

The Kingdom of Tonga

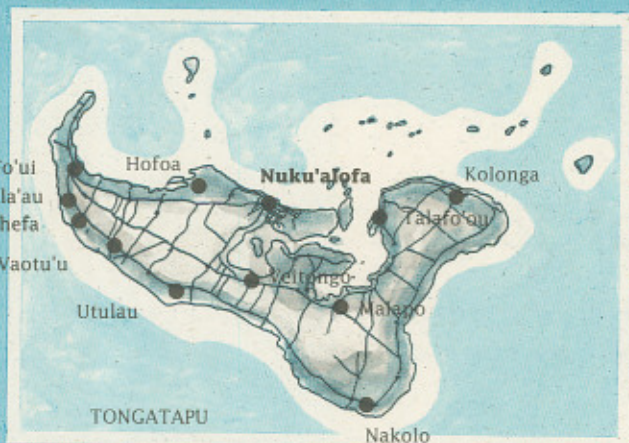
*action strategy
for managing the environment*

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for the Government of the Kingdom of Tonga

IUCN
The World Conservation Union



The Kingdom of Tonga



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Foreword

The Government of the Kingdom of Tonga recognises the importance of the environment to the health, welfare and economic development of the Kingdom. This recognition led to the preparation of an Environmental Management Plan for the Kingdom over the period 1989-1990, with the financial assistance of the Economic and Social Commission for Asia and the Pacific (ESCAP).

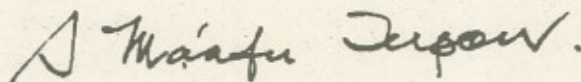
The continual review and revision of the Environmental Management Plan, to ensure relevance to current issues, has culminated in this Action Strategy for Managing the Environment of the Kingdom of Tonga. This Action Strategy outlines the key environmental issues in the Kingdom and identifies strategies to address them. This Strategy is an important first step forward to ensuring sustainable economic development and environmental management in Tonga.

The Government will try to ensure the implementation of strategies outlined in the Action Strategy, particularly in the priority areas identified, such as environmental awareness and education, disposal of solid

wastes and sewage, strengthening environmental administration, and protecting the Kingdom's biodiversity.

We are grateful for the financial and technical support provided by the Asian Development Bank (ADB) and the World Conservation Union (IUCN) and for the collaborative assistance of the South Pacific Regional Environment Programme (SPREP) in co-ordinating the project. The Government of the Kingdom of Tonga welcomes the opportunity of working alongside ADB, IUCN and SPREP in the implementation of the Action Strategy.

I would urge ADB, IUCN, and SPREP as well as other bilateral and multilateral donors to come forward to participate in and support the implementation of this Action Strategy, to ensure that both economic growth and environmental quality are maintained for this and future generations.



Dr S. Ma'afu Tupou
Minister for Lands, Survey and Natural Resources
The Kingdom of Tonga

Contents

Map of the Kingdom of Tonga iv

Foreword v

Message from the ADB xi

Message from SPREP xii

Acronyms xiii



1 Introduction 1

2 The Setting 3

2.1 Natural resource endowment 4

2.1.1 Land 4

2.1.2 Agriculture 5

2.1.3 Forest resources 6

2.1.4 Marine resources 6

2.1.5 Water resources 7

2.1.6 Mineral resources 7

2.1.7 Energy resources 7

2.2 The people 8

2.2.1 Population distribution & growth 8

2.2.2 Education 9

2.2.3 Employment 10

2.3 Economic Growth 10

2.3.1 Sectoral growth patterns 11

2.3.2 Household expenditure & income 14

2.3.3 Investment & consumption 14

2.3.4 Balance of payments 14

2.3.5 Revenue & recurrent expenditure 16

2.3.6 External debt 16

2.3.7 Development assistance 17

3 Environmental constraints & issues 18

3.1 Environmental legislation 18

3.2 Environmental training & education 19

3.3 Environmental management planning 19

3.4 Environmental Impact Assessment 20



- 3.5 Environmental protection 21
- 3.6 Resource management 22
 - 3.6.1 Marine 22
 - 3.6.2 Agriculture 22
 - 3.6.3 National Park & Reserve development 23
 - 3.6.4 Coastal swamp & mangrove areas 23
 - 3.6.5 Drinking water 24
 - 3.6.6 Local construction materials 24

4 Action strategies 25



- 4.1 Strategy 1: Improve environmental awareness & education 26
 - *4.1.1 National environmental awareness outreach programme 26
 - *4.1.2 Surveys of environmental attitudes & resource-use practices 27
- 4.2 Strategy 2: Improve disposal of solid wastes & sewage 28
 - *4.2.1 National recycling programme 29
 - *4.2.2 Waste disposal management programme 29
 - *4.2.3 Urban biological sewage treatment pilot trial for low-lying areas 30
- 4.3 Strategy 3: Strengthen the national capability for environmental management 31
 - *4.3.1 Enact comprehensive natural resource legislation 32
 - *4.3.2 Strengthen the institutional capability of the Environmental Planning Section 33
 - *4.3.3 Raise the level of environmental skills of professional, resource-based staff of the Civil Service 33
- 4.4 Strategy 4: Assess implications of climate change & sea-level rise 34
 - *4.4.1 Environmental study of climate-sensitive ecosystems 34
- 4.5 Strategy 5: Counter the misuse of hazardous chemicals 35
 - *4.5.1 Pesticide control measures 36
 - *4.5.2 Monitoring for hazardous agrochemical residues 36
 - *4.5.3 Chemical waste workshop 37
- 4.6 Strategy 6: Foster the use of renewable energy sources 38
 - *4.6.1 Promote photovoltaic technology 38
 - 4.6.2 Promote the replanting of fuel-wood trees 38
- 4.7 Strategy 7: Improve & update basic data on natural resources 39
 - *4.7.1 Develop a national resource information system (TONGRIS) 40
 - *4.7.2 Natural resources & ecosystems survey 40
 - *4.7.3 Strengthen the knowledge of insect pests & beneficial insects of the Kingdom 40

- 4.8 Strategy 8: Protect the Kingdom's biological diversity 41
 - *4.8.1 *Strengthen wildlife management capability in the Kingdom* 42
 - 4.8.2 *Replanting of traditional, medicinal & culturally important plants* 42
 - *4.8.3 *Management planning for protection of 'Eua National Park* 42
 - *4.8.4 *Preservation of key natural & cultural sites in Vava'u* 43
 - *4.8.5 *Royal Memorial Botanic Gardens* 43
 - *4.8.6 *Pilot programme for the control of rats & feral cats on selected outer islands* 43
- 4.9 Strategy 9: Foster sustainable use of marine resources & the coastal zone 44
 - *4.9.1 *Develop coastal zone management plans for the Kingdom of Tonga* 44
 - *4.9.2 *Tropical marine ecology training* 45
 - *4.9.3 *Renew the search for alternative sources of sand for construction purposes* 45
- 4.10 Strategy 10: Ensure sustainable use of the land resource 46
 - *4.10.1 *Prepare comprehensive land-use plans for the Kingdom of Tonga* 47
 - *4.10.2 *Develop & promote sustainable agricultural development & practices* 47
 - *4.10.3 *Strengthen land management for rural development & agriculture* 47
- 4.11 Strategy 11: Improve the supply of drinking water 48
 - *4.11.1 *Roof water catchment & rain-water storage programme* 49
 - *4.11.2 *Public education on conservation of water* 49



