys conducted in this study found that the priorities of Tongatapu were quite different to those of the outer islands (see Tables 5.3.6 and 6.4.3). The influence of the media in disseminating environmental information has a wider positive impact in Tongatapu than in the outer islands. Also government environmental ‘activities’ have been concentrated in Tongatapu – the local area specific policy could initiate more attention and activities to the outer islands. The local area specific policy in the outer islands could be further developed and implemented in divisional environmental plans.

#### **Strategy 5: Develop Environmental Management Plans**

The local area specific policy could be in the form of a five-year environmental plan for each island division. Such planning is not new to Tonga as the five development planning was only phased out in 2000 and replaced by the SDP. The five year environmental plans should be able to feed into the national process for the SDP as the SDP is a revolving three year development plan (CDP, 2000).

The main objective of the environmental plans is to translate area-specific policies into implementable actions, aimed at preserving, restoring, or developing the functions or properties of given areas. For example: (These are summarised from Chapter 3 – Table 3.3.1, Sections, 3.4.2.4, 3.4.3.5, 3.4.4 & 3.5).

- Niua Islands could be promoted as the organic island of Tonga as pesticide and fertilizers are not yet used, though taro from Niua is exported. Niua is home for rare and protected birds (*Megapodius pritchardii* and *Pachyphala jacquinoti*);
- Vava’u is unique for its sheltered harbour, whale watching, and pristine uninhabited islands are a habitat for sea birds;
- Ha’apai has an extensive reef system, turtle breeding areas, and the volcanic islands of Tofua with unique botanical resources;
- ‘Eua has the largest remaining indigenous forest in Tonga with associated fauna; and

- Tongatapu for its extensive lagoon system.

The area specific policy links these functions and characteristics with the environmental problems and specific circumstances of the areas. Further, the divisional environmental plans should provide the base for other sectors in government (i.e. Ministry of Fisheries, Ministry of Agriculture and Forestry etc.) to develop their own environmental policies in line with, and complementary to the environmental plan of that island.

The proposed divisional environmental plans would be the first time in Tonga that area specific environmental problems would be addressed in a management approach. The author believes that the problems of the outer islands have been largely neglected, while the focus has been on Tongatapu. There is therefore, an urgent need to bridge this gap, by using an approach that would not repeat the existing ad hoc management arrangements (Chapter 4, Sections 4.4). Further, the environmental plans approach would initiate the devolution of responsibility and decision making to the divisional development committees, NGOs, and the private sector. The planning process for preparing environmental management plans is suggested in Theme 4.

#### **Strategy 6: Establish A National Commission for Sustainable Development**

In order to successfully pursue sustainable development objectives, there is an urgent requirement to strengthen existing national institutions and administrative capacity. A new institutional response that may be considered by Tonga is the establishment of a high level body such as a National Commission for Sustainable Development (NCSD), chaired by the Prime Minister, with a broad membership, including ministers responsible for economic planning, finance, environment, commerce and industries, education, lands, fisheries, agriculture, tourism, industry, health, justice and outer islands government representatives (Governors of Vava'u, and Ha'apai, Government Representatives of Niua and 'Eua), private sector (oil companies, importers and exporters, tourist operators) and major community groups and NGOs. The existing DCC could provide the basic structure for the proposed NSDC with the suggested additional board members and extended terms of reference focusing on sustainable development. The NCSD should then replace the DCC.



### **Actions for Establishment of the National Commission for Sustainable Development**

A multi-pronged action is hereby suggested for the government, composed of restructuring of government agencies, new legislation (Section 7.3), and seeking relevant assistance from regional and international organisations.

#### **Institutional Restructure:**

There are government departments which exist without a legislative portfolio; a Cabinet and Privy Council Decision created them. They are the DOE, CDP, Statistics Department and the Division of Renewable Energy and Mineral Resources. However, these departments and division individually play important government roles (i.e., DOE – environmental planning and management; CDP – national strategic development plans; and the Statistics Department – national census and collating national statistics (import and exports, etc.)). The government should review the institutional structure and current responsibilities of these departments with a view as to how effectively they would complement each other's roles and technical capabilities in the light of the new proposed NSDC. For example, the Statistics Department is in a position to extend its responsibilities to collect relevant environmental information together with the census.

#### **Regional and International Cooperation:**

Realising the constraints arising from limited government funds and human resources in Tonga, the country inevitably has to rely on greater regional and subregional cooperation for building and strengthening national institutions and administrative capacity for sustainable development.

Although the basic cost of the restructure should be covered from the existing budgets of agencies to be involved, there is also opportunity for the government to prioritise the areas where it spends public funds. With the current on-going regional and international 'pressure' for sustainable development coupled with national indicators of resource degradations and a failing economy, it is envisaged that sustainable development and establishment of a NCS D would be identified as government priority. There would, however, be extra financial requirements especially for training, monitoring and enforcement, which are currently lacking in the current government estimates for almost all departments.

The government then should further expand and deepen its regional and international cooperation with organizations and governments that provide institutional and administrative capacity building, especially in areas where Tonga is lacking in expertise, and where joint activities in research and training could help to overcome national resource constraints. In the Pacific, a number of agencies are involved in providing assistance in institutional reform and capacity building, e.g. the SPREP, SPC, SOPAC, FFA, ADB, UN Agencies, WSSD, Australia, New Zealand, and International NGOs.

#### **Mandate of the Proposed National Commission for Sustainable Development**

A key mandate of the Commission would be to ensure coordination and cooperation between public departments; local authorities and other government and non-governmental organisations engaged in environmental protection activities.

The major responsibilities of the commission would be:

- provide the institutional framework for the divisional environmental plans, including policies and strategies;
- implement sustainable development policies;
- facilitate national-level coordination and the overseeing of sustainable development of national government departments;
- promote public awareness;
- advance the use of science and new technology;
- provide effective and meaningful public participation in sustainable policy making and implementation of relevant programs; and
- consider the use of appropriate economic instruments as a tool for promoting of sustainable development activities, such as new tax incentives for development that recycle or manage waste or to diversify and upgrade products. Fiscal instruments should be used to encourage sound land use and coastal zone practices.

#### **7.2.1.2 Implementation Requirement**

##### **Time Scale**

The new policy process could be implemented immediately with a Cabinet Decision approving the new process within the existing structure with minimal disruption to current

relevant functions of key government departments (as indicated in the Target Groups). The 8th SDP (2004-2007) provides the opportunity to merge economic growth objectives with sustainable development objectives, into a national sustainable socio-economic development policy for Tonga, as the over-arching objective of the eighth SDP.

However, political, economic, social and environmental circumstances change over time, and there is a need for the SDP planning process to follow a responsive/adaptive management approach to account for and recognise these changes. Legal backing in the form of an appropriate legislation should be targeted to be in place for the 9<sup>th</sup> SDP planning processes.

The divisional environmental plans initially could be developed in phases to provide for expert advice and for training and for building up awareness in the outer islands. The DOE in collaboration with other agencies and civil societies is in a position to start immediately on an environmental plan for Tongatapu, pending the approval of Cabinet, as appropriate experts are available in Tongatapu and many of relevant baseline studies have been carried out in Tongatapu (as explained in Chapter 3). The Vava'u, Ha'apa, 'Eua, & Niua Environmental Plans could follow in phases after the Tongatapu Plan.

### **Target Groups**

The Central Planning Department (CPD) is currently responsible for preparation of the Strategic Development Plans, and is the secretariat for the National Development Committee (DCC). Table 7.2.1 lists the current members of DCC and suggested new members. The existing DCC membership reflects the dominant economic outlook of the SDP. The additional members would provide a 'sustainable development' perspective and the perspective of the civil societies, and wider representation from key civil societies from the outer islands, as they comprise important target groups for developing, implementation, enforcement and support of sustainable development strategies. The Department of Environment (DOE) and the CDP should initiate the dialogue and consultation with all relevant departments and report to Cabinet through DCC on the feasibility of a national sustainable development commission.

All other target groups are to make up the consultation and negotiations group for the SDP planning phase, such as church groups, women's village committees, exporters, importers (pesticides, chemicals, and consumer goods), NGOs, tourist operators and tourist facilities

owners, political movement bodies, farmers, fishers, commercial banks, boards and government departments.

Key natural resource base government agencies that should have sustainable development or sustainable resource management goals and objectives, apart from the CPD and the DOE, are the MLSNR, MAF, MOF, TVB, MLCI, MOW and MMP.

**Table 7.2.1 DCC Current Members and Suggested New Members for DCC for the Immediate Implementation of the New Policy Making Process**

<b>DCC Existing Members</b>	<b>Suggested Additional Permanent Members</b>
Prime Minister (Chairman)	Minister for Environment
Minister of Finance	Community nominated member from each island division (Vava'u, Ha'apai, Niuas and 'Eua) to be nominated through the annual meeting of the Tonga Association of Non Government Association (Umbrella NGO for all NGOs in Tonga)
Minister of Labour, Commerce & Industries	
Chief Secretary & Secretary to Cabinet	
Secretary for Foreign Affairs	
Chief Establishment Officer	
Solicitor General	
Director of Planning	

Using the existing structure, the DCC, VDC, HDC, EDC and EUC should be the key committees to set the criteria and the process for the preparation of the divisional environmental plans. The DOE should provide the technical advice to the Development Committees. However, the membership of the divisional development committees needs to be revised to reflect a better representation of each island division.

### **Resources Required**

It is expected that no new resources would be required, as the new process would fall in line with the CPD estimate and budget for the SDP preparation. The strategy calls for a change in process and approach promoting open consultation and transparency between government departments and government established committees and communities, using the existing structures and human resources.

If the above process is approved, the Department of Environment (DOE) would require a new budget item. The divisional development committees would then use the budget to develop the environmental plans. The DOE should also be in a position to seek technical and financial assistance for the planning process of the first set of five-year environmental plans. However, the government needs to commit to continue the budget support for this strategy.

### **Evaluation**

The government should ensure appropriate evaluation mechanisms are approved for the SDP and the Divisional Environmental Plans. CDP and the DOE could, through a joint effort, initiate the development of national indicators for sustainable development to evaluate performance of the contributions of the plans to improving the environment, the well-being, and living standards of the people of Tonga. Producing a State of the Environment Report for Tonga once in every six years could provide the evaluation for the five years environmental plans, while the SDP could consider a shorter-term evaluation mechanism. Figure 7.2 shows the inter-relationships (by the arrows) of *Strategies 1-6*, where the National Sustainable Development Commission, when established, would provide the institutional framework the overall management of the policy framework for sustainable resource and environmental management developed in this study (see Section 7.2.1 – *Strategies 1-6*).

### **Envisaged Constraints for the Proposed Institutional Restructure**

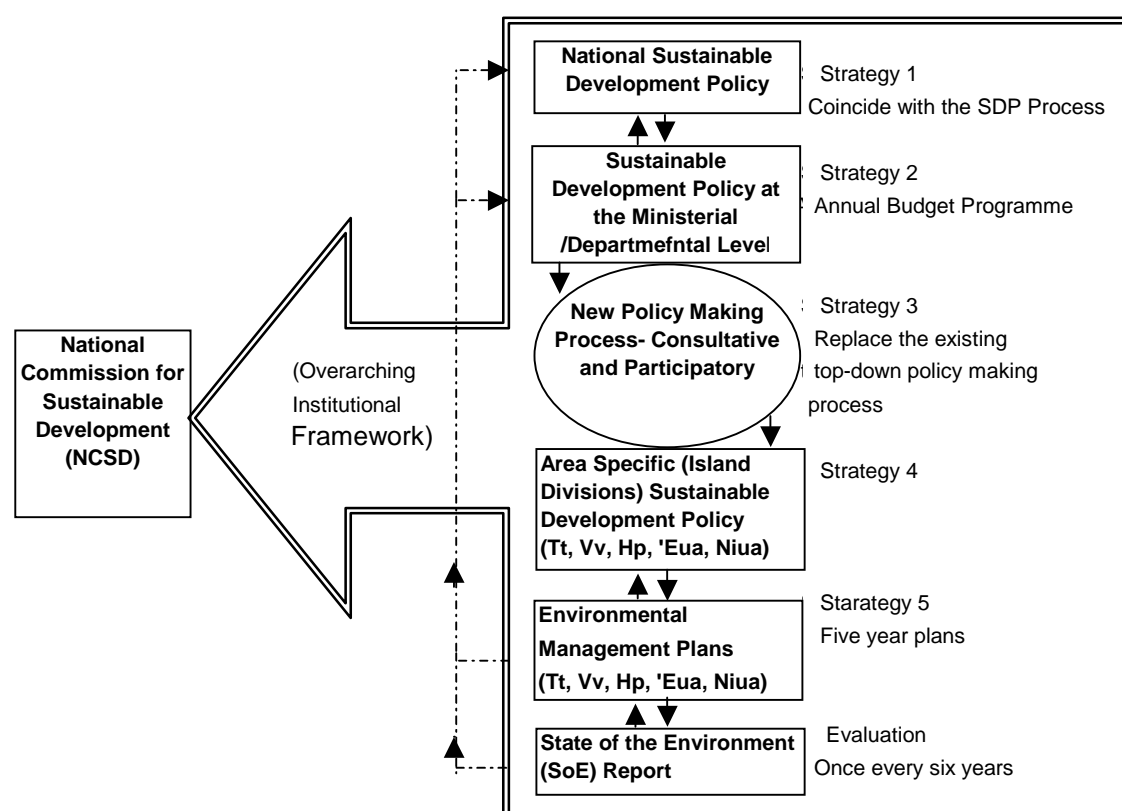
Lack of effective national cross-sectoral, interdepartmental coordination and willingness for an open consultation with the community remain the key obstacles to institutional reform in Tonga. Further, inadequate skilled manpower and resources allocated to the enforcement existing legislation (Section 7.3), weak official status, and authority accorded to agencies dealing with sustainable development and environmental issues are also constraints that have to be addressed and eliminated. The experiences of Tonga suggest that institutional and administrative capacity building is a protracted and complex process that requires sustained political commitment and sufficient resources.

However, these obstacles could be solved with the regional and international cooperation as described above. Tonga should aim to strengthen its national sustainable development bodies by enhancing their political and legal status, increasing their staffing levels, and improving their modalities of operation. The government should commit to the enforcement and implementation of legislation and formulated national strategies.

Particular attention should be paid to where ‘environmental’ expertise is placed and to coordinating economics/finances issues with conservation as well as promoting coordination between the two institutions (i.e. by involving more economist and financial planners in conservation planning or training).

In order to achieve the objectives and strategies proposed here, there should be more individuals with the power (Cabinet Minister level) and will to champion the idea of sustainable development and environmental protection at the upper decision-making level of government. This should be the case not only at the policy making stage but also at the law drafting<sup>3</sup>, and enactment stages, and at the implementation and enforcement stages.

**Figure 7.2: Inter-Relationships among Policy Process, Environmental Management Plans, Commission for Sustainable Development and Evaluation Mechanisms**



Based on Strategies 1-6 ((Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai); SDP – Strategic Development Plan (a three year revolving national development plan for Tonga).

### 7.2.2 Theme Two-Legislative Framework for Sustainable Development Policy

In Chapter 4, it was noted that the existing legislation framework for environmental related issues was based on what was seen as priorities at the time. The development of the legislation was guided by the portfolio of existing agencies then. (i.e. *the Land Act 1903*, the *Public Health Act 1913*, the *Garbage Act 1949*, and the *Birds and Fish Preservation Act 1915* (described in Chapter 4, Section 4.5). However, emerging

environmental issues (see Table 7.1.1) were not directly addressed by this early legislation. Later legislation (*Forestry Act 1961*, *Parks and Reserves Act 1976* and the *Fisheries Act 1987* among others) focused on control, but were weak on management aspects. There were issues of overlapping responsibilities, with management responsibilities not clearly defined (Chapter 4, Section 4.6.2).

A major weakness in the existing legislation framework is the lack of implementation, enforcement and insufficient penalties. In the community survey (Chapter 5, Section 5.5.3.6), the majority of the respondents claimed that legislation is too lax, either because it is not enforced, or the fines are light. There is also a lack of awareness of the legislation by the people. People, therefore, do not comply with the legislation.

Researchers have stated that the coordination among multi-sectoral uses of resources requires new methodological approaches and new legislation for access and use of environmental resources, and sustainable development plans should consider the available priorities and transform these into policies and goals (see Chapter 2, Section 2.3.2.2). These views are adopted here in this study in considering the new legislation and amendments suggested in the following objectives and strategies

#### **Policy Goals**

- ❖ Strengthen environmental capabilities in Tonga through enhancing of the ‘environmental provisions’ in the existing legislation and recommending new ones to address ‘emerging ’ environmental issues, to achieve sustainable resource and environmental resource management (sustainable development); and
- ❖ Strengthen the institutional base for environmental management.

#### **Objectives**

In order to provide sound legislative support that is responsive to the new policy framework for environmental and resource management in Tonga, the objectives considered here are developed taking into account the causes of legislative constraints on sustainable environmental management issues. The aim is to solve those problems in both the short term and long term for Tonga. Another consideration is to provide legislative support, where necessary, for the implementation of the environmental strategies that would lead to achieving the ‘environmental themes’ identified in this study. The objectives of theme two are as follows:

- to legally formalise the new policy making planning process (Section 7.1.2);
- to amend existing legislation in line with the weaknesses identified in this study;
- to enact long standing proposed legislation; and
- to establish new approaches to improve enforcement.

#### **7.2.2.1 Action Strategies**

##### **Strategy 7: Introduce New Legislation**

In the short term, it is suggested in *Strategy 1* (section 7.2.12) that a Cabinet Decision could start the new policy-making process and to establish sustainable development as a priority policy for Tonga during the preparation phases for the upcoming 8th SDP planning period (2004 - 2007). It is considered that the new policy making planning process would have time to be tested, reviewed, and there would be time establish appropriate mechanisms, during the 8th and 9th SDP (considering that there might be a delay in the immediate Cabinet Approval for the new process).

However, in the longer term, a new legislation should be the target to be enacted prior to the 10th SDP period (2012-2015) to legally formalise the following new processes:

- establishment of a National Commission for Sustainable Development;
- mechanism for open consultation with communities in the policy making process (lacking in the existing legislation framework);
- the five year environmental plans for each main island group (Tongatapu, Vava'u, Ha'apai, Niua and 'Eua) and the process of creating time;
- devolution of decision making to divisional committees and establishing the roles of the divisional committees; and
- looking at combining (in a coordination way) significant sustainable management provisions within the existing legislation. Such existing legislation would include the *Birds and Fish Preservation Act* and the *Parks and Reserves Act*.

The proposed new legislation could be in the form of an Environmental Management Act, having a broad objective of sustainable development for Tonga. The new legislation should target: defining clear responsibilities for national committees and divisional



committees; establishing coordination mechanisms between national and divisional committees, government departments and ministries, NGOs, private sector, and the communities; and, establishing mechanisms for innovative joint enforcement responsibility between government, private sector and the communities. More autonomy for target groups for self-regulation within a clear normative framework provided by the legislation could also be considered. Consideration in the new legislation should be given to incorporating principles such as the Precautionary Principle, Public Participation Principle, and Principle of Sustainable Development (Agenda 21); the Preventive Principle (de Sadeleer 2002), and the ecosystem management or a total island management approach.

#### **Strategy 8: Strengthen Existing Legislation Through Reviews and Amendments**

The suggested improvement to the existing relevant legislation for sustainable environmental management is to bring the existing legislation more in line with the current and emerging community environmental and resource issues in Tonga as identified in this study.

The process for improving the existing legislation would be much shorter than the formulation of new legislation, and would require no extra budgetary resources. However, required amendments would depend on the responsible Cabinet Minister's commitment to initiate the process. The following legislative amendments are recommended:

#### **Amendment of the 1875 Constitution of Tonga -- Part III & the 1903 Land Act**

Section III of the Constitution deals with 'The Land' and reaffirms the principles of land holdings in Tonga (Chapters 3 and 4, Sections 3.4.1 & 4.2.1). The *Land Act*, Sections 3, 4, 5, & 7 prescribed land tenure in Tonga. While the basis of the land tenure was a very significant and a far sighted move and appropriate at the time when commoners were oppressed and did not own land, its continued application has led to many environmental problems in Tonga. The amendments to 'Land' issues should be considered both in the context of the Constitution and in the *Land Act*.

Section 5 of the *Land Act* prescribed "every male Tongan subject by birth is entitled to a grant by the Minister of Lands, of 3.3387 hectares as a tax allotment and an area not exceeding 1618.7 square metres as a town allotment". Although this is no longer feasible in Tonga, considering the fact that there is a shortage of land available for allotments, the

Minister of Lands has vigorously implemented this provision, leading to allocation of coastal lands, swamps, mangrove areas, and even the lagoon itself.

Cabinet and Privy Council Decisions are urgently required to immediately ban any further (new) allocation from the Government Estate and Government Reserves for tax or town allotments until the findings of a Land Commission Investigation are presented to Cabinet and Privy Council. Any new allocations from the Royal Estate or Nobles Estate, however, would not be affected.

The Privy Council should establish a Land Commission Inquiry mandated with the following tasks:

- review Part III of the Constitution and any other Parts of the Constitution affected by Part III (specifically in relations to the Royal Estates, Hereditary Estates and Government Estates) to determine how much land is still ‘available’ in Tonga;
- conduct consultation on the views of the people of Tonga on mechanisms to solve the land shortage (i.e., possible decrease of the prescribed size for tax and town allotments to be granted to the landless ‘younger brother’ in the same land ownership family);
- review the status of Tongan landowners who have migrated or changed citizenship and how their land is being managed; and
- widely publish the investigation exercise by the Land Commission.

The Ministry of Lands would assist the inquiry by supplying the required information. Such an exercise hinges on the population dynamics of a country, and Tonga’s population policy should be considered simultaneously.

### **Freehold Land**

The non-tradability of land under the existing land tenure system (except leasehold) may contribute to sub-optimal land distribution and lack of investment in Tonga. The Land Commission Inquiry could also address this issue. Another related issue that should be considered in parallel is the situation about naturalised Tongans (produced by selling Tongan Passports). These people are now residing in Tonga, and demanding their rights to land (per.obs).

**Land Act (Sections 74, 94, & 95) & All Laws Regulating Agricultural Activities**

The *Land Act* (Sections 74, 94, & 95) deals with granting leases for agriculture. It is suggested that these Sections be amended to include a requirement for environmental factors to be taken into account during the inspections carried out by the Ministry of Agriculture in connection with applications for agricultural leases (Chapter 4, Section 4.5.1).

All other existing laws regulating agricultural activities should be reviewed and amended to provide for environmental protective measures, e.g. soil conservation, being made an integral part of the agricultural system (Chapter 4, Section 4.5.1.1).

**1961 Forestry Act**

There is a need to improve the awareness of the district officers about Part III of the *Forestry Act* regarding establishment of the village forest area. The village forest areas could provide an opportunity for community involvement in the management of common resources and promote the conservation of community forest resources. Eighty one percent of the respondents in the community survey (Chapter 5, Section 5.3.3.10) believed that Town and District Officers have important environmental management roles and 77 % of the respondents believed that community groups could do much to conserve community resources.

Part III of the *Forestry Act* should be amended to allow for the categorization of the remaining indigenous forests into community forest, sanctuaries, water supply reserve forest (as in the case of 'Eua) and coastal protection forest depending on their present conditions and use status. This is especially important for areas which are now undivided or which have remaining stands of indigenous forest (Chapter 3, Section 3.4.4.2 & 3.4.4.3). One of the reasons that could have caused the non-implementation of Part III of the *Forestry Act* may be the lack of such available forest or the difficulties in the negotiation processes with the Estate holder (Government, Nobles, Royal or individual) to release such forests for community forests.

There are possible solutions for these problems. Financial compensation of the Estate holder or land exchange (provision of another piece of land elsewhere, in compensation for the forest to be conserved for the communities) could be considered. Further, most coastal forest is 'owned' by the government, as it is located within the coastal area. This is

the area that not only provides many of the forest products required by the communities, it is also the area that suffers much abuse and degradation (deforestation, burning, soil erosion, inundation, salt sprays). Communities could play a role in coastal forest management, but the government should facilitate the establishing of access sites to the sea, closed and open areas for forestry product, appropriate education programs, replanting schemes, and community and government or community and NGOs management strategies possible in a co-management arrangement (Chapter 2, Section 2.3.2.3).

#### **1989 Fisheries Act**

The main weakness of the *Fisheries Act* is its lack of implementation and the inadequacies in penalties (Chapter 4, Section 4.5.2). For example, Sections 5(5), 8(6), 21, 24, 34, 35 & 30 of the *Fisheries Act* should be reviewed and penalties amended to reflect the seriousness of non compliance.

The majority of the respondents in the three communities surveyed perceived that the CPUE of key fisheries resources and fisheries habitat is declining (Section 6.4.1.2). The declining trend was perceived by most of the three communities (Taunga, Felemea and Manuka) to be caused by overfishing and commercial fishers from ‘outside their island (as in the case of Tuanga and Felemes) or village’ (as in the case of Manuka). However, it was noted from the analysis that there are provisions in the current *Fisheries Act* that could have addressed these problems, but they have not been implemented. For example, the *Fisheries Act* provides for the development of Fisheries Plans and for the declaration of any areas of the fisheries waters to be a reserved area for subsistence fishing (*1989 Fisheries Act*, s. 3 & s. 22(1)).

Improving the capacity of the MOF, in terms of trained man power, appropriate equipment and finances, has to be a priority to the government, as it appears that many of the impacts identified during the community survey are caused by the lack of implementation and enforcement of the *Fisheries Act* (Table 6.4.5).

There was a strong indication from Taunga, Felemea and Manuka that the communities would like to be more involved in the management of coastal resources, and all communities prioritised ‘allocation of exclusive community fishing area’ as most important. However, the communities also identified other needs apart from the from appropriate legislation, such as education and awareness programs, and the establishment of community marine protected areas (Chapter 6, Section 6.4.1.4 and Table 6.4.5).

Although this is only the view of the three communities surveyed for the purpose of this study, the three communities were selected carefully to provide a good representation of the three main island groups and of the fishers of Tonga. From the experience of the author in Tonga, the community coastal resources management options identified above (and in Chapters 4 and 6) could be inferred and interpreted with some confidence as the preferred coastal resources management options for the whole of Tonga.

Therefore, it is suggested that the *Fisheries Act* could provide the legal instrument for more community participation in coastal resources management and for ‘exclusive community fishing areas’. Sections 3 and 7 of the *Fisheries Act* currently provide for limited community participation. A wider community consultation and participation could be prescribed if the reference to “fishermen” is replaced with “fishing communities” or “stakeholders” in the relevant provisions.

Appropriate amendments to the *Fisheries Act* to provide for more community participation in the management of fisheries resources in terms of ‘exclusive community fishing areas’ and ‘community marine protected areas’ could be considered. Possible amendments for consideration should include:

- community participatory rights;
- community fishery special management areas;
- designation of coastal communities responsible for special management areas;
- the relationship and roles of the Ministry of Fisheries (government) and the communities designated for management; and
- regulation of fisheries in special management areas with consideration to ‘limited access’ to those areas and enforcement.

The most appropriate approaches of participatory management (discussed in Section 2.4.2.3 of this thesis) that would be suitable for Tonga should be discussed thoroughly with the communities concerned. The use of By-Laws is worth considering in Tonga as in the case of Samoa (Chapter 2, Section 2.3.3). The existing power of the Minister for Fisheries (Tonga) to make regulations (*Fisheries Act 1989*, s. 59 (1)) could be amended to include the making of By-Laws with communities concerned.

However, this study noted that issues of community based fishery management objectives are relatively new to Tonga and despite high expectations of its potential role in achieving

sustainable resource management, its practicability on the ground is unclear, unless there is support from the international community, the government, and from the wider national civil society, including the churches (a very powerful institution in Tonga). In order to ensure the smooth transition and devolution to 'community based' management (whether in partnership with the government or with another organisation in a co-management or completely self-managed regimes), existing national/local institutional and cultural structures need to be involved right from the beginning.

Further, the process establishing community by-laws, as described in King & Fa'asili (1998a; 1998b), as in Chapter 2, Section 2.3.3, could provide an opportunity for the communities in Tonga to be actively involved in decision-making that would directly affect them and contribute to the crystallisation of the concepts before incorporation into legislation or by-laws. Although this concept is 'new' it is achievable in Tonga. The current state of coastal resource problems, community priorities, and the inability of the current management framework to sustainably managed fishery and coastal resources which in turn affect communities' livelihood are compelling indications that communities are 'open' and are willing and ready to try out new management strategies.

The loss of the provision for whales protection (repealed *Whaling Industry Act*) with the enactment of the *Fisheries Act 1989* (Chapter 4, Section 4.5.2), should be rectified as a matter of urgency. Considering the important contribution eco-tourism (whale watching) is playing in Tonga's dwindling economy, the current global program for whale conservation and the strategic location of Tongan waters on the whale migration routes, it is suggested that consideration be given to the incorporation of the protection of whales and turtles (turtles currently lack protection in the Fisheries Legislation) in the Fisheries Regulations. Other countries in the Pacific have marine mammals conservation legislation, such as PNG, Vanuatu, and the Solomon Islands.

#### **Parks and Reserves Act 1976**

The inactivity of the Parks and Reserves Authority established by the *Parks and Reserves Act* in managing parks and reserves reflects the following problems:

- the conflicting responsibility the Minister of Lands, Survey and Natural Resources (i.e., his responsibility to distribute land prescribed by the *Land Act* and his responsibility for conservation prescribed by the *Parks and Reserves Act*) (see Chapter 4, Sections 4.5.3 and 4.5.3.1); and

- the Act is not yet regulated (Chapter 4, Section 4.5.3.1 and Appendix 2).

The *Parks and Reserves Act* is an important piece of legislation for the purpose of biodiversity and wildlife conservation in Tonga, but the full capacity of the legislation is not realised due to lack of implementation. The following amendments are suggested for the *Parks and Reserves Act*:

- to replace all reference to the Minister of Lands, Survey and Natural Resources with the ‘Minister responsible for the Environment’; and
- to replace all reference to the Secretary for Lands, Survey and Natural Resources with the ‘Director of Environment’;
- immediate consideration be given to enacting regulations authorised by the Act.

It is considered that the constitutional responsibility of the Minister of Lands does not provide for ‘strong’ conservation ethics which leads to conservation being not a priority for the agency which is supposed to promote conservation. It would not be a ‘conflict of interest’ for the Department of Environment Department to implement the *Parks and Reserves Act*, as conservation is one of its main responsibilities.

#### **Birds and Fish Preservation (Amendment) Act 1989**

The main constraints with this legislation is that it is not stated clearly who is responsible for the implementation of this Act (Chapter 4, Section 4.5.3.1); therefore it is not implemented and enforced. It is suggested that an agency responsible for the implementation of this Act should be clearly identified in the Act. The list of protected birds should be updated. Thaman et al. (1996) (the latest survey on the status of biodiversity in Ha’apai) provided a comprehensive list of terrestrial and marine biodiversity resources (species) that were perceived by the communities of Ha’apai to be rare.

#### **Tonga Water Board Acts, 1996 & 1974**

Water is a very limited and valuable resource in small islands like Tonga, with no major source of surface water apart from the rainfall, and a reliance on thin underground fresh water lenses. However, the lack of conservation measures (Chapter 4, Section 4.5.3.2) in the existing legislation is a major concern. The following amendments are suggested for the *Tonga Water Board Act*.

The Tonga Water Board and its Act should be expanded to include responsibility for all water extraction, conservation measures, collection and delivery systems, including rural areas. It is also suggested that legislation be considered to clearly detail the responsibilities of the three agencies concerned, the MLSNR, MOH and TWB.

#### **Co-ordination and Enforcement**

An effective working mechanism should be established for better co-ordination and collaboration between the MLSNR, MOF, MAF and DOE and the community for establishment and management of community forest, community fisheries areas and marine parks and reserves. The activities of each agency currently impinge on those of the others and there is a need to set out a clear demarcation of responsibility for each agency. Considering the lack of resources in government agencies for enforcement, this is one area where co-operation and co-ordination and community support is required. A memorandum of understanding<sup>4</sup> between groups can be used to accomplish better co-ordination and clarify responsibilities. Likewise, better coordination is urgently required between the MLSNR, HOH and Tonga Water Board for the management of Tonga's Water Resources. All of the above mentioned Acts should all be revised with the aim of strengthening the penalties for infringements.

#### **Strategy 9: Enact Key Draft Legislation for Sustainable Development**

As discussed in Chapter 4, Section 4.6.1.1, there are two pieces of legislation that are very important for the sustainable environmental and resource management for Tonga and for protection of Tonga's marine resources that have been drafted, but not yet enacted – the 1999 EIA Bill (see below) and the Marine Pollution Act 1992.

The Marine Pollution Bill considers the release or threat of hazardous substances, such as oil and other pollutants, into the marine environment. This is an important Bill considering the high potential for such disasters to occur and is in line with Tonga's obligations under relevant international and regional conventions (Section 4.6.1.1). Pollution of coastal and marine areas was ranked third (20 %) when respondents were asked to list the two most important environmental issues in Tonga today. The most important priority was 'litter and dumping of rubbish in public places' (42 %) and the second was 'waste from business and service stations' (21 %). The survey results clearly indicate that marine/coastal pollution is a priority issue in Tonga (Section 5.3.1.2). Similarly, sources of land-based



pollution usually related to human activities that affect the coastal/marine areas were also raised as an important coastal issue (Table 6.4.3).

### **The Environmental Impact Assessment Bill**

In this section, the implementation of the existing EIA policy (Section 4.3.2.2) is discussed (this process could be implemented prior to the enactment of the Bill) and the EIA process when the Bill is enacted. The first part considers a change in the decision-making process the government currently uses to screen development projects and the issue of licences as required by the law. The second part suggests amendment to the EIA Bill and recommends its immediate enactment as a priority for the sustainable environmental and resource management for Tonga.

#### **(i) Changes to the Current Decision Making Process in the Absence of the EIA Legislation**

Several problems were shown in Figure 4.2 and Figure 4.3. First, there is total lack of 'environmental consideration', and consultation in the current decision-making decision process for development projects. Second, within the existing process, there appears to be national committees (Fig. 4.2 - i.e. VDC) who are not following the same process as the other national and divisional committees although they have the similar responsibilities. Third, national development committee (DCC) and all other divisional committee (VDC, HDC, EDA, NDC) are based in Nuku'alofa with little input from the outer islands.

Applying Handler's (1988) view (Chapter 2, Section 2.5) to the case of Tonga suggests that the lack of effective dialogue and consultation within the decision making process leads to arrogance and complacency at the expense of the environment and the communities that are affected by development. Papadakis (1999) stressed that in order to achieve systems effectiveness, constructive dialogue with all parties involved should be the aim of each 'member' of the system. The fact that the VDC is chaired by the Ministry of Foreign Affairs (MOFA)) and is not following the existing decision making process is what Papadakis (1999) explained as obstacles for effective policy-making. These obstacles arise from the varying levels of power between government agencies (politically, the MOFA is the most powerful Ministry in Tonga).