5 Principles for implementation 50

- 5.1 Ownership 50
- 5.2 Cross-sectoral involvement 50
- 5.3 A focus on regional participation 51
- 5.4 Environmental Impact Assessment 51
- 5.5 The role of the Environmental Planning Section 52
- 5.6 Packaging & prioritisation of programmes 52
- 5.7 Review 52

References 53

Appendix I

Detailed programme profiles outlined in the Action Strategy 56

Contents list of programmes profiles 56

Tables

- 2.1 Population by Divisions & growth rates for the 1976 & 1986 censuses 8
- 2.2 Internal migration, 1976-1986 9
- 2.3 Estimated real GDP growth by sector for the period 1975-1990 11
- 2.4 Contribution to GDP at factor cost for the period 1975-1990 12
- 2.5 Growth of investment, consumption & related variables over the DP V period (1985-1990) 13
- 2.6 Total imports growth, 1985/86-1989/90 14
- 2.7 Exports of major commodities, 1985/86-1989/90 15
- 2.8 External debt & debt service, 1982-1989 16
- 3.1 Protected areas in the Kingdom of Tonga 21

Notes

Numbering system

The legal numbering system has been used in this report, that is:

(Level 1) 2;

(Level 2) 2.1;

(Level 3) 2.1.1; and

(Levels 4) without number.

In Chapter 4, Level 2 indicates the Strategy, and Level 3, the Programmes.

*** Programme profiles**

In Chapter 4, Action strategies, a number of Level 3 (Programmes) headings in the Table of Contents are marked with an asterisk (*). This

indicates that programme profile has been prepared for that programme to a general format, required by the Asian Development Bank and other donor agencies for project identification, for consideration for funding action. The purpose of the programme profiles is to assist the early implementation process. The programme profiles are contained in the Appendix.

For those programmes *not* marked with an asterisk, special funding is not considered to be required. Mostly, such programmes call for some form of administrative action.

Message from the ADB

The Asian Development Bank is pleased to associate in assisting one of the Pacific region's most ambitious undertakings — the preparation of National Environmental Management Strategies (NEMS) in a number of Pacific countries. This assistance has been provided through a Regional Technical Assistance grant to the South Pacific Regional Environment Programme (SPREP). The World Conservation Union (IUCN) has also collaborated in providing technical advisory services.

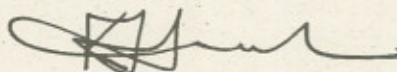
Our involvement reflects two factors. Firstly, our confidence in SPREP as the prime sub-regional environmental organisation in the South Pacific region. The Bank has been pleased by the way in which SPREP has co-operated closely with member governments in addressing environmental issues in island countries and by the calibre of SPREP's staff work as well as the work of the national task forces which guided the country level activities.

The second factor is a commitment by the Bank to sustainable development. We are acutely aware of the vital importance of economic development for the Pacific Island countries and are equally concerned for the limited natural resources and often fragile nature of the environment of these countries. It is thus critical

that development continues, but in a manner which is truly sustainable ecologically. Only by following such a course of action can the quality of life currently enjoyed by Pacific people be assured for future generations.

The need for sustainable use of natural resources has been the underlying theme of the NEMS documents. The preparation of NEMS has been a challenging task and has involved a wide range of government and non-government organisations in each country. The nature of the issues and the complexity of the challenges faced have been great. As ever, Pacific countries have risen to the challenge and I believe the commitment shown in the development of the Strategies is a true reflection of the intimate bond which Pacific Island peoples have with their environment. Nonetheless, this "commitment" and "challenge" has now to be put to visible action programmes.

The Asian Development Bank welcomes the publication of the Action Strategy for Managing the Environment for the Kingdom of Tonga. It is an important event for environmental management in the Kingdom of Tonga and the Bank will be pleased to consider ways and means of assisting with its implementation.



Dr Kazi F. Jalal
Chief, Office of the Environment
Asian Development Bank

Message from SPREP

We Pacific Islanders share a common aspiration for economic development and improved living standards for our people. However, we are aware that this development cannot be at the cost of the environment. We have lived in close harmony with our island environment for thousands of years and we are well aware of its importance to our way of life. We face the complex challenge, in common with many other countries of the world, of achieving economic development in a way which will not significantly affect our environment. This major challenge must be addressed if our Pacific way of life is to survive.

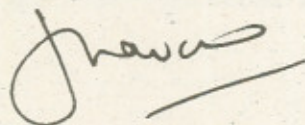
The development of National Environmental Management Strategies (NEMS), of which this Action Strategy is a part, has been a major tool in addressing these issues. This development was made possible through the generous financial and technical assistance of the Asian Development Bank and the World Conservation Union (IUCN). This assistance is gratefully acknowledged.

This Action Strategy for Managing the Environment is a practical document which aims to identify the major

environmental issues in the Kingdom of Tonga and the priority environmental programmes which are required to address them. The strategies and programmes in this Action Strategy were prepared by SPREP in consultation with the Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources. They are based on views expressed by government and non-government agencies at the major national symposium on the Environmental Management Plan held in Nuku'alofa in 1990.

The NEMS process has proved most useful in raising awareness of environmental issues. In the wake of the United Nations Conference on Environment and Development (UNCED) this Action Strategy also provides the foundation for implementing much of Agenda 21 in the Kingdom of Tonga. However, the success of the NEMS exercise will ultimately be judged by its implementation. If the Action Strategy report sits on a shelf and gathers dust, then the exercise has failed.

SPREP looks forward to working with the Kingdom of Tonga and with other regional and international organisations in the implementation of the Action Strategy.



Vili A. Fuavao
Director
South Pacific Regional Environment Programme

Acronyms

ACEL	Australian Centre for Environmental Law	GDP	gross domestic product
ADB	Asian Development Bank	GEMS	Global Environmental Monitoring System, UNEP
AIDAB	Australian International Development Assistance Bureau	GIS	geographic information system
CPI	consumer price index	GNP	gross national product
DP	National Development Plan of the Kingdom of Tonga	GOT	Government of the Kingdom of Tonga
DP III	(Third) National Development Plan, 1975/76-1979/80	GRID	Global Resource Information Database, UNEP/GEMS
DP IV	(Fourth) National Development Plan, 1980/81-1984/85	GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
DP V	(Fifth) National Development Plan, 1985/86-1989/90	ICZM	Integrated Coastal Zone Management Programme
DP VI	(Sixth) National Development Plan, 1990/91-1994/95	IDEC	Interdepartmental Environment Committee, GOT
DSIR	Department of Scientific & Industrial Research	IFAD	International Fund for Agricultural Development
EC	European Community	ILO	International Labour Organisation
ECG	Economic & Commercial Group, GOT	IUCN	The World Conservation Union
EEZ	Exclusive Economic Zone	JICA	Japanese International Co-operation Agency
EIA	Environmental Impact Assessment	MAF	Ministry of Agriculture & Forestry, GOT
EIS	Environmental Impact Statement	MLSNR	Ministry of Lands, Survey & Natural Resources, GOT
EMP	Environmental Management Plan for the Kingdom of Tonga (ESCAP, Bangkok, 1990)	MOF	Ministry of Fisheries, GOT
EPS	Environmental Planning Section, MLSNR	NGO	non-governmental organisation
ESCAP	Economic and Social Commission for Asia and the Pacific	NZODA	New Zealand Overseas Development Administration
FAO	Food and Agriculture Organisation of the United Nations	RETA	Regional Environmental Technical Assistance Project, RETA 5403, ADB
FFA	Forum Fisheries Agency, South Pacific Forum	SOPAC	South Pacific Applied Geoscience Commission
FPSI	The Foundation for the Peoples of the South Pacific International	SPBCP	South Pacific Biodiversity Conservation Programme
FY	financial year	SPC	South Pacific Commission, Noumea, New Caledonia