Figure 7.3 suggested a means of addressing the constraints in the existing decision making process as discussed above. The new process is very similar to the existing one and is in line with existing legal requirements, but with the additional insertion of 'environmental

consideration' and a focus on wider consultation during the initial steps of the decision making process (dotted lines and shadow boxes in Fig. 7.3). This may provide ways to minimize any foreseeable negative environmental impacts, encourage positive environmental effects, and inform and canvass relevant views from stakeholders on the project.

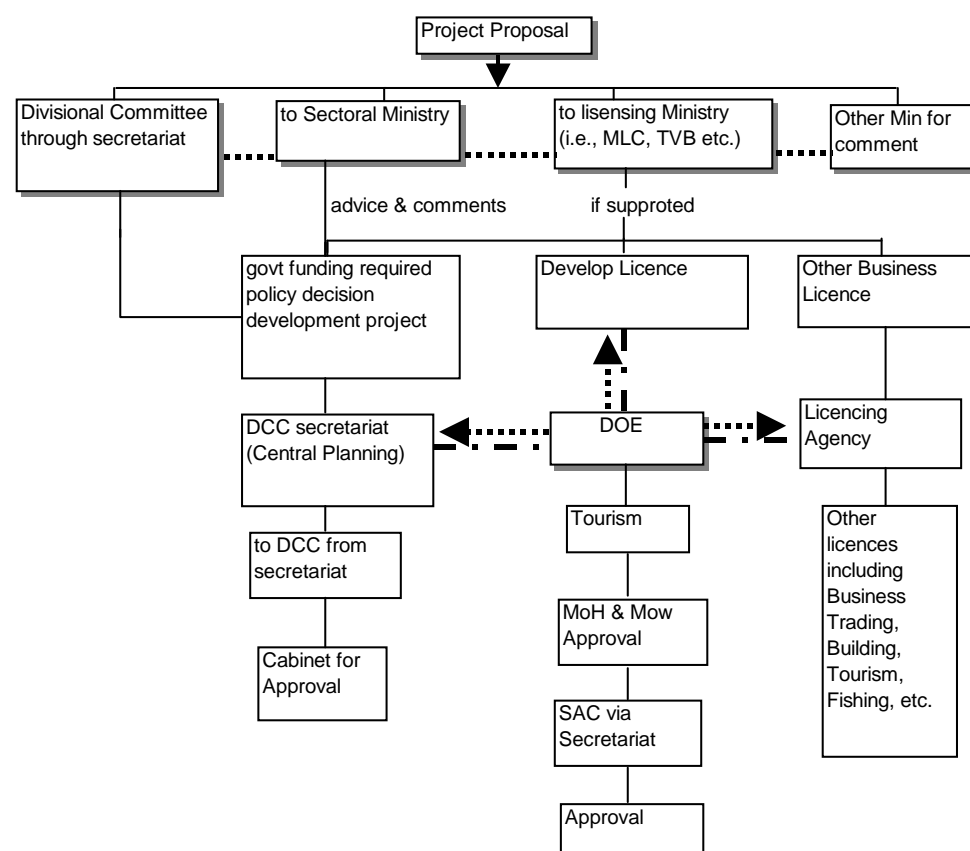
The revised decision making process (Fig 7.4) suggests the following emphasis as in the process:

- wider consultation with stakeholders should be conducted at the beginning of the process, including island divisional committees if the proposed project is for the outer islands. The aim of the consultation and dialogue is not to stop<sup>5</sup> the project but to improve the project in terms of sustainability goals. This is represented by the shadow boxes at the first row of Fig. 7.4;
- all divisional committees are to follow the process and the direct submission of development projects to Cabinet is to be stopped immediately;
- the CDP licensing authority to immediately revise its project applications forms and criteria in consultation with the DOE. 'Environmental requirements' should be included in the project proposals for specific licences required (considering that environmental requirements for a licence to build a tourist facility would be different from a licence to export aquarium species) and also to identify projects that may not need to go through the 'extra' process for an environmental consideration by DOE;
- before any projects that require environmental screening proceed in the process (Fig. 7.4), they should be forwarded to the DOE by either CPD or licensing authority for screening for potential environmental impacts or requirements for a full EIA if required, and for the DOE to return the projects proposal to CPD or licensing authority within ten working days from the day of receiving the project (the ten working days is to make sure that DOE would not unnecessarily delay projects and fuel anti 'environmental' views among government; This is the actual time limit used in the EIA Bill);
- the CPD or the licensing authority is to convey to project proponents any requirement for a full EIA or further information from DOE. Projects proponents are to resubmit to the DOE through the CPD or licensing authority a revised project proposal with full environmental assessment. The DOE is to return its

decision to the CPD or licensing authority within 28 days (time used in the EIA Bill) from the date of receiving of the environment assessment report; and

- based on recommendation of the DOE, CDP and the licensing authority, the remainder of the process as shown in Fig. 7.4 should continue.

**Figure 7.3 Proposed New Decision Making Process for Development Projects**



Sources: Based on Figures 4.2 & 4.3 and on the Constraints Identified in the Chapters 2-6.

**(ii) Enactment of the EIA Bill**

The EIA Bill is crucial for providing the legal tool for sustainable development. One of the major constraints with the existing EIA policy is that, in the absence of legal requirement, authorities could easily ignore environmental impact assessment; this would be at the expense of the environment and its resources and subsequently the quality of life of the people of Tonga. The fact that the EIA Bill has been drafted, passed through the Law Reform Committee, and approved in principle by Cabinet with suggested amendments

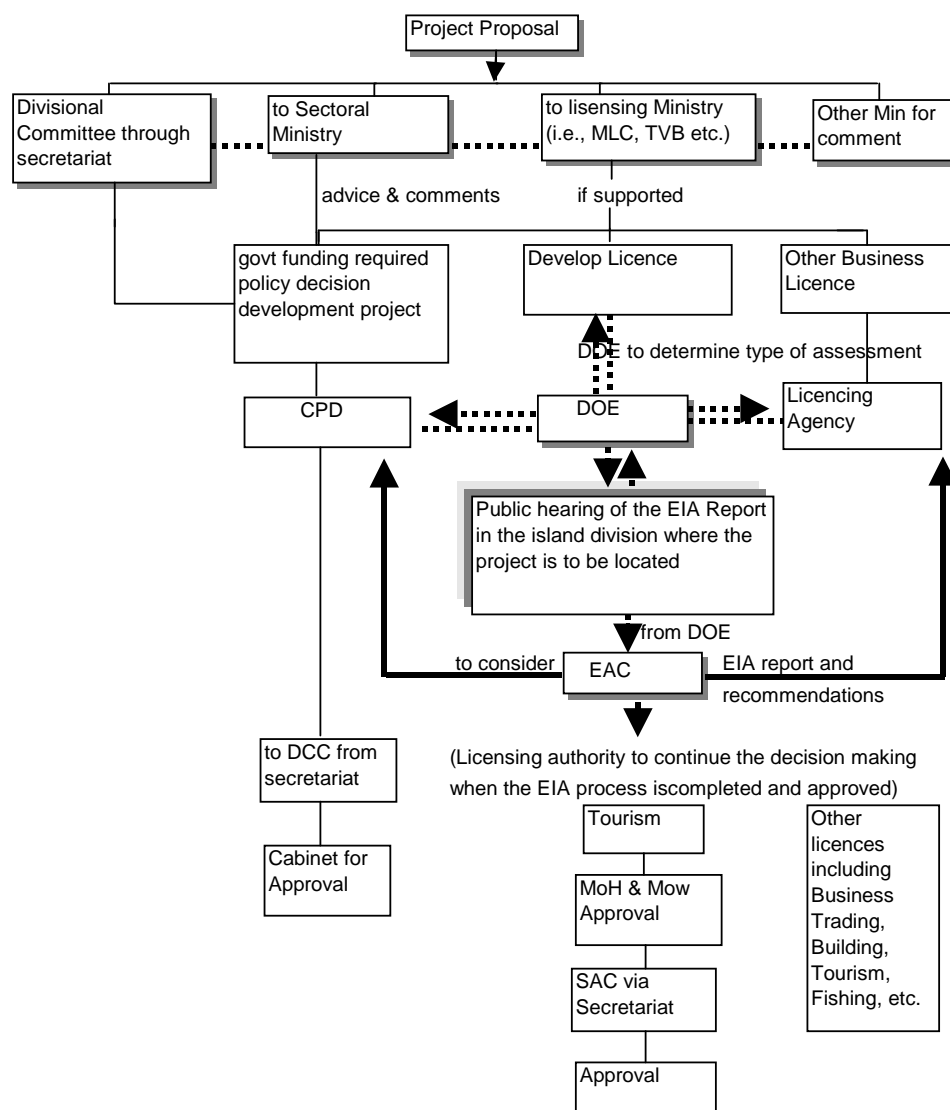
(Chapter 4, Section 4.6.1.1), and the recent establishment of the Environment Department, are indications that the government is willing to 'change' its decision making process regarding development activities in Tonga to incorporate EIA. This is a step towards achieving sustainable development.

As discussed in Chapter 4, Section 4.6.1.1, Sections 16 and 21 of the EIA Bill could be amended to strengthen community participation by clearly prescribing a community participation process in the EIA Bill. This would be the main difference of this Bill from existing legislation where public participation is at the discretions of the cabinet minister responsible for the legislation.

Another feature of the EIA Bill is the provision of appeal by either the proponent or those opposed to the project. Apart from Sections 16 and 21, where the public could lodge their opinion of a particular project, Section 17 provides the opportunity for the proponent to lodge (in writing) with the Environmental Assessment Committee (EAC) any dissatisfaction with the EAC's decision or to withdraw the applications.

Section 27 of the EIA Bill prescribes the power of the Minister responsible for Environment to make regulations relevant to the Bill. The current requirements of the EIA Bill imply effective inspections and enforcement. The DOE is lacking in skills and resources and the government may not be in a position to immediately provide for effective inspections and enforcements in terms of training, skilled staff and appropriate technology. Therefore the Section 27 may need to be expanded to provide the Minister responsible for the Environment with power to encourage appropriate cooperative effort from communities, industries and business (i.e. by entering into agreements, MOUs or Code of Practices).

Figure 7.4 Development Decision Making Process as Prescribed by the EIA BILL



Source: Figure 7.2 and requirements of the EIA Bill, 1999

### 7.2.2.2 Implementation Plan

#### Time Scale:

Strategy 6 could be carried out immediately as legislative reviews and proposals for amendments depend on each agency responsible. All natural resource base agencies should ideally make it a priority to review their legislation with the goal of sustainable development in mind.

The Land Commission Inquiry could be targeted for establishment immediately after approval from Cabinet and Privy Council. The Land Commission should be in a position to submit to Cabinet its findings within a year from the establishment date.

The process for the suggested amendment to the *Land Act* (Sections 74, 94 and 95), all laws regulating agricultural activities, the *Forestry Act 1961* and the *Fisheries Act 1989* should start immediately as these pieces of legislation are totally ineffective in their current state for the purpose of sustainable resource management. Specific suggested amendments (i.e., environmental consideration prescriptions for agricultural leases) should be completed and approved within a relatively short time frame, as the recommended amendments are not in conflict with existing provisions of the said legislation or other existing legislation in Tonga.

The process for the establishment of community forests, however, as prescribed by the *Forestry Act*, may require a longer time frame, as this would involve community consultation and negotiations with land owners, as well as identifying relatively undisturbed forest to be conserved or replanting in degraded areas. The most recent forest surveys in Tonga (Chapter 3, Section 3.4.4.2) concluded that human activities are the main threats to the remaining forests. This conclusion inferred that there is an urgent need for an immediate commitment from government and communities for the sustainable management of the remaining forests and the related fauna and flora in Tonga.

Similarly, the process for establishing community fisheries management would take some time to develop, coupled with extensive consultation and dialogue. The process should start soon, as a matter of urgency, as pressures on coastal resources are ongoing.

Both the Marine Pollution Bill and EIA Bill could be enacted at the same time. Their immediate enactment is desirable as further delay continues unsustainable resource practices that have adverse impacts on the limited and fragile coastal resources. If the steps in Figure 7.3 were implemented according to the existing EIA policy by the time the EIA Bill is enacted, there would not be any major changes to the development decision process as the foundation has been laid down in Fig 7.3. When the EIA Bill is in force the 'public hearing' and the 'EAC review' provisions are added to the Fig. 7.3 steps, making it Figure 7.4.

**Target Group:**

The DOE should be responsible for initiation of the new legislation in *Strategy 5* in consultation with all relevant government departments, the private sector and communities. The Minister of Lands, Survey and Natural Resources should request Cabinet to approve an immediate ban on new subdivisions for tax and town allotments from government land and reserves, while assessing the land use and land availability

problems. The Minister of Lands is the key person to seek establishment of a Land Commission as suggested above. However, the ban of new allocations from government land and reserves should not be postponed while time is taken to ‘find other mechanisms’ or establish the Land Commission.

Government agencies and NGOs involved in population issues, e.g. the Ministry of Health, Ministry of Education, Central Planning Department, the Family Health Alliance and the Tonga Family Planning Association would be requested to provide to the Land Commission with any necessary information. As all Tongans will be affected by this exercise, the Ministry of Lands should seek to widely publicise the purpose of the exercise and establish a process for an open consultation and dialog to seek the opinion of the Tongan people.

Amendments suggested for the *Land Act*, *Forestry Act* and *Fisheries Act* are the responsibilities of the relevant ministries or departments in consultation with the Crown Law Office and the community. However, the challenge is how to get the responsible ministries/departments (MLSNR, MAF and MOF) to initiate the suggested changes. Given the low priority accorded to sustainable management issues by these government agencies (as described in Chapter 6 of this study), the question then is – are these ministries willing and interested in initiating a legislative amendments process, and to persist with it until community acceptable action is achieved?

The following strategies are suggested as to answer the above crucial question:

- *Strategies 1 and 2*, are important prerequisites to set the scene for integrating national sustainable development objectives into government ministry work programs;
- The DOE should play the advocate, coordination and consultation role using effective information dissemination (i.e. media, environmental reporting, information bulletin, intragovernmental workshops etc.) to inform and promote adoption of sustainable development objectives to other government departments and the private sector; and
- The public and NGOs have power to persuade and provide pressure on cabinet ministers or parliamentarians requesting appropriate responses from government on environmental or sustainable development issues.

The DOE should immediately seek Cabinet approval to strengthen its existing EIA policy (Chapter 4, Section 4.3.2.2) and confirming the process in Figure 7.3. The DOE after consultations with the CDP and licensing authorities is to submit to Cabinet environmental guidelines that development project proponents are to provide as part of the application requirements.

The DOE, the CDP and licensing authorities, and other government agencies involved in the process of decision making for development projects, should jointly conduct appropriate public awareness programs on the 'new' environmental requirements, the objectives and what is expected from project proponents. This will assist in education and promote the idea to all stakeholders and avoid any misunderstanding of the new policy. A fairly large number of respondents (55%) 'disagree' and 'are not sure' with the 'statement that government has clear sustainable development policies' (Table 5.3.15). Similarly, the communities of Taunga, Felemea and Manuka believed that more education and awareness programs, and especially to reach to the outer islands is a 'most important management tool' (Table 6.4.5). This result is not surprising as public awareness for government policies is rarely carried out (per. obs).

The Ministry of Marine and Ports (MMP) is responsible for the Marine Pollution Bill, whereas as the EIA Bill is the responsibility of the DOE. Currently both the MMP and the DOE have the same responsible minister -- the Deputy Prime Minister. This political change occurred in 2001. Both ministries should take advantage of this political change and push for the enactment of the bills as the Deputy Prime Minister is a very senior position in Cabinet.

#### **Resources Required**

The DOE should engaged the services of a legal expert (legislation drafting) with experience in Tonga or in the Pacific for *Strategy 5*. There would be additional financial costs for this. The other cost involved would be for the consultation process and awareness raising programs about the new legislation. This is considered a small and affordable cost in comparison to the envisaged objectives of the legislation and the future return in terms of sustainable management of the environment and resources.

The Land Commission would require a new budget line in the MLSNR estimates. There would be a need for the Government to fund the Commission according to the approved terms of reference. This exercise is vital for the long term planning for sustainable



development. This is not going to be an easy exercise in Tonga, considering the political structure, land being the ‘only’ resource, and the social attachment and status Tongans place on the land ‘ownership’. However, as it is crucial for the overall sustainable development of Tonga, land allocation and ownership must be addressed. It is not considered an impossible exercise if all available channels and pressure are used for the establishment of a Land Commission.

The suggested legislative amendments would not require additional financial resources as the suggested amendments should fall within the existing job descriptions of relevant senior staff of each target ministry. What is required though, is commitment from those senior officers to see that the suggested amendments are considered and approved by the proper authorities. Appropriate legislation is an important management tool required for the implementation of the ‘new sustainable development policy objective’ of relevant government agencies.

No extra financial and technical resources are required on the part of the government to implement the process suggested in Figure 7.3, as this applies to government agencies in their work and is in line with the existing target ministries estimates. The extra cost, however, would be borne by the project proponent if a major EIA is required. Proponents are to contract EIA expertise for this task. Government agencies and officers should not carry out EIA studies to avoid conflicts of interest, since the government would be responsible for assessing the EIA report. The main challenge is a change of attitude and a willingness to shift from ‘traditional ways of doing things’. If sustainable development is the goal of all target ministries as suggested (in *Strategy 2*) this process would provide an effective tool for achieving and promoting sustainable development objectives of each agency.

The immediate enactment of the Marine Pollution and the EIA Bills would not require extra cost or resources. However, when both Bills are enacted there would be additional resources required for relevant training of government officers, and awareness programs using the Tonga media to let the public know of the legislation and its requirements. This process was not carried out with other legislation (per. obs). Further, in the community surveys (Chapters 5 and 6), participants claimed that they are ‘not aware of the legislation’.

Technical assistance would be required for the establishment of national guidelines, criteria for determining major and minor projects, guidelines for Environmental

Management Plans (EMP) for public lands, guidelines for code of practices etc. Regional and international cooperation is in a position to assist Tonga in this area as it is in line with the objectives and relevant programs of SPREP, SOPAC, SPC, and FAO, among others.

### **7.2.3 Theme Three--Framework for Waste Minimisation, Recycling and Disposal Management**

Waste management problems (solid waste, sewage and hazardous waste) have been identified as the most important environmental issues in Tonga today (Chapter 5, Sections 5.3.1.2, 5.3.3.4 and 5.3.5.4; and chapter 6, Sections 6.4.1.3 and 6.4.1.5). Waste management problems are also very difficult to solve and threaten not only to the environment, but human health as well. Aspects of waste management problems appear as a priority or as important in the four categories of the environmental perceptions survey results (priorities, knowledge, attitude and opinions, and skills and behaviour) in Chapter 5 with the main results summarised in Table 7.1.1.

#### **Policy Goal**

- ❖ Establish a waste management framework for overall planning, waste minimization, waste management handling (including hazardous waste), recycling, and increase community awareness to minimize environmental, health, economic and aesthetic problems incurred by mismanagement of waste.

#### **Objectives**

In addition to the objectives suggested in Chapter 5, Section 5.4.2.1, the following are recommended as well:

- to improve waste management policies, regulation, and planning;
- to promote waste minimisation and recycling;
- to improve waste management services (handling, collection, storage, and disposal);
- to improve management of hazardous waste;
- to improve management of special waste; and

- to aggressively use the media effectively to promote waste awareness programs targeting different age groups, specific to each island situation and linking to population issues.

#### **7.2.3.1 Action Strategies**

A Draft Solid Waste Management Plan for Tongatapu was completed in 2000 through a collaborative effort of key ministries such as DOE, MOH, MOW, TWB, CDP, MLCI and NGOs<sup>6</sup> and communities, with technical and financial assistance from AusAID with the Tonga Environmental Management and Planning Project (TEMPP), (Dever, 2000).

#### **Strategy 10: Improve Waste Management Policy, Regulations and Planning**

The government should endorse the Draft Solid Waste Management Plan and make it priority policy so the Plan can be implemented. Although the Plan was for Tongatapu only, the process for developing the plan could be repeated to develop solid waste management plans for the other islands. The process used for developing the draft solid waste management plan was ‘new’ and a shift away from the traditional method of developing management plans in Tonga which have been characterized by a single ministry or department producing a plan. The draft solid waste management plan involved consultation and coordination among key ministries and four<sup>7</sup> others that participated in the TEMPP project, NGOs and communities around Tongatapu. This process is an indication that consultation and coordination could be effective in Tonga.

However, amendments to related policy, legislation, and planning are crucial for the effective implementation of the waste management plan (Chapter 4, Section 4.5.3.3). Dever (2000) recommended that government to consider an anti-littering and anti-dumping laws and also recommended for government to consider measures to improve the effectiveness of the regulatory system including the following:

- education and training of the relevant government officers on enforcement of the anti-littering and anti-dumping laws;
- making provision for on - the - spot fines for littering and dumping of solid waste;
- increasing the range of government officers able to enforce anti-littering and anti-dumping laws, e.g. to include town officers, district officers, DOE officers, and others;

- providing more specific powers/controls for the MOH officers to regulate the handling, storage and disposal of solid waste at all premises, i.e. domestic, institutional, commercial and industrial premises, and construction sites; and
- providing MOH officers with increased and more specific powers to regulate waste disposal operations/facilities.

In the Draft Solid Waste Management Plan an institutional reform was recommended to Cabinet to establish the institutional framework for the implementation of for the plan. The responsibility restructure recommended that the operation of a new sanitary landfill site be transferred to MOW, as MOW has the technical skills (civil engineering) and the heavy machinery, with DOE to monitor the underground water and other environmental parameters, while MOH strengthens its policy and regulatory roles. The Cabinet Ministers concerned approved this institutional coordination and reform of responsibility which was then approved by Cabinet (per.obs.). The *Public Health Act* (Part VI of Act 29 of 1992 – Waste Disposal and Refuse Dumping Ground) needs to be amended to reflect the change in institutional responsibilities as approved by Cabinet.

The *Public Health (Dumping Grounds) Regulations* need to be amended to include the requirement for an environmental impact assessment to be carried out before a dumping site is declared, and that restoration measures be made a specific requirement when a disposal site is declared closed.

Since the Draft Solid Waste Management Plan does not cover hazardous waste, it is suggested that the government consider a Hazardous Materials Act. The study by Bagchi, & GOT (2000), on National Profile of Chemicals Management Infrastructure in the Kingdom of Tonga provides baseline information for the development of a hazardous materials act. Tonga should also seek assistance from regional and international organizations to establish an appropriate national hazardous waste management program in line with relevant conventions, (i.e. the Waigani Convention, the SPREP Convention and the POPs Convention) to which Tonga is a signatory.

#### **Strategy 11: Assess Options for Waste Minimisation and Recycling**

Waste minimisation and recycling is critical to achieving sustainable development in a small island like Tonga. This is particularly so considering the lack of available land for landfill waste disposal and the ever increasing quantities of waste, in particular imported packaged goods, vehicles, etc. requiring local disposal. Waste minimisation could provide

a valuable extension of the life of future landfill waste disposal sites (Dever, 2000), e.g., mulching or composting of organic waste (made up more than 60 % of the waste that goes to the dump) instead of going to the landfill. Other potential recycle for plastic bottles, cans and metals were considered (Refer Dever, 2000).

#### **Strategy 12: Improve 'Special' Waste Management**

Special waste is defined in Dever (2000) as medical waste, sludge, sewage, waste oil, motor vehicle tyres and batteries, shipping waste and highly putrescible and odorous wastes. Management strategies were recommended for each of these special waste categories in Dever (2000).

#### **Strategy 13: Target Program for Solid Waste Management Awareness**

The Draft Solid Waste Management Plan for Tongatapu covers well the issues found in this study in relation to waste management. Details will not be repeated here. Other relevant strategies are:

- on site waste handling and storage;
- Waste collection;
- Waste disposal; and
- Awareness and education and training needs (Dever, 2000).

The suggested waste management strategies in Dever (2000) emphasised a broad community awareness program addressing anti-littering and indiscriminate dumping of solid waste; waste minimisation and recycling; waste handling and storage, and waste disposal. Focused community education programs, addressing home composting, and separation of garden waste for composting and establishing community recycling schemes are important. This is in line with this study's findings where only 19% of the respondents believed that they would definitely know and a further 29% believed that they would have a fair a fair idea how to start a household compost heap. Further, younger respondents (less than 54 years old) are not so confident to start a compost heap, which implies that an awareness, education program is very much needed.

Forty percent of the respondents in the community environmental perception survey claimed that their most damaging behaviour to the environment is the burning of 'green' waste. Sinclair Knight Merz (1999) found that burning of all waste is a common practice

in Tonga. Therefore it is suggested here that issues of burning of waste, such as, what to burn and what not to burn, sorting of waste before burning, amount to be burned and where to burn, health issues and other environmentally friendly way to dispose of waste, etc. could be included in community education programs.

### **7.2.3.2 Implementation Requirements**

#### **Time Scale**

The government of Tonga should implement the Draft Solid Waste Management for Tongatapu as a matter of priority as suggested in *Strategy 3*.

#### **Target Group**

Dever (2000) identified the target groups for this major project to be a joint collaboration between MOH, MOW, DOE, NGOs, Communities and community groups. The Ministry of Education (MOE) and the Tonga media (TV, radio and newspaper) would play a role in the community awareness and education programmes.

#### **Resources Required**

The total costs of the implementation of the Solid Waste Management Program for Tongatapu, which include the closure and rehabilitation of the old dump site (Tukutonga Dump), building of the new site, equipment, training, monitoring and awareness programs have been estimated to be T\$4 million over a period of five years. AusAID has agreed, in principle, to finance the project by providing technical experts, equipment, training and the cost of project administration. Tonga's contribution would be in terms of manpower (staff). There is also a strategy in place for the project to become self financing after the aid funds are finished in five years time, at the completion of the project (Dever, 2000).

The success of the project rests firstly on the continued coordination and collaboration of all target groups especially among MOH, MOW and DOE, and the government of Tonga's commitment to vigorously pursue the financial strategy suggested for the on going management, monitoring and maintenance of the sanitary landfill. Second, a successful and effective awareness and education program targeting at changing the attitudes and practices of the Tongans to waste management is needed.

#### **7.2.4 Theme Four--Framework for Sustainable Management of Coastal Resources**

The importance of coastal resources cannot be underestimated in the context of Tonga, but as seen from the previous chapters, coastal resources in Tonga are under threat from development, population pressure and from natural phenomena.

The perceived causes of coastal resources degradation are due to human activities; 26% of respondents identified destructive use of coastal forest/mangroves and habitats as their most environmentally damaging behaviour and a further 21% of respondents identified the 'way of fishing' i.e. breeding of reef, small size nets etc., as their most environmentally damaging behaviour. However, 21% of respondents said that they have modified their fishing habits for conservation purposes, but 36 of respondents said that they do not clearly understand what is and is not harmful. This implies that people may change their behaviour if they knew what to do.

There is not much difference (in the percentage of respondents) between those said that 'they would definitely know how to reef glean safely/those who have a fair idea' and those 'who are not sure/does not have any idea at all' (54% to 46% respectively). Appropriate awareness and education programs are strong tools to increase the proportion who know how carry out certain activities without destroying the environment and its resources. Different awareness programs could target females and males as techniques and areas of fishing are different (Table 6.3.2).

The three villages survey (Taunga, Felemea and Manuka) showed that coastal fishery resources are declining and also the coastal forest and coastal habitats such as water quality, and coral reefs. The communities surveyed suggested more participation in the management of community coastal resources, considering the limited capacity of the government.

The strategies suggested below are in addition to the policy and legislation strategy relating to coastal resources in *Strategies 1 & 2*. The theme, sustainable management of coastal resources, includes coastal resources such as forest, mangroves and sand as well as coastal fishery and habitats.

##### **Policy Goals**

- ❖ Improve productive capacities of inshore fisheries and other nearshore ecosystems and maintain sustainable yields;

- ❖ Adopt community strategies for participation in coastal ecosystem management; and
- ❖ Preserve the natural interconnections known for coastal ecosystems.

### **Objectives**

In addition to the action strategies suggested below under this theme, the following objectives and activities, based on the findings of the previous chapters, are important to consider for the sustainable management of coastal resources:

- to encourage favourable working mechanism for better co-ordination and collaboration among key government agencies and between these agencies with the communities;
- to strengthen regular monitoring and assessment of coastal systems capabilities of the MOF and the DOE;
- to develop a program of coral reef and seagrass monitoring, selecting ‘disturbed and undisturbed sides;
- to monitor marine organisms (i.e. coastal fisheries) and develop with the communities strategies for the ‘wise use’ of these resources;
- to establish community coastal and marine protected areas to protect and conserve community resources, including coastal forest/mangroves as habitats, and shoreline/foreshore protection;
- to strengthen the management of existing marine parks and establish marine parks in the outer islands with the objective of marine biodiversity conservation;
- to establish pilot community ‘exclusive’ coastal fishing areas with a view to establishing coastal community fishing areas nationwide based on the lessons learned from the pilot sites;
- to establish areas for subsistence fishing only, as suggested in the Fanga’uta Lagoon System Management Plan;
- to strengthen the roles of key community figures, such as, town officers and district officers, to enforce fisheries regulations;
- to intergrate local skills and knowledge for coastal/biodiversity conservation;



- to develop 'integrated island management plans' including coastal and land areas;
- to implement existing management plans (Fanga'uta Lagoon System Management Plan);
- to assess opportunities for alternative income for the outer islands;
- to ensure protection of ecologically valuable and economically harvestable fisheries;
- to protect coastlines from erosion, siltation and pollution;
- to preserve the aesthetic and recreational qualities of the natural shoreline
- to develop appropriate 'mangrove specific' awareness programmes about its ecological and socio-economic values;
- to raise community awareness of the need for sustainable sand mining practices including its effects, i.e. beach erosion;
- to promote research into new/alternative source of sand and limestone aggregates.

#### **7.2.4.1 Action Strategies**

##### **Strategy 14: Improve Coordination and Collaboration at the Ministerial/Departmental Level**

Relevant government ministries and departments should seek to establish favourable working agreements especially among the MOF, MLSNR, MOW and DOE and the various communities. Coordination and collaboration would not only facilitate sharing of expertise and resources for research, enforcement and for conducting joint community coastal programs. The activities of each agency have in the past, impinged on those of the others and there is a need to set out a clear demarcation of responsibility for each agency. This can be accomplished by memorandum of understanding between groups, after full discussion.

It is also important that government agencies give out the same 'message' to the communities through their respective community extension and awareness programs.

Such programs should be complimentary so as to strengthen community convictions that government agencies are working together towards the common goal of conserving community coastal resources. It is only then that government would gain the community trust and support for community-based sustainable coastal resources management programs. As indicated in *Strategies 1 and 2*, government has to shift from excluding communities to promoting community participation, if sustainable development is to be achieved in Tonga.

#### **Strategy 15: Improve Monitoring and Assessment Capacity**

CPUEs in the representative study areas visited (Tongatapu – Manuka, Vava’u – Taunga, and Ha’apai – Felemea) have been reported to be in decline over the past decade. This study’s findings were in line with anecdotal evidence and the few earlier studies that have been carried out in Tonga (Thaman, et al., 1996; Gillet et al., 1998; World Bank, 1999; Lubett, 2001).

The Tonga Environmental Management and Planning Project (TEMPP) established an inter-agency Tonga National Monitoring Core Team (TNMCT)<sup>8</sup>, which was approved by Cabinet in 2001. The work of the TNMCT needs to be extended to the outer islands as little survey work on coastal resources conditions has been carried out there.

The TNMCT and laboratories in Tonga currently have the capacity and the skills to monitor key fisheries species, water quality, water chemistry, biological indicators (corals, seagrass, algae) and faecal coliforms. Capacity of the TNMCT will need to be upgraded to monitor other parameters if this is found to be necessary. Tests for persistent organic materials or metals, when required, could be carried out in laboratories overseas.

The head of departments who are represented in the TNMCT should decide and approve the annual work programs of TNMCT prior to the preparation of each budget, until the National Sustainable Development Commission (NSDC) is established (as suggested in *Strategy 6*). The head of departments or NSDC should prioritise the monitoring program that should be carried out by TNMCT in that financial year and consider the need for long term monitoring of certain parameters.

The work of the TNMCT needs to feed into the preparation of the Environmental Management Plans as suggested by *Strategy 5*, and the State of Environmental Reporting. The data and information collected by the TNMCT should be interpreted and distributed

to government agencies and the public, as well as keeping a data base within the DOE Environmental Resource Centre, and the data should be accessible government agencies, the public and to researchers.

Results of the community surveys in this study suggested a high community awareness of the conditions and changes occurring in coastal areas. There is a possibility for the TNMCT to collaborate with community groups in systematic community monitoring programs and for TNMCT to provide the basic training required, collect the information from the communities at agreed times, interpret the information and establish strategies to present the interpretation to the community concerned. In this way, the communities may be encouraged to continue or change resource use practices as they 'see' the positive changes they have made, and the TNMCT would collect the information or data for its wider national monitoring role.

There is also an opportunity for TNMCT to liaise with the Ministry of Education (MOE), Curriculum Development Unit for possible field surveys to be conducted by high school students in the subjects that require local studies. These suggestions would be cost saving to TNMCT plus providing valuable awareness to communities and school students of Tonga.

No regular monitoring has been attempted of the reef conditions or catches of the most productive and important coastal fisheries resources of Tonga. The community perceptions survey of trends in coastal fisheries resources claim an increase in the CPUE of some species such as finfish, emperor, snapper etc., especially in Taunga and Felemea; however, the reason for the increase was not related to management rather it was because of better technology and operations in new fishing areas usually farther away from the community. It is suggested that regular monitoring of coastal catches be established as well as regular monitoring of the biological conditions of coral reefs and the sea grass beds.

#### **Strategy 16: Foster Integrated Management of Coastal and Marine Protected Areas**

Out of the estimated 700, 000 sq. km EEZ for Tonga, only 284 ha is being protected (chapter 3, Section 3.6.3) and this only in Tongatapu. This is a very small area to ensure any beneficial effect at all. There is a need to establish marine parks or marine protected areas (MPA) in the outer islands as well. However, from experience, the existing marine parks are not managed successfully due to a lack of government commitment. The recent

institutional restructure in Tonga (the separation of a Department of Environment for the Ministry of Lands), the relevant policy reforms suggested in *Strategies 1 and 2*, and marine parks still provide a viable conservation tool for Tonga. However, there is a need for renewed commitment from the government. On the other hand, MPAs in the outer islands are more likely to be supported by the local communities, as there is little government infrastructure there to do so, and these communities have expressed a wish to have greater control of their environment.

Since the legal framework for establishment and management of marine parks already exists (and taken into consideration the relevant suggested amendments (Theme 2)) marine parks in Tonga would still achieve the desired goals as the issues of dealing with traditional fishing rights owners are absent in Tonga. However, to gain community support and awareness, government agencies should commit to a better working relationship, and to enable future development of marine parks through effective and broad community consultation addressing:

- goals and objectives of the marine parks;
- regulations of the marine parks;
- new areas important for the conservation and sustainable use of biological diversity;
- community roles (in partnership with NGOs and government) in the management of marine parks; and
- benefits to the communities surrounding fishing areas.

#### **Strategy 17: Conserve Coastal/Marine Biodiversity**

Tonga's coastal/marine biodiversity resources play a crucial role in the development of the nation's economy. Not only do they provide food, medicine and industrial products but the coastal/marine biological diversity also affords the Tongan communities a 'life support system' that maintains natural processes. In addition, the diversity of coastal/marine life has much aesthetic value for the communities as well as for visitors to Tonga. These valuable benefits clearly show the importance the marine biodiversity resources have socially, culturally and economically.

As suggested in previous chapters, the coastal biodiversity resources of Tonga are under increasing pressure from human induced stresses. There are several coastal species that are

perceived to have become extinct in Tonga due to increasing fishing pressure with indications that several sedentary species (Table 6.4.2) are under threat.

Activities that should be considered along with this strategy include the following:

- In order to properly manage resource (marine and coastal) it is imperative to have a good understanding of ecosystems and the conservation of biodiversity. Mapping the diversity of resources would form the baseline from which changes can be detected and appropriate resource management plans be formulated; and
- To satisfactorily manage resources, it would be necessary to know what resources are available, how many are available, how are the resources 'fished' or used (marketing, home consumption, other uses etc.) and what the sustainable level of harvest is. This information would be obtained through resource inventory, socio-economic surveys and stock assessments.

#### **Strategy 18: No net loss of mangroves and littoral forest**

The remaining mangrove areas in Tonga are potentially prone to high human impact (Table 3.5.4). A surprising 68% of respondents in the community assessments were not sure whether mangroves have value or not, and only 30% agreed that mangroves do have value (Fig 5.2 & Appendix 5.1). This result suggests that there is a large number of Tongans who perceive that mangroves have 'no value'. This perception could mean 'no economic value or ecological value' as the question did not differentiate between the two. However, this suggestion is confirmed by only 12% of respondents selecting 'loss of coastal forest and mangroves' from a given list (prompted) as a priority environmental issue, and only 3% of respondents selected 'removal of mangroves' (unprompted) as a priority environmental issue (Table 5.3.3). In Manuka, loss of mangroves was identified as a key environmental issue (Table 6.4.1), thus mangrove replanting in Manuka and in areas where mangroves are found but disturbed is very important.

Mangroves are extremely important not only for stabilizing the shoreline, habitat for crustaceans, part of the spawning route (food chain) of mullet and other lagoon fish species (Zann, 1984; Kaly, 1998) but have significant cultural uses (Pelesikoti, 1992a). Ellison, (1999) suggested a no net loss of mangroves for Tonga. Ellison suggested that any loss of mangrove area for any purpose should be compensated for by replanting of an equal or greater area of mangroves at a suitable intertidal site at the cost of the developer.

This is present in the Queensland legislation, and is in the Pohnpei Mangrove Management Plan (Ellison, 1999). The same principle could be considered for other littoral forests in Tonga, considering the effect of sea spray and wave action causing damage to plantations and vegetation as well as causing coastal erosion.

The no net loss of mangroves and other littoral forest was adopted and suggested in the Fanga'uta Lagoon System Management Plan for Tonga (Pelesikoti et al., 2001) and it is recommended in this study that the government should take immediate action to implement the Plan.

The main challenges for this strategy lie in the fact that government is the main developer in Tonga, and therefore government should allocate other land for the 'compensation area'. Pelesikoti et al. (2001) recommended government development be restricted to areas where mangroves have been highly disturbed and are already damaged and 'total conservation' to areas where mangroves are still intact and less disturbed.

#### **Strategy 19: Assess Opportunities for Community Fishing Areas**

The need for 'exclusive' community fishing areas was identified in the findings of the community perceptions of trends and factors affecting coastal resources (Chapter 6). There was a very high perception that coastal resources degradation is caused by commercial fishers from outside each village, those who are using destructive fishing methods (also from outside the village) and too many fishers (also from outside the village). Therefore each community suggested more participation in the decision-making and management of 'their' coastal resources and livelihoods, considering the lack of central government capacity to implement the management roles accorded by the existing policies and legislation of Tonga.

As a management priority, communities suggested more participation in management and restrictions of 'outside' fishers from 'community fishing areas'. It is the general belief of the communities studied that to achieve sustainable management of coastal resources they should participate in the decision making process that affect the use of coastal resources. However, communities also indicated that assistance from external organisation i.e. government, NGOs, regional organizations, is needed to ensure the smooth running of the community fishery areas, in terms of making sure that there is legal support (as suggested in *Strategy 2*), providing of advice, training, awareness and education and financial support.

### **Pilot Community (Co-Management) Coastal Fishing Areas**

As 'Community Fishing Area' is a new concept to Tonga, this study suggests that pilot community fishing areas be established first with communities who are willing to trial this management option. A pilot program in each main island group is suggested to raise the level of awareness as the issues and access to information and assistance are very different in each island group. The pilot programs for this strategy should address the following elements of a community coastal fishing area:

- the definition and demarcation of a 'community';
- community institutions;
- rules of the community fishing area;
- mechanisms to exclude other fishers from the area;
- mechanisms for enforcement;
- types of fishing gear and activities allowed in the community fishing area;
- consideration of limited access or closed season for whole or part of the community fishing area; and
- roles of the government and other external stakeholders.

Lessons learned from the pilot program should provide the basis for incorporation into legislation and the nationwide introduction of the program.

### **Strategy 20: Adopt Integrated (Whole) Island Environmental Management Plans**

The size of the islands of Tonga makes it a waste of resources to differentiate land and coastal area management plans. An integrated management plan was initiated by the TEMPP in the Fanga'uta Lagoon System Management Plan (Fig. 3.6) where concern for land-based activities that have impacts on the ecological condition of the lagoon are given as much attention as the actual fisheries activities inside the lagoon. Addressing socio-economic issues of communities around the lagoon and sustaining its life support ecosystems were the basis for the building the management plan (Pelesikoti et al., 2001).

Strategy 5 suggested divisional environmental plans. The process that TEMPP established for developing the Fanga'uta Lagoon System Management Plan should be used for the development of the integrated environmental plans for each island division; combining

scientific information with people's priorities and needs, based on actual field survey, community consultations, and government department coordination. Figure 7.4 shows the planning steps for developing an integrated environmental management plan in a flow chart to include:

- problem identification, analysis, including an inventory and analysis of relevant environmental attributes;
- formulation of goals and objectives to define the future form and quality of the environment, with emphasis on community input;
- formulation of alternative to achieve the goals and objectives;
- testing and evaluation of alternative using explicit criteria; and
- selection and implementation of the favoured alternative, including monitoring, feedback, and system change.

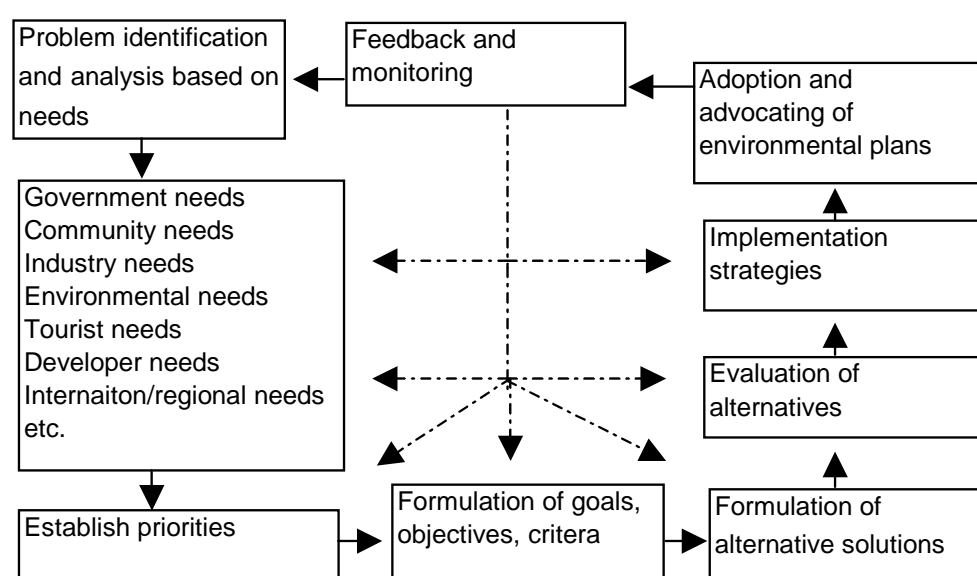
The first few steps of planning an environmental management plan involve 'problem identification' and 'analysis' to identify the 'environmental priorities' or 'needs' that require attention. This is done through assembling environmental issues through meetings, workshops, or surveys not only on community's perceptions of the environment but of the ecological condition of the environment (either through literature review, inventory or base line studies). It is very important at this stage that a wide selection of stakeholders (Fig. 7.5) are included.

This would lead on to developing goals, objectives, and formulation of alternative solutions. When all stakeholders have evaluated all alternative solutions proposed and determine the implementation strategies 'most suitable' for the environment and socio-economic situation in Tonga, then formal adoption is sought from the Cabinet for the plan to be 'released' to the community through hard copies and the use of media and community forums.

Monitoring and feedback are important mechanisms which will not only evaluate implementation but will provide for opportunities to evaluate the priorities, the goals and objectives and the alternative solutions, thus making the environmental management plan 'a working document' that is sufficiently flexible to respond to emerging issues during implementation.



**Figure 7.5: Flow Diagram Presenting The Planning Process for an Integrated Environmental Management Plan: Establishing Problems Based on Community Needs**



Modified from Baldwin (1985) and GOT & ESCAP (1990)

**Strategy 21: Investigate Opportunities for Alternative for Sources of Income**

A relatively high percentage of respondents from the outer islands (Niua, ‘Eua, Vava’u and Ha’apai) in the environmental perceptions survey (Chapter 5) claimed that lack of alternative sources of income and poverty are priority environmental issues. Similarly, one of the main causes of coastal resources CPUE decline and perceived decline in the conditions of coastal habitat, is the lack of alternative sources of income.

The objectives of sustainable resource management would become very difficult and frustrating to implement in Tonga if the government ignores community needs for a steady income and economic growth. Strategies that the government should address alongside the ‘push’ for sustainable development include the following:

- conducting feasibility studies to determine what alternative income generating activities worth pursuing
- marketing strategies for the outer islands to market their handicrafts (mats, tapa cloth, baskets etc.);
- strategies to ensure that the raw material for handicrafts are replanted;

- strategies to upgrade skills in handicrafts according to market preferences;
- strategies to promote eco-tourism in consultation with the communities and the tourist industry.

#### **Strategy 22: Implement Appropriate Environmental Impact Procedures**

Coastal development should be subject to social, economic and ecological assessment and extent of the assessment should be determined by the EIA policy as suggested in *Strategy 7*.

Sand mining (from respondents in Tongatapu, Vava'u and Ha'apai) and run-off into the harbour (from respondents in Vava'u) were identified as priority environmental issues (Chapter 5, Section 5.3.1.3). Two recent donor-funded projects in Tonga that were implemented without due consideration of environmental assessment (in the opinion of the author) are examples of the government decision makers thinking that environmental assessments are an unnecessary cost. Yet the projects turned out to have huge environmental impacts for Tonga.

The first was the road improvement work in Vava'u (1997-2001); at the completion of the road improvement, the Vava'u people perceived that there was more run off compared to before the road project (Kaly et al., 2001a). The second project is the changing of the main water pipes at Nuku'alofa (2001) where the new pipes were required to be laid on a sand bed. This saw major beaches in Tongatapu further stripped and sand was dug from allotments by the coast where vegetation was cleared and left bare with huge holes (per. obs). These two projects are among many which warn the government that trying to save money at the cost of the environment would cost more in the long run to the people of Tonga.

#### **7.2.4.2 Implementation Requirement**

##### **Time Scale**

Ideally *Strategies 14 and 15* should be implemented as soon as possible, but target agency capacity and priorities determine the time scale for getting activities off the ground. *Strategies 14 & 15* have been started within the TEMPP, and the challenge here is the continuation of these activities by the target agencies after the donor input to the TEMPP has been completed. *Strategies 19 and 20* have links to *Strategies 1 and 7* ('establish a

national sustainable development policy’ and ‘introduce new legislation’ respectively) and the timing for *Strategies 19 & 20* implementation will depend on implementing of *Strategies 1 and 7*.

#### **Target Groups**

The key player for *Strategy 19* is the Ministry of Fisheries in collaboration with the the MLSNR, DOE, MAF, MOE, TVB, Tourism Industry and the target communities for various activities. The tourism industry in Tonga includes the airlines, Tonga Chamber of Commerce, hotels, motels and beach resorts and the National Tourist Association.

#### **Resources Required**

Significant resources are required for this strategy in terms of technical (expertise and training) and financial assistance. Apart from bilateral and multilateral assistance, the target government agencies are in a position to seek regional and international assistance as each agency is in direct contact with relevant regional and international organisations that could provide assistance. For example:

<b>Tonga Agency</b>	<b>Regional/International Organisation Provide Assistance</b>
Ministry of Fisheries (MOF)	Secretariat of the Pacific Commission (SPC) Forum Fisheries Agency (FFA), UNDP
DOE	South Pacific Regional Environment Prog(SPREP), United National Development Prog (UNDP)
Ministry of Lands, Survey and Natural Resources (MLSNR)	South Pacific Applied Geosciences Commission (SOPAC)
Tonga Visitors’ Bureau (TVB)	Tourism Council of the South Pacific (TCSP)
Ministry of Agriculture	Food and Agriculture Organization of the United Nations (FAO)
Ministry of Education	United Nation Education, Scientific and Cultural Organisation (UNESCO)

#### **7.2.5 Theme Five: Sustainable Management of Land Resources**

General sustainable land resources policy issues and legislation requirements are discussed in *Strategies 1-9*. The strategies discussed here are specifically for underground water, forest, biodiversity, and activities that are based on land resources, i.e.’ agriculture, population, habitation and their impacts of land resources (Table 7.2.2).

**Table 7.2.2 Community Priorities -- Land Resources Issues**

<b>Water Issues</b>	<b>Biodiversity Issues</b>	<b>Issues Arises from Commercial Agriculture</b>	<b>Land Planning Issues</b>
<ul style="list-style-type: none"> <li>- underground water pollution</li> <li>- droughts (lack of rainwater as the main source of water for the outer islands)</li> </ul>	<ul style="list-style-type: none"> <li>- loss of native forest and general deforestation</li> <li>- loss of habitat, biodiversity and wildlife</li> <li>- uncontrolled domestic animals (pigs etc.,)</li> </ul>	<ul style="list-style-type: none"> <li>- increased pests, weeds and plant diseases</li> <li>- increased soil degradation, which is indicated by the increase in commercial agriculture and the increase in use of fertiliser and pesticide</li> <li>- soil structure breakdown</li> <li>- soil erosion</li> <li>- excessive use of pesticides and fertilizers</li> <li>- mechanisation/commercial agriculture</li> </ul>	<ul style="list-style-type: none"> <li>- increasing urban population</li> <li>- lack of land use planning</li> <li>- the shortage of good vacant land for residential purposes in and around the Nuku'alofa urban areas has led the heavy urban migration of recent years to settle in the swampy and coastal low-lying areas of Tongatapu</li> <li>- the lack of land use planning means the juxtaposition of incompatible land uses, too few parks, lack of recreational and playgrounds and shopping areas, and inability to separate residential from industrial areas.</li> </ul>

Sources: Chapters 3 and 5 of this Study

Land resources are not only extremely important to Tonga but are very limited and fragile in the context of small landmass islands. The values of the land resources to the community are very diverse, and many of them are not always immediately obvious. In essence, the land resources are part of the human life-support system, and for this reason need careful management. Sustainable management of land resources is not preserving the environment for its own sake, but about looking after ones own livelihood and future, because communities depend on a healthy environment for our continued survival and prosperity.

The benefits Tonga's communities obtain from land resources fall into two categories. Communities obtain goods from the land resources such as water, firewood, medicinal plants, fruits and crops, etc. Communities also obtain services from land resources, such as habitats to support wildlife, fresh air, soil for agriculture and land to build on, etc. The 'goods' and 'services' roles of the environment apply equally to marine and land resources. In order for Tonga to continue to gain benefits from the land resources in the future, the following objectives and strategies are suggested. If these objectives and strategies are not implemented, one could expect the benefits from land resources to decline and the livelihood of the people of Tonga would also decline.

Apart from sewage and septic seepage that might pose a pollution threat to underground water (addressed in *Strategy 4*), a major concern with underground water pollution is

attributed to commercial agricultural activities. Morrison (2000a) (refer Table 3.6.5) detected very low concentrations of chlorfluazuron, fluilazole, carbaryl and dimethoate in sediment samples in the Fanga'uta Lagoon and TWB (1995) detected <1µg/L of volatile organic compounds (organochlorine and organophosphorus pesticides) in the main well (Chapter 3, Section 3.4.3.5) providing water for Nuku'alofa. Although these findings show very low concentrations, the significance of these two studies indicate that there is some movement of compounds from the land and that continued monitoring is very important.

Domestic animals such as pigs, dogs, goats and cattle that are allowed to roam free have become a nuisance (animal droppings, and dogs sometimes attack people) and an environmental hazard (destroy crops, seedlings, gardens, etc.) despite early protection prescribed by the *Pounds and Animals Act 1903*, as the Act is poorly enforced.

#### **Policy Goal**

- ❖ Foster sustainable use of land resources.

#### **Objectives**

The sustainable environmental and resource management objectives for this theme are as follows:

- to promote agro-forestry;
- to promote organic farming and search for appropriate markets (local and overseas);
- to protect agricultural soil from erosion, soil physical breakdown, salinization and pollution;
- to increase sustainable food production to ensure food security at all times in Tonga;
- to guard against importation of diseases or pests which might harm local food fauna and flora;
- to improve education and awareness programmes for safe use, storage and disposal of agro-chemicals and pesticides;
- to protect and enhance terrestrial biodiversity;
- to maximize efficient use of land for food, cash crops and livestock;

- to improve management of domestic animals; and
- to promote awareness of water conservation and good practices.

#### 7.2.5.1 Action Strategies

##### **Strategy 23: Focus on Sustainable Agricultural Policy**

The shift from the traditional agricultural system (explained in Chapter 3, Section 3.4.2.3) to commercial agriculture and increase in population pressures are the main causes of land resources degradation (Chapter 3, Section 3.4.2). However, for a country whose development is based on limited land resources, there is a general lack of sustainable agricultural development policy. In order to reverse the negative effect of commercial agriculture, a sustainable agricultural development policy needs to be developed, approved and implemented to help plan and implement the following policies of:

- improving the utilisation of land resources to maintain a stable social and ecological environment;
- safeguarding the interests of both producers and consumers, by attending to the needs of production, conservation, marketing and distribution in an integrated manner; and
- improving farming systems and practices to increase the sustainable productivity of the land.

Important objectives to be included in the sustainable agriculture development policy are:

- emphasis on agro-forestry for maintaining fertility, protections of crops from storms and salt sprays, prevention of erosion and production of valuable wood products, medicines, nuts and fruits;
- promote intercropping techniques to lower disease problems with parallel decreased used of pesticides;
- establishing research and programmes to address invasive species issues;
- research for biological control of diseases;
- research into high-yielding plant varieties, disease-resistant and salt water resistant planting materials for subsistence crops and trees for wood resources;

- use of appropriate, water efficient irrigation technology for drought periods;
- maintenance of cropping diversity through encouraging farmers to protect trees and plant a range of cultivars;
- developing a national germplasm/planting material collections;
- placing a moratorium on the felling of important cultural trees;
- training of extension workers and informing farmers on the legal aspects of land leasing and registration to facilitate secure tenure of land;
- develop appropriate (agricultural specific) community awareness programs; and
- emphasis on agro-forestry for maintaining fertility, protections of crops from storms and salt sprays, prevention of erosion and production of valuable wood products, medicines, nuts and fruits.

#### **Strategy 24: Develop Land-Use Plans for Agriculture**

Land use and land use planning in Tonga have to be considered within the context of the socio-political-economic system. Aspects of land for forestry, community forest and parks, management plans for government land, and coastal land (for littoral forests and mangroves), and the lack of land have been covered in earlier strategies. However, agricultural land also faces a threat from population growth and from growth of villages especially in the main island of Tongatapu. The land use plans for agriculture should address the need to:

- ensure food security for the people of Tonga; and
- protect agricultural land against permanent alienation to other land uses.

#### **Strategy 25: Promote Water Conservation and Protection Schemes**

Water is one of the critical resources for the small, isolated, widely scattered islands of Tonga. Further, Tonga has limited options to develop the country's freshwater resources. Groundwater occurrences are highly dependent on regular recharge events.

The geophysical setting of Tonga leaves her vulnerable, not only to extreme climatological and seismic events, but also more critically to periods of low recharge and adverse environmental impacts, including underground water pollution and saline intrusion (Mimura & Pelesikoti, 1997; Furness, 1993). For example, saltwater intrusion is a major problem and in the small islands of the Ha'apai group, well water is too saline for

human consumption and rainwater collected in water tanks is the only source of water (ESCAP & GOT, 1990). Limits in terms of water quantity and quality can be reached very quickly in periods of low recharge (Furness, 1993).

The high percentage of respondents who selected 'pollution – solid waste, land degradation, climate change and sea level rise and other sources of pollution' (70%) as the 'most important environmental issue in Tonga today' (Table 5.3.3) suggests that there is a high potential risk of water pollution in Tonga. Both Taunga (in Vava'u) and Felemea (in Ha'apai) identified water shortage as a key issue during drought periods.

A working policy should be prepared between the MOH, MLSNR and TWB clearly defining areas of responsibilities and areas of co-operation. Since TWB has the technological skills and resources for sustainable management of the water resources (TWB has just completed a seven year institutional strengthening project funded by AusAID). This study suggests that TWB be expanded to include responsibility for all water extraction, collection and delivery systems, including rural water. TWB is also in a position to maintain these functions, as it is run on a competitive commercial basis.

Areas that should be considered in the water conservation and protection scheme should include the following:

- promoting policies encouraging efficient management and use of existing water resources;
- providing a safe, sustainable supply of potable water for the communities in the outer islands;
- protecting water resources from contamination by animals waste (free roaming animal is a priority environmental issue) and from pit toilets (still widely used in the rural areas and in the outer islands);
- increasing community involvement and responsibility in rural water supply schemes and water conservation program;
- supplying adequate water for agricultural and industrial needs;
- TWB to lead and assist communities groups, NGOs, village water committees and the general public in conservation skills through appropriate community programmes and effective use of media;



- increasing the assistance to the outer islands for the building of water tanks and targeting that every household should have a water tank;
- research required in the area of water desalination technology;
- specifically for ‘Eua – to establish buffer zones around the ‘Eua watershed to assist and control further deforestation; and
- to draw a water emergency plan for the outer islands that are dependent on rain water for the prolonged drought periods.

**Strategy 26: Enforce Proper Management of Domestic Livestock**

Pigs are the major livestock of Tonga and are considered the cause of major environmental problems. Several respondents that selected land degradation as an important environment issues at the local area, were concerned about the problems caused by pigs and other domestic animals (Table 5.3.4). A higher percentage of respondents believed that ‘dealing with free roaming pigs and other domestic problems are much worse now as compared to over the past five years (Table 5.3.9). In Felemea, one of the perceived causes of decline in water clarity around the jetty area could be due to pigs scavenging at low tide (Table 6.4.3).

Pigs roam freely everywhere and constantly damage crops and ornamental plants and gardens. Pigs are also a vector for numerous parasitic worms and other diseases (ESCAP & GOT, 1990).

The main problem with keeping pigs in piggeries is the lack of pig feed. Traditionally pigs are fed on food scraps, coconuts, cassava and supplemented by rooting and scavenging. Tonga will not be able to successfully solve the ‘pig’ problem if long term availability of pig feed is not considered. The following strategies are suggested:

- research into sustained low cost local pig food;
- Livestock Division of MAF to consult with communities to establish best ways of addressing the ‘pig scavenging’ problems;
- promote and influence the social importance Tongans have on pigs in their diet and promote other sources of meat; and

- improved integration of pigs, chickens and cattle into the existing system by using agricultural produce instead of imported feed and collection of manure for fertilisers.

#### **7.2.5.2 Implementation Requirement**

##### **Time Scale**

The timely implementation of the sustainable use of land resources theme is very important for the overall 'sustainable development' goal of Tonga. This theme is the backbone of the Tonga's economy and it is important that people 'see' that economic growth and sustainable development are complimentary to each other in the long run, and they can benefit from implementing sustainable land management strategies.

##### **Target Agency**

The Ministry of Agriculture and Forestry (MAF) is the target agency for the agricultural, forestry and livestock related strategies. MAF has a Forestry Division, a Livestock Division, a Research Division and an Advisory/Extension Division. The Forestry Division has responsibilities for reforestation, and nurseries. The Livestock Division conducts livestock extension and advisory to farmers and the division to advice farmers on pigs feed and feed for other animals as well. The research division investigates all aspects of agriculture, livestock, pest and disease control, agro-forestry, nurseries and appropriate technology, and the advisory/extension section provides the important link of all the divisions of the ministry to the farmers and the wider community.

For the water conservation and protection strategies, the MOH, TWB and MLSNR are the key target agencies. Village water committees are important target groups as well for the water resource strategy.

##### **Resources Required**

Research activities would require additional financial resources as well as the availability of human resources to utilise those resources. The lead agency should be in a position to seek government assistance as well as regional and international assistance.

### **7.2.6 Theme Six: Precautionary Planning for Climate Change, Sea Level Rise and Related Extreme Weather Conditions**

Tonga, like other small island in the Pacific, is particularly vulnerable to global climate change, climate variability and sealevel rise. The Disaster Preparedness Division of the Ministry of Works (MOW) has completed a very comprehensive National Disaster Preparedness Plan in 2001, which Cabinet has endorsed. It is now the MOW responsibility to request to government resources to implement the Plan or to seek regional and international assistance. However, notable from the plan is an emphasis on preparedness for the three phases of cyclones (warning phase, during cyclone and after the cyclone phase) and preparedness for tsunami and earthquake.

Tonga's enabling programme under the Climate Change Convention and its preparation of its first communication to the conference of the parties is expected to be completed in late 2003. The enabling programme will provide as essential foundation for national strategies to address climate change and expected sea level rise issues. The preliminary study by Mimura and Pelesikoti (1997) gave some indication of the magnitude of the problems Tonga would face with sea level rise.

#### **Policy Goals**

- ❖ Increase public and political awareness of the impacts of climate change and sea-level rise;
- ❖ Strengthen coastal area development through the adoption of integrated coastal planning and management, integrating EIA tools at the early process of development planning, and the use of environmental codes of practice; and
- ❖ Improve Tonga's preparedness for natural disasters (cyclones, tsunami, earthquake etc.).

#### **Objectives**

The main objective, as to be expected from this theme, is to protect the people of Tonga and their properties from the effects of climate change. The second objective would be to increase the awareness of the people of Tonga to issues surrounding global environmental

issues that affect Tonga such as sea level rise so that people can make informed decision in their planning and activities.

Integrated coastal management (ICM) has been promoted as a means of managing a range of human activities and natural processes which affect coastal systems, including climate change and sea level rise (SPREP, 1997). The development of national capacity to avoid or mitigate coastal degradation and to develop and implement adaptation strategies will therefore rely greatly upon the development and implementation of ICM approaches relevant to Tonga.

EIA is a management tool that should be used to further the policy of sustainable development and is one of the mechanisms that could be used to assess the impacts of potential sea level rise, storm surges and cyclones on coastal development (SPREP, 1997). Similarly, environmental codes of practice or conduct are effective means of enlisting support from developers and business in the absence of regulations (Richards, 1998; [www.fao.org/fi/agreem/codecond/ficonde.asp](http://www.fao.org/fi/agreem/codecond/ficonde.asp)). Codes of Practice are needed for tourist facilities (beach resorts, hotels), coastal reclamation, coastal infrastructure, etc. There is a number of important steps or objectives that could be undertaken to lessen the impacts of these natural phenomena in Tonga including the following:

- to participate in global and regional relevant negotiation, transfer of technology and skills, training etc., to strengthen Tonga's mitigation capabilities especially in the agriculture and the waste management sector as this will directly address local sustainable development issues;
- to survey and monitor climate-sensitive ecosystems in the outer islands of Tonga to identify vulnerable areas;
- to promote the importance of preserving the role coastal ecosystems (coral reefs, mangroves, sandy beaches) in protecting coastlines from erosion and inundation;
- to collaborate with relevant regional agencies in researches on the impacts of sea level rise and extreme weather on coral reef, seagrass and selected key coastal resources;
- to produce relevant awareness materials for Tonga on the effect of sea level rise;
- to promote the voluntary participation of the private sector in integrated coastal management;

- to enforce the use of EIA in coastal developments;
- to build capacities of personnel among staff of government and non-government organisations involved in monitoring and assessment of climate change issues, cyclones, earthquake, tsunami etc.;
- to train climatologists and environmental managers knowledgeable about climate change and related issues; and
- to integrate climate data and information in government policy, environmental impact assessment, planning, teacher training and media reports.

#### **7.2.6.1 Action Strategies**

##### **Strategy 27: Develop Appropriate National Policies for Sea Level Rise and Extreme Weather Events**

In addition to the expected policies to be developed as a result of the action strategies discussed under this theme, Tonga lacks appropriate policies to deal with climate change issues and the extreme weather conditions that Tonga currently and will continue to face. There is a lack of appropriate policies related to the climate change issues apart from a draft building code (still under consideration) for new buildings to following guidelines for ‘better’ cyclone resistant structures (MOW, 2000). Multilateral Environmental Agreements (MEAs) provide the main link with global policy in climate change and related issues (Miles, 1999). There is a need for Tonga to participate effectively in the development of such global agreements i.e., such as in the UNCLOS, UNFCCC, CBD and the CMS all of which Tonga has ratified.

Although Tonga contribution to global green house gases (GHG) is expected to be insignificant, communities have raised a concern for the effects of climate change and sea level rise, which is observed in increasing coastal inundation, and severe coastal erosion. Similarly the impacts of cyclones and storm surges equally pose grave threats for Tonga. Therefore relevant policies in the following areas are imperative for the Government of Tonga to consider:

- to develop policies considering the ‘food security’ of Tonga in the scenarios of elevated salt water content due to expected sea water intrusion and elevated water table;

- to collaborate with other countries in research activities in drought resistant and salt resistant varieties of crops and tree species;
- to develop as emergency plans for the security of the water resources of Tonga (especially the underground fresh water lens) according to the IPCC sea level rise scenarios.

**Strategy 28: Assess Adaptation Strategies**

In order for Tonga to comprehensively develop its adaptation and mitigation strategies; the following baseline activities are expected to be implemented in the current GEF Tonga Climate Change Enabling Project:

- survey and collect base line data on climate change and sea level rise and in cooperation with relevant projects currently implemented in the region;
- assess the effects and the socio-economic implications of the impact of climate change, climate variability and sealevel rise;
- map areas vulnerable to sealevel rise;
- develop and assess adaptations and mitigations options for Tonga including costing; and
- improve public and political understanding of the potential effects and impacts of climate change and related consequences.

**Strategy 29: Device and adopt integrated coastal management**

Although, there is still scientific uncertainty about the local climate change and sea level rise (IPCC, 2001)<sup>9</sup>, it is essential, for the protection of Nuku'alofa and coastal villages of Tonga to adopt carefully integrated coastal management. This is particularly important as Tonga is frequently affected by cyclones, storm surges, heavy rain, etc. However, in the case of Tonga, where coastal management responsibility is not clearly defined, it is suggested that before an integrated management plan is considered an institutional framework should be established. The National Commission for Sustainable Development (NCSA) suggested in *Strategy 6* should be the institution to coordinated the planning for an integrated coastal area management. For the time being a working agreement in the form of a MOU between MLSNR, MOW, TVB, MOF, MOFA, MOF, DOE, MMP, NGOs and community representatives should provide for integrated coastal area planning. The

following activities are to be addressed by the institutional framework for integrated coastal area management:

- to develop a nationally agreed coastal area management objectives;
- to define arrangements for managing the Plan;
- to ensure greater community involvement;
- to establish a cogent policy for integrated coastal zone management and environmental impact assessment to control land based pollution from reclamation, construction, and agriculture;
- to ensure that the integrated coastal management plan is consistent with the national policy of sustainable development; and
- to foster a multi-disciplinary approach in the development and implementation of the integrated coastal area management.

#### **7.2.6.2 Implementation Requirement**

##### **Time Scale**

Tonga's capacity to prevent the impact of climate change is limited. The IPCC is researching all the 'uncertainties' regarding the rate of sea level rise, the role of carbon dioxide 'sinks' such as forests, the role of the ocean, the growth rate of coral reefs under different scenarios of sea level rise, the geological movement of the earth versus the rise of the sea and the development of vulnerability index etc. However Tonga, like many other small islands, cannot afford to wait until all the scientific evidence is confirmed.

Tonga should adopt the precautionary principle approach as a matter of priority and urgency, in its development planning. The precautionary principle implies 'wise and long term' planning from the perspective of small islands striving to protect resources for the benefit of the people of Tonga now and in the future.

##### **Target Group**

Climate change and existing climatic condition issues have impacts that affect all levels of society, therefore it is expected that target groups would involve the government, the private sector, and the communities.

The DOE and the Disaster Preparedness of the MOW need to coordinate their activities and initiate the process of establishing relevant policies to address climate change issues and extreme weather events in consultation with government agencies and communities.

The DOE and the MOW are to also responsible for developing integrated coastal area management in consultation with government agencies and with communities. This process could be linked to *Strategies 5, 16, 20* by way of complementing each other, making actions and responsibilities clear so as not to duplicate effort and stretched resources. For example *Strategy 5* (Division Environmental Management Plan) would focus on overall development of an island (i.e., 'Eua Environmental Management Plan) and address development issues affecting the environment of 'Eua – such as deforestation, land subdivision, lost of wildlife, waste management, agricultural issues (pests, pesticides, invasive species etc.). *Strategy 16* is to focus on sustainable management of coastal ecosystems and habitats including water quality, corals, seagrass, the impacts of various fisheries activities, natural weather events (link to *Strategy 20*) and land based activities (link to *Strategy 5*). Where as *Strategy 20* is to focus on coastal developments such as tourist facilities, roads, wharfs reclamation, etc. the use of EIA as a tool to minimize adverse impacts (links to *Strategy 5 and 16*) is to protect development and people's properties and lives from potential sea level rise and other extreme events.

### **Resources Required**

The costs of responding to climate change depend on the options considered. The options most appropriate for Tonga are:

- adaptation: emphasizing strategies and measures for reducing expected damages; and
- policies: requiring environmental assessment of new construction works (covered in *Strategies 7 & 9*) and linked to policies for strengthening integrated coastal management capacity in Tonga.

Although there are no accurate estimates of costs of protection against climate change in small island developing States per se, IPCC estimates that adaptations to climate change could lead to an average cost approximately equal to 0.43 per cent of gross domestic product of most developing countries. For the Caribbean small island developing states, IPCC has projected the costs of new construction of protection alone at US\$ 1.1 billion (1990), (CSD 6<sup>th</sup> Session, 1998).



Implementation of any adaptation or mitigation strategies will be difficult for Tonga due to lack of relevant and appropriate resources, at the technical, technological and financial levels. Unavoidably Tonga has to look for assistance from the regional and international community. However, much can still be carried out at the national level such as institutional capacity building within the cross-sectoral disciplines of climate change (energy, water, fisheries, transport and infrastructure, etc.) as an integral part of national development for deal with any predicted adverse impacts.