SPREP	South Pacific Regional Environment Programme, Apia, Western Samoa
TCSP	Tourism Council of the South Pacific
TONGRIS	Tonga Resource Information System
UNCED	United Nations Conference on Environment and Development, Rio de Janeiro, June 1992
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US	United States of America
USP	University of the South Pacific
WWF	World Wide Fund for Nature

Notes

Except where otherwise indicated, all currency amounts are in pa'anga (\$T). While the value of the pa'anga is set from a basket of currencies, its exchange rate is on a par with the Australian dollar.

A financial year spans the period 1 July to 30 June. FY 1994 refers to the period 1993-1994.

Introduction



The origin of this Action Strategy lies in the RETA (Regional Environmental Technical Assistance Project), No. 5403, funded by the Office of the Environment of the Asian Development Bank and executed by the South Pacific Regional Environment Programme. The Kingdom of Tonga was one of five countries which agreed to participate in a regional programme directed at strengthening the environmental management capabilities of Pacific Island member countries of the Asian Development Bank. A key element of the programme was the preparation of National Environmental Management Strategies (NEMS) for the participating countries; another (for all member countries) was training in Environmental Impact Assessment (EIA) procedures. In Tonga's case, the National Environmental Management Strategy was not prepared, as a detailed Environmental Management Plan (EMP) had already been prepared for the Kingdom over 1989-1990 with the assistance of ESCAP (ESCAP 1990), and had been the subject of a major national symposium held in Nuku'alofa on 27-29 August 1990.

The EMP contained many programme proposals. The Interdepartmental Environment Committee (IDEC), set up by the government at ESCAP's request for the preparation of the EMP, decided that RETA might best contribute to the protection of Tonga's environment by assisting with securing funds for the implementation of eleven programmes then considered of highest priority by IDEC. These programmes were approved by His Majesty's Cabinet.

However, with the passage of time and inevitable changes in emphases or circumstances that had occurred for some EMP programme proposals, the Chairman of the IDEC, Sione Latu'ila Tongilava, saw that Tonga would benefit from the preparation of an Action Strategy which would take a fresh look at strategies and programmes for protection of the Tongan environment and advancement of the principle of sustainable development.

The preparation of this Action Strategy was then undertaken by SPREP in November 1992. However, it should be recognised here that the limited time available for this exercise precluded any substantive public consultations on the strategies and programmes drafted. The views are those of the Environmental Planning Section (EPS) and the SPREP Resource Team; however, the drafting team was very conscious of views expressed at the 1990 EMP Symposium by the wide range of government and non-government agencies represented there.

The first half of the Action Strategy is presented in five chapters. Chapter 2 presents a brief overview of the natural resource endowment of the Kingdom. This is primarily derived from the EMP (ESCAP 1990), from the Environment Sector Strategies (Thistlethwaite 1990), and particularly from the Kingdom's National Report to UNCED (GOT 1991b). Much of the recent economic information was taken from the Sixth National Development Plan (DP VI), 1991-1995 (GOT 1991a). Where more detail is sought, the reader is referred to those publications. Chapter 3 discusses some of the environmental constraints and issues of concern to His Majesty's Government.

Individual strategies are presented in Chapter 4. There are eleven of these, with each addressed by one or more programmes towards strategy implementation. These strategies are:

Strategy 1

Improve environmental awareness and education

Strategy 2

Improve disposal of solid wastes and sewage

Strategy 3

Strengthen the national capability for environmental management

Strategy 4

Assess implications of climate change and sea-level rise

Strategy 5

Counter the misuse of hazardous chemicals

Strategy 6

Foster the use of renewable energy sources

Strategy 7

Improve and update basic data on natural resources

Strategy 8

Protect the Kingdom's biological diversity

Strategy 9

Foster sustainable use of marine resources and the coastal zone

Strategy 10

Ensure sustainable use of the land resource

Strategy 11

Improve the supply of drinking water

Lastly, in Chapter 5, some basic principles for implementation of the Action Strategy are discussed. A list of useful environmental references for Tonga is attached.

The second half of the Action Strategy (the Appendix) presents more detailed information on those programme profiles for which foreign funding would need to be sought in implementation of the strategies. These profiles are simple, one or two page presentations which give programme aims and scope, a brief description, cost estimates, likely executing agency, potential benefits and issues, and the time frame sought for the programme.

The environmental setting



The Kingdom of Tonga lies between 15° and 23°50' South Latitude and 173° to 177° West Longitude, and has an area of 390,128 sq km. The Kingdom is an archipelago of 172 named islands with an area of 747 sq km, the 36 inhabited islands totalling 670 sq km. Six islands comprise three-quarters of the land area and contain 90 per cent of the Kingdom's population of 94,649 (GOT 1991c).

There are four groups of islands extended over a north-south axis: Tongatapu and 'Eua in the south; Ha'apai in the middle; Vava'u in the north; and the small Niua group in the far north. The capital, Nuku'alofa, is on Tongatapu. Many of these islands are coralline in origin, comparatively flat and often encircled by fringing reefs. Some atolls are raised by tectonic action. There are also some islands of volcanic origin, notably in the west of the Ha'apai Group.

Easily accessible shallow-water reefs and shoals (less than 10 m deep) cover about 550 sq km while an additional 3,045 sq km constitutes sea floor within the 200-metre shelf. Tonga therefore can be considered to have about 1,200 sq km of readily accessible land and marine resources, 3,000 sq km of marine resource more difficult to utilise, and a pelagic and deep-water zone of about 393,000 sq km. This deep-sea zone will increase to an estimated 677,021 sq km (SPC estimate) when the final borders of the 200-mile EEZ are declared.



This coralline island of the Ha'apai Group with its flat terrain, white sand beaches and fringing reef, is typical of many of the islands of the Kingdom. (photo: R.J. Thistlethwaite)

Although the Kingdom lies within the tropics, its climate is moderated by its maritime environment. On Tongatapu, the average annual temperature is 23°C with a maximum of 32°C and a minimum of 11°C. Rainfall averaged 1,775 mm per year over the period 1950–1989. There is a distinct wet season from November to April. The prevailing winds are the south-east trades which blow for about three-quarters of the year. On Vava'u, it is much wetter, with rainfall averaging 2,289 mm per year spread over 146 rain-days. The average temperature there is 25.1°C with a small variation from wet to dry season. High-intensity, short-duration rainfall can occur at any time of the year, but particularly during the cyclone season.