A number of externally funded projects on climate change from AusAID and the Global Environment Facility have assisted Tonga to be better informed of the ramifications of climate change and its associated impacts, for instance the regional Pacific Islands Climate Change Program (PICCAP) and the National Climate Change Enabling Project.

### **7.3 Principles for Implementation**

The implementation of the policy framework for sustainable resource and environmental management for Tonga suggested in this thesis will be consistent with the Strategic Development Plan Seven (SDP 7 – 2001-2003) and subsequent ones, as long as sustainable development is a national goal. It seems it will still be a priority regional for and international goals for some years yet according to evidence from the recent Earth Summit on Sustainable Development.

In addition, the policy framework developed in this study is a ‘working document’ that allows for adaptation and flexibility in view of anticipated new developments. The government should take into account strategic recommendations, as highlighted in this policy framework and existing policies related directly or indirectly to the sustainable natural resource management sector. In this context, the following elements should be given due attention:

- applying environmental and social analysis, impact assessment and mitigation measures according to the new rules recommended in this study;
- taking into account the local organization capacity when deciding on the scale and design of activities to be supported;
- ensuring and applying gender-based planning and implementations techniques;
- carrying out financial and economic analysis of project proposals;

- giving appropriate attention to biodiversity conservation in all programs to be implemented; and
- keeping in mind the need to be able to quantify expected outputs which include: reduced forest degradation; increased participation in training activities; increased community participation in policy making; improved equity and income distribution; increased wildlife conservation (habitat and species number) etc.

As this is the first policy framework for sustainable environmental and resource management developed for Tonga, it should create the momentum for the government to reform its policy and decision making process for a sustainable future for Tonga. Ultimately, for the successful implementation of this policy framework it calls for better coordination among government agencies and with communities and the ‘decentralization’ of its decision making process. Government agencies then, in consultation with the communities are to develop plans to implement the strategies put forward in this study. Regular review of the policy framework would provide opportunities of evaluate and refine its policies.

Unlike larger countries, where different levels of government exist (i.e., national, state/provisional and local) Tonga is administered from Nuku’alofa by a National government. It is argued in this thesis that it is politically difficult at this stage and would be very costly for a small country to establish various levels of governments to effect the decentralization of the decision-making policy. Further, it may slow down Tonga’s process towards sustainable development and environmental degradation continues, while politicians argue out the ‘form of decentralisation’.

This thesis argues that decentralisation of decision making and management, could start with more open consultation and a coordination process as suggested by the new policy framework, customizing its policies to each situation and island group (through the divisional environmental plans) and strengthening local communities to ‘act’ accordingly and to be able to influence national policy making.

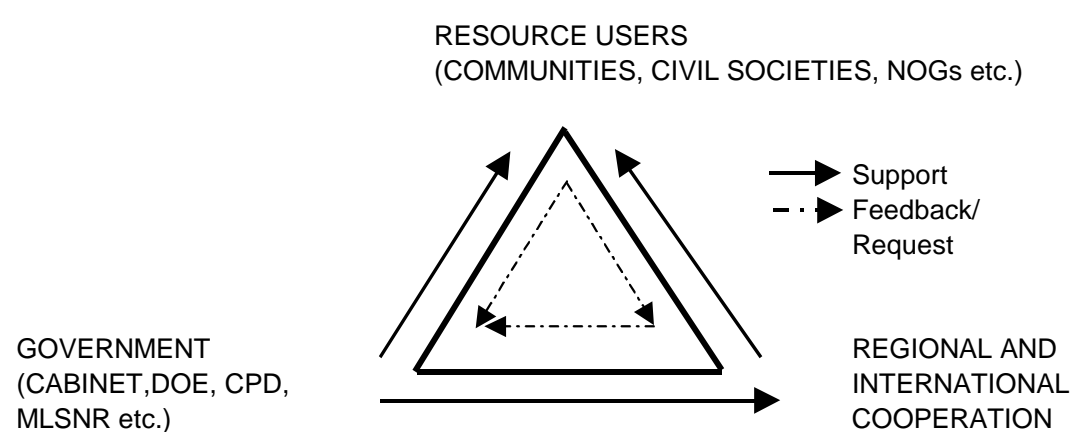
However, there are a number of important principles which should guide the implementation of this policy framework for sustainable environmental and resource management.

### 7.3.1 Ownership

The development and implementation of the policy framework must, at all stages be guided by the priorities of the people of Tonga, i.e. they must have ownership of both process and product. There is clear role for the government to establish the new policy process suggested in this study, and to conjointly work with the communities to achieve an overall national goal of sustainable development for Tonga. Community involvement is the key to encouraging greater community compliance with the sustainable development policies (Imperial, 1999).

This can be best achieved by a three-way partnership (Fig. 7.6) between the government and resource users and by recognising the important assistance role played by the regional and international organisations.

**Figure 7.6: Three-Way Partnership Model for Local Development**



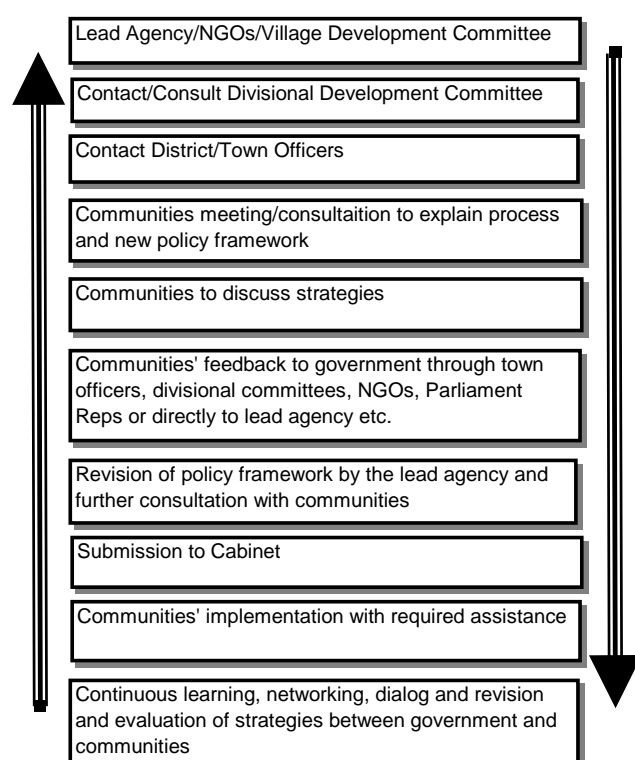
Source: Adapted from Munasinghe 1993

#### 7.3.1.1 Government – Community Consultation Model

A clear articulation of objectives, strategies, responsibilities, as well as feedback is a crucial management principle of the new policy framework for sustainable environmental and resource management, that stresses that all of society must play a role in achieving sustainability. In order to do this, the government must develop a process whereby the new policy framework objectives, strategies and expected role of the resource users are clearly articulated (Fig. 7.7). At several stages in the consultation model the community

has a role to provide feedback to government and the process may be adjusted for changes that the community may require. For example, communities are represented in the divisional development committees (i.e. step 2 from the top of Fig. 7.7), district and town officers are representatives of the community (and live in the community and brought in the process the views of the community), community feedback is in the process, revision and further community consultation and the continued learning, networking and dialogue with the communities is also vital for a consultation model. The arrows in Fig. 7.7 indicate that the consultation process could either start by means of an agency, a committee or an NGO or start from the community level.

**Figure 7.7: Government – Community Consultation and Participatory Model**



Source: Modified from Milich and Varady (1999)

### 7.3.2 Cross-Sectoral Involvement

The nature of environmental issues facing Tonga necessitates a cross-sectoral approach, involving the range of governmental, non-government and community groups engaged in environmental and natural resources management. Further, the responsibility for environmental management does not rest with any one agency; there are a number of

agencies which have important environmental responsibilities and must be closely involved in the implementation of this policy framework.

There is scope for voluntary working agreements between the government agencies, or between government and various sectors of community or industry. This should become a 'normal' process for the consultation and implementation of the new framework.

#### **7.3.2.1 Flexible Implementation Instruments**

In terms of implementation strategies for the policy framework, one of the most important management principles is that of flexibility in the use of instruments. Instead of relying on one instrument alone, such as regulations, the government should use a mix of instruments to achieve sustainable development goals.

The mix might include regulation, voluntary agreements, economic instruments, and supporting programs. A policy of using non regulatory instruments does not mean that regulations are abandoned, but rather streamlined and supplemented by the use of other instruments, such as codes of practice, memoranda of understanding, agreements etc. It also means that the government carefully tailors its choice of instruments to address the specific conditions of each problem and the needs of the groups involved.

#### **7.3.3 Research and Monitoring**

Policymaking should be based on sound information. Science and other relevant information should be an integral part of policymaking throughout the process, not only at the beginning.

Understanding and incorporating resource users socio-economic conditions, concerns and interests into management strategies are crucial to increase the perceived legitimacy of decisions and make compliance with rules and regulations easier. Therefore socio-economic surveys must be conducted regularly to determine the effects of management decisions on the stakeholders. This will improve policy decisions to minimise adverse impacts and maximise benefits to stakeholders and demonstrate the value of sustainable management of natural resources and services to the general public, stakeholder groups and policy-makers. This in turn will generate greater support for sustainable management of natural resources.

Monitoring is a crucial element in decision-making on the design and implementation of environmental policy. It is the duty of the lead government agency, the National Sustainable Development Commission (NSDC), (when established) and the TNMCT to compile a picture of environmental quality, environmental performance of target groups and progress made at the national level. Only then can the results be discussed politically and socially. In order to compile a picture of environmental quality, it is crucial to establish nationally agreed indicators of environmental quality to guide monitoring and maximise the use of limited resources by focussing on national indicators for sustainable development.

Important data gaps that were identified in Chapter 3, Sections 3.6.1.2 and 3.6.2.1 could guide the activities of the TNMCT establishing a baseline state of the environment, against which future assessment could be compared. In order to contribute to the development of relevant research and monitoring, the government and NGOs should consider the following strategies:

- participation in relevant regional and international programmes in order to tap into the expertise and resources available in the international community;
- promoting information exchange among government and non-government agencies and with the communities;
- providing high quality scientific and policy oriented information for policymakers and planners in order to improve their decisions about sustainable resource management; and
- facilitating the training of communities and government agencies in the areas of resource monitoring and translating monitoring information into policies and management options.

#### **7.3.4 Public Environmental Education**

Environmental education is a multi-phased management tool that extends beyond informing and creating awareness for communities about how to protect the environment. Such learning can help people make wise choices in all of their various roles – as consumers/resource users, employees and citizens – by assimilating, analysing and evaluating the complex and diverse sources of information, data and opinion about the environment (National Council for Science on the Environment (NCS), 2000). Such

knowledge is essential if Tonga is to meet the difficult challenge of achieving sustainability, i.e. insufficient public and government understanding of the scientific basis of resource management exacerbates unsustainable practices.

According to the findings of Chapter 5 of this thesis, there seems to be a 'low level' of environmental knowledge in Tonga with regard to: the value of mangroves; that the use of destructive fishing methods may lead to a decline in fisheries resources; and that pollution will eventually affect the coastal waters and the fresh water table (Section 5.3.2). The 'level of education' and the place where 'respondents live' are significantly represented in the 'most knowledgeable group'. This suggests that education plays an important role in promoting 'awareness' and, in the case of Tonga, where respondents live (in the main island of Tongatapu or in the outer islands, Nuku'alofa (the capital) or in the rural areas) has implications for the quality of education available, access to multi forms of media, and access to government information.

There is still a large proportion of Tongans who believe that 'nature would always provide, or that God would always supply natural resources in Tonga' (Section 6.4.1.4). The significance of this perception is that it partly explains the underlying reasons why there is a lack of appropriate community response to resource degradation, as environmental issues will be taken care of by 'nature' (per. obs). Obviously, there is a need to educate the people of Tonga to understand the relationship of ecosystems to humans and how 'human use' affects them and the rate of environment recovery/growth.

It seems that the people of Tonga believe more in international media than the local media (Figure 5.5.3), although the international media rarely reports on local environmental issues. This suggests that there is a need to 'educate' the local media on local environmental issues to effectively deliver usually 'technical information' in a form understandable by the general public.

Specific recommendations that should be considered alongside the implementation of the 'new' policy framework for sustainable resource and environmental management are (see also Chapter 5, Section 5.4.2.1):

- prioritising public environmental education by the government and to reflect in all the activities of the key agencies such as the MAF, MLSNR, MOF, TVB, MOH, MLCI and DOE;

- producing ‘Tonga specific’ environmental education programs in the Tongan language and to cover issues relevant to the community;
- educating the media in Tonga about environmental issues so they can effectively and clearly disseminate environmental information, this could be the responsibility of relevant government agencies;
- developing environmental education curricula suitable for the existing vocational schools in Tonga;
- providing provision for in-service training in environmental education for existing teachers;
- fostering the use of community group initiatives in environmental education such as community theatre groups, dramas, singing competitions, etc. to environmental themes;
- seeking assistance and grants for NGOs who are involved in environmental education programs; and
- developing environmental education programmes targeting specific groups in the society, i.e. politicians, cabinet ministers, town officers, district officers etc.

#### **7.3.4.1 Capacity Building**

In the longer term, capacity building in the areas of sustainable development should start within the formal education system. It is education that provides an increased awareness of environmental issues and produces future citizens who are more environmentally responsible individuals (King, 2000). Introducing students to environmental subjects at an early age is most important, as young people are particularly receptive to learning environmental values and behaviour. In addition, information and values communicated to the young can be a way of raising the awareness of parents and the general community (King, 2000). Chapter 37 of the Agenda 21 gives importance to promoting and ongoing participatory process to define country needs and priorities in relation to Agenda 21 and in so doing to strengthen human resource and institutional capabilities (CSD, 1997).<sup>10</sup>

In the case of Tonga, of particular concern in this study is capacity building in the areas of sustainable resource management for community groups/committees, NGOs, the general public and government institutions responsible for resource management. Tonga is in a



position to benefit from regional and international initiatives to improve management capacity by participating in relevant regional programs especially in:

- sharing of expertise and relevant experiences with other Pacific Islands;
- participating in relevant training and specifically providing opportunities for NGOs and key community figures to participate in those training;
- being involved in study tours to learn from the ‘successes’ of community based management in other countries;
- using of community and traditional leaders to raise awareness and to increase knowledge of those practices which serves to protect the environment;
- using of existing networks and institutions to spread ‘an environmental protection messages, e.g., by calling upon the services of religious groups and/or community groups; and
- accessing relevant management and scientific information such as journals, research, newsletters and current scientific reports on climate change, coastal management and land resources management to ensure ‘updating of knowledge’ for resource managers in the government agencies.

#### **7.3.4.2 Regional and International Participation**

The small size of the Tongan Government and limited finances and skills restrict the development of environmental management plan and full use should be made of funding and technical expertise available from countries and organisations within the region and internationally.

However, the government of Tonga should make sure that the assistance is addressing widely consulted upon and agreed community priorities, and for the overall goal of achieving sustainable development for the community concerned.

#### **7.3.5 The Role of the Department of Environment**

The Department of Environment (DOE) is currently the key environmental agency in Tonga. It has a key role in the co-ordination and implementation of environmental

programs in Tonga and an important advocacy role for the government in various regional and international fora in relation to the environment (Thistlewaite et al., 1993).

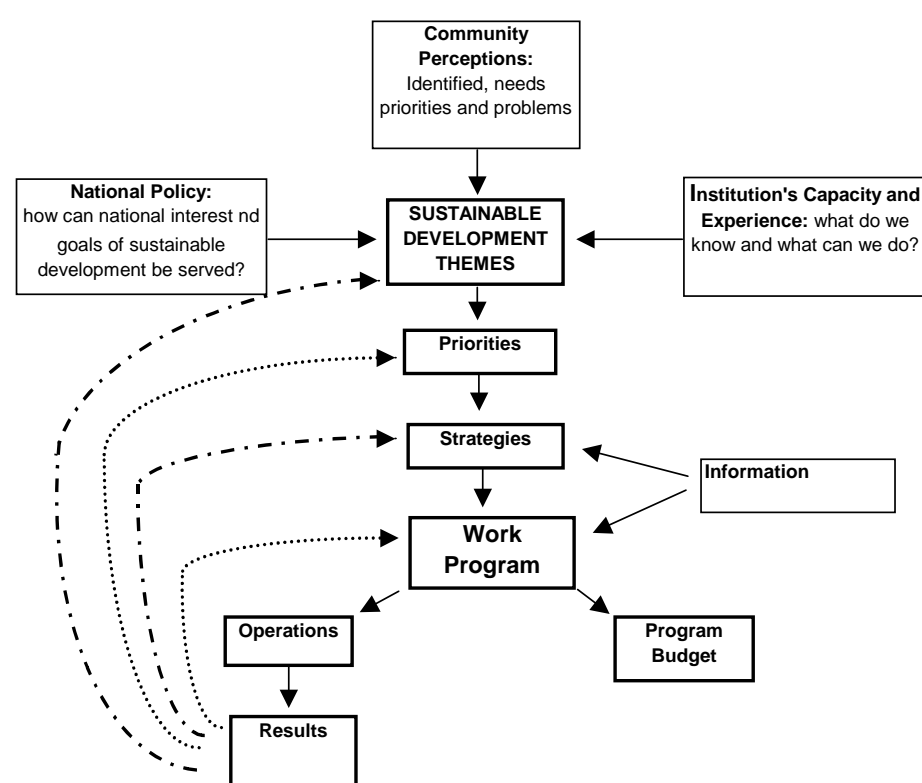
Prior to the establishment of the National Commission for Sustainable Development (NCSD) (Theme 1 – *Strategy 6*), it is expected that the DOE would be the lead agency to coordinate the implementation of the policy framework for sustainable resource and environmental management, in co-operation with the communities and the government. As such, it is crucial that DOE is supported politically with appropriate skills and infrastructure to enable it to adequately fulfill its responsibilities. It is also very important that DOE be immediately provided with a legal mandate for its recent establishment (Section 4.4.1). This thesis recommends the immediate enactment of the 1999 EIA Bill as a way of providing DOE with the legal backing and mandate in addition to establishing EIA procedures in Tonga.

### **7.3.6 Review**

The policy framework for sustainable management of environmental and resource management developed in this study reflects the perceived environmental priorities, constraints and issues, and the strategies most needed to address them at the time of this study. Inevitably, these perceptions will change, often quite rapidly, as community, national, and international circumstances change, and the importance attached to environmental issues changes and new issues arise. Consequently, the value of this study is its potential practical application in Tonga and for future researchers to review this framework based on what aspects of the strategies have been implemented, the lessons learned, the changes in the state of the environment, and the changes in the socio-economic conditions of the people of Tonga in terms of the sustainable development goal.

However, through continuous (government-community) learning, networking, dialogue, revision and evaluation (Fig. 7.7), the ‘new’ policy framework developed in this study would be continuously updated. Figure 7.8 provides information about the national policy, people’s priorities and institution’s capacities and experience, and how the policy framework could be regularly reviewed and updated.

**Figure 7.8: A Model for Reviewing the Policy Framework for Sustainable Resource and Environmental Management in Tonga.**



Source: Modified from Milich and Varady (1999)

### 7.3.7 Obstacles to Implementation of the Policy Framework

The new policy framework for sustainable resource and environmental management is suggesting changes to the existing management framework. The main changes focus on devolution of the decision-making process to include the communities, better coordination at the government level, and for policies to be responsive and relevant to community environmental issues. However, the central government management regime has a tradition of assuming that they are acting in the best interests of communities. Further, the existing resource and environmental management framework is rooted in an eighteenth century framework. Therefore, certain obstacles can be expected to be faced by the promotion of this policy framework.

The first constraint is political apathy. There needs to be a shift from the 'traditional way' of management to the 'new' process suggested in this study. Lack of political enthusiasm could be caused by a lack of appreciation of the relationships/linkages of social, economic,

ecological development to overall development (sustainable development) of Tonga. Another cause could be that decision makers may not 'want' to move from their 'comfort zones' to a process/area that would require them to work more closely with the people. Political apathy for sustainable development could be also caused by the 'concern' of decision makers that they may be losing control over their 'traditional' areas of responsibility.

The second constraint would be a general lack of community awareness and understanding of the grave state of Tonga's environment and the common perception that community members are 'not responsible' for environmental and natural resource degradation. Communities believe, that given time, environmental degradation will correct itself, or that it is responsibility of the government and external organizations.

The third constraint is the lack of 'public funds', and that there are 'other' pressing needs. Fourth, there is a real lack of management skills at the senior levels in the government, and a general lack of scientific and technical expertise in the various areas of social, economic and ecological development in Tonga (ESCAP & GOT, 1990; Thistlewaite et al., 1993; ADB, 2002).

#### **7.3.7.1 Mechanisms to Overcome Obstacles**

This study recognized that the constraints discussed above may contribute to the lack of achievement of the policy framework goals. In addition, the policy framework is a complex multi-disciplinary concept that will require the active participation and support of a wide range of government departments and the people of Tonga. Action strategies suggested in this study will confront some difficult and fundamental issues in Tonga. Cooperation and agreement may not be easy to achieve, given the expected conflicting viewpoints, but this is crucial if the framework is put into practice and be implemented effectively.

There are, however, mechanisms that could provide opportunities for the implementation of the framework, and enable the use of 'conflicting views' to strengthen the framework and the process for sustainable development in Tonga. Such mechanisms are:

- 'Top level' environmental awareness campaigns must be a priority to help to 'convert' politicians and decision makers to the sustainable development course. It

is important to provide a strong link -- that the very economic development that the government and the people of Tonga aspire to has a foundation in sustainable development principles (linking social equity, economic growth and ecological conservation), (Barbier, 1993; Munasinghe, 1993);

- The government and the NGOs have a role in promoting environmental awareness to the wider community of Tonga through the existing formal and non - formal education systems. The media could play an important function here -- and government and mass media could work collaboratively to timely and disseminate easy to understand environment information. This collaboration could be in a form of an ‘environmental media association’, or similar setup, with membership from the education experts, media experts, scientists and community members to develop daily/weekly or monthly environmental media programs;
- The regional, international, bilateral and multilateral organisations and bodies have important roles in furthering the sustainable development principles and processes at the national level. This role could be seen in each donor agency’s own funding policy – that EIA is an essential component of any funded projects. Donors should use local or regional experts to conduct the assessments, further encouraging and developing local expertise;
- Financial institutions in Tonga such as the Tonga Development Bank, Bank of Tonga and ANZ bank should assist in the effort to promote sustainable development by changing their policies to allow more local development of sustainable industries or ventures by giving incentives to these initiatives;
- Not all the actions for the policy framework require additional funding (as seen from the *Strategies 1 to 29*). Where additional funding is required, the author believes that if Tonga prioritizes its spending, improves its financial management to ensure adequate funding for operations and maintenance, and commits to change to achieve sustainable development, financial constraints is a ‘perceived’ constraint only, rather than a reflection of the actual financial situation in Tonga. However, some action strategies are beyond the financial capacity of Tonga, such as adaptation and mitigation strategies for climate change, sea level rise and extreme weather events, and would require financial assistance both from the private sector and from the international community; and

- As part of the mechanisms for implementing this policy framework, a national ‘environmental training needs assessment’ would help to identify the specific expertise that Tonga is lacking (or is present but not used) for the implantation of the sustainable development processes. Short term and long term strategies should be development to address the lack of scientific/technical (technicians) and management skills. There is also the problem of the ‘brain drain’ in Tonga, where the trained manpower is leaving for other countries (CPD, 1998 and 2000). Though unavoidable, the government of Tonga should assess its employment policies, incentives for trained people to return or to stay in Tonga, and investigate exchange of skilled personnel with its neighboring countries.

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<sup>1</sup> National refers to not only Tongatapu but to include all the major island divisions, i.e. Vava’u, Niua, Ha’apai, and ‘Eua.

<sup>2</sup> Divisional Committees or Island Divisional Committees refer to the Vava’u Development Committee (VDU), Ha’apai Development Committee (HDV), ‘Eua Development Committee (EDC) and Niua Development Committee. DCC – Development Coordination Committee is an overall national development committee. Divisional Environmental Plans refer to Environmental Plans of Tongatapu, Vava’u, Ha’apai, Niua and ‘Eua

<sup>3</sup> Drafting of legislation and developing of environmental standards and quality criteria should be based on the economic and financial affordability of the country, rather than direct copying of legislation from the developed countries.

<sup>4</sup> Memorandum of Understanding (MOU) is a commonly used management catalyst in moving forward the sustainable development agenda. MOU is an agreement between parties or among parties that establishes a mechanism for cooperation among agencies agreeing to the MOU for a particular course of actions.

<sup>5</sup> With the experience of the author in Tonga, views within the government that environmental consideration or environmental impact assessment ‘stops’ development is common in Tonga and generally used as an excuse to ignore an existing policy requiring an EIA.

<sup>6</sup> The NGOs participated in the planning for the draft waste management project were ‘Aloua ma’a Tonga, Tonga Trust and Langa Fonua ‘a Fefine Tonga.

<sup>7</sup> The four other ministries who participated in the TEMPP were Ministry of Fisheries (MOF), Ministry of Agriculture and Forestry (MAF), Ministry of Marine and Ports (MMP), and the Ministry of Education (MOE).

<sup>8</sup> Members of the National Environmental Monitoring Committee are Senior Ecologist & Environmentalist Officer (DOE) as the coordinator, Microbiologist (MOH), Fisheries Officers (MOF), Health Inspector (MOH), Water Chemists (TWB), Tourist Officer (TVB), Park Ranger (DOE), Soil Scientist (MAF) and an officer from the Disaster Preparedness Division (MOW).

<sup>9</sup> IPCC is the Intergovernmental Panel on Climate Change – its Working Group 1 *Report on Climate Change 2001*, which contain reports on ‘Scientific Basis’, ‘Impacts, Adaptation and Vulnerability’, ‘Mitigation’ and Synthesis Report.

<sup>10</sup> CSD is the United Nations Commissions of Sustainable Development acting as the preparatory committee for the World Summit on Sustainable Development Organizational Session, New York, 30 April-2 May, 2001.

# CHAPTER EIGHT

## CONCLUSIONS

### 8.1 Introduction

The four main objectives of this study were to:

- identify environmental issues and problems through the analysis of Tonga's state of the environment;
- identify the weaknesses of the existing resource and environmental framework;
- identify communities' sustainable development priorities; and
- develop a new policy framework for sustainable resource and environmental management for Tonga.

The main findings of this study are summarised in this chapter together with suggestions for possible future research which could further enhance the understanding of sustainable development issues in the context of Tonga and in the small islands of the Pacific.

### 8.2 Tonga's State of the Environment – Main Environmental Issues and Problems

Despite data gaps, the information on the environment of Tonga has been analysed, although mostly in a descriptive manner due to the nature and type of information available (it was not produced for the purpose of state of the environment reporting). Generally, the overall state of the biophysical environment of Tonga is a cause for considerable concern.

Population growth, migration patterns, population density and existing policies have dramatically increased pressure on most of the urban centres in the main islands of Tonga. The forms of pressure have been seen in increasing subdivision of low lying areas, mangrove areas and extensions into the sea. In Nuku'alofa, 11% of its urban population live in low-lying areas around the coast due to land shortage. Shortage of available land

for subdivision in accordance with the requirement of the *Land Act 1903* not only accounts for the subdivision of low lying areas (coastal), but also for encroachment into agricultural land and increasing agricultural land lease arrangements that do not have any requirements for environmental protection (for forest and biodiversity conservation, for water conservation, for soil tillage, etc.). However, the policy of allocating land to every sixteen and above years old male, and coastal low lying area reclamation has kept encouraging Tongans from the outer islands to move to Nuku'alofa and Tongatapu. Throughout Tonga, the indigenous forest areas have declined (Wiser et. al., 1999) due to increased demand for wood, forest resources and clearing for agriculture. Therefore wildlife that is dependent on the forest habitat has also declined (Rinke, 1990; EPACS, 1990; and Thaman, 1995; Drake et. al., 1996).

The population pressure has also resulted in increasing quantities of waste generated and the problems associated with waste management. These range from lack of appropriate landfill areas, managing the cost of a rubbish collection service, and the operational cost of the landfill. The high level of these costs has resulted in the haphazard management of waste (solid, sewage, and hazardous waste) (Dever, 2000) and this poses serious threats to the environment and the people.

Tonga's main economic activity is agriculture. The main pressures of agricultural activities on the land resources of Tonga are deforestation, increasing use of agricultural chemicals and pesticides, soil fertility and structure degradation (Manu, 2000), and potential pollution threats to the underground water lens. Associated problems of crop pests and diseases are also increasing.

Although the information available for describing the state of the coastal resources is mostly for the main island of Tongatapu Nuku'alofa, anecdotal evidence points to the same coastal management issues occurring in Vava'u and Ha'apai (the second and the third largest island divisions). Coastal areas and resources are under pressure from increasing population demands related to reclamation and siltation, land based pollution (such as the rubbish dump in Nuku'alofa), waste (sewage, waste oil, PCB oil from transformers), too many fishers (over fishing), fishers' techniques (fish traps, wall of death, dynamiting), and to lack of management.

As a result, coastal resources are declining in abundance and diversity of fisheries (of most coastal fisheries resources). More coastal water pollution is occurring around Nuku'alofa



and Neiafu, and some areas in Fanga'uta lagoon have elevated faecal coliform counts and signs of coral reef and seagrass stress.

Both land and coastal resources are commonly impacted by natural disasters (cyclones, storm surges etc.), and associated coastal erosion, inundation and salt spray, prolonged droughts and global climate change and sea level rise.

Other anthropological activities that also shape the state of land and coastal resources are construction, businesses (service stations, small industrial activities), quarrying, sand mining, and mismanagement of domestic animals (especially pigs). These have adverse environment impacts due to lack of appropriate responses (lack of appropriate policies and lack of enforcement of existing ones) and lack of 'environmental considerations' during the planning and the implementation stages of these activities.

Priority areas for action, summarised from the state of the land and coastal resources in Tonga are, concerned with:

- the need to establish nationally agreed sustainable development indicators for ecosystems resilience, integrity and reduced threats to ecosystem integrity;
- the need for regular monitoring of the state of the fresh water table, soil, forest (and other land resources), coastal waters and coastal ecosystems and coastal fishery resources (against the agreed indicators);
- the need for waste (solid, sewage, and other hazardous) management;
- the need for biodiversity conservation (addressing important cultural and indigenous fauna and flora in land resources and coastal/marine biodiversity);
- the need to change the 'culture' of looking after domestic animals (pigs); and
- the need to find alternative sources of sand for building.

### **8.3 Weaknesses of the Existing Resource and Environmental Management Regime**

Analysis of the current resource and environmental management framework (Chapter 4) showed that there are four main areas (decision making structure, policy, legislation, and community participation) where the weaknesses and constraints for sustainable development lie. Some of these areas overlap. For example, the government is not

structured in a way that would enable the integrated efforts that may be needed to deal effectively with the threats to natural resources to be undertaken. Further, the current lack of any planning mechanism for regulating multiple uses of the coastal zone has resulted in subdivisions of wetland areas and a proliferation of fishing activities in important areas for wildlife such as in the marine parks.

The existing resource and environmental management framework is based on an eighteenth century constitution that has three main aims in relation to resource and environmental management. First is to consolidate the power of the King and his lineage through inheritance of land and right to the throne. Second is to liberate the common people from the authority of the chiefs and the kings, and the third is to distribute the land to every Tongan male sixteen years and over. Therefore, current government structure reflects those aims which basically reaffirms that power and decision making are carried out by a very few and land is being distributed with no provision for land use planning and conservation. Sustainable development principles were 'unheard of' at the time the constitution was developed.

Sustainable development became a national development goal in 1991 (Sixth Five Year Development Plan, 1991-1995), and this was reaffirmed in the Strategic Development Plan Seven, 2001-2003. The central policy guideline is to promote environmentally sustainable development that is consistent with the priority economic and social needs of Tonga (CPD, 2001). However, the framework for resource and environmental management of the centrally top-down management regimes has not changed to effectively address this 'new national goal'. For example, decisions about resource use are made with little consideration for environmental impacts, have very little input from the community, and lack coordination among the responsible government agencies.

The national goal of sustainable development has not been supported by appropriate policies; therefore, the goal 'remains' on paper only. The general approach to resource and environmental management is still sectoral and ad hoc with little coordination on policy making, implementation, and the effects of one policy on another in terms of resource use and outputs.

What little 'sustainable development' activity that has occurred to date has been focussing in Nuku'alofa and Tongatapu, and neglected the outer islands (Vava'u, Ha'apai, 'Eua and Niua). It is recommended in this study that area specific policies (*Strategy 4*) for

sustainable development be designed and implemented for the outer islands as well to address environmental issues unique to these islands.

Weaknesses of the environmental provisions of the existing national legislation identified in Chapter 4 have direct implications for the goal of sustainable development in Tonga. First, they hinder cooperation and coordination in administering and control of environmental provisions as the provisions are scattered through a range of laws such as those providing for public health, fisheries, water and land.

Further, most of the important environmental provisions are found in legislation that is quite 'old', and has been the responsibility of 'traditional' sectoral agencies; some agencies are responsible for two or more pieces of legislation that have conflicting objectives. Another constraint is that 'emerging environmental' issues grew beyond the scope of the original law and capacity of the responsible agency, therefore the legislation falls short on new issues and the responsible agencies do not have the capacity to implement.

Two important environmental laws for the process of sustainable development in Tonga are the EIA and Marine Pollution Bills which have been slow to be enacted. This study recommends that efforts should be made to enact these Bills (with some recommendations to improve communities' participation in the EIA process (Chapter 4, Section 4.6.1.1)) as this would greatly further the goal of sustainable development.

The policy framework developed in this study recommends the introduction of new legislation (Section 7.2.2 – Strategy 7). The proposed legislation (an Environmental Management Act) will not only address the constraints described above (i.e., lack of coordination in administering the environmental provisions of the existing laws, lack of requirement for effective community participation and lack of sustainable resource and environmental management laws) but will also formalise an institutional structure (the establishment of a National Commission for Sustainable Development (NCSD) to oversee sustainable development policy development and related actions in Tonga.

The existing management framework, described in Chapter 4, showed a lack of effective public participation in decision and policy making (for environmental and resource management issues). Therefore, the main proposition made by this study that 'the existing environmental and resource management framework and the environmental perceptions of the people of Tonga perpetuate environmental degradation and unsustainable practices'

(Section 1.3.1.1) is affirmed by the lack of appropriate policy, lack of legislation and coordination (as described above) coupled with the lack public participation.

## 8.4 Community Perceptions and Priorities

Based on the results derived from Chapters 5 and 6, the following factors in relation with community perceptions were identified which confirm and support the need to develop a policy framework for sustainable resource and environmental management. The ‘supportive’ factors are presented for the four main island divisions (areas) used in this study (Table 8.4.1).

**Table 8.4.1 Factors Identified in Support for the Need for a Policy Framework for Sustainable Resource and Environmental Management**

Percentage of respondents with an answer of 50 % and over is interpreted as a High in this table, and below 50 % as Low (Chapter 5). If an environmental ‘issue’ is raised in all or two of the study locations (Manuka, Felemea, Taunga – Chapter 6), it is a High and applies to the island division where these study locations are located.  
(Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands)

Factors	Island Division (Area)			
	Tt	Vv	Hp	OI
Degree of perceiving environmental issues as priority now and in the future	High	Low	Low	Low
Degree of awareness of local environmental issues or concerns	High	High	High	High
Level of knowledge of environmental issues	High	Low	Low	Low
General level of concern about environmental problems	High	High	High	High
Effect of laws on sustainable management of resources	Low	Low	Low	Low
Degree of community awareness of relevant existing legislation	Low	Low	Low	Low
Level on community participation in national decision policy making for sustainable development issues	Low	Low	Low	Low
Level of believing that it is quite possible to have both a prosperous economy and a healthy environment	High	High	High	High
Level of agreeing that each individual must take responsibility for doing all that they can to protect the environment	Low	Low	Low	Low
Level of agreement with that the individual is not expected to take environmental issues seriously when the government and business are ineffective or irresponsible	High	High	High	High
Degree of agreement that community groups can do a lot in the community to conserve community resources	High	High	High	High
Degree of believing that the government of Tonga has the capacity to implement sustainable development policies	Low	High	Low	High
Level of skills in reef gleaning (conservative methods)	Low	Low	Low	Low

Factors	Island Division (Area)			
	Tt	Vv	Hp	OI
Level of skills in making a household compost	Low	Low	Low	Low
Degree of agreeing that the government sets clear sustainable development policies	Low	Low	Low	Low
Level of agreeing that government agencies are influential in 'changes in behaviour' relating to the environment	High	High	High	High
Degree of agreeing that the point of protecting the environment is because we owe it to our children and the future generations	High	High	High	High
Intensity of community beliefs that nature/God will always 'correct itself' or supply resources	High	High	High	High
Level of overall perception concerning the effectiveness of community institution in sustainable resource and environmental management	Low	Low	Low	Low

Generally, the patterns of community environmental perceptions, knowledge, skills, attitudes and behaviour have evolved in accordance with the extent of the communities' level of education, place of residence, involvement in existing management regimes either at the community level or at the government level, influence of movement (to capitals in Tonga or overseas), and access to media and environment information based on population pressure, economic activities available (commercial agriculture, fisheries, tourists services etc.), and intervention or lack of appropriate government policy.

Lack of community participation in decision-making has led to 'alienation' of communities from responding to, or taking part in, the 'solution or management of environmental problems'. Although respondents showed a 'high level' of agreement that community groups can do much to conserve community resources, there was a 'low level' of agreement that individuals must take responsibility for doing all that they can to protect the environment, and a 'high level' of agreement that the individuals are not expected to take environmental issues seriously when the government and business are ineffective or irresponsible. This is a clear affirmation that government can influence community environmental attitudes, perceptions and behaviour.

The most important reason for conserving resources and taking care of the environment as shown by the community responses was that 'we owe it to our children and the next generation'. Further, community responses confirmed a preference for more community participation in decision making; for policy to be based on community priorities; a more open, consultative and more coordinated approach to policy making; and 'community

based' management for community resources. Other community environmental perceptions conclusions which emerged from this study are:

- Socio-economic factors such as education (university degree and diploma), income levels (upper income bracket), area of residence (Tongatapu) and gender (male) have significant influence (most knowledgeable) on the level of environmental issues knowledge;
- Education level did not have much influence on the level of concern for the environment, perceiving an improvement in the quality of the environment nationally and locally; while age, gender, area of residence, and income levels have much influence (i.e. those who live in Tongatapu and from low income bracket families believed that the quality of the environment of Tongatapu had improved in contrast to 54 years old people and over old, and females were the group least concerned that there was an improvement in their island/village environment);
- Education level did not have much influence on perceptions that the Government of Tonga has clear sustainable development policies;
- Only gender (females) and income level (low income households) agreed more with the view that government has the capacity to implement sustainable development policies throughout Tonga; and
- Tongan communities are well aware of the changes in their biophysical environment.

Comprehensive information has been obtained on community priority issues and concerns that require sustainable management. Based on the findings of this study the priorities or concerns crucial for a sustainable development goal were identified). These are part of the new policy framework developed by this study. They are as follows:

- ❖ Land resources degradation (addressed in Theme 5, Action Strategies 23-26) – loss of biodiversity, deforestation, water pollution, lack of water in the outer islands, soil degradation and erosion, and domestic animals destruction/scavenging.
- ❖ Coastal resources degradation (Theme 4, Action Strategies 14-25) – declining fisheries resources, habitat/ecosystem degradation, coastal water

pollution, wetlands reclamation, destructive fishing methods and coastal erosion.

❖ Cross cutting issues (affect land and coastal resources)

- Extreme weather conditions (Theme 6, Action Strategies 27-29) – cyclones, storm surges, salt-water sprays, droughts, floods and earthquake.
- Climate change and sea level rise (Theme 6) – inundation, salt-water intrusion into fresh water lens, intensity and frequency of the extreme weather conditions.
- Waste management (solid, sewage, and hazardous waste) (Theme 3, Action Strategies 10-13) – lack of capacity to manage waste, lack of knowledge and skills in management of hazardous waste, lack of recycling opportunities, lack of awareness and incentives to reduce waste generated, indiscriminate dumping of waste.
- Population growth and migration patterns (Themes 4 and 5) – increasing pressures on both land and coastal resources in the main islands for settlement, agriculture and for fisheries, and lack of alternative sources of income/lack of development in the outer islands.
- Government commitment (Themes 1 and 2) -- lack of government commitment/support for sustainable development issues, lack of holistic planning for economic development.
- Legislation (Theme 2, Action Strategies 7-9) – lack of environmental protection/conservation requirement, old/not applicable to emerging issues, uncoordinated, lack of enforcement, people are not aware of the regulations, lack of EIA procedures and other relevant instruments to guide and support sustainable development.
- Policy (Theme 1, Action Strategies 1-6) -- lack of sustainable development policies that are priorities to the government, lack of sector coordination in policy making and implementation, lack of public awareness of policies, and lack of public participation and coordination in policy making, policies were irrelevant to community priorities, outer islands special issues were usually neglected in the

policies, lack of government support (in terms of resources) for implementation of its own policies and lack of community support.

- Institutional framework (Themes 1 and 2) – lack of specific institutions with political status and support to coordinate sustainable activities, vague institutional management responsibilities within the existing management regime, lack of institutional adaptability to address emerging environmental issues and ineffective use of trained manpower.
- Community awareness (Themes 1-6) – lack of general awareness of what is an appropriate response to specific environmental issues, lack of relevant community awareness programmes and information, and lack of community groups and NGOs involved in (strong advocate of) sustainable development issues.
- Community perceptions (Themes 1-6) – a general sense of perceiving that nature will be able to correct environmental issues, a general sense of perceiving that environmental issues should be addressed and corrected by the government or an external agency.

## **8.5 The Policy Framework for Sustainable Resource and Environmental Management**

Based on the priorities identified, a ‘new’ policy framework for sustainable resource and environmental management was developed. The environmental/resource priorities were grouped into six sustainable development themes, each theme has policy goals, objectives and action strategies, followed by a time scale, resources required and target groups. The six main sustainable development themes are as follows:

- ❖ A Sustainable Development Planning Process;
- ❖ Legislative Framework for Sustainable Development Policy;
- ❖ Framework for Waste Minimization, Recycling and Disposal Management;
- ❖ Framework for Sustainable Management of Coastal Resources;
- ❖ Sustainable Management of Land Resources; and



❖ Precautionary Planning for Climate Change, Sea Level Rise and Extreme Weather Conditions.

The wide nature and scope of the priority issues identified in this study, confirmed the need for a policy framework for sustainable environmental and resource management that is responsive to community priorities now and to future priorities. It must also be flexible and adaptable, interdisciplinary and integrative in approach, open to community participation at all levels of the management plan cycle, and have a sound legislative, monitoring and feedback framework.

Although community priorities may change with time, the three basic foundation principles of sustainable development (ecological sustainability, sustainable economic growth and a sustainable society (as discussed in chapter 2, Section 2.2)) would not become outdated and these ‘priorities’ should be promoted in parallel with this framework.

However, two supporting mechanisms and factors are crucial for the successful implementation of the policy and evaluation of the policy framework for Tonga. They are the community itself and the government and non-government organizations (Fig. 8.1). The government or the community alone does not have the capacity to implement the policy framework. The influence, communication/dialogue and support of government/non government agencies and communities must remain open and ‘active’ in order to realize the national goal of sustainable development for Tonga.

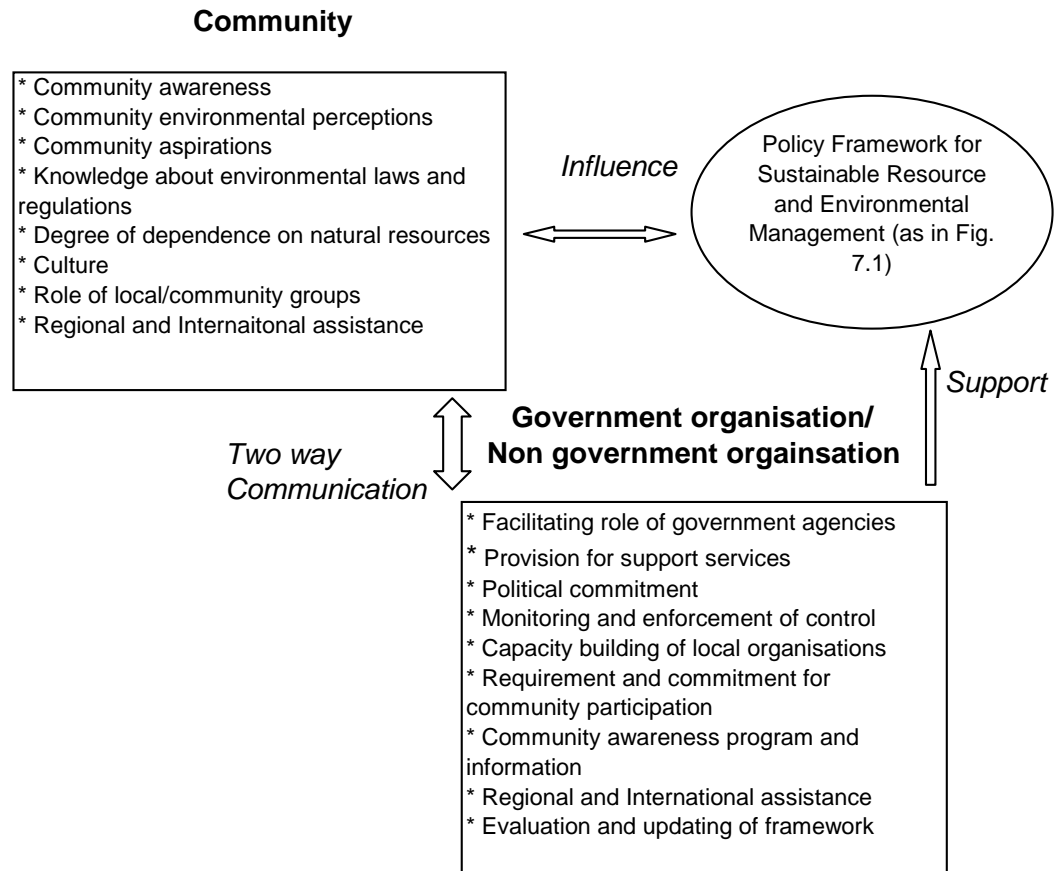
The ‘partnership’ explained in Fig 8.1, however, could be constrained by limited resources and capacity at the national and local levels. Therefore, international NGOs and organization have an important role to play in terms of capacity building including community capacity, direct funding assistance, practical skills and technology transfer.

The policy framework demonstrated how Tonga (and other Pacific Islands) could examine from ‘within’ locally generated sustainable develop issues and develop a management framework that is relevant to local situations. Further, the two underlying barriers to sustainable development, ‘the existing management regime and the community environmental and resource use perceptions’ and their influence on each other have been the central focus in developing the policy framework in order to eliminate and change the barriers into options for sustainable resource and environmental management. The policy framework has been developed with a clear understanding of the problems involved.

This policy framework would also help to pave the way for more community participation in environmental management, both at the national and community level, and for other forms of participatory resource management in Tonga. This policy framework also indicates ways in which community environmental priorities can be accorded genuine consideration, and resource users and owners can become generators of relevant policies as well as implementers of those policies. Such consideration could play a valuable role in further legitimizing and institutionalizing genuine participatory practice, thus ensuring that Tonga is following the right path towards achieving sustainable development.

Although co-ordinated and integrated environmental planning and management in Tonga are in their infancy, they will be of increasing interest and concern in the future. There is a need to strengthen environmental agencies, develop appropriate policies, institutional arrangements and manpower resources, and educate both top decision makers and the public.

**Figure 8.1 Factors and Support Mechanisms to Strengthen the Policy Framework for Sustainable Resource and Environmental Management**



## 8.6 Suggested Future Research

This study, whilst being unique in developing a policy framework for sustainable management of natural resources, and useful in providing substantial and informative baseline data, has also identified ‘information gaps’ relevant for sustainable development processes in Tonga in which further studies could be carried out. These include:

- there is currently insufficient information to establish trends and changes in the state of land, marine and coastal resources;
- data on the lifecycles of agrochemicals, pesticides and fungicides entering Tonga is not accessible;
- data on soil erosion, the effect of commercial agriculture on the soil and biodiversity is limited;

- lack of monitoring of key fisheries resources perceived by communities to be declining;
- there is a need for documentation of fishing methods used in Tonga for commercial and subsistence fishing;
- establishment of national criteria for establishing reserves; and
- establishment of nationally agreed sustainable development indicators for the purpose of state of the environment reporting.

Future studies could add to the findings of this study if the proposed policy framework is reviewed in the light of feedback obtained from key people in Tonga (politicians, cabinet ministers, church leaders and experts (scientists, lawyers, managers, technicians, etc.)). Further, investigation of the ‘real’ cost of implementing this policy framework in Tonga versus the cost to the environment if the policy framework is not implemented would assist in putting the issue into perspective, and justify public funds spent on sustainable resource and environmental management.

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*Land (Removal of Sand) Regulation*  
*Mineral Act 1949*

**Noxious Weeds Act 1903**

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## APPENDICES

### Appendix 1: Summary of Current Site Inspection and Environmental Monitoring as Required by License or Part of Ministry Mandate

Ministry	Site Inspection Activities	Permit/Licensing Monitoring
Labour Commerce & Industry	The site of proposed businesses are inspected to ensure that they meet safety standards etc.; no environmental component.	Monitoring to ensure safety/labour standards and other business license requirements are met; no environmental component.
Health (Environmental Health Inspectors)	Site inspections undertaken for building applications to ensure area is appropriate for septic system and whether or not it conflicts with existing use; septic tanks and fields are inspected from time to time depending on staff commitments; also food establishments are inspected for health requirements only.	Water quality (bacterial) testing of drinking water supplies but this is not associated with a particular license or permit; if sanitation activities are privatised the situation regarding monitoring of tips etc. may change.
Central Planning	No site inspections with environmental component.	No monitoring responsibilities with an environmental component.
Agriculture and Forestry (note - there are no large-scale forestry programs that require site inspections or monitoring, in the Tongatapy, however the Forest Plantation in 'Eua is in the area of 'Eua water catchment	Site inspection regarding the suitability of land for assessing lease applications are undertaken from time to time but environmental considerations are not necessarily included; inspection of plants and animals imported into the country (quarantine).	There are 2 active licenses to import and sell pesticides; there is no routine or ongoing monitoring of pesticides and herbicides storage, distribution or use. The situation may change when the Pesticide Bill is passed, which will place tighter controls on the sale and use of pesticides as well as widening the power to inspect and monitor.
Tourism	Site inspection may be conducted when applications are received but there are no specific environmental criteria for assessing the proposal; if the tourism officer has environmental concerns DoE is contacted.	Annual site inspections to ensure tourism permit requirements are met, these do not have environmental conditions, however, DoE staff can accompany the inspection if Tourism requested.
Water Board	No licenses are issued and therefore the only site inspections (biological & chemical) are the bores that the Water Board owns.	Monitors the water quality (biological) in urban areas but this is not associated with a particular license or permit.
Works	Site inspection done to assess the structural and engineering integrity of building/capital works (including port and marine works); no environmental component.	During construction to ensure building conforms to the design plan, no environmental component.
Marine and Ports	Only inspections are boat surveys, if there is an oil spill a site inspection would be undertaken.	Potential if there is significant oil spill; potential for environmental monitoring if ports are privatised and environmental performance is a criterion.
Fisheries	Potential aquaculture sites have been identified for oysters and seaweed. Currently the sites are not associated with a particular development license or application.	Only fishing licenses are issued currently; no aquaculture licenses have been issued, FAO has provided a draft policy on a licensing system for aquaculture at the request of the Ministry.
MLSNR	Site inspections for bores (water); when land leases are issued an inspection may be conducted if it has the potential to be controversial; occasional inspections for sand mining applications are undertaken.	When permission is given to drill a bore MLSNR monitors the water quality (physical parameters) as it is drilled and then every 3 months.

**Appendix 2: Summary Table of Existing Legislation, by Sector, Strengths & Weaknesses and Action Needed**

Sector/Resource used and outputs Responsible Ministry	Existing Legislation	Strengths & Weaknesses	Areas Needing Attention/Action
Agriculture & Forestry/  MAF & MLSNR	Plant Quarantine Act, 1981 as amended  Forestry Act, 1961 Part III	Weakness: Conflicting role of Extension officers  Lack of EIA guidelines for the consideration of agricultural lease  Strength: Provide for the screening of new plants material entering Tonga Weakness: Lack of enforcement	Act lacking implementing regulations  Institutional strengthening urgently required, considering the fragility of the island ecosystem to invasive species  Lack of distinction between forest reserve for future and productive use and Nature Forest Reserve No regulation It is suggested that EIA provisions be included within the Forests Act
MAF	Forestry Produce Regulations, 1979	Strength: Control export of forest produce. Weakness: The regulation do not apply to wood carvings, handicrafts, etc	All existing laws regulating agricultural activities be reviewed, to ensure environmental protective measures e.g. soil conservation, are make an integral part of the agricultural system; and to ensure that old Acts are brought into line with new policies on the environment, nationally and internationally (i.e. Tonga is a member of FAO and party to related FAO agreements).  Lack of enforcement
MAF	Pesticide Act, 2000	Weakness: Lack of impact assessment for storage facilities and how pesticides and stored, lack of provision to monitor specific pesticide that may posed threats if not managed properly	Storage, sale & distribution not covered by the Act, Lack of enforcement provision, need to enact the Draft Pesticide Bill recommended and drafted by the FAO in 1989



<b>Fisheries</b>  MOF	Fisheries Act, 1989 (No. 18 of 1989)	Strength: Provide for public participation; strong on monitoring, enforcement of conservation measures; penalties- strong deterrent Weakness: unclear management roles in marine reserves; lack of implementation; conflicting roles of extension officers; loss of stronger marine mammals (whales) protection in the repealed Whaling Industry Act; lack of coordination with relevant government sectors	Need to address lack of coordination with relevant agencies
<b>Land Resources</b>  MLSNR  MLSNR	Land Act, 1903 and subsequent amendments  Section 22 regulate the removal of sand, stone, metal and 'materials'	Weakness – conflicting roles of meeting need for land for residential purposes & protecting/conserving susceptible delicate lands such as swamps, low lying area, etc; The definitions of “land” is too broad – it encompass minerals, water, coastal area, seabed is no longer appropriate to the development and institutional structure in Tonga at the now and into the future Insufficient monitoring an weak enforcement	Legal land entitlement of male, 16 years and over yrs and over is no longer possible; Land Act need to be reviewed to be inline with government institutional restructure and expansion  Alternative sources of sand have to be identified
<b>Water Resources/</b>  TWB MOH MLSNR	Water Board Act and Regulations, 1966  Public Health Act, 1913, s37-45) Cabinet Direction	Weakness: All three measure allows only minimal control of water pollution and does not set standards for the constructions and protections of wells and sanitary facilitates; Inadequate penalties for offences/lack of enforcement of protective measures	Overlapping & duplication of functions among the three institutions
Public Health/  MOH, MLSNR, MAF	Public Health Act, 1913  Section 98, on Toxic Waste	Weakness: Conflicts of interest due to overlapping jurisdiction/ penalties for offences very light/ monitoring & enforcement weak	Over lapping responsibilities, more trained staff & more resources  Strict monitoring and enforcement

<p><b>Pollution/</b> MOH, MLSNR, MAF</p>	<p>Petroleum Mining Act, 1969  Garbage Act, 1949 Public Health (Refuse Dumping) Regulation</p>	<p>Weakness: No regulations, lack of enforcement  No regulations, lack of enforcement</p>	<p>Lack of institutional capacity, clarify roles between MOH and MLSNR</p>
<p><b>Industry/</b> MLCI, TVB</p>	<p>Industrial Development Incentive Act</p>	<p>Weakness: Environmental considerations not taken into account</p>	<p>That granting of licenses be tied to environmental conditions and safeguards</p>
<p><b>Biodiversity and Wildlife conservation/</b>  (Unclear) but the following play some roles – MAF, MOF, MLSNR</p>	<p>Parks and Reserves Act (Act Nos 11 of 1976 and 20 of 1988) Birds and Fish Preservation (Amendment) Act, 1989</p>	<p>Strength: Provide for conservations areas  Weakness: No regulation; Authority inactive; Lack of public participation  Weakness: no regulations, lack of enforcement, list of protected species are outdated, lack of provision for habitat conservation, lack of public awareness</p>	<p>MLNSR no longer have the capacity; insufficient monitoring and weak enforcement  Need to address institutional coordination and sharing of expertise and resources  Need to update list of protected species</p>

### Appendix 3: English Translated Survey Questionnaire on the Environmental Attitudes, Skills and Knowledge of the People of Tonga

**Introduction:** My name is Netatua Pelesikoti, I am conducting a survey on Environmental Attitudes, Skills and Knowledge of the People of Tonga as part of my research for a PhD Award on Environmental Management. Your household was selected from a sample to be included in the survey subject to your agreement. The participation of a member of your household is entirely up to you. Any information you may wish to give me will be kept strictly confidential and use solely for the purpose of this study.

**Contact Details:** Netatua Pelesikoti, Department of Environment, Ph 25- 050, Home-24-513 ([npepacs@kalianet.to](mailto:npepacs@kalianet.to)) or Environmental Research, University of Wollongong, NWS ([np03@uow.edu.au](mailto:np03@uow.edu.au)), Ph (02) 4221-4044

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Respondent Village/District:  
Respondent Island Group:

Number:  
Time/Date survey:

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Explanatory Notes:

**Environment** – in this questionnaire refers to all natural resources (land/soil, flora and fauna/plants and animals, sea, fishes, water, air etc) and how they are being managed in Tonga

**Environment Quality** – in this case refers to clean air and water/sea, abundance or decreasing marine resources/sea food, rich and good quality soil, or degraded soil, no litter and pollution/ litter is a big problem, abundance or little forests (for firewood, habitat, fruits trees, medicinal trees, fragrance trees etc), beautiful and clean beaches/ugly beaches, no pigs digging up places!, no mosquito breeding places, intact mangroves or otherwise etc. etc. etc).

**Sustainable Development** - Promoting development at a rate and such a way as to ensure that the quality of the environment and the supply of the resource is maintained and, wherever practicable, enhanced to meet the needs of the present generations without compromising future generations' need (1999, EIABill)

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#### LEVEL 1: QUESTIONNAIRE

SURVEY OF ENVIRONMENTAL PERCEPTION, KNOWLEDGE, SKILLS, ATTITUDES AND BEHAVIOUR OF THE PEOPLE OF TONGA

##### Question 1.

a) Among the issues which are listed on this card (**Show card A**), what would you say are the **two** most important issues for attention by the Government **at present**? (Circle up to **two**)

b) Now thinking ahead about ten years, which of the things on this list (**Card A**) do you think will be the **three most important** issues for attention by the Government **at that time**?

##### (Card A)

	a)	b)
Farming and agriculture	01	01
Education	02	02
Health	03	03
Fisheries	04	04
Crime	05	05
Unemployment	06	06
Infrastructures (Roads, wharfs, airports)	07	07
The environment	08	08
Alcohol and other drugs	09	09
Bilateral and multilateral relations (AID)	10	10
Not sure	20	20

## Question 2

a) What would you say is **the single most important environmental issue** in Tonga today?  
(Write in **one** answer clearly and concisely; probe to clarify, if necessary say 'you've mentioned several things - which one would you say is the most important?')

b) Among the issues that are list on this card (**Show card B**), which would you say are the **three most important environmental** issues in Tonga today? (**circle up to three**)

### (Card B)

Pollution of coastal areas and the ocean	01
Climate change and sea level rise	02
Soil erosion, land degradation	03
Litter and dumping of rubbish in public places	04
Uneven development (Development of Nuku'alofa vs Neiafu, Pangai etc)	05
Waste from businesses and service stations	06
Over fishing and diminishing coastal fisheries	07
Household rubbish and garbage	08
Transport and storage of dangerous chemicals (oil spillage etc)	09
Loss of forest and useful trees (cultural/ medicinal/fruit trees)	10
Wasteful packaging (plastic bags, diapers)	11
Noise of night clubs in residential areas	12
Sanitation and waste water	13
Poor living conditions in low-lying areas	14
Damages to reef (and other marine ecosystem from blasting and anchors)	15
Lost of coastal forest and mangrove	16
Unregulated/not enforced and excessive use of agricultural fertilisers/ pesticide	17
Free ranging pigs (and other domestic animals)	18
Beach sand mining/ugly beaches	19
Salt water intrusion into the water source	20
Not sure	21
<b>Others</b>	22

c) Is there any environmental issue or problem **affecting your own local area** that particularly concern you? If so, what are they?

(Write in **one main issue** clearly and concisely)

OR (circle if applicable) No, nothing in particular.....99

## Question 3

In general, **how concerned are you** about environmental problems? Would you say you are concerned a great deal, a fair amount, not very much, or not at all?

A great deal	1
A fair amount	2
Not very much	3
Not at all	4
Not sure	5

## Question 4

a) Overall, would you rate the quality of the environment in **Tonga** in **1996-2001** as compared to **5-10 years ago**, as much better, a little better, the same, a little worse or much worse? (Circle one number in column **a**)

b) And how would you rate the quality of the environment in your **island** at the same time period, as much better, a little better, same, a little worse or much worse? (Circle one number in column **b**)

c) And how would you rate the quality of the environment in your **local community** –at the same time period as, much better, a little better, same, a little worse or much worse? (Circle one number in column c)

	a)	b)	c)
Much better	1	1	1
Little better	2	2	2
Same	3	3	3
A little worse	4	4	4
Much worse	5	5	5
Not Sure	6	6	6

#### Question 5

a) **Over the past twelve years or so**, has there been anything that you have **changed** in your own behaviour or the way you live or work, **for environmental reasons** - that is, because you think that the change may be helpful for the environment? If yes, what are the **main change(s)** you have made?

(Circle up to **four** responses - If respondent made changes earlier but none in the past year, circle **code 29**, If respondent reports no changes at all, circle **code 30**)

Start to recycle rubbish/do more recycling (composting, reuse things/bottles, containers)	01
Start to be more aware of environmental impacts of misusing agricultural fertilisers, pesticides herbicides etc. and use accordingly to instruction (i.e., read instructions carefully, wear protective clothes, wash hands, etc.)	02
Take own shopping bag	03
Participating in clean-up campaigns etc (beaches, public areas etc.	04
Cut down in use of motor vehicles, use bus, bicycle, walk etc	05
More careful about disposing of oil, paints, batteries etc. (not down the sink or to the sea )	06
Keep my property clean and free of harmful insect	07
Plant and save variety of trees	08
Always fenced my pigs and look after (and other animals) in my property	09
Wise use of energy (electricity or firewood etc.) (i.e. turn off when not in use or put the fire out after cooking)	10
Sort suitable rubbish to burn	11
Save water, keep animals away from, and stop wasteful use of water	12
More careful about birds, turtles habitat etc.	13
More careful when collecting medicinal plants (few leaves rather than a whole branch)	14
Modify ways of fishing/observe fisheries regulations about size limits and protected species etc.(Not using crowbars/ smashing the reefs, poisons)	15
Modify farming practices (i.e. traditional farming, organic farming, avoid clear felling of trees, intercropping, etc.)	16
Join environment groups/committees that are active in environmental activities	17
Save/replanting and conserving mangrove	18
Other (Specify)	20
Made earlier changes but nothing in the past year	29
No, can't think of any changes I've made	30

**Go directly to question 6**

If respondent has identified any changes in 5(a):

b) Are there **any particular people or types of people** who you think have influenced you to make that change/those changes? (circle **all** that apply, **do not** read list)

Grandparents, parents, children/grandchildren, etc.	01
Friends, neighbours, colleagues etc.	02
Prominent public figures i.e. Ministers (government or churches) nobles	03
NGO's, environment and conservation groups	04
Village committees, village meetings (fono, kavatonga) etc.	05
Government departments or authorities	06
School teachers or church leaders	07

The media or media personalities	08
A consultant/visitor	09
Other (Specify)	10
Nobody in particular	11
Not sure	12

c) How important was each of the things on this list (**Show card C**) in influencing you to make that change/those changes which you just mentioned- was it very important, fairly important, of some importance, or of little or no importance?

(Card C)	Very imp.	Some imp.	Little/ No imp.	Not Sure
i) I read a book or magazine or I saw films or TV programmes that made an impression on me	1	2	3	4
ii) A number of my friends, relatives, neighbours or colleagues were doing these sorts of things	1	2	3	4
iii) I began to understand clearly what the environmental consequences of my actions really were	1	2	3	4
iv) I was influenced by government training/programmes	1	2	3	4
v) It became easier or more practical to change (ie. There were rubbish bins available)	1	2	3	4
vi) I felt I couldn't leave it to other people, I had to do my bit	1	2	3	4

d) Was there anything else that was important in leading you to make that change/those changes?

Yes (Specify)	1
No I can't think of anything else	2

### Question 6

Most of us, in one way or another, probably do things that may be bad from an environmental point of view. This might be at home, in our work, leisure activity etc. What would you say are the most **damaging things**, from an environmental viewpoint, about **your own** behaviour or the way you live or work? (Circle up to four).

Failure to recycle (enough in all situations)	01
Use a lot of toxic chemicals, herbicides, pesticides	02
Misuse/overuse of forest resources/plants	03
Habit of littering, careless with rubbish etc	04
Unsafe disposal of oil, paints, batteries, etc.	05
Buy/use products that do not naturally degrade in the environment (disposable nappies, plastic bags and packaging etc.)	06
The way I managed my land (ploughing, clearing forest)	07
The way I fish (all sizes, destructive fishing methods etc.)	08
Never re-plant useful trees, but like using and cutting down trees	09
My pigs (and other animals) are roaming free and I am not responsible for the damages they have caused	10
Do not believe in saving electricity (or firewood etc.)	11
I burn all 'green' rubbish	12
Failure to save water/ wasteful use of water	13
Destruction of coastal forest unnecessary (trees, wildlife/ birds habitat)	14
(Other) aspects of my work/the sort of work I do (Specify job):	15
Other (Specify)	16
Not sure, can't identify anything	21

### Question 7

a) What are the main reasons that **you yourself** may do things that are bad from an environmental point of view? (Circle up to **two**)

Don't clearly understand what is harmful and what is not	01
Cost, more concerned with saving money	02
Lack of interest, laziness	03
Don't have time	04
It's more convenient/more comfortable/less messy, etc.	05
Ignorance/lack of awareness	06
Do not like to be told what to do, don't like what government, NGOs, etc. try to get me to do	07
Don't want to be the first to change; don't want to be different	08
Necessity, no practical alternative	09
That's the only way/methods that get me the results I want	10
Other (Specify):	11
Not sure	12
Not applicable/don't think I do harmful things	13

### Question 8

Now I would like to ask you some specific questions:

- Suppose you were out **fishing** (reef gleaning), which one of the following best describes how much you know of 'safer and conservative method' of reef gleaning' (e.g., turn rock back to their original position, not breaking live coral, etc.) (Read out and circle a number in column **a** below)
- If you were asked to **start a household compost heap**. Which one of the following best describes how much you would know about doing that? (Read out; circle one number in column **b** below)
- Suppose you wanted to **find out some specific information/advice regarding use, and disposals of certain fertilizer**. Which of the following would best describe your ability to find advice for the proper applications and disposals of pesticide and agricultural chemicals? (Read out and circle one number from column **c** below)

	a)	b)	c)
I'd definitely know how to do that	1	1	1
I'd have a fair idea how to do that	2	2	2
I'd have some idea but I wouldn't be too sure	3	3	3
I wouldn't have much idea at all how to do that	4	4	4

### Question 9

On this card (**Show card D**) is a list of different environmental issues or situation. For each one can you please tell me if you think that, **over the last five years, things in Tonga** have become much better, better, worse or much worse, or if there has been little or no change. (Read out each item in turn; circle **one** number on **each line**)

#### (Card D)

	Much better	Better	Little or no change	Worse	Much worse	Not sure
a) The environment in general	1	2	3	4	5	6
b) Protection of endangered plants and animals	1	2	3	4	5	6
c) Cleanliness of beaches and coastal areas	1	2	3	4	5	6
d) Dealing with household waste	1	2	3	4	5	6

e) Fresh water source quality	1	2	3	4	5	6
f) Transport, storage and disposal of hazardous chemicals	1	2	3	4	5	6
g) Soil conservation	1	2	3	4	5	6
h) Dealing with waste from companies and business	1	2	3	4	5	6
i) Cooperation on environmental issue with other villages/district	1	2	3	4	5	6
j) Protection of useful trees (medicinal plants, and perfumery trees etc.)	1	2	3	4	5	6
k) Dealing with free roaming pigs and other domestic animals	1	2	3	4	5	6
l) Abundance and quality of coastal fisheries resources	1	2	3	4	5	6
m) Dealing with the general litter (rubbish)	1	2	3	4	5	6

### Question 10

Now I'd like you to look at this list and indicate whether you think that each of the statements is **true or false**. Please put a circle around one number on each line to show your answer.