2.1 Natural resource endowment

It is not the intention of this section to repeat the considerable volume of environmental information contained in earlier reports. This section will merely attempt to summarise available information in order to give the reader an adequate technical background to the later presentation of action strategies (Chapter 4). The main sources of information have been the EMP (ESCAP 1990) and the 1991 National Report to UNCED prepared for the Interdepartmental Environment Committee (GOT 1991b) and later endorsed by His Majesty's Cabinet on 29 May 1991.

The reader should consult the References section at the end of this report if additional information is sought, particularly the Environmental Management Plan (ESCAP 1990), and also the Environment Sector Strategies report (Thistlethwaite 1990). However, it should be noted that the database on natural resources of the Kingdom is as yet quite slim, and/or somewhat dated, and thus the information sought simply may not be available.

2.1.1 Land

The Constitution of 1875 legalised the land-use system developed during the 1779–1852 civil war period where families had a small area of land within a defensive fortification ('*api kolo*) where they lived, and a place outside in the bush where they could garden ('*api 'uta*). This pattern of land use continues today. The Act of 1882 established the entitlement of each Tongan male over 16 years of age to both a town '*api* ('*api kolo*) not exceeding 0.4 acre (0.16 ha) and a tax '*api* or garden '*api* not exceeding 8.25 acres (3.3 ha). Title of the allotments is assigned by the Ministry of Lands, Survey and Natural Resources (MLSNR) and then becomes hereditary.

All land in the Kingdom is Crown Land with four tenure categories: three Hereditary Estates of (i) the King, (ii) the Royal Family, and (iii) the Nobles and Matapule; with the fourth category (iv) as Government Land. It is only tenure categories (iii) and (iv) from which the '*api* allotments are drawn. In addition, land from any of the four categories can be leased, with the possibility of a single individual holding up to 10 '*api* for periods up to 20 years (1980 and 1983 Amendments to the Land Act). A person can have only one town and one garden hereditary '*api*. The land may not be sold, but it can be mortgaged as security for a debt.

Tenure is dependent on the fulfilment of a number of conditions. Among these are two of specific environmental import:

- 1) the allotment must be maintained in a "reasonable" state of cultivation; and
- 2) the land may not be "abandoned" for more than two years.

The King, with the consent of Privy Council, has the power to retrieve land from any holder for public purposes, in which case the dispossessed may be

compensated with an offer of replacement land, money, or both. That power has rarely been used.

Most of the allocatable land has been distributed for 'api. Much of the remaining government land consists of lakes, marsh or mangrove swamps, cliffs, small islands with little or no water, and volcanic islands with little access and poor agricultural potential; 6.9 per cent of land is held in the nobles' estates. But some 790 ha on the 'Eua plateau is probably unsuitable for agriculture, although possibly of potential for forest development.

2.1.2 Agriculture

Agriculture has always been the principal sector of the economy and remains the primary source of livelihood for over two-thirds of the population.

Most islands have gentle overland slopes with the exception of some steeper areas on the higher islands, such as 'Eua and Vava'u. The soils are inherently fertile in the main islands, being derived predominantly from an andesitic volcanic ash mantle overlying coralline limestone platforms. These soils have

Young taro. This major food staple is a prominent component in the traditional agriculture system and is now also being grown more intensively for export.



excellent physical properties; they are friable, well structured, well drained, have a moderate water-holding capacity and range from slightly acid to slightly alkaline with high levels of calcium and magnesium, a high cation exchange capacity and high base saturation (Orbell 1983; Orbell et al. 1985; Potter 1986; Wilde & Hewitt 1983). Hence these soils can support a wide variety of crops suited to the climatic conditions.



Father and sons planting cassava in their garden on Vava'u. (photo: Glenn Jowitt)

Traditional Tongan farming is an agroforestry system of bush or grass fallow with cultivated coconut palms or other useful trees creating a multi-level overstory for predominantly root crops (Thaman 1976). Traditional practices, however, are fast being replaced by intensive horticultural production, for example of squash-pumpkin and watermelon requiring greatly increased input of fertilisers and pesticides. The main

agricultural crops today are vanilla, squash (Japanese pumpkin), watermelon, bananas and root crops. Coconuts, once the major crop for copra production and for coconut oil and copra meal, have virtually ceased to be harvested commercially, apart from the local culinary market. The major root crops are yam, taro, sweet potato, cassava, and giant taro.

2.1.3 Forest resources

Only limited areas of indigenous forest remain in the Kingdom, primarily in very steep or otherwise inaccessible areas, in coastal littoral areas and swamps, or in mangrove swamps. The total area of better quality forest was about 4,000 ha, with 3,779 ha estimated on 'Eua (Larsen & Upcott 1982) of which 1,747 ha was considered accessible, and a further 324 ha of potentially exploitable forest on Tofua (a volcanic island in the Ha'apai Group) (Thompson 1976). There is also a small area of better quality forest on the island of Late in Vava'u. Even then, much of the forest is secondary. Except for 'Eua, there is limited information on the botanical composition or timber resources of Tonga's remaining natural forests.

The islands of Tafahi and Kao have undisturbed cloud forest on steep slopes, and other small, indigenous forests of note occur on Niuatoputapu and Late.

Mangrove forests are restricted to sheltered lagoon coastlines and are limited in size and of mediocre quality. Nevertheless they are locally important as sources of food, firewood, handicraft materials, and dyes for tapa cloth. They also play an extremely important biological and environmental role as marine nurseries and for coastal protection.

2.1.4 Marine resources

Coastal areas below the high tide mark are Crown property and the rights to all resources (sand, dead coral, marine life) are vested in the Crown. However, anecdotal evidence points to a long-standing tradition of common use of marine resources, and certainly common use is the practice today.

The reefs and lagoons are the prime fishery for subsistence supplies. 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.

Inshore pelagic zones, which vary in depth from 75 m to more than 600 m and usually not exceeding 30 km from land, are rich in small pelagic species of tuna, dolphin, mackerel and sardines. Offshore pelagic fishing effort is concentrated to the west of the island groups where areas of upwelling occur and beyond the



*Tongan women are renowned for their skill in producing tapa cloth of the highest quality.
(photo: Glenn Jowitt)*



A ready supply of fresh water is critical to Tonga's continued development. (photo: SPREP).

600 m contour. Resources of this zone comprise the 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.

2.1.5 Water resources

Water is a critical resource for the small, widely scattered islands of the Kingdom. For most of Tonga's populated islands, the water resource is either rainwater stored in concrete tanks, or a thin lens of fresh water on a highly porous limestone substrate. The volcanic islands have small groundwater aquifers, and there are some fresh-water lakes and springs. Volcanic 'Eua has one ephemeral stream and several ephemeral lakes along its eastern ridge. The groundwater supplies on 'Eua come from caves high above sea level.

In Tongatapu, the groundwater pumping potential is estimated at 5.1 million cubic metres of drinking water per year. The fresh-water lens lies above sea level, and its thickness reaches 20 m in the interior. It is estimated that 25–30 per cent of the average annual rainfall recharges the groundwater resources.

2.1.6 Mineral resources

There are no known commercial deposits of any valuable mineral in the Kingdom. With hydrocarbons, while there is yet no proven resource, there is currently an exciting prospect in the region between Tongatapu and 'Eua with a reported oil quality similar to that found in the Gulf.