	True	False	Not sure
a) Deforestation in Tonga is a severe problem	1	2	3
b) The litter problem in Tonga is mainly caused by people's attitude towards rubbish (i.e. somebody would pick it up or I will clean the yard on Saturday)	1	2	3
c) Most pollutant eventually end up in the water table and the sea	1	2	3
d) Most environmental issues in Tonga could be minimised if managed properly	1	2	3
e) A lot of native birds and plants have become extinct in Tonga	1	2	3
f) Decline in fisheries could be caused by destructive fishing methods	1	2	3
(g) Mangroves have no value	1	2	3

### Question 11

On this card (**Show card E**) is a list of people or organisation in the community who may provide us with information on issues relating to the environment. In general, how reliable do you think information from each of these sources would be? (**one** circle on each line)

#### (Card E)

	Very reliable	Fairly reliable	Hard to say	Fairly unreliable	Very unreliable
a) Schools	1	2	3	4	5
b) Business and Industries	1	2	3	4	5
c) Government departments	1	2	3	4	5
d) A foreign visitor	1	2	3	4	5
e) Local committees or groups	1	2	3	4	5
f) NGOs	1	2	3	4	5



g) Friends or neighbours	1	2	3	4	5
h) Religious leaders/churches etc.	1	2	3	4	5
i) Local Media (TV, radio, papers)	1	2	3	4	5
j) International media	1	2	3	4	5

### Question 12

We've talked about various things that may be good or bad in terms of protecting the environment. As you yourself see it, **what is the point** of doing things that may help to protect the environment? (circle up to **two** responses)

Survival of the planet	1
Owe it to our children/grandchildren/future generation	2
Protecting people's health and safety	3
Socio-economic reasons – so that we can sustain a reasonable standard of living, continue to have a source of income, adequate food etc.	4
Quality and enjoyment of life – e.g. Clean water, fresh air, and fish to catch etc.	5
The law of the country required us to protect the environment	6
We have a duty to look after things; humans have no right to destroy natural systems; it's just the right thing to do	7
Other (Specify)	8
Not sure	9

### Question 13

Now I'm going to read a list of possible **causes** of Tonga's environmental problems. They are also printed on this card (**Show card F**). As I read each of them, please tell me how much you think it contributes to the environmental problems here in Tonga – a great deal, a fair amount, not very much, or not at all?

(Read out **each** item in turn; circle **one** number on **each** line)

#### (Card F)

	A great deal	A fair amount	Not very much	Not at all
a) Overpopulation-there are too many people using up resources	1	2	3	4
b) Lack of awareness and education-people just don't know what to do to protect the environment	1	2	3	4
c) Lack of enforcement of existing legislations	1	2	3	4
d) People's attitudes towards the environment – 'things to be used' - they are self corrected or reproduced easily	1	2	3	4
e) People's perception of development and what is seen as 'progressed/advanced or being developed' i.e. (It is a sign of being 'advanced' if one drinks coca cola, use plastic bags, diapers etc. without thinking of the consequences/cost of disposing of rubbish or the loss of money)	1	2	3	4
f) Lack of alternative sources of 'livelihood'	1	2	3	4
g) Government does not place enough emphasis on protecting the environment to be in pace with the development	1	2	3	4
h) Business and industry are allowed to litter and pollute the environment	1	2	3	4
i) Government services such as waste management is very inefficient	1	2	3	4
j) Not enough land for Government to distribute	1	2	3	4

### Question 14

On this page (**Show card G**) there are several statements. In each case, can you please tell me whether you Agree strongly, Agree, Disagree or Disagree strongly with the statement or unsure. (Circle **one** number on each line).

#### (Card G)

	Agree strongly	Agree	Not sure	Disagree	Disagree Strongly
a) Government has set clear sustainable development policies	1	2	3	4	5
b) The Government of Tonga has the capacity to implement its sustainable development policies	1	2	3	4	5
c) Community groups can do a lot in the community to conserve community resources	1	2	3	4	5
d) Community groups can do a lot in the community to conserve community resources	1	2	3	4	5
e) The community has the capacity to manage community resources	1	2	3	4	5

### Question 15

There are some government rules, which are intended to protect or improve the environment by regulating what individuals, companies, farmers etc. may do. Do you feel that these environmental regulations are much too strict, a bit too strict, about right, a bit too lax, much too lax for each of the following (**show Card H**)

#### (Card H)

The Regulation of:	Much too strict (too strict/hard)	A bit too strict	About right	A bit too lax	Too lax (too weak)	Not sure
a) Tax and town allotment holder (land holder)	1	2	3	4	5	6
b) Littering in public places	1	2	3	4	5	6
c) Tourist industries	1	2	3	4	5	6
d) Protected Areas	1	2	3	4	5	6
e) Fisheries industry/fisheries management	1	2	3	4	5	6
f) Sand mining	1	2	3	4	5	6
g) Forestry regulations	1	2	3	4	5	6
h) Domestic animals (pigs, cattle)	1	2	3	4	5	6

### Question 16

i) On this card (**Show card I**) there are two pairs of statement about certain matters. Looking at the first two statements, can you tell me whether you agree more with Statement A or with Statement B. (Read out **first pair** of statement; circle one number in first column below.)

#### (Card I)

(A) Tongans will increasingly have to make hard choices between economic growth and protection of the environment

(B) It is quite possible to have both a prosperous economy and a healthy environment

ii) Now looking at the second pair of statements-do you agree more with Statement A or with Statement B. (Read out **second pair**; circle **one** number in the second column)

(A) Each of us as an individual must take responsibility for doing all that we can to protect the environment and improve the environment

(B) You can't expect the individual to take environmental issues seriously when the Government and companies/business are ineffective or irresponsible.

	i)	ii)
Agree more with A	1	1
Agree more with B	2	2
Hard to say	3	3

**Question 17**

There are several statements in this question (**Show card J**), in each case, can you please tell me whether you Agree strongly, Agree, Disagree, Disagree strongly with the statement (circle **one** number on each line).

**(Card J)**

	Agree Strongly	Agree	Not sure	Disagree	Disagree Strongly
a) It is easy to obtain reliable information about environmental matters	1	2	3	4	5
b) In Tonga we are doing too little, too late, to protect the environment	1	2	3	4	5
c) Tongans can no longer afford to ignore environmental problems as hard earned economic growth will be spend on correcting the environment, that provide the resources for economic growth	1	2	3	4	5
d) There is a lot of environmental information provided by the Tongan media	1	2	3	4	5
e) I feel quite confused by all the different information and claims I hear about environmental issues	1	2	3	4	5
f) There is a lot that I as an individual can do to help protect the environment	1	2	3	4	5
g) I do what I can do to improve the quality of my land as it is going to be inherited by my children	1	2	3	4	5
h) Media campaigns (e.g. Lobster man) do a lot to encourage people to do the right thing to protect the environment	1	2	3	4	5

**Question 18**

Are you are member of any group whose main concern is protection of the environment?

Yes.....1  
No.....2

**Question 19**

What would you say is the **single most important thing** that the government could do to protect or improve the environment over the next few years?

( listen to the response, probe to clarify if necessary, and write in **one clear** answer.)

OR (circle if applicable) No particular suggestion.....99

(In order for me to check the numbers of people in different groups in the sample, I'd like to ask a few questions about you or your household.)

**Question 21**

Can you please tell me which one of these age groups (**Show card L**) you are in? You just need to say the number that applies.

**(Card L)**

19 – 23 years	1
24 – 28 years	2
29 – 33 years	3
34 – 38 years	4
39 – 43 years	5
44 – 48 years	6
49 – 53 years	7
54 – 58 years	8
59 – 63 years	9
64 – 68 years	10
69 – 73 years	11
Not stated	12

**Question 22**

In what country/island were you born?

Tongatapu	01
‘Eua	02
Ha’apai	03
Vava’u	04
Niua’s	05
Other countries (Specify)	06

**Question 23**

a) Are you still at secondary school? (still, as school does **not** include form 7 and training colleges)

Yes.....1
(Go to question 24)

No.....2

b) If **NO** what is the highest level of education you have completed? (Read out)

No formal school	1
Primary school	2
Some secondary school	3
Completed secondary school	4
Trade or technical qualification	5
University degree, Diploma or higher degree	6
Not stated	7

**Question 24**

Which **one** of these (**Show card L**) best describes you?

**(Card L)**

In paid work (full time or part time-includes being self-employed)	1
Unemployed and looking for work	2
Student	3
Home duties	4
Retired	5
Other (Specify)	6

(Go to Question 26)

**Question 25**

a) If in paid work (**code 1 in Q 24**), what is your (main) source of income?

Fisher.....	1
Farmer.....	2

Other (Specify):

(Ensure that you write in a full description – eg primary school teacher, apprentice motor mechanic, shop assistance, self employed, carver etc.)

**Question 26**

a) Which **one** of the following **best** describes this household? (circle one only)

A one-person household	1
Couple or a family	2
A group household, two or more families (Extended family – with grandparents, and other relatives etc.)	3
Other (specify):	4

b) Are there children aged **under 19** who usually live in this household?

Yes	1
How many?	
No	2

**Question 27**

Which of the numbers of this card (**Show card M**) indicates the gross income of your household, that is, total income of all household members aged 18 or more from all sources, before tax? Please just read out the relevant number from the card.

(If respondent is uncertain, ask ‘What is your best estimate?’)

**(Card M)**

T\$ 1,500 per year or less (\$50 per week or less)	1
Between \$ 1,501 and \$ 5,200 per year (\$50 and \$ 100 per week)	2
Between \$ 5,200 and \$15,600 per year (\$100 and \$300 per week)	3
Between 15,601 and \$31, 200 per year (\$300 and \$600 per week)	4
Over \$31,200 (Over \$600 per week)	5
Not stated	6

**Question 28**

How many vehicles (excluding motor bikes etc.) that are normally parked in this household garaged or at your home?

None	1
One	2
Two	3
Three or more	4

**Question 29**

Is the respondent –	
Male?	1
Female?	2

**Question 30**

(Complete this.)

**Type of dwelling:**

Tongan house	1
European style house	2
Other: (specify)	3

**Question 31**

How many males in this household?	
How many females in this household?	

**THANK YOU FOR YOUR TIME AND HELP – MALO ‘AUPITO E FIE TOKONI**

**Appendix 4: Environmental Concerns in Local Areas by Main Category of Concerns**

	Total n=44 7	Gender		Age Group				Residence						
		M n=21 1	F n=22 6	19-23 n=10 2	24-33 n=13 0	34-53 n=16 2	54+ n=53	Tt n=278		Vv n=75		Hp n=58		OI
		U n=154	R n=124	U n=29	R n=46	U n=17	R n=41	n=36						
%	%	%	%	%	%	%	%	%	%	%	%	%	%	
Land degradation	23.0	23.0	23.0	25.2	20.1	23.4	20.0	10.0	15.5	1.3	4.0	16.0	12.1	33.3
Pollution-solid waste	19.0	20.0	17.3	19.2	20.1	15.3	20.0	17.0	6.1	15.0	4.0	5.2	2.0	3.0
Coastal/Marine degradation	15.0	13.0	17.3	13.3	19.0	14.0	-	6.1	8.0	5.3	11.0	17.2	10.3	-
Climate change and associated problems (Sea level rise, storm surges, inundation etc.)	15.0	13.6	16.0	11.3	16.0	17.2	20.0	8.0	1.1	25.3	5.3	17.2	-	19.4
Pollution – Others (Sewage, water pollution, waste oil, batteries etc.)	13.4	14.5	12.4	13.3	11.2	14.4	33.3	9.0	9.0	4.0	3.0	3.5	2.0	6.0
Others	9.2	8.1	10.2	6.2	9.5	13.0	7.0	2.2	1.4	-	11.0	7.1	3.4	39.0
Environmental legislation and policies	5.0	6.3	4.0	9.0	3.0	4.0	-	3.6	3.2	3.0	1.3	5.2	-	-
Run-off into the harbour	1.3	2.6	0.4	3.0	1.2	-	-	-	-	8.0	-	-	-	-

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands, U – Urban areas, R – Rural Areas

A – Did not complete secondary school, B – Completed secondary school/tech qualification

C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

**Appendix 5 : Priority Environmental Issues for Government Action to Protect the Environment of Tonga in the Next Few Years**

	Total n=447 %	Gender		Age Group				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Attention to law enforcement problems	35.4	32.1	39.0	37.1	35.0	36.0	20.0	25.0	41.0	56.0	17.4	44.9	62.0
More public participation	20.0	18.0	22.0	20.0	23.1	15.3	13.3	26.4	14.2	10.3	21.4	20.4	12.0
Increased and improve environmental awareness and education	19.0	26.0	12.0	17.0	18.3	19.0	40.0	21.0	18.0	15.0	32.1	8.0	12.0
Deal with pollution issues	15.0	13.0	17.0	11.3	15.0	20.0	13.3	17.1	17.0	3.0	18.0	15.0	4.0
Enactment of appropriate legislations and policies	11.4	12.0	11.2	15.2	9.0	10.0	13.3	11.0	10.1	16.2	11.2	12.2	10.0

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands, U – Urban areas, R – Rural Areas  
A – Did not complete secondary school, B – Completed secondary school/tech qualification  
C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket



### Appendix 5.1: Responses to Seven True/False Statements on Environmental Issues

	Correct answers %	Not sure %	Wrong answers %
A lot of native birds and plants in Tonga have become extinct	80.3	1.6	18.2
Litter problems in Tonga is mainly caused by people's attitude towards rubbish (i.e. somebody would pick it up or I would clean up on Saturday)	73.6	1.3	25.1
Composting returns nutrients to the soil for plant growth	69.1	4.5	26.4
Deforestation is a severe problem in Tonga	60.5	11.0	28.5
Most pollutants eventually end up in the sea or water table	48.3	0.7	51.0
Decline in fisheries could be caused by destructive fishing techniques	34.7	5.4	60.0
Mangroves have no value	30.2	68.2	1.6

### Appendix 5.2: Assessment of Change in the Quality of the Environment in Tonga and in Various Divisions and Community

	Tonga %	Local Community				
		Total %	Tongatapu %	Vava'u %	Ha'apai %	Outer Islands %
Much better	14.3	11.9	11.5	4.0	24.1	11.1
A little better	36.2	36.0	34.5	42.7	37.9	30.6
Same	26.2	26.2	21.2	37.3	32.8	30.6
A little worse	13.2	16.8	20.9	9.3	5.2	10.4
Much worse	9.8	9.2	11.9	6.7	-	8.3
Not sure	0.2	-	-	-	-	-
	100.0	100.0	100	100	100	100

**Appendix 6: Percentage of Tongans Perceiving Improvement in Aspects of the Environment in Tonga over the past Five Years**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=162 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Fresh water source quality	81.0	81.9	80.1	81.2	77.8	86.4	73.3	77.0	93.3	74.1	92.2	92.1	74.2	63.2	86.2	79.3	69.4
Cooperation on environmental issues among villages/districts	73.2	72.4	74.0	73.5	68.1	80.2	80.0	77.3	40.0	79.3	100	79.6	67.3	67.7	79.1	69.4	64.0
Cleanliness of beaches and coastal areas	54.5	54.1	55.0	57.0	51.2	54.1	66.7	48.4	69.3	53.5	72.2	66.2	47.2	35.3	67.7	46.4	30.0
Protection of culturally useful trees (medicinal and perfumery plants)	52.4	47.1	57.2	46.4	54.4	56.7	60.0	46.0	46.7	79.3	69.4	54.6	52.5	45.6	63.8	43.4	38.0
The environment in general	40.5	43.0	38.1	40.4	7.3	49.5	13.3	42.5	38.7	19.0	63.9	38.9	43.2	39.7	33.7	47.5	40.0
Dealing with free roaming pigs and other domestic	37.1	36.2	38.1	39.1	35.5	39.6	20.0	30.2	40.0	43.1	75.0	43.1	34.6	25.0	34.7	44.0	22.0
Dealing with the general litter problem	33.0	38.4	28.0	29.8	29.8	40.9	46.7	31.7	29.3	51.7	20.0	41.7	27.0	20.6	44.0	26.8	18.0
Protection of endangered plants and animals (wild life)	32.1	33.6	30.5	29.1	31.0	37.0	33.3	5.0	22.7	12.3	61.1	32.4	31.1	34.0	31.1	33.9	28.0
Soil Conservation	29.2	26.8	31.6	28.5	27.2	33.9	26.7	29.0	17.3	43.1	33.3	35.4	23.0	25.0	36.7	23.7	22.0
Transport, storage and disposal of hazardous chemicals	29.0	32.6	25.3	32.0	23.2	31.1	46.7	25.0	54.7	-	50.0	30.7	31.5	17.7	30.1	30.2	22.0
Dealing with household waste	25.0	25.0	25.0	23.8	24.4	25.0	40.0	32.0	29.3	-	5.6	21.6	28.8	27.3	21.7	26.4	31.3
Dealing with waste from companies and businesses	12.2	11.9	12.4	16.0	8.3	12.7	13.3	9.4	18.7	12.5	19.4	12.2	13.0	10.3	13.5	11.2	12.0
Abundance and quality of coastal fisheries and resources	11.0	11.4	10.6	12.0	7.1	14.1	20.0	11.9	10.7	6.9	11.1	8.8	13.6	12.0	10.7	12.3	6.0

Key: Tt – Tongatapu; Vv – Vava’u; Hp – Ha’apai; OI – Outer Islands; A – Did not complete secondary school; B – Completed secondary school/tech qualification; C – University degree or diploma; D – Lower income bracket; E – Middle-income bracket; and F – Upper income bracket.

**Appendix 7: Percentage Believing that Environmental Information from Various Sources is Very/Fairly Reliable**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
International media	91.0	92.0	90.0	90.1	93.0	87.4	100	90.3	89.3	100	83.3	93.0	89.4	90.0	90.0	92.0	90.0
Schools	88.0	88.0	88.1	88.1	86.3	89.2	83.3	91.7	88.0	79.3	72.2	86.0	89.0	93.0	93.3	81.2	94.0
Government departments	87.0	89.0	85.0	87.0	84.0	90.1	87.0	83.4	89.3	100	83.3	88.4	84.5	87.0	93.3	79.0	92.0
Local media (TV, radio, papers)	84.2	83.0	85.4	89.3	85.0	76.0	87.0	85.4	81.3	90.0	72.2	84.0	83.1	88.2	82.0	85.1	90.0
Local committees or groups	76.0	75.1	77.0	76.5	72.0	78.4	93.3	80.0	75.0	64.0	69.4	79.0	71.1	78.0	83.0	70.0	74.0
Religious leaders/churches	74.0	65.5	81.4	72.2	77.4	70.3	66.7	75.1	65.3	78.0	72.2	73.2	76.0	69.1	70.3	78.0	70.0
NGOs	71.2	73.0	69.5	64.7	73.7	75.7	73.3	75.3	55.0	70.0	78.0	69.3	70.0	79.4	62.0	79.0	80.0
Friends or neighbours	67.1	63.3	70.8	66.0	69.5	65.0	67.0	71.0	60.0	51.7	81.0	74.4	60.6	58.8	70.3	69.0	52.0
A foreign visitor	56.1	53.2	59.0	60.0	58.0	53.2	53.3	59.2	36.0	67.2	56.0	56.5	55.9	56.0	51.3	60.0	60.0
Business and Industries	45.0	50.5	40.0	45.3	44.3	46.0	40.0	48.0	43.0	33.0	47.2	48.0	44.3	37.0	47.0	46.0	40.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands

A- Did not complete secondary school, B – Completed secondary school/tech qualification

C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

**Table 8: Tongan Community - Agreement with Opinions on Specific Environmental Propositions**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
I do what I can do to improve the quality of my land as it is going to be inherited by my children	89.3	88.2	90.3	80.1	91.8	97.3	93.3	91.0	93.3	82.8	77.8	86.6	90.7	94.1	84.7	91.8	98.0
Media campaigns (e.g. Lobster man) do a lot to encourage people to do the right thing to protect the environment	83.5	82.8	84.1	87.4	80.5	82.9	80.0	92.8	82.7	51.7	63.9	80.6	88.9	79.4	84.7	81.1	90.0
There is a lot that I as an individual can do to help protect the environment	82.1	84.2	80.0	65.6	88.1	93.7	93.3	82.3	82.3	75.9	88.9	79.2	83.2	88.2	78.6	84.6	84.0
Tonga can no longer afford to ignore the environment as economic growth will be spent on correcting the environment to maintain that growth	73.2	71.5	74.8	71.5	79.2	64.9	80.0	66.2	77.3	91.4	88.9	68.5	78.4	76.5	66.3	80.1	70.0
In Tonga we are doing too little too late to protect the environment	44.7	45.7	43.8	43.7	43.8	50.0	53.3	47.1	48.0	32.8	38.9	39.8	45.7	57.4	38.8	48.5	54.0
I feel quite confused by all the different information and claims I hear about environmental issues	43.9	44.3	43.4	48.3	43.2	42.3	20.0	31.3	66.7	62.1	63.9	45.8	46.3	32.4	44.4	47.0	34.0
It is easy to obtain reliable environmental information	28.6	28.1	29.2	29.8	33.1	22.5	13.3	33.5	21.3	27.6	8.3	19.9	34.6	42.7	25.5	30.6	34.0
There is a lot of environmental information provided by the Tongan media	12.3	10.9	13.7	13.9	13.0	9.0	6.7	17.3	4.0	1.7	8.3	6.9	16.7	19.1	8.7	13.8	20.0

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands; A – Did not complete secondary school, B – Completed secondary school/tech qualification; C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

**Appendix 9: Respondents who Agreed with Five Statements Regarding Government/Community's Environmental Management Role and Capacity**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M N=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Community groups can do a lot in the community to conserve community resources	81.4	81.0	82.0	84.0	72.3	81.2	87.0	79.0	77.3	95.0	89.0	84.0	82.1	74.0	82.0	82.1	76.0
Town and District Officers have important environmental management roles	77.2	72.0	82.0	78.2	79.3	70.3	93.3	81.0	73.3	79.3	56.0	72.2	82.1	81.0	71.0	81.0	96.0
Communities have the capacity to manage community resources	54.1	62.0	46.5	52.0	53.0	61.0	47.0	53.5	40.0	60.3	78.0	61.4	44.0	54.4	57.0	53.0	54.0
The government of Tonga has the capacity to implement sustainable development policies throughout Tonga	45.0	37.4	52.0	43.3	42.0	50.0	60.0	36.3	62.2	43.0	80.0	47.0	44.1	41.2	49.5	41.0	48.0
Government has set clear sustainable development policies	24.0	20.0	28.0	25.2	23.0	20.0	60.0	27.1	37.3	1.7	8.3	20.4	26.1	31.0	18.4	26.7	38.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands  
A – Did not complete secondary school, B – Completed secondary school/tech qualification,  
C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

**Appendix 10: Tonga Community Skill Levels in Knowing how to Reef Glean but not to Destroy the Reef**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Definitely know how to	20.6	20.5	21.0	13.3	23.1	23.4	40.0	21.3	19.0	22.4	17.0	23.3	17.0	22.1	22.0	20.0	20.0
Fair idea how to	33.0	40.0	26.1	21.0	33.0	50.0	40.0	36.1	29.3	19.0	39.0	32.6	31.0	38.2	33.3	34.0	32.0
Some idea, but not too sure	22.2	21.4	23.0	23.0	22.0	23.4	13.3	19.1	15.0	57.0	6.0	22.0	23.5	21.0	24.6	19.4	18.0
Not much idea at all	24.2	18.2	30.1	43.3	22.5	4.0	7.0	37.3	23.5	1.7	39.0	22.3	29.0	19.1	21.0	27.0	30.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Appendix 11: Tongan Community Skill Levels on Capacity to Start a Household Compost Heap**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Definitely know how to	17.0	17.0	17.0	11.3	21.0	18.0	20.0	16.1	17.3	16.0	22.2	17.0	19.0	13.2	8.0	26.0	20.0
Fair idea how to	29.0	30.3	27.0	19.2	24.3	44.1	53.3	33.5	23.0	21.0	17.0	29.0	25.3	35.3	33.0	23.0	34.0
Some idea, but not too sure	21.3	20.4	22.1	20.0	20.1	25.2	20.0	14.0	20.0	45.0	42.0	19.0	25.0	22.1	22.0	21.0	18
Not much idea at all	33.3	33.0	34.1	50.0	35.0	12.6	7.0	36.3	40.0	19.0	19.4	36.1	31.5	29.4	38.0	31.0	28.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands, A – Did not complete secondary school, B – Completed secondary school/tech qualification  
C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

**Appendix 12: Tongan Community Skills Levels on Ability to Seek Advice for Applications and Disposals of Pesticide and Agricultural Chemicals**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Definitely know how to	35.2	37.3	33.2	30.5	38.1	36.0	40.0	35.0	35.0	24.0	28.0	26.4	42.2	47.1	25.1	45.4	38.0
Fair idea how to	23.0	22.3	23.0	17.0	17.0	37.0	47.0	24.2	20.0	21.0	19.4	25.0	21.1	19.1	30.0	16.0	22.0
Some idea, but not too sure	14.1	13.0	15.5	11.3	13.1	20.0	13.3	13.0	9.3	7.0	44.4	18.1	11.2	8.8	16.0	13.0	12.0
Not much idea at all	28.0	28.0	28.3	42.0	32.1	7.2	-	28.2	21.3	48.3	8.3	31.2	25.5	25.0	29.2	26.0	28.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands

A – Did not complete secondary school, B – Completed secondary school/tech qualification

C – University degree or diploma, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

**Appendix 13: Factors that were Very/Fairly Important in Influencing Changes in Behaviour**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
I read a book or magazine or I saw films or TV programmes that made an impression on me	91.4	90.4	92.3	93.2	90.0	93.0	77.0	92.3	95.0	81.0	94.4	89.2	94.0	93.0	90.0	92.2	94.0
I felt I couldn't leave it to other people, I had to do my bit	90.2	89.3	91.2	92.0	88.0	92.0	92.3	89.1	93.2	89.1	94.4	86.1	94.1	94.0	88.3	91.4	92.0
A number of my friends, relatives, neighbours or colleagues were doing these sorts of things	90.0	92.2	88.0	89.4	87.0	95.0	92.3	91.4	75.3	95.0	100.0	91.0	86.4	96.0	93.0	86.0	94.0
It became easier now i.e. there are rubbish bins available	87.0	86.0	86.2	86.1	86.2	91.0	69.2	87.0	88.0	84.5	89.0	84.4	88.3	91.4	87.0	87.2	84.0
I began to understand clearly what the environmental consequences of my actions really were	84.4	82.3	86.0	83.1	92.0	77.0	69.2	85.0	77.0	91.1	89.0	78.4	90.0	91.0	80.0	89.3	84.0
I was influenced by government training/programmes	82.0	82.0	81.1	83.2	80.2	83.5	62.2	82.3	82.2	76.0	83.3	82.0	79.4	85.1	82.0	81.4	84.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands  
A – Did not complete secondary school, B – Completed secondary school/tech qualification  
C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket



**Appendix 14: Changes Made for Environmental Reasons in the Past Year**

	Total n=447 %	Age Group				Residence				Household Income Level		
		19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	D n=196 %
Participating more in clean up campaigns (i.e. beaches, public places, village cemetery/meeting area etc.)	43.4	38.0	50.0	41.4	40.0	48.2	53.3	10.3	39.0	33.2	47.5	68.0
Keep properties clean and free from harmful insects	38.5	44.0	36.1	38.0	20.0	42.1	41.3	21.0	33.3	30.1	44.4	48.0
Conserving water	37.4	41.1	40.2	32.0	13.3	29.0	41.3	60.3	58.3	41.0	39.0	20.0
Replanting more plants and saving variety of trees	36.2	34.0	38.0	32.4	67.0	38.1	39.0	22.4	39.0	33.2	37.2	44.0
Taking care of disposing of oil, paints and batteries	27.1	26.0	27.2	31.0	13.3	15.4	44.0	48.3	56.0	27.0	28.1	24.0
Fencing of pigs	26.4	26.0	25.0	27.0	47.0	33.5	19.0	3.5	25.0	35.0	18.4	28.0
More aware in using agricultural chemicals and pesticides (reading instruction, wear protective clothes)	25.0	20.0	28.0	28.0	20.0	23.4	5.3	45.0	44.4	22.5	22.5	42.0
Reducing destruction of medicinal plants as not to destroy the plant (i.e. few required leaves rather than a whole branch)	24.0	28.0	19.0	27.0	20.0	20.0	28.0	24.1	47.2	25.5	30.0	6.0
Conserving use of energy (electricity or firewood)	21.0	19.2	24.0	22.0	7.0	22.0	21.3	21.0	14.0	27.0	26.0	10.0
Modifying fishing habits for conservation purposes	21.0	15.0	22.0	27.0	27.0	27.0	7.0	12.0	17.0	16.3	26.0	22.0
Taking own shopping bag	16.3	14.0	17.0	20.0	13.3	20.1	13.3	12.1	-	29.1	15.0	14.0
Starting to recycle more/reuse	15.0	15.0	14.0	16.2	13.3	16.0	8.0	12.1	22.2	22.5	13.0	8.0
Reducing use of vehicles (cars)	16.1	17.2	14.0	20.0	7.0	16.0	27.0	12.1	3.0	14.0	14.3	20.0
Sorting rubbish	11.0	12.0	9.5	12.0	13.3	12.0	11.0	14.0	-	20.4	14.0	10.0
Join environmental groups	10.0	10.0	11.0	5.4	20.0	9.0	24.0	2.0	-	8.2	13.0	14.0
Saving mangroves (replanting and conservation)	2.5	-	2.4	5.4	-	4.0	-	-	-	6.1	14.0	8.0
Modifying farming practices for environmental reasons	1.0	1.3	-	2.0	-	1.1	2.0	-	-	3.1	1.0	4.0
Other	0.2	-	1.0	-	-	0.4	-	-	-	1.5	0.5	-
Made earlier changes but none in the past year	2.0	2.0	2.0	1.0	7.0	2.0	1.3	3.5	-	1.5	2.0	-
No, can't think of changes I've made	2.5	5.3	1.2	-	7.0	3.0	1.3	5.2	-	3.1	1.5	2.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands, D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

**Appendix 15: People who have Influenced Changes in Behaviour**

	Total n=447 %	Residence				Education			Household Income Level		
		Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
Government departments	77.0	75.2	81.3	76.0	81.0	81.0	74.1	71.0	81.0	74.5	74.4
Village committees	74.3	72.3	83.0	76.0	69.4	78.2	72.2	66.2	79.1	73.0	64.0
NGOs, environmental groups	72.0	72.0	80.0	71.0	61.0	75.5	69.1	68.0	76.0	70.4	66.0
The media and media personalities	59.0	55.0	71.0	59.0	61.1	62.0	57.0	51.5	64.0	58.2	44.0
School teachers and church leaders	57.3	54.0	73.3	50.0	56.0	58.3	57.0	54.4	58.2	57.1	56.0
Prominent public figures	40.5	41.0	48.0	31.0	39.0	38.4	40.1	47.1	41.3	39.0	46.0
Friends, neighbours	32.2	31.0	40.0	31.0	31.0	33.3	32.1	29.4	35.0	30.0	34.0
A consultant/visitor	26.0	23.7	33.3	29.3	17.0	30.0	22.0	22.1	28.0	24.0	24.0
(Family members) Grandparents, parents, children	11.4	9.0	20.0	10.3	14.0	11.0	12.0	13.2	11.0	11.2	14.0
Other	11.0	9.4	12.0	16.0	11.1	12.0	10.0	10.3	8.2	14.0	10.0
No body in particular	8.0	9.0	7.0	2.0	11.1	7.0	9.0	7.4	7.0	8.0	10.0
Not sure/not stated	4.3	4.3	5.3	2.0	6.0	3.0	4.3	9.0	4.0	5.0	6.0

Key: Tt – Tongatapu, Vv – Vava’u, Hp – Ha’apai, OI – Outer Islands

A – Did not complete secondary school, B – Completed secondary school/tech qualification,

C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

**Appendix 16: Factors that were Very/Fairly Important in Influencing Changes in Behaviour**

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D N=196 %	E n=196 %	F n=50 %
I read a book or magazine or I saw films or TV programmes that made an impression on me	91.4	90.4	92.3	93.2	90.0	93.0	77.0	92.3	95.0	81.0	94.4	89.2	94.0	93.0	90.0	92.2	94.0
I felt I couldn't leave it to other people, I had to do my bit	90.2	89.3	91.2	92.0	88.0	92.0	92.3	89.1	93.2	89.1	94.4	86.1	94.1	94.0	88.3	91.4	92.0
A number of my friends, relatives, neighbours or colleagues were doing these sorts of things	90.0	92.2	88.0	89.4	87.0	95.0	92.3	91.4	75.3	95.0	100.0	91.0	86.4	96.0	93.0	86.0	94.0
It became easier now i.e. there are rubbish bins available	87.0	86.0	86.2	86.1	86.2	91.0	69.2	87.0	88.0	84.5	89.0	84.4	88.3	91.4	87.0	87.2	84.0
I began to understand clearly what the environmental consequences of my actions really were	84.4	82.3	86.0	83.1	92.0	77.0	69.2	85.0	77.0	91.1	89.0	78.4	90.0	91.0	80.0	89.3	84.0
I was influenced by government training/programmes	82.0	82.0	81.1	83.2	80.2	83.5	62.2	82.3	82.2	76.0	83.3	82.0	79.4	85.1	82.0	81.4	84.0

Key: Tt – Tongatapu; Vv – Vava'u; Hp – Ha'apai; OI – Outer Islands; A – Did not complete secondary school; B – Completed secondary school/tech qualification; C – University degree or diploma; D – Lower income bracket; E – Middle income bracket; and F – Upper income

**Appendix 17: Respondent's Own Most Environmentally Damaging Behaviour**

	Total n=447 %	Age Group				Residence				Household Income Level		
		19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	D n=196 %
Habit of littering, dumping of anywhere "available"	41.2	48.0	39.2	39.0	27.0	42.5	52.0	26.0	37.1	40.0	39.0	54.0
Unsafe disposal of batteries, oil, paints, medical supplies etc.	41.2	41.0	40.0	46.0	27.0	50.0	47.0	-	32.0	40.5	41.0	52.0
Burning of 'green' waste	40.0	38.4	42.0	37.0	47.0	25.2	61.3	78.0	47.2	46.5	37.2	24.0
Misuse/overuse of forest resources and plants	36.0	25.2	38.0	43.2	60.0	43.0	29.3	17.2	25.2	32.0	38.1	40.0
Buying/ and excessive using of non/slow degradable products (diapers, plastic bags etc)	33.3	32.0	40.0	29.0	7.0	24.1	31.0	79.3	38.1	28.2	34.0	48.0
Haphazard use of a lot of toxic chemicals, herbicides, pesticides	28.2	31.4	29.0	24.3	20.0	23.7	20.0	50.0	44.4	35.0	22.0	30.0
Letting domestic animals (pigs) free/unattended	27.7	34.5	23.1	25.3	33.3	32.0	23.0	2.0	50.2	33.2	25.0	20.0
Destructive use of coastal forest/mangroves and wildlife habitats	25.7	23.0	23.1	37.0	7.0	23.0	31.0	21.0	44.4	26.0	30.0	14.0
Failure to recycle (enough in all situation)	24.4	28.0	24.0	22.0	20.0	27.0	32.0	17.2	-	19.4	30.0	24.0
The way I fish (all sizes, using techniques that might be damaging etc.)	20.8	21.0	21.0	21.0	27.0	29.1	9.3	-	14.0	20.0	22.5	20.0
Lack of water conservation (wasteful use of water)	19.5	19.2	24.0	14.0	13.3	9.4	31.0	64.0	3.0	18.4	22.0	16.0
Ways land is being managed/use and its resources (ploughing, clearing of forest, fertilizers etc.)	18.3	17.0	15.4	26.1	13.3	23.4	9.3	10.3	12.0	18.0	19.0	20.0
Not replanting enough trees	17.0	20.0	17.2	12.0	13.3	19.0	5.3	26.0	9.0	13.3	17.4	24.0
Failure to save energy	12.1	15.2	10.1	10.0	20.0	12.0	12.0	10.3	19.4	12.0	15.0	4.0
Aspects of my work/sort of work I do	4.3	5.0	4.1	4.0	7.0	2.5	8.0	-	17.0	6.6	3.1	-
Other	5.0	2.0	4.1	3.6	26.7	6.1	-	-	3.0	3.1	4.1	4.0
Not sure, can't identify anything	7.0	2.0	6.0	9.0	27.0	9.0		-	6.0	10.0	2.0	6.0

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands D – Lower income bracket, E – Middle-income bracket, F – Upper income bracket

Appendix 18: Perceived Reasons for Environmentally Damaging Behaviour

	Total n=447 %	Gender		Age Group				Residence				Education			Household Income Level		
		M n=211 %	F n=226 %	19-23 n=102 %	24-33 n=130 %	34-53 n=162 %	54+ n=53 %	Tt n=278 %	Vv n=75 %	Hp n=58 %	OI n=36 %	A n=216 %	B n=162 %	C n=68 %	D n=196 %	E n=196 %	F n=50 %
More concerned with cost	39.4	34.4	44.3	43.1	39.0	37.0	40.0	36.3	15.0	79.3	50.0	44.4	35.0	35.3	45.4	35.0	32.0
Don't clearly understand what is and is not harmful	35.8	43.4	28.3	31.1	37.0	42.3	27.0	33.8	53.3	21.0	39.0	39.0	36.4	25.0	38.0	34.0	36.0
Don't have time	28.9	24.0	34.0	27.2	33.1	26.1	20.0	22.0	31.0	78.0	-	26.0	33.0	29.4	21.2	31.1	44.0
More convenient/faster/less messy	24.5	20.4	29.0	26.0	24.0	23.0	33.3	23.0	40.0	1.7	42.0	25.0	24.1	25.0	18.4	32.1	22.0
Lack of interest/laziness	21.9	25.3	18.6	22.0	22.0	23.0	20.0	29.0	15.0	10.3	3.0	14.0	27.0	35.3	17.0	26.0	30.0
Necessity no practical alternative	19.2	17.2	21.4	22.0	19.0	17.1	13.3	20.0	23.0	10.3	28.0	22.0	15.4	21.0	23.5	18.0	8.0
Ignorance/lack of awareness	11.2	11.3	11.1	13.3	8.0	13.0	20.0	1.3	17.3	-	3.0	10.0	12.4	13.2	13.0	10.0	12.0
Don't want to be different	11.0	14.0	8.0	10.0	10.1	13.0	20.0	8.0	21.3	-	31.0	15.3	9.3	1.5	18.0	7.0	2.0
Don't like to be told what to do	3.4	4.1	3.0	3.0	4.0	4.0	7.0	5.0	-	-	3.0	3.2	4.0	3.0	5.0	3.0	2.0
The only way known	3.1	4.7	2.2	1.3	5.3	2.8	-	4.3	1.3	-	3.0	0.5	3.1	12.0	-	5.0	10.0
Not sure	0.2	-	0.4	-	-	1.0	-	0.4	-	-	-	0.5	-	-	0.5	-	-
Not applicable/don't think I do harmful things	0.2	-	1.0	1.0	1.0	-	-	1.0	-	-	-	0.5	0.6	-	1.0	-	-

Key: Tt – Tongatapu, Vv – Vava'u, Hp – Ha'apai, OI – Outer Islands; A – Did not complete secondary school, B – Completed secondary school/tech qualification; C – University degree or diploma, D – Lower income bracket, E – Middle income bracket, F – Upper income bracket

**Appendix 19: English Translation of Open-Ended Questionnaire for Round One of a Delphi Survey on Community Perception of Coastal Resources Trend and Management Issues**

Introduction:

The researcher, Netatua Pelesikoti is responsible for this survey as part of her fieldwork for the requirement of a PhD thesis. You are invited to participate in the survey due to your skills and knowledge in coastal fisheries. If you are willing to participate your answers will be kept confidential, used solely for the purpose of the survey and would not have any implication what so ever on yourself or your family. During the cause of the survey we (Netatua, 'Asipeli Palaki, Tukia Lepa,) will be staying in your village and can be contacted through the Town Officer should you have any questions.