Sand and limestone quarries constitute the only minerals of commercial value. Currently there are 12 quarries on Tongatapu, of which one is exhausted with another—the largest production quarry—now half-exhausted. In Vava'u there are six quarries, one of which is abandoned and another (Talau) is nearly exhausted.

2.1.7 Energy resources

Tonga is heavily dependent on imported liquid fuel and liquefied petroleum gas to supply its commercial, industrial and domestic energy needs. Petroleum imports currently account for 30–40 per cent of the total energy consumption. Firewood and coconut husks, together with limited use of wind and solar energy, comprise the remainder.

Electrical generation capacity has increased greatly over the past decade, although there are still non-electrified villages in the outer islands. All electricity is produced with diesel-powered generators. Firewood comes from any available source, including tax 'api, mangroves, dead windfall branches, construction off-cuts, and coconut. On Tongatapu, good fuel wood is rapidly becoming scarce and small bundles of preferred firewood species command a high price in the Nuku'alofa market, much of it ferried in from 'Eua.



Tongans are devout people. This congregation packs the Centenary Church in Nuku'alofa. (photo: Glenn Jowitt)

2.2 The people

The Tongan people are Polynesian in origin and the socio-political order is a blending of traditional Polynesian elements and Western influences. The social structure has three tiers consisting of the Royal Family, nobility, and the people.

The resident population is estimated at about 97,000 (94,649 in 1986) of which 67 per cent live on Tongatapu, with 30 per cent in Nuku'alofa itself. In addition, an estimated 30,000 Tongans live overseas, mostly in New Zealand, Australia and the United States.

Over the past fifty years there has been a pattern of increasing urbanisation of the people, seen not only through emigration to urban centres overseas, but also through migration from the outer islands to the Greater Nuku'alofa Area, and from rural areas of Tongatapu to the capital.

Population density varies greatly from island to island. For example, in the Ha'apai Group density varies from 2 inhabitants per square kilometre on Tofua Island to 685 inhabitants per square kilometre on Kotu Island.

2.2.1 Population distribution & growth

The distribution of population in the Kingdom is very uneven, with Tongatapu the fastest growing at an average annual rate of 1.1 per cent during the last intercensal period, 1976–1986. The population of Niuas and Vava'u also grew, although much more slowly than Tongatapu. The population fell slightly in 'Eua, with a much steeper decline for Ha'apai.

The overall average annual growth rate of 0.5 per cent reflects the high level of overseas migration. While there is no detailed demographic analysis of the 1986 census, the data indicate the birth rate was about 30 live births per 1,000 people. The current death rate can be assumed to be about 6–7 deaths per 1,000. Thus the natural increase is about 23.5 per thousand (or 2.35 per cent). The net overseas migration rate (rate of natural increase less intercensal growth rate) is then about 1.85 per cent.

If this migration rate is applied to the census population, a net outflow of about 17,500 people occurs each year. Recent studies of passenger manifests for

Table 2.1 Population by Divisions & growth rates for the 1976 & 1986 censuses

Census Division	Population		Annual rate of growth (%)
	1976	1986	
Tongatapu	57,411	63,794	1.1
Vava'u	15,068	15,175	0.1
Ha'apai	10,792	8,919	-1.9
'Eua	4,486	4,393	-0.2
Niuas	2,328	2,368	0.2
Total	90,085	94,649	0.5

Source: 1986 census (GOT 1991c).

Table 2.2 Internal migration, 1976–1986

Census Division	Non-migrants	In-migrants	Out-migrants	Net migrants	Lifetime net migrants ¹
Tongatapu	36,622	3,860	2,528	+1,332	+7,877
Vava'u	9,961	1,396	1,603	-207	-2,535
Ha'apai	6,005	963	1,916	-953	-4,690
'Eua	984	290	643	-353	-153
Niuas	1,470	542	361	+181	-499

¹ Based on the usual residence at the time of birth and at the time of the 1986 Census.

Source: Sixth Five-Year Development Plan, 1991–1995 (GOT 1991a, Table 4.5).

arrivals and departures suggest that current emigration rates are even higher. Because the census figures are averages over a ten-year period, this suggests also that emigration may be higher now than it was ten years ago.

While the census provides only limited information about the nature of migration overseas, it does provide more precise information about movement within the Kingdom.

Table 2.2 summarises internal migration over the 1976–1986 period. Tongatapu had a net migration gain of 1,332 persons and Niuas also gained 181 persons; Ha'apai lost 953 persons, 'Eua lost 353 persons, and Vava'u lost 207 persons.

Islands closer to Tongatapu have larger migration streams than those further away. (The Niuas' situation is a special one of earlier residents who vacated the Division later returning home.) The largest gain in migrants to Nuku'alofa is in the 10–24 age groups, as would be expected given the greater educational and employment opportunities.

2.2.2 Education

Few persons fail to attend school at least at the primary level. Consequently there is a very high level of literacy—99.6 per cent in the 1976 census. While a strict comparison cannot be made between the 1976 and 1986 censuses, it is reported that education attainment improved considerably over that decade, with 55.8 per cent going on to secondary school. Details on the numbers completing secondary education, those qualifying for tertiary studies, and the percentage going on to university undergraduate study are not readily available. Reliable data are not available on the percentage of university graduates who return to work in the Kingdom and on those who elect to secure higher paid jobs overseas. However, it should be noted that the bonds with country and family are extremely strong and it is not uncommon for graduates to work in a foreign system for some years and then return home to give the Kingdom the benefit of their knowledge and experience.

2.2.3 Employment

For convenience, the report of the 1986 census divided the population of work-force age (15 years and over) into three groups: employed, unemployed, and not economically active (this last category includes those who spend some time engaged in economic activities but whose main activities are non-economic). About 51 per cent were economically active with about 9 per cent of these unemployed, that unemployment level varying from 10.7 per cent in Nuku'alofa to 8.2 per cent in the rest of the country. Nationally, male unemployment was 6.4 per cent, while the female rate was 18.7 per cent. Male unemployment in Nuku'alofa was 9.3 per cent.

Unemployment was most pronounced among young people as they seek employment in line with their education and expectations. The unemployment rate for 15-19 year old males was 27.6 per cent and more than 50 per cent for females of the same age group.



The production of handicrafts is a thriving cottage industry. These Vava'u women are selling their handicrafts in the Neiafu market. (photo: Glenn Jowitt)

About 50 per cent of the employed population were wage and salary earners; 36.8 per cent were subsistence farmers, the majority of whom produce for subsistence only, although large numbers also sell some of their produce; 7.2 per cent were cash-crop

farmers; and 5.4 per cent were engaged in a family business. (Omitted from the employed category are those women who work in gardens, on farms, or sell food at the market but at the same time undertake a range of domestic household tasks. These were classified as "home duties" in the unemployed category.)

It would appear that unskilled Tongan labour is not prepared to perform menial jobs for low wages. The subsistence economy appears to absorb the large group of so-called unemployed. There is a large pool of willing labour for the medium skill, office jobs, but a shortage of skilled, experienced Tongans for the more senior roles in the bureaucracy and in private industry.

2.3 Economic growth

Information for this section on economic growth was extracted from the National Report to UNCED (GOT 1991b) which in turn heavily relied on information presented in Development Plan VI (GOT 1991a).

The Development Plan reported that the trend of economic growth had declined during Development Plan periods III, IV, and V, spanning the period 1975-1990. The average growth rates for each period, respectively, were 3.7, 3.4 and 0.05 per cent. The estimated average annual growth rates for each of DPs III, IV and V are given in Table 2.3. Tonga expected to achieve a GDP growth of about 5 per cent during DP V, but real GDP growth did not match that goal.

In terms of growth, the agricultural sector was stagnant over the 14-year period. Economic growth in most sectors declined over the DP V period to the point where it was almost negative; this was partly attributed to the lack of growth in the agriculture sector, the sector which makes the dominant contribution to GDP.

Table 2.4 compares the contribution to GDP (at factor cost) of the various sectors within the economy over the DP III, DP IV and DP V periods.

Table 2.3 Estimated real GDP growth by sector for the period 1975–1990 (average annual growth rates, in %)

Sector	DP III	DP IV	DP V ¹
Agriculture, forestry & fisheries	0.2	0.0	-0.4
Mining & quarrying			3.5
Manufacturing	5.7	4.4	1.1
Electricity & water	12.2	9.8	6.2
Construction	13.6	24.7	-6.0
Trade, cafes & hotels	3.0	3.3	-1.0
Transport & communications	21.3	-0.9	2.3
Finance & business services	4.0	5.0	2.5
Community & personal services	4.2	6.7	0.9
GDP at market prices	3.7	3.4	0.05
Net transfers & factors income	n/a	8.9	-0.5
Disposable income	n/a	4.7	-0.9
Disposable income per capita	n/a	4.2	-1.3

¹ Data for DP V period do not include 1989–1990 financial year estimates.

n/a: not available

Source: Sixth Five-Year Development Plan, 1991–1995 (GOT 1991a).

2.3.1 Sectoral growth patterns

Agriculture

It has already been said that Tonga has a small economy dominated by semi-subsistence, smallholder agriculture. At the end of the DP IV period, the natural resources sector (agriculture, forestry and fisheries)

was estimated to contribute more than 40 per cent of GDP, and it was expected this sector would increase by an average 15 per cent per year during DP V. Table 2.3 indicates a zero average growth rate for DP IV and a small negative rate for DP V.

Vanilla growing is one of the brighter components of Tongan agriculture, although difficulties were

Table 2.4 Contribution to GDP at factor cost for the period 1975–1990 (in % of GDP)

Sectors	DP III	DP IV	DP V
Agriculture, forestry & fisheries	50.2	31.2	30.5
Mining & quarrying		0.1	
Manufacturing	5.3	3.5	4.6
Electricity & water	0.9	0.8	1.2
Construction	3.6	9.4	6.6
Trade, cafes & hotels	13.4	10.4	10.7
Transport & communications	3.7	6.5	6.5
Finance & business services	7.3	5.3	6.1
Community & personal services	15.1	12.6	11.8

Source: Sixth Five-Year Development Plan, 1991–1995 (GOT 1991a).

experienced during DP V with husbandry and marketing. While market prices declined in 1989, earning expectations remain high and vanilla remains an attractive crop to growers. The export performance for root crops is also encouraging, with the markets far from saturated, but stiff export competition is faced from other Pacific nations for taro and cassava.

Fisheries

Pelagic resources of albacore tuna and deep-water snapper fishing offer good prospects of increased export earnings for this sector. When the EEZ is finally declared, the resource area more than doubles in size. Top market prices are paid for fresh, chilled fish—not frozen—and hence the potential exists to improve the value of exports from the current catch if air freight services and marketing are improved.

Manufacturing

The turn round in the growth of the manufacturing sector during DP V to become one of the strongest growth areas in the economy is largely attributed to the government's policy of encouraging activity at the Small Industries Centre. While the contribution to the economy is still small, the sector has been a valuable source of employment. About three-quarters of the manufacturing growth is attributed to the textile subsector.

Tourism

There were 21,000 air arrivals in 1989, with tourists comprising about 60 per cent of these. With an estimated value in 1989 of \$T 11.5 million, tourism has become a major component of the economy with every indication that the rate of growth will continue.

Table 2.5 Growth of investment, consumption & related variables over the DP V period (1985-1990)

<i>Variables</i>	<i>Average annual growth rate (%)</i>
Domestic income	
GDP at factor cost	+0.05
GDP at market prices	+0.05
Consumption	
Private final consumption	-1.6
Public final consumption	+2.0
Total final consumption	+1.0
Savings	
Private savings deposits	+4.1
Private remittances from abroad	-6.5
Credit to households	
Personal credit	+42.5
Housing credit	+14.0
Total credit to households	+19.7
Investment	
Dwelling construction	+3.3
Industrial & commercial construction	-12.1
Equipment	+1.5
Public enterprises investment	+213.0
General government investment	-5.7
Total investment	-2.3

Source: Sixth Five-Year Development Plan, 1991-1995 (GOT 1991a).

Tourism is now a significant employer and the hospitality trade will attract increasing numbers of school-leavers as the industry expands.

Construction

There was a marked recession in private house construction over DPV, a not unexpected result of a period of tight liquidity.

2.3.2 Household expenditure & income

Household expenditure exceeded household domestic income by an average of 42 per cent during DP V. This reflects the level of private remittances from abroad, and personal or housing loans.

Private remittances from abroad declined in real terms at an average annual rate of 6.5 per cent during the 1986–1989 period, and there is evidence that the level of remittance has tapered off sharply since then as the recessions in Australia and New Zealand hardened and affected the capacity of emigrant family members there to continue their previous level of monetary support.

While remittances declined, personal savings grew at an average annual rate of 4 per cent at constant prices. This suggests there may have been a forced change in consumption patterns and household expenditure. Furthermore, a substantial growth in personal and housing credit to households could also be explained

by decreasing remittances from abroad and the need to borrow to maintain a standard of living previously supported by remittances.

2.3.3 Investment & consumption

Total investment throughout the 1986–1990 period represented an annual average of 22.5 per cent of domestic income as measured by GDP at market prices. The total investment was also equivalent to 31 per cent of total final consumption. Investment expenditure over the five years did not grow in real terms. This lack of growth is mainly attributed to a decreasing trend in private investment. Industrial and commercial construction expenditure declined sharply over the period at an annual average of 12 per cent. Direct foreign investment remained small in proportion to total private non-housing investment.

2.3.4 Balance of payments

Exports declined in proportion to imports. In the late 1960s, export receipts covered two-thirds of import expenses; this ratio decreased to 36 per cent at the beginning of the 1970s, then to 24 per cent by the end of the 1970s, and to 18 per cent by the end of the 1980s. The strong demand for imports continues, supported by the growth in foreign aid and private remittances, with the latter the single most important item in Tonga's external account.

Table 2.6 Total imports growth,¹ 1985/86–1989/90 (\$Tm)

1985/86	1986/87	1987/88	1988/89	1989/90
60.32	65.56	68.70	68.83	72.69

¹ The nominal import values have been deflated by the import component of the CPI.

Source: Sixth Five-Year Development Plan, 1991–1995 (GOT 1991a).