**Theme 1: Perceived trend in fisheries (Catch per Unit Effort of Key Resources)**

Catch per Unit Effort (CPUE) was used as indicator of successful management if there is an increase in catch per unit effort. CPUE trends were phrased in terms of easily observable measures – for example, how long it took to fill a bucket with fish.

- Three coastal fisheries of importance to you or to your household
- Own assessment of CPUE of your selected 3 fisheries resources as compared to the last decade.
- Causes of the changes in trend (both increasing and decreasing trend)
- Additional information or explanation you wish to make
- Relative quantities of fisheries sold or used for home consumptions

**Theme 2: Perception of habitat trends**

Three key habitats that are common in all three-study sites were selected with the help of the key persons in the community. These were also used as indicators of the status of the coastal ecosystems that supports the fishery resources. Any changes in these indicators in the last decade could be easily observable. The three key indicators of habitat trend were clarity (increasing clarity or decreasing clarity), coral abundance and diversity (increasing in coverage and increasing in different type or decreasing) seagrasses (increasing or decreasing in coverage). Circle a number in each row that closely represented your perception of these habitats trend.

- Views about:
  - Coastal water clarity
  - Coral coverage and diversity
  - Seagrass coverage and health
- Factors affecting habitats trend you identified
- Additional information or explanation you may wish to make

**Theme 3: Community fishery management**

Of the committees or any informal arrangement in your community, please assess the views of these committees or groups on sustainability issues (i. e., is sustainability or conservation issues often discussed in those groups gatherings). Please circle the number that best represent your views on those community committees or groups with regard to sustainability and conservation issues.

- Existing community fisheries committees or association
- Indication of whether fisheries committees are strong in sustainability issues or not
- Any other (general) Community/Village Development committee
- Indication of whether you think these committees are strong in sustainability issues or not
- Any policy or management options you would like to see in your community to improve coastal fisheries management
- Relative importance of options identified above.
- Additional information or explanation you may wish to make

MALO 'AUPITO - THANK YOU

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**Appendix 20: Description of coral and seagrass variables measured in this study. An underline in the Corals table means that species names are unsure. One Tongan name could be used to different species.**

<b>Corals</b>					
<b>Hard Corals</b>					
<b>Tongan name</b>	<b>English name</b>	<b>Scientific name</b>	<b>Family</b>	<b>Units</b>	<b>Replicates</b>
Feo manga	Digitate coral	<i>Stylocoeniella guentheri</i>	Astrocoeniidae	%	5
Feo kilekila	Bushy coral	<i>Pocillopora damicornis</i>	Pocilloporidae	%	5
Feo hui	Bushy coral	<i>Stylophora pistillata</i>	Pocilloporidae	%	5
Feo me'atui	Staghorn coral	<i>Acropora nobilis</i>	Acroporidae	%	5
Feo peleti	Plate coral	<i>Acropora hyacinthus</i>	Acroporidae	%	5
Feo punga	Massive coral	<i>Porites lobata</i>	Poritidae	%	5
Feo manga	Digitate coral	<i>Porites cylindrica</i>	Poritidae	%	5
Feo matala/ fakamalu	Mushroom coral	<i>Fungia spp.</i>	Fungiidae	%	5
Feo kalauni	Crown coral	<i>Galaxea astreata</i>	Oculinidae	%	5
Feo loungutu		<i>Lobophyllia</i>	Mussidae	%	5
Feo tu'utaha		<i>Caulastrea sp.</i>	Faviidae	%	5
Feo 'uto	Brain coral	<i>Platygyra dae</i>	Faviidae	%	5
Feo luoluo lalahi	Massive coral	<i>Montastrea spp.</i>	Faviidae	%	5
Feo tapaenga		<i>Turbinaria reniformis</i>	Dendrophylliidae	%	5
Feo fifisi	Fire coral	<i>Millepora tenella</i>	Milleporidae	%	5
<b>Soft Corals</b>					
Feo molu	Soft corals	<i>Sarcophyton</i>		%	5

<b><u>Algae &amp; Seagrasses</u></b>					
<b>Tongan name</b>	<b>English name</b>	<b>Scientific name</b>	<b>Units</b>	<b>Replicates</b>	
Musie kongokonga	Segmented Green alga	<i>Halimeda</i>	%	5	
Musie tahi	Seagrass	<i>Halophila ovalis</i>	%	5	
Musie tahi	Seagrass	<i>Halodule uninervis</i>	%	5	
Musie fua	Strawberry alga	<i>Dictyosphaeria sp.</i>	%	5	
		<i>Caulerpa serrulata</i>			
Musie lau	Deadman's eye	<i>Valonia sp.</i>	%	5	
Musie lau	Sea lettuce	<i>Ulva lactuca</i>			

Sources: Local Fishers; Ministry of Fisheries Poster on Fishes of Tonga; Thaman et al., 1996; <http://www.actwin.com/fish/species/index.phb>; & Kaly et al., 2001

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**Appendix 21: Common English, Tongan and Scientific names of Important Fisheries Resources Identified in the Survey**

General Groups	Tongan names	Scientific names
<b>(FISH)</b>		
<b>Reef Finfish</b>		
rockcod, coral trout	Ngatala	<i>Cephalopholis, Plectropomus spp.</i>
parrotfish	Hohomo	<i>Scarus spp.</i>
seaperch	Fangamea	<i>Lutjanus rivulatus</i>
emperor	Mangaa, koango	<i>Lethrinus nebulosus and Lethrinus miniatus</i>
travallys	Lupo	<i>Carangoides, Caranax and Gnathanodon spp</i>
parrotfish	pose, kiliofu, hohomo	<i>Scarus spp.</i>
coral cod	ngatala kula	<i>Cephalopholis miniatua</i>
snapper, jobfish	Palu	<i>Apharaeus, Pristipomoides spp.</i>
eel	Toke	<i>Gymnotorax spp</i>
surgeonfish	pone	<i>Acanthurus spp and Ctenochaetus striatus</i>
unicornfish	'ume	<i>Naso spp.</i>
Siganidae (rabbitfish)	ma'ava	<i>Siganus argenteus</i>
seabream	kulapo	<i>Gymnocranius euanus</i>
<b>Inshore Finshish</b>		
big-eye scad	'otule	<i>Selar crumenophthalmus</i>
goatfish	Vete	<i>Mulliodichthys, Parupeneus and Upeneus spp</i>
rabbitfish	O	<i>Siganus fuscatus/trilobatus</i>
Sliver biddys	matu	<i>Gerres spp.</i>
mulletts	kanahe	<i>Crenimugil and Liza spp.</i>
lethrindae	hoputu	?
<b>INVERTEBRATES</b>		
shellfish		
bivalve shells	kaloa'a, kuku	<i>Anadora spp.</i>
<b>Shellfish</b>	fingota	?
clams		
clams	kukukuku	?
giant clams	vasua	<i>Tridacna spp.</i>
<b>Turtles</b>		
hawksbill turtles	Fonu koloa	<i>Eretmochelys imbricata</i>
<b>Octopus</b>		
octopus	feke	<i>Octopus cyanea</i>
<b>Lobster</b>		
lobster/crayfish	'uo	<i>Panulirus spp.</i>
<b>Mollusks</b>		
turbo	'elili	<i>Turbo spp.</i>
trochus		
<b>Crab</b>		
mudcrab	tolitoli	<i>Scylla serrata</i>
<b>Reef Holothurids</b>		
sea urchin	tukumisi	<i>Tripneustes gratilla</i>
<b>Seaweed</b>		
seaweed	limu	<i>Cladosiphon sp,</i>
seagrass	(Refer Appendix 20)	
<b>Beche-de-mer</b>		
beche-de-mer/sea cucumber	mokohunu	<i>Holothurai (Microthele) nobilis</i>

? Scientific name not found

Sources: Local Fishers; Ministry of Fisheries Poster on Fishes of Tonga; Thaman et al.,1996 ; <http://www.actwin.com/fish/species/index.phb>



## Appendix 22: Results of Analyses of Water Quality Indicators

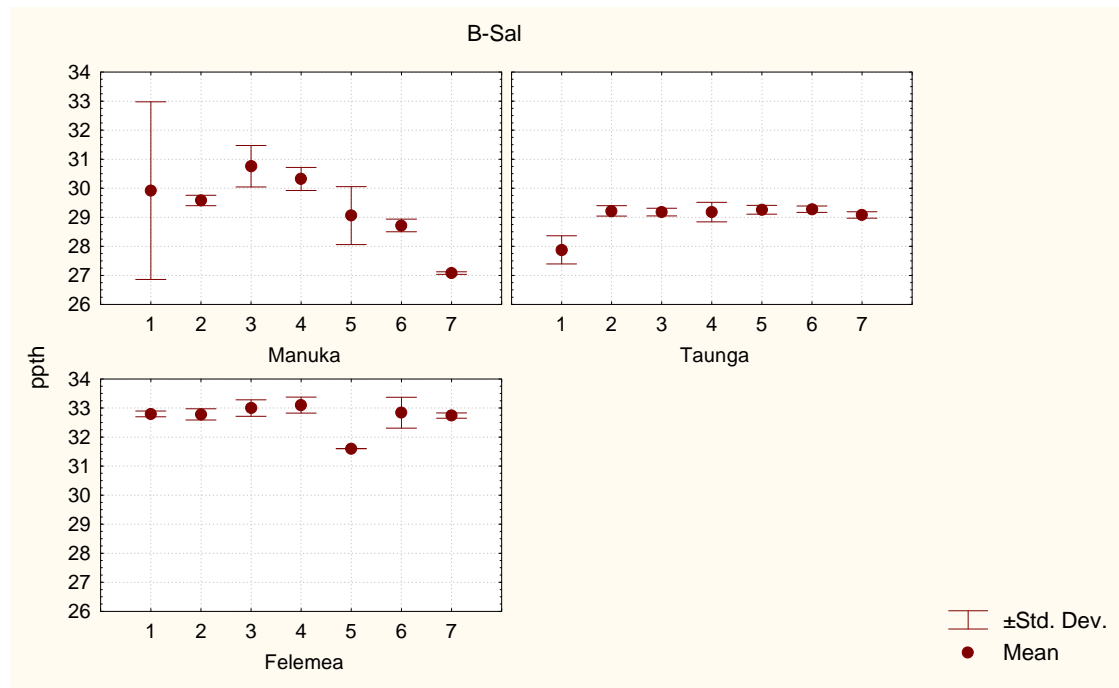
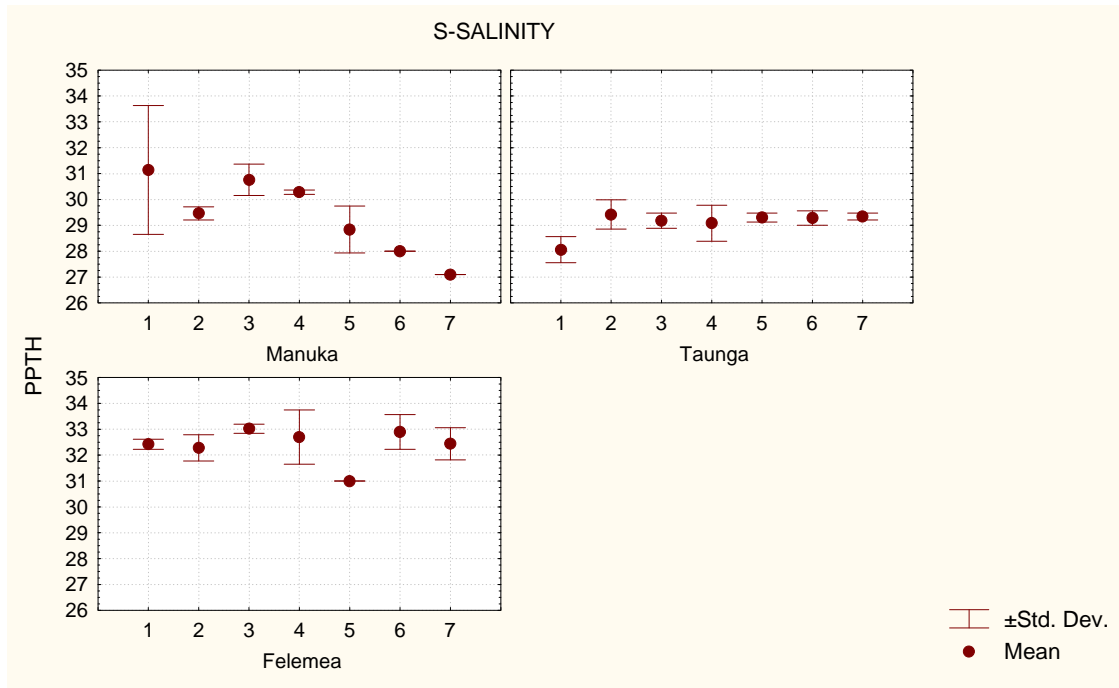
### 22.1: Univariate analyses for water quality variable. Note that a multivariate analysis was not possible (matrix near-singular).

L=Location (Manuka, Taunga, or Felemea); S(L)=Site nested in location (between 5 and 7 random sites around each community); \*= $p < 0.05$ ; NS= $p \geq 0.05$ ; DO=Dissolved oxygen; S-B=difference as measured by Surface-Bottom value, or *visa versa*.

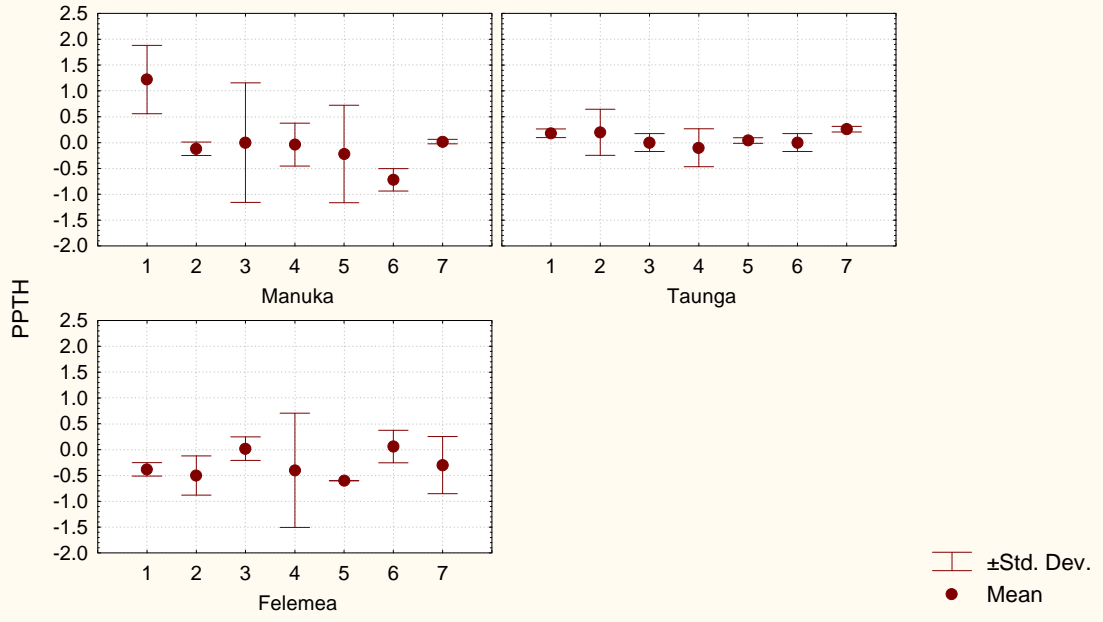
		df effect	MS effect	df error	MS error	F	P-level	Significance
Surface salinity	L	2	117.37	18	3.09	24.44	0.00	*
	S(L)	18	4.79	84	0.71	4.37	0.00	*
Bottom Salinity	L	2	145.1	18	1.89	48.84	0.00	*
	S(L)	18	3.32	84	0.79	2.39	0.00	*
B-S Salinity	L	2	1.48	18	0.74	1.53	0.15	NS
	S(L)	18	0.71	84	0.33	2.27	0.00	*
Surface Temperature	L	2	16.12	18	2.31	13.75	0.00	*
	S(L)	18	7.25	84	0.19	12.31	0.00	*
Bottom Temperature	L	2	25.46	18	2.77	13.86	0.00	*
	S(L)	18	5.28	84	0.07	41.17	0.00	*
S-B Temperature	L	2	2.05	18	0.88	0.36	0.23	NS
	S(L)	18	1.29	84	0.15	5.92	0.00	*
Surface DO	L	2	469.74	18	1.34	307.13	0.00	*
	S(L)	18	14.74	84	0.07	18.07	0.00	*
Bottom DO	L	2	456.18	18	1.91	205.10	0.00	*
	S(L)	18	14.45	84	0.02	86.17	0.00	*
S-B DO	L	2	0.10	18	0.17	1.53	0.38	NS
	S(L)	18	0.10	84	0.09	1.97	0.43	*
Surface pH	L	2	10.4	18	1.17	7.51	0.01	*
	S(L)	18	1.28	84	0.23	5.15	0.00	*
Bottom pH	L	2	6.85	18	1.46	1.70	0.26	NS
	S(L)	18	4.70	84	6.09	8.77	0.00	*
S-B pH	L	2	22.53	18	5.51	3.67	0.01	NS
	S(L)	18	4.09	84	4.33	5.66	0.00	*
Surface Turbidity	L	2	1374.63	18	2.22	6.83	0.14	*
	S(L)	18	620.49	84	59.72	21.02	0.00	*
Bottom Turbidity	L	2	1744.12	18	2.26	2.26	.1333	NS
	S(L)	18	772.33	84	63.58	63.58	.0000	*
B-S Turbidity	L	2	44.58	18	3.92	6.83	0.04	*
	S(L)	18	11.37	84	18.15	21.02	0.00	*
Secchi disc	L	2	10.66	18	0.06	100.67	0.00	*
	S(L)	18	0.18	84	0.00	56.78	0.00	*

\* Note: These analyses done with untransformed data despite being heterogeneous because appropriate transforms could not be found to stabilize the variances.

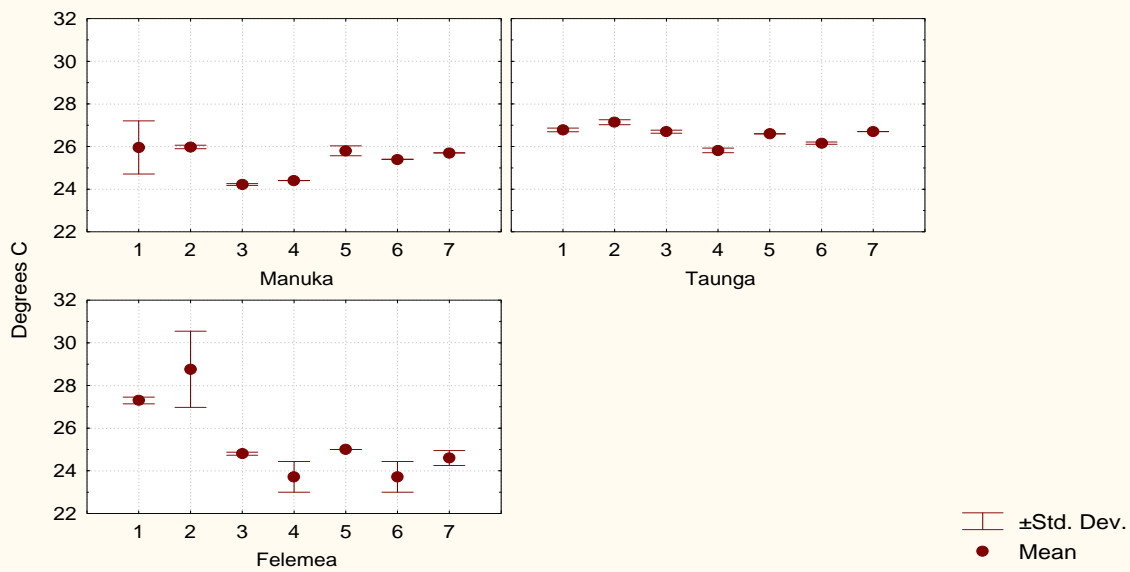
**22.2: Graphs of mean +/-SE values of selected water quality indicators in coastal environments around each target community.**



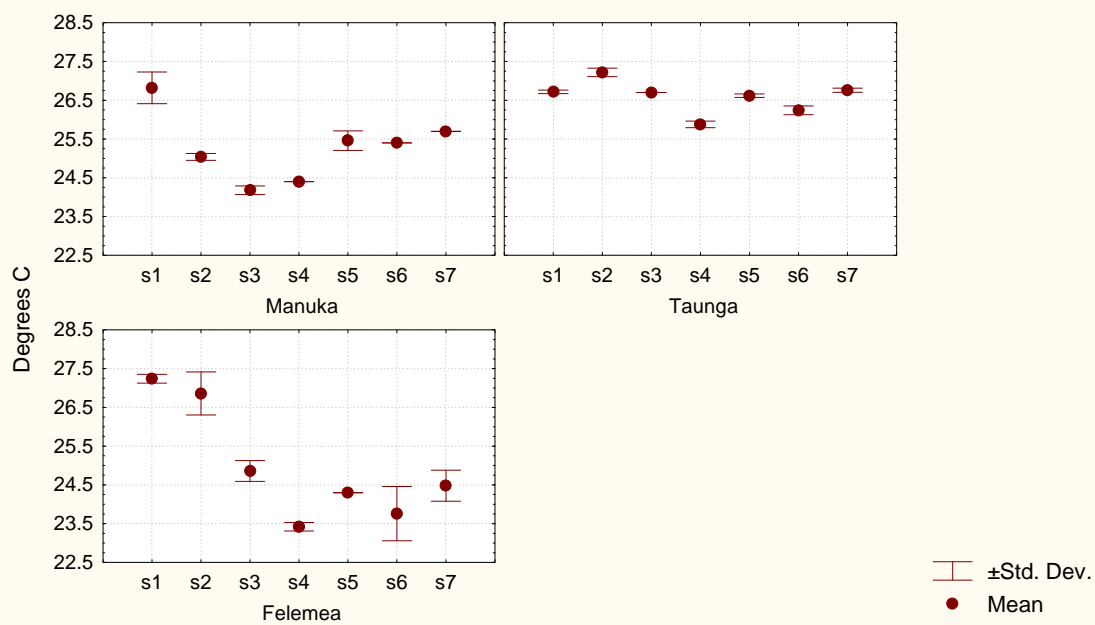
### D-S SALINITY



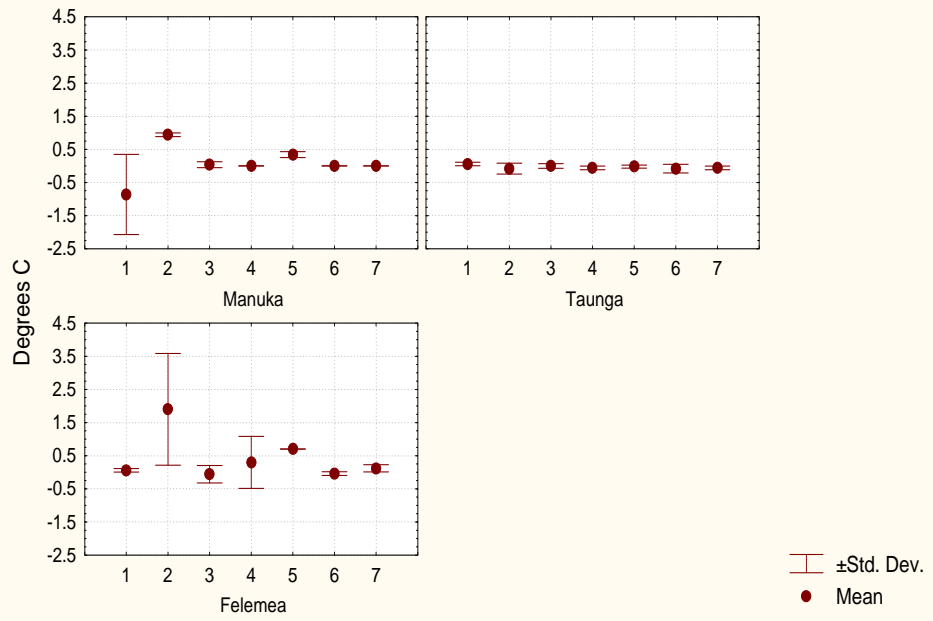
### S-TEMP



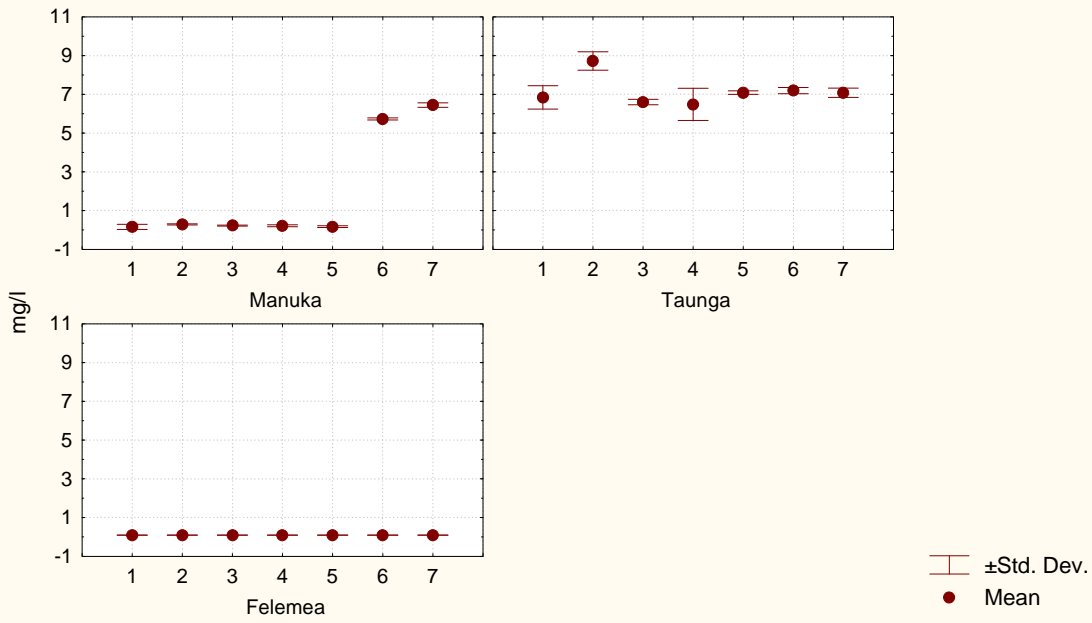
### B-TEMP



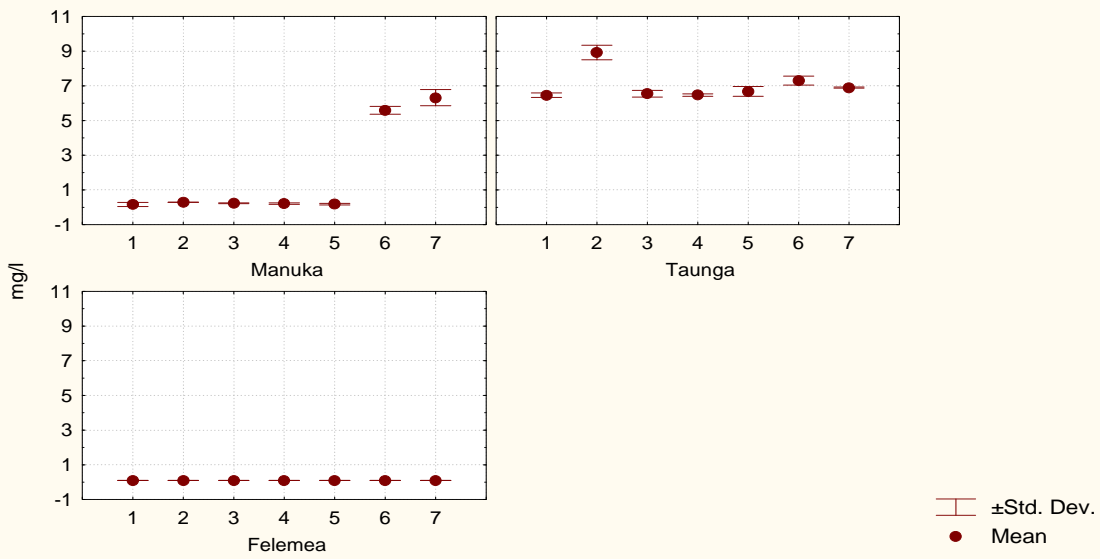
### D-TEMP



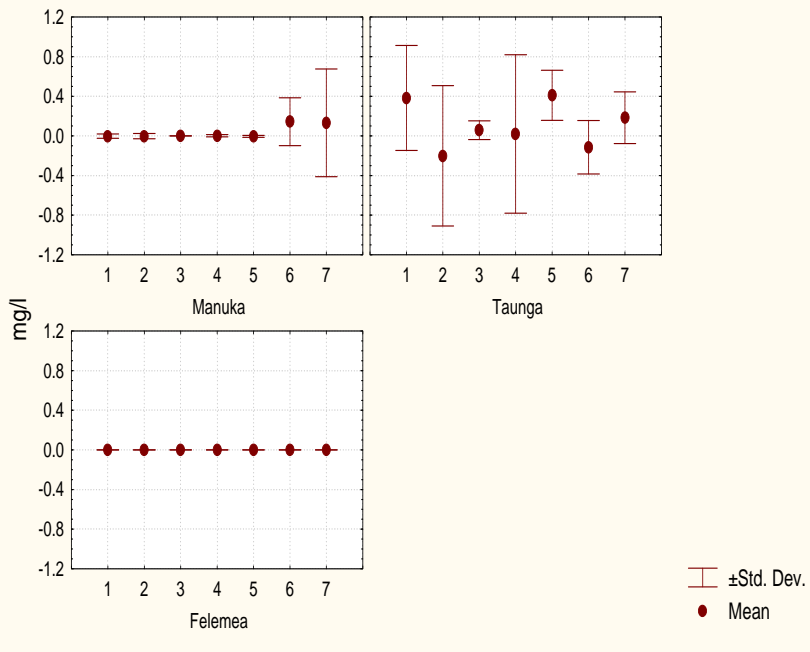
### S-DO



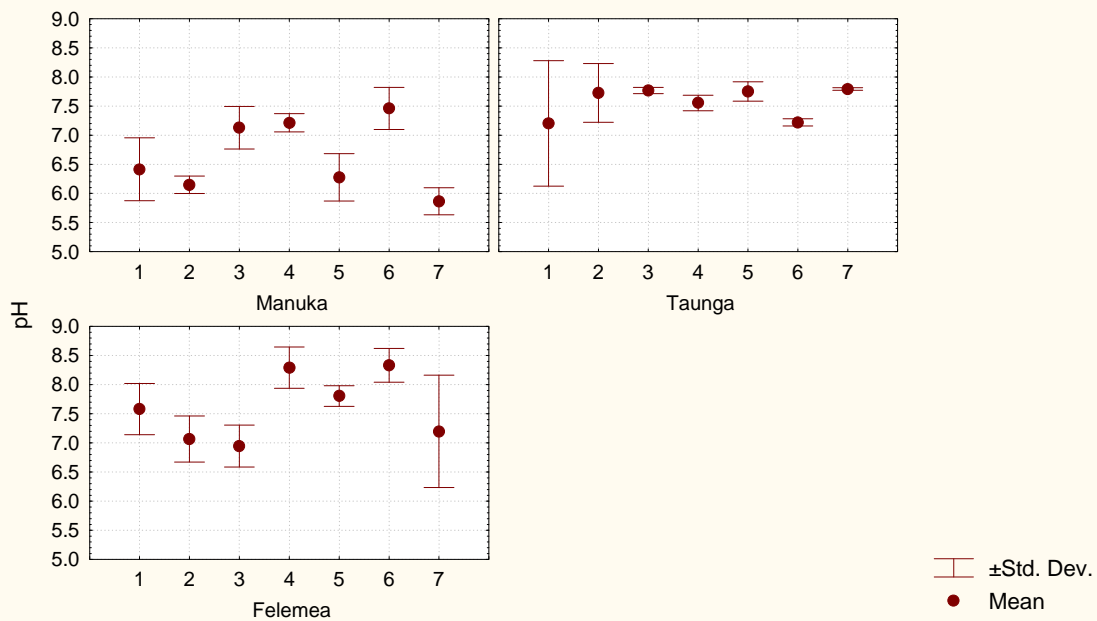
### B-DO



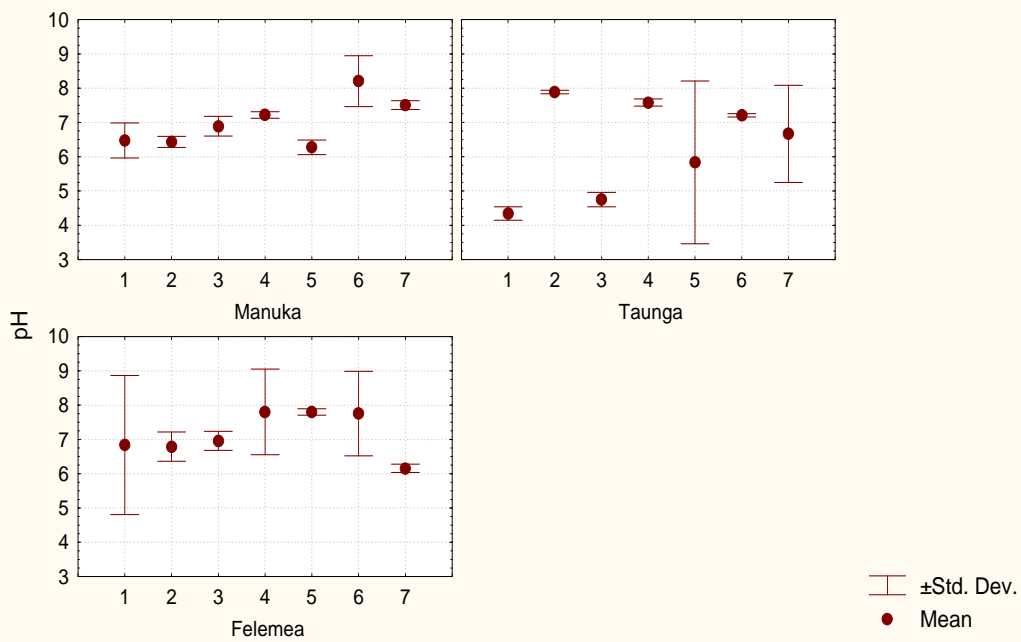
### D-DO



### S-pH

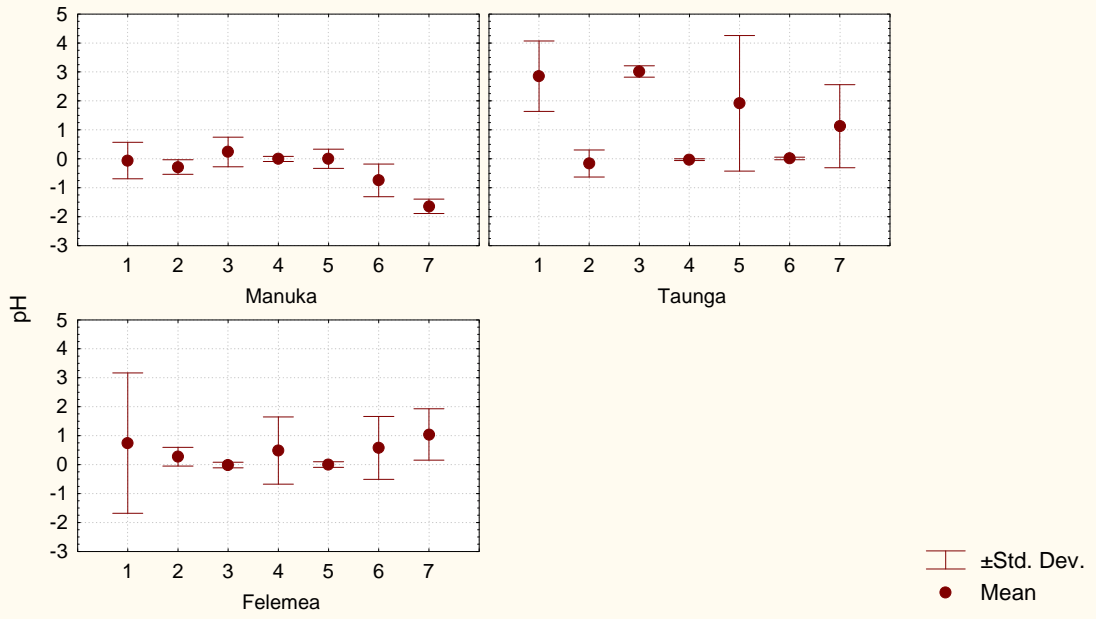


### B-pH

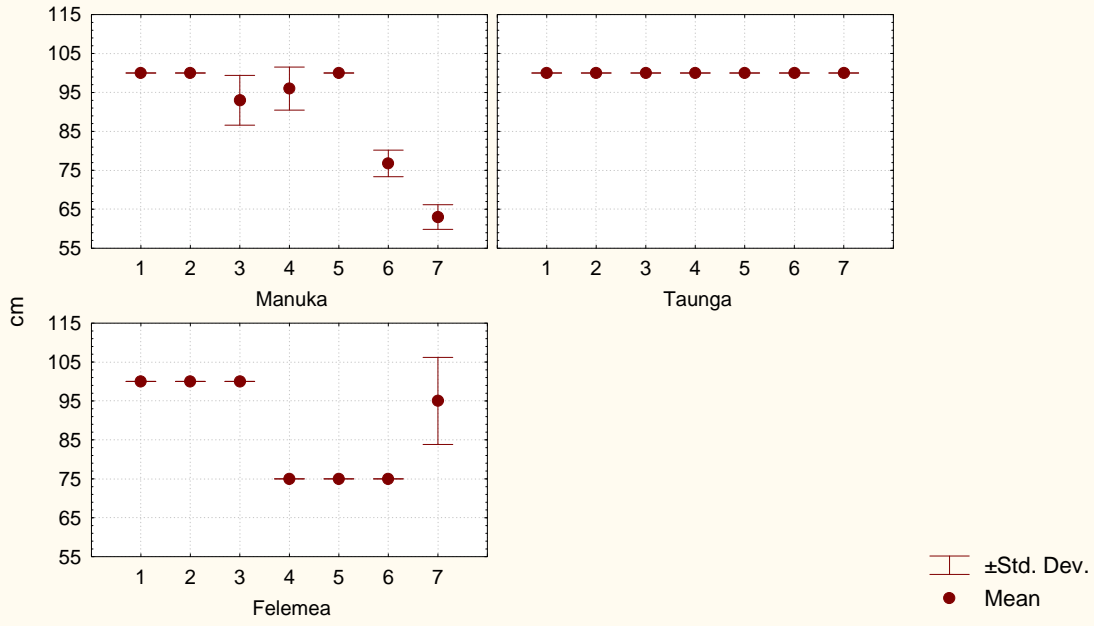




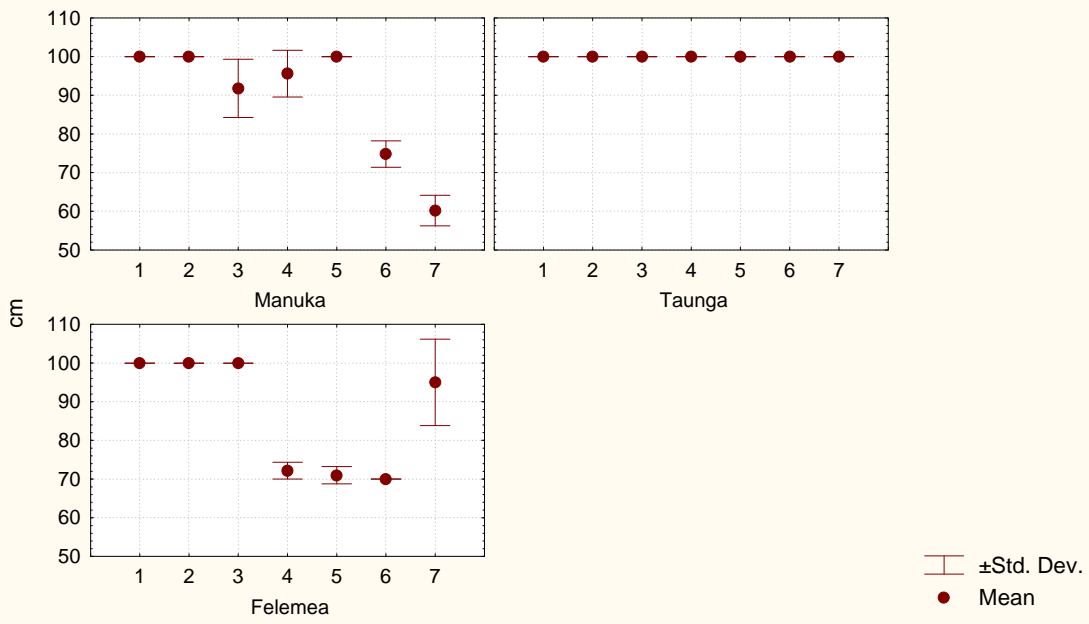
### D-pH

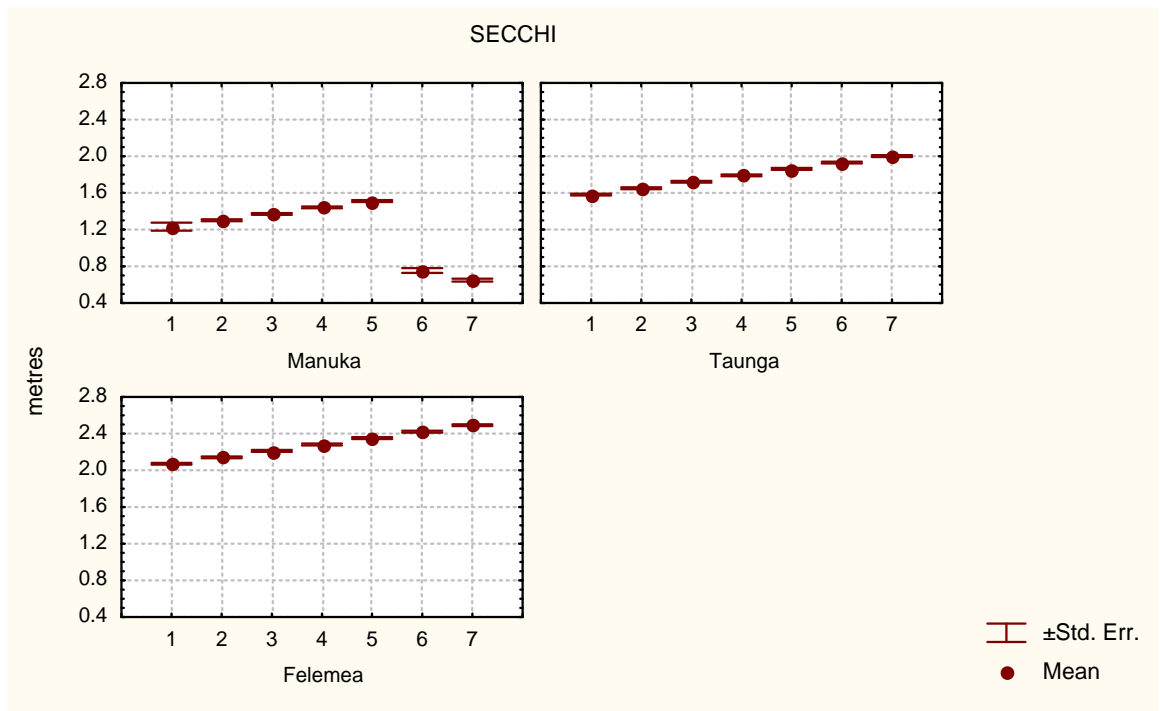
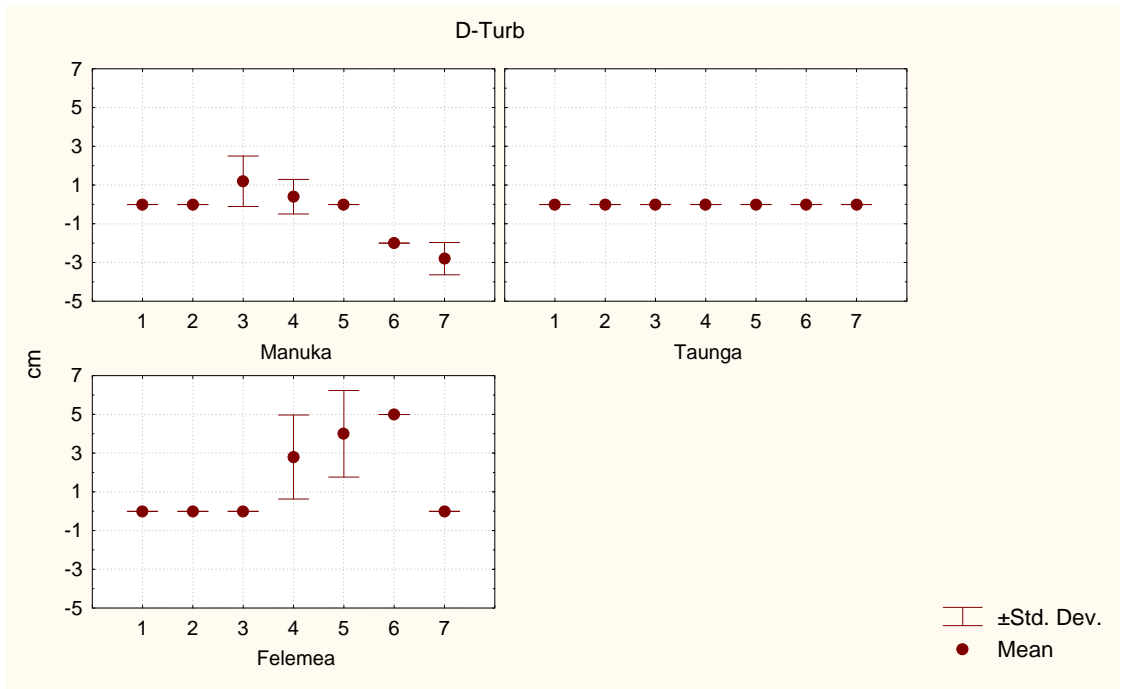


### S-Turb



### B-TURB





## Appendix 23: Corals and Algae

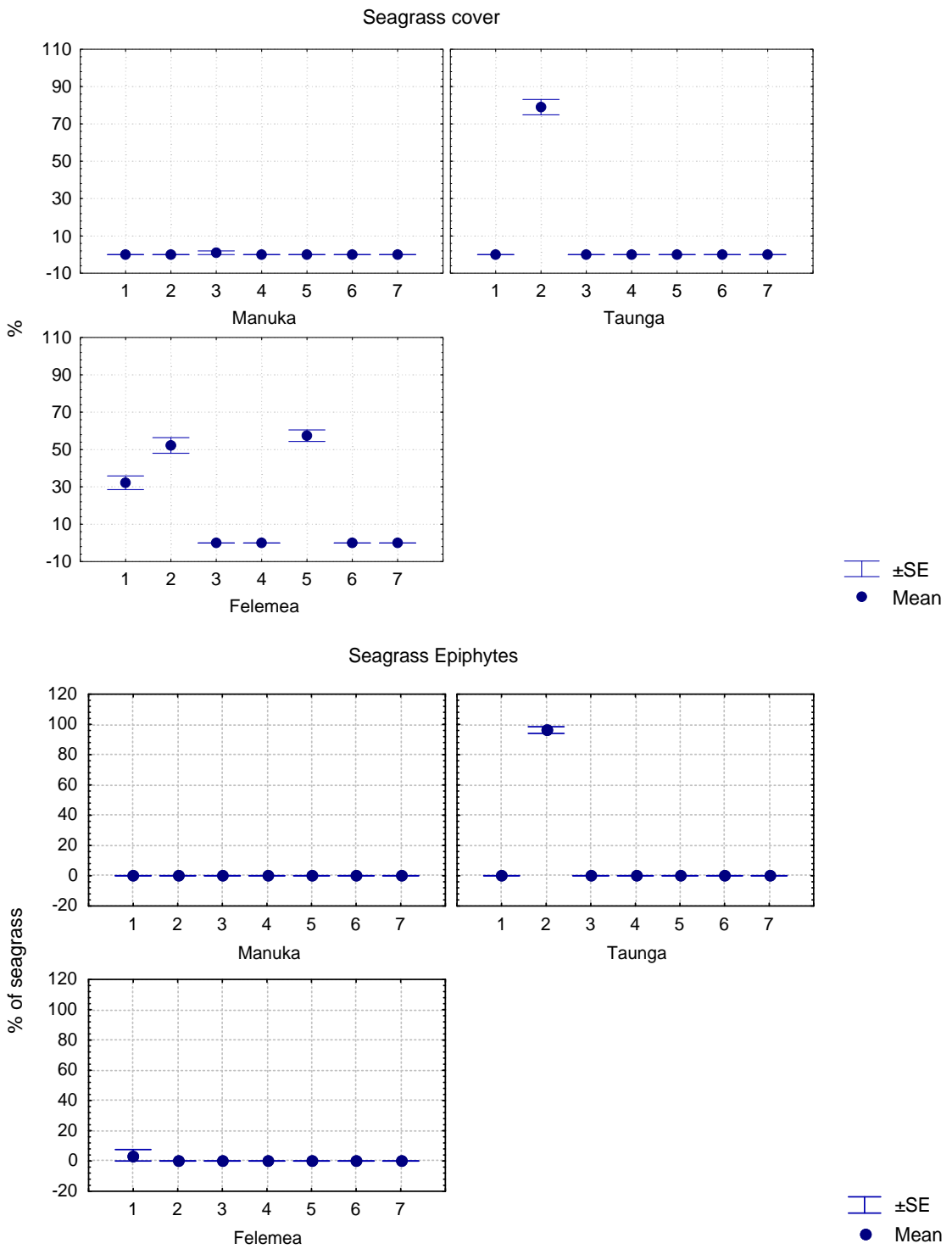
### 23.1: Multivariate analysis of variance for benthic seagrass, coral and algal communities.

	Wilk's Lambda	Rao's R	df 1	df 2	P-level	Significance
L	0.188	2.24	14	24	0.04	*
S(L)	~0.00	20.00	126	522	0	*

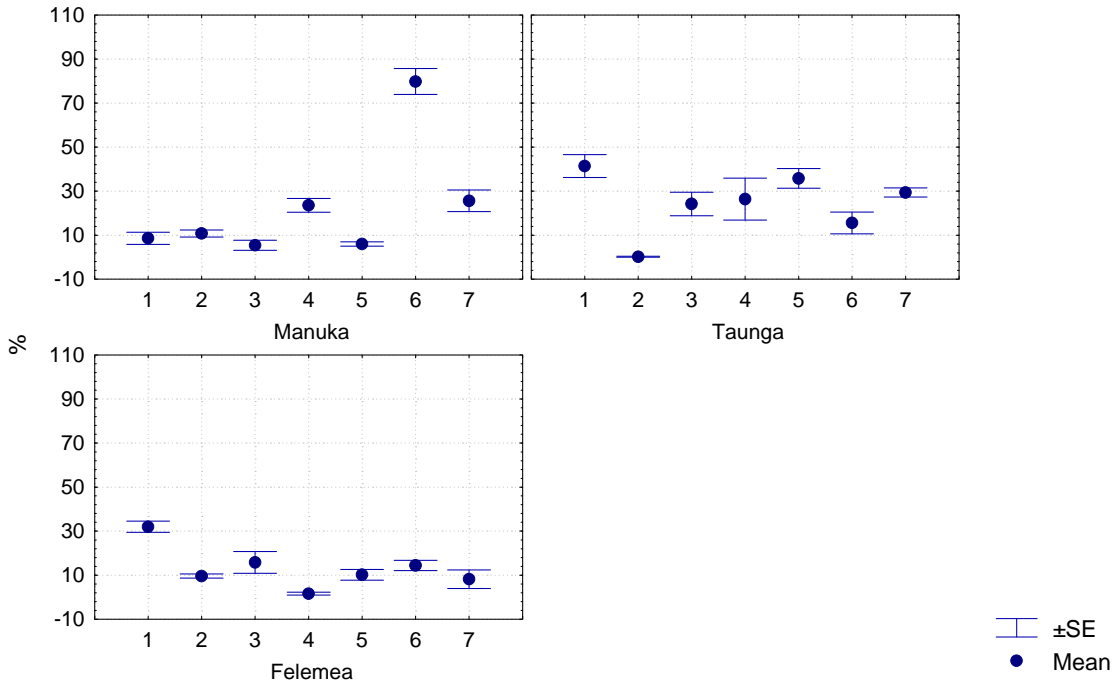
### 23.2: Univariate analyses of variance for selected coral and algal indicators.

		Df Effect	MS Effect	Df Error	MS Error	F	P-level	Significance
Seagrass	L	2	3553.87	18	2648.41	1.34	0.29	NS
	S(L)	18	2648.41	84	13.99	189.37	0.00	*
Seagrass epiphytes	L	2	2123.69	18	2210.42	0.96	0.40	NS
	S(L)	18	2210.42	84	4.55	485.85	0.00	*
Soft corals	L	2	1.83	18	7.77	0.24	0.79	NS
	S(L)	18	7.77	84	1.99	3.90	0.00	*
Algae	L	2	1356.15	18	1622.67	0.84	0.45	NS
	S(L)	18	1622.67	84	81.45	19.92	0.00	*
Diversity Algae	L	2	9.04	18	4.90	1.85	0.19	NS
	S(L)	18	4.90	84	0.63	7.73	0.00	*
Hard Corals	L	2	102.03	18	257.85	0.40	0.68	NS
	S(L)	18	257.85	84	15.73	16.39	0.00	*
Diversity Hard Corals	L	2	9.72	18	36.53	0.27	0.77	NS
	S(L)	18	36.53	84	2.09	17.51	0.00	*

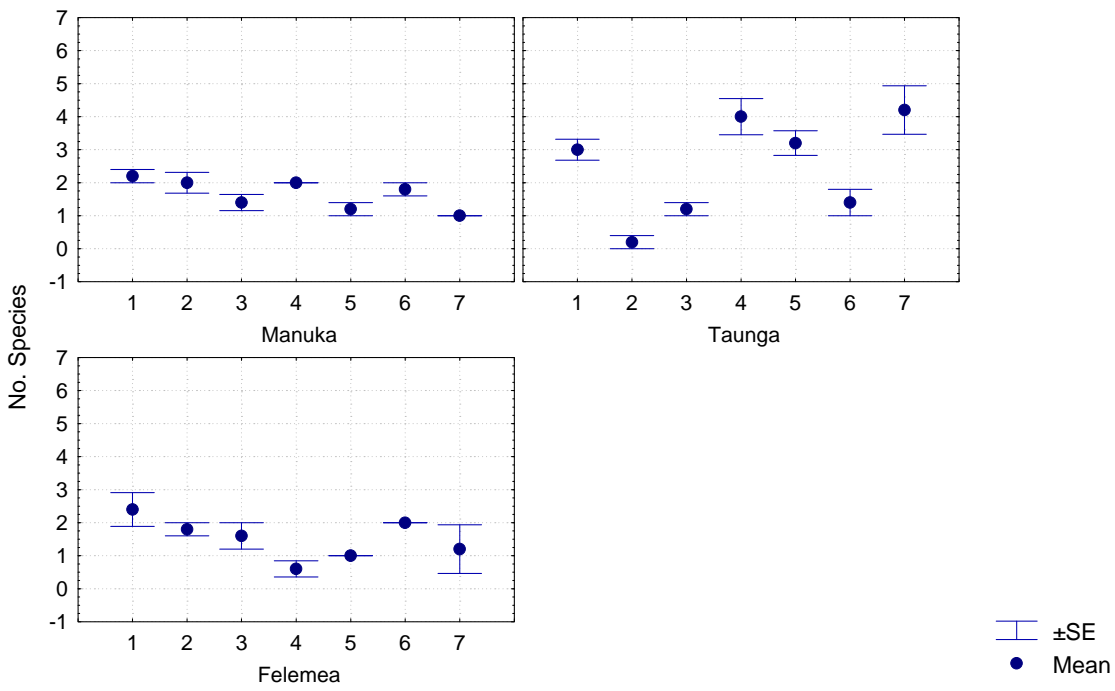
**23.3: Graphs of mean  $\pm$ SE values of selected coral and algal indicators in coastal environments around each target community.**



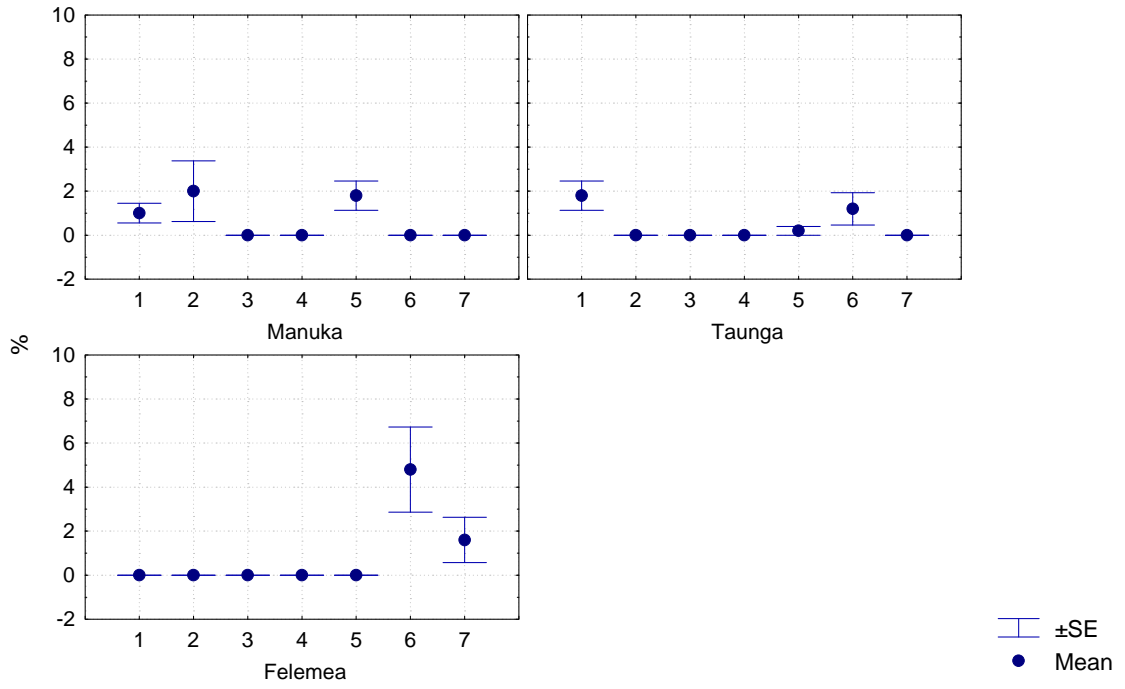
### Algae



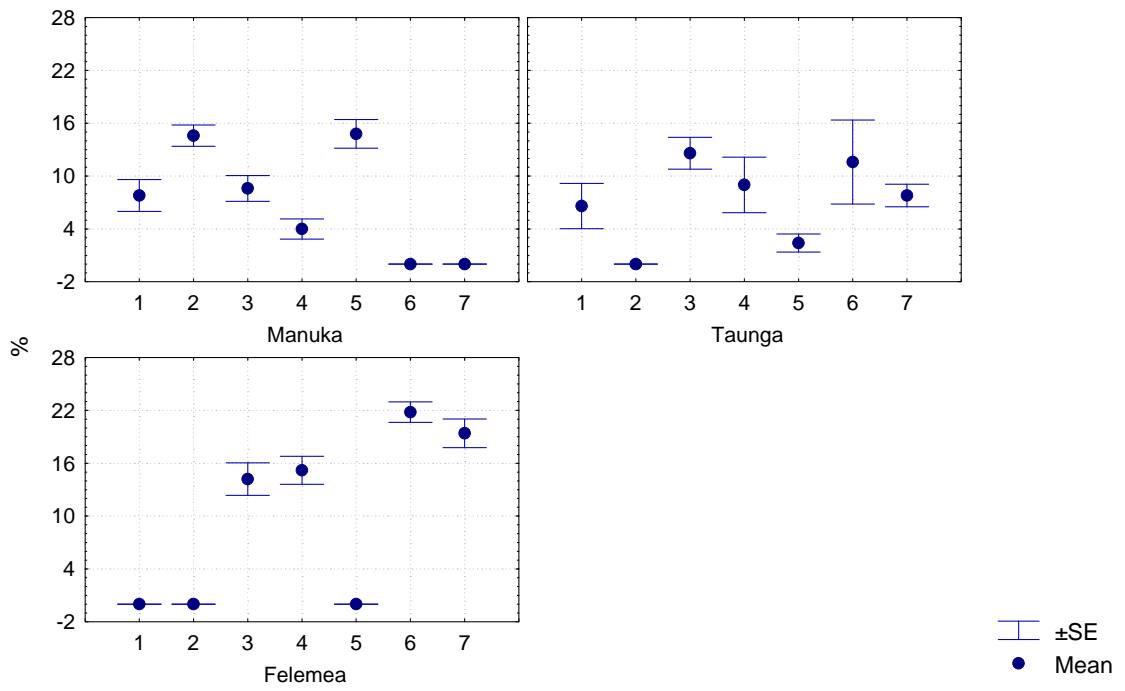
### Algal Diversity



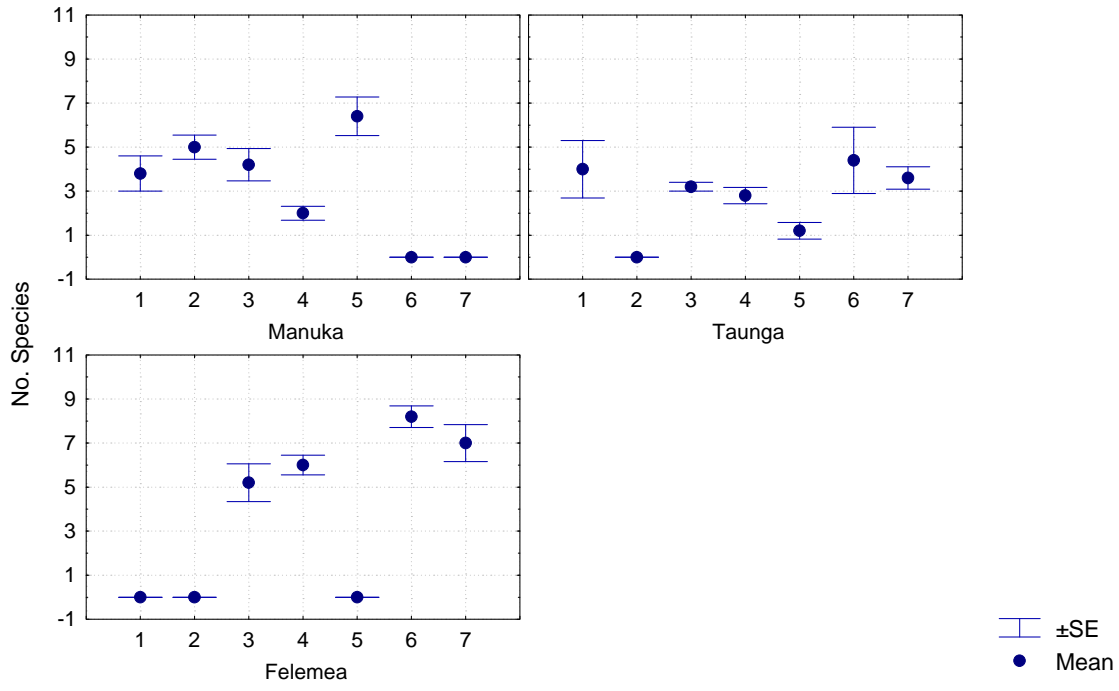
### Soft Corals



### Total Hard Corals



### Diversity of Corals





**Appendix 24: Priority Environmental Problems and Issues Identified in this Study**

<b>Land Resources Problems</b>	<b>Coastal and Marine Resources</b>	<b>Socio-Economic and Other Problems</b>	<b>Institutional Problems</b>	<b>Legislative/Policy Problems</b>
underground water pollution	sea level rise extreme climatic conditions, inundation, flooding, droughts, storm surges (land problems as well)	environmental projects are donor driven rather than based on community priorities (institutional as well)	lack of proper planning for land resources economic development	outdated legislation
increased soil degradation	coastal and wetlands allocation and reclamation	lack of community awareness and conservation skills	lack of appropriate sustainable development policies	lack of enforcement of existing legislation
increased use of fertiliser and pesticide and lack of proper management	limestone quarrying and sand mining (land problems as well)	lack of appropriate awareness and education programmes	available information are not used or reached decision makers	lack of appropriate legislation for overall sustainable development goals
increased pests, weeds and plant diseases;	coastal pollution from land based activities	lack of community participation in policy and decision making process there communities to not commit to sustainable development	lack of implementations of marine reserves and plans	lack of enforcement
loss of native forest and general deforestation;	lack of marine protected area	weak link between economic growth and management of resources	lack of regular monitoring	lack of updating (amending) of old legislations
problems of increasing solid waste	coastal deforestation	over reliance on government (spoon fed attitude)	where is available, it does not reach decision makers or used by decision makers	lack of public input and effective participation required by the legislation (institutional, socio economic as well)
loss of habitat, biodiversity and wildlife;	loss of marine biodiversity	perceptions of resources that it would eventually recover no matter how it is used	lack of coordination and government agencies and the communities	legislation are not based on Tonga's situation rather often based on other first world
land allocation (as prescribed by the land tenure)	destructive fishing techniques	lack of alternative sources of income	lack of public input and effective participation	lack of appropriate policies policy process is not clear
land shortages	over fishing	misconception of development	people are not familiar with the legislation	lack of EIA requirement
data on soil erosion or effect of commercial agriculture is limited	sewage pollution (land resources problems as well)	population growth and migration to urban centres	overlapping and unclear management powers and responsibilities	legislation are too lax and fines are too small
land of land use planning	lost of fisheries habitat	perception that communities are not part of environmental management	lack of government commitment in terms of financial allocation to environmental management	
free roaming domestic animals (pigs and others)	Increased siltation	attitude that environmental problems belongs to the government	lack of appropriate national indicators for sustainable development	