The economy is obviously vulnerable to fluctuations in remittances and foreign aid. Past attempts to broaden the productive base of the economy and lessen the dependence on transfers have not been successful. Remittances and foreign aid will undoubtedly continue, but the dependence of the Kingdom's economy on these is undesirable and the government's policy is to support diversification and growth of exports.

Imports

Imports during the DP V period (1986–1990) grew steadily from \$T 60.3 million in 1985/86 to \$T 72.7 million in 1989/90 (see Table 2.6).

Exports

Table 2.7 illustrates the fundamental change in the Tongan economy with a decline in the value of agricultural exports and a rapid rise in the value of manufactured exports. The agricultural export value is now expected to flatten out, with some value recovery as recently planted vanilla crops come into production. Fish exports increased steadily until 1989 and then fell back to 1988 levels; the value of these exports is realistically expected to grow with the development of the albacore tuna industry. The Small Industries Centre has been successful in improving export manufacturing, with a significant leap in 1990 (particularly in knitwear manufacture).

Table 2.7 Exports of major commodities, 1985/86–1989/90 (\$T'000)

Commodity	1985/86	1986/87	1987/88	1988/89	1989/90
Coconut products	2,994	2,934	1,829	1,522	832
Vanilla	1,182	1,418	1,191	2,504	829
Bananas	1,041	1,859	797	517	185
Watermelon	195	2	16	6	15
Root crops	280	353	544	865	1,823
Fish	649	1,249	1,292	2,048	1,445
Manufacturing	1,045	1,419	1,864	3,060	3,420
Total	7,386	9,234	7,533	10,522	8,549
Composition of exports (%):					
Agriculture	77	71	58	51	43
Fish	9	14	17	20	17
Manufacturing	14	15	25	29	40

Source: Sixth Five-Year Development Plan, 1991–1995 (GOT 1991a).

2.3.5 Revenue & recurrent expenditure

By the end of the 1980s, government expenditure was rising faster than revenue, due mainly to a major increase in recurrent expenditure. Over the DP V period, recurrent expenditure grew 5.2 per cent per year faster than revenue, at constant prices. The recurrent balance was in deficit throughout DP V, with the exception of 1987/88.

Onshore development funds, which include external grants and loans, grew in real terms by 11 per cent per year, while onshore development expenditure fell by 4 per cent per year, reflecting a general delay in the implementation of projects funded by external development assistance.

The trend in recurrent expenditure over the period 1982-1990 has been for greatly increased expenditure on government administration (+16.5 per cent as a percentage of total outlay), with a 16 per cent decline

in economic services and a 3.5 per cent decline in social services. At constant prices, government expenditure in economic services fell over DP V by an average of 6 per cent per year, a result which the government seeks to counter during DP VI.

2.3.6 External debt

External debt rose slightly in real terms over the DP V period, with the main increase being in the area of multilateral debt. The increases in external debt for 1982-1989 period (see Table 2.8) also reflect the depreciation of the Australian dollar, to which the Tongan pa'anga (dollar) was pegged, against the US dollar, the currency in which most of Tonga's foreign debt is payable. The debt service ratio remained small, under 3 per cent, because most external borrowing has been on favourable terms.

Table 2.8 External debt & debt service, 1982-1989 (\$Tm)

	1982/83	1984/85	1986/87	1988/89
External debt	24.7	31.0	49.0	50.1
<i>Bilateral</i>	17.4	18.2	26.5	23.5
<i>Multilateral</i>	7.3	12.8	15.5	19.1
<i>Commercial</i>	—	—	7.0	7.5
Debt service	0.6	1.2	1.3	2.2
<i>Amortisation</i>	0.2	0.7	0.7	1.2
<i>Interest</i>	0.4	0.5	0.6	1.0
External debt/GDP	28.6%	28.7%	33.8%	30.1%
Debt service ratio	1.4%	2.0%	1.6%	2.5%

Source: Sixth Five-Year Development Plan, 1991-1995 (GOT 1991a).

2.3.7 Development assistance

Aid contributes about 27 per cent of the GNP, with Australia the largest donor, followed by Japan, the European Community, and New Zealand. A number of other countries have bilateral technical co-operation arrangements. Multilateral and regional agencies with assistance programmes in Tonga include the World Bank, ADB, IFAD, ILO, UNEP, SPC and UNDP.

Official aid has become an important source of funds for the economy, exceeding the level of exports during the DP V period. Development expenditure over DP V totalled \$T 111 million in 1991 prices. Over 60 per cent was incurred directly by aid donors (i.e. offshore), not passing through government accounts; and of the onshore finance (from domestic sources, or foreign loans or grants going through government accounts), 63 per cent was foreign, mostly in the form of bilateral aid from Australia and New Zealand, and loans from the Asian Development Bank and the European Community. Two-thirds of the bilateral aid came from Australia and New Zealand.

Environmental constraints & issues



Most major environmental concerns of Tonga are already being addressed through a range of government policy and programmes. Some gaps are evident, with many readily amenable to correction given the necessary human and financial resources. A few notable problems are extremely complex and difficult to address, such as land-use planning and land utilisation.

3.1 Environmental legislation

There is as yet no comprehensive environmental legislation but there is a large body of legislation, some going back more than fifty years, which contains provisions of environmental importance. These include: Animal Diseases Act, 1979; Birds and Fish Preservation (Amendment) Act, 1989; Fisheries Act, 1989; Forests Act, 1961; Forest Produce Regulations, 1979; Garbage Act, 1949 as amended; Harbours Act, 1903 as amended; Land Act, 1903 as amended and s22 of the Land (Timber Cutting) Act; Minerals Act, 1949; Noxious Weeds Act, 1903; Parks and Reserves Act (Act Nos 11 of 1976 and 20 of 1988); Pesticides Act, 1976 and 1981; Petroleum Mining Act, 1969 as amended and Petroleum Mining Regulations (G.S. 107/85); Plant Quarantine Act, 1981, as amended; Polynesian Heritage Trust, 1984; Public Health Act, 1913 as amended and Public Health (Refuse Dumping Ground) Regulations; Rhinoceros Beetle Act, 1912 as amended; Territorial Sea and Exclusive Economic Zone Act, 1978; Tourist Act, 1976; and the Waterboard Act, 1966 as amended. There is also a series of Town Regulations and Public Health (Building) Regulations covering house location, town cleanliness, planting, cutting of plants, pig and goat control, and littering. A comprehensive Marine Pollution Bill has been drafted (1992) which would meet Tonga's international obligations for protection of the marine environment against pollution.

The length of this list of legislation indicates the current inherent difficulty, if not impossibility, of administering environmental controls in a cohesive

and co-ordinated way. This is seen as a major flaw which will be overcome only when comprehensive environmental legislation is introduced. Indeed it might prove possible (as was recently done in New Zealand where one resources Act replaced sixty separate pieces of legislation) for Tonga to introduce a comprehensive resources Act embracing land, water resources, marine resources, mineral resources, flora and fauna, forest produce, environmental management, national parks and reserves, and other aspects of environmental protection such as hazardous chemical control.

3.2 Environmental training & education

There is a limited public perception of environmental problems and opportunities for sustainable development. Public awareness and education have long been recognised as an urgent need if the success of environmental programmes is to be ensured.

The Curriculum Development Unit of the Ministry of Education has incorporated environmental education as formal courses within the school curriculum. Considerable progress has been made in the development of materials to support the environmental courses but

Student assembly in a cyclone-damaged school in Neiafu, Vava'u. It is at school, as well as in the home, that children receive training which can lay the foundation for the future sound environmental management of the nation's resources. (photo: Glenn Jowitt)



a great deal remains to be done to ensure teachers have the necessary teaching materials and can make effective use of them. The earlier environmental sciences course emphasised classroom teaching with only quite limited activities outside. The new environmental curricula will place much greater emphasis on organised field exercises for school students, and involve community organisations where possible. The Environmental Planning Section (EPS) will support the environmental training activities of the Ministry of Education to its maximum capacity.

In the preparation of educational materials the Ministry of Education draws on the expertise of several staff. The Ministry of Lands, Survey and Natural Resources (MLSNR) has staff trained in environmental science and these staff work closely with the Ministry of Education. While there has been much effort in the preparation of environmental science teaching materials, further effort is needed to ensure effective implementation, both in the formal teaching process and through practical, hands-on activity and community extension.

Apart from the education system, all ministries with responsibility for the natural, social and built environment (which embraces just about everything) have a teaching/extension role.

3.3 Environmental management planning

During the process of preparation of the national Environmental Management Plan (ESCAP 1990), the government formed an Interdepartmental Environment Committee (IDEC) in 1987 comprising heads of relevant departments. The IDEC's role was to co-ordinate the preparation of the EMP and compile and review the documentation. A national EMP Symposium on 27-29 August 1990 was the culmination of that activity. The Symposium recommended to Cabinet that the IDEC be retained to supervise the implementation of the EMP. Subsequently, it was also the IDEC which served as the co-ordinating body for the preparation of the National Report to UNCED (GOT

1991b) and helped shape the development and execution of the RETA programme elements for the Kingdom.

The IDEC, comprising MLSNR (Chair), Health, Foreign Affairs, MAF, Works, Labour, Commerce and Industries, Planning, and the Tonga Visitors Bureau, has not been disbanded but now meets rarely; special meetings of the IDEC can be called if required. However, as an effective body to oversee the implementation of environmental strategies and programmes, it is notable that the IDEC has no administrative capacity in its own right, other than through the MLSNR. The IDEC also lacks representation from the Police Department whose role it is to enforce environmental regulations, and also from the Department of Education which plays a central role in raising environmental awareness. Nor does IDEC include any representation from the private/business sector and non-governmental organisations.

Under the current National Development Plan (DP VI), environmental administration is vested with the Ministry of Lands, Survey and Natural Resources. Within the MLSNR, the government's policies are implemented by an Environmental Planning Section (EPS) which currently has a professional/technical staff of six with two of these undertaking environmental training in Australia. One officer is expected shortly to be admitted to a Ph.D in Environmental Sciences and has been formally designated to take a senior role in the MLSNR on his return. Of the permanent staff positions, two have ecology/environmental science functions, and three with national park/reserve functions (a Park Supervisor and two National Park Rangers). In addition to permanent staff, the EPS also has a staff of ten Parks and Reserves workers to carry out field programmes. Currently two Peace Corps volunteers are also working in the Section.

In the 1990/91 financial year, environmental administration received 0.14 per cent of the total annual government budget for the Kingdom. While there are many competing demands on the Kingdom's limited

budget, very little in the way of improved environmental planning and management will be achieved without a significant increase in human and financial resources for the Environmental Planning Section. The provision of adequate funds for essential recurrent expenditure to maintain the protected area system and other current environmental activities is particularly tight; without a significant increase in such operational funds it will not be possible for the Section to undertake additional new programmes. The level of staffing and recurrent expenditure allocated to the environmental sector compared to other competing sectors is taken by aid donors as an indicator of the real priority of government for environmental conservation and sustainable development.

In addition to the MLSNR's Environmental Planning Section, other sectoral line departments have a number of environmental responsibilities. These are discharged by departmental staff in general, but no department has yet designated or recruited officers with a specific environmental protection role for the departments' administrative functions.

There is no formal mechanism for public participation in environmental management planning and management, either through IDEC representation as indicated above, or through other channels. Representatives of community organisations and the churches may be invited as observers to special meetings (as was the case with the EMP Symposium). Real achievement in improving environmental problems is going to depend heavily on public support and commitment, and thus public participation in the decision-making process will be one key element.

3.4 Environmental Impact Assessment

Formerly, the responsibility for environmental management for the Kingdom was vested in two government authorities, the Central Planning Department and the Ministry of Lands, Survey and Natural Resources. The government's administrative arrange-

ments were that Central Planning assessed the potential environmental risk of a development proposal, passing higher risk projects to the MLSNR for Environmental Impact Assessment (EIA). Then, in 1985, all environmental responsibility was vested with MLSNR, the Central Planning Department playing a co-ordination role.

Several years ago the government decided that all major new projects would be subject to EIA. The current policy is for the Central Planning Department to pass all development proposals to the MLSNR which then assesses whether a proposal will require EIA. Where the Environmental Planning Section has the capacity, or can call on expertise available locally, the EIA would be conducted in-house; otherwise a request would be made to SPREP for its technical assistance. A draft Environmental Impact Statement (EIS) would be prepared and circulated to relevant government authorities for comment and subsequently a final EIS prepared for consideration by Cabinet. That is the theory. In practice, very few development proposals have been subjected to EIA. The translation of the government's policy into practice has been hampered by the lack of legislation to back up the policy.

3.5 Environmental protection

Tonga currently has seven protected areas. These comprise five National Marine Parks and Reserves, the 'Eua National Park, and one National Historic Park.

In addition, there are several Protected/Traditional Areas of Respect. On Tongatapu these are: Captain Cook's Landing Place; Futu Ko Vuna; Giant Clam Sanctuary (1986); Hule Fortification; 'Otu Langi; Ha'atafu Missionary Landing Site; Mt Zion; Pangai si'i; Site of First Sacrament; and Vuna Road Reserve. Fa'onelua Gardens (Tongatapu) has been converted to a free market area and the value of the gardens destroyed as a result. In Vava'u, the Areas of Respect are: Giant Clam Sanctuary (1988); and Pouono.

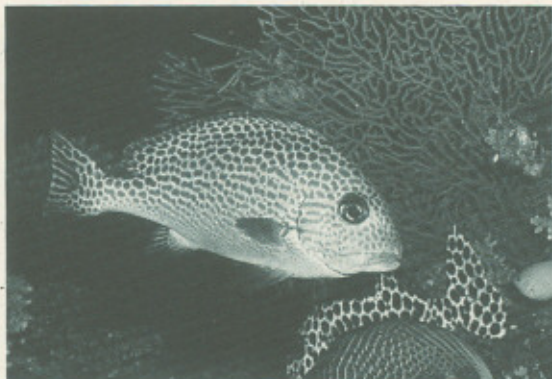
Table 3.1 Protected areas in the Kingdom of Tonga

Name	Area (ha)	Year estab.
Ha'amonga Trilithon	23.0	1972
Ha'atafu Beach Reserve	8.4	1979
Hakaumama'o Reef Reserve	126.0	1979
Malinoa Island Park	73.0	1979
Mounuafu Island Park	33.0	1979
Pangaimotu Reef Reserve	49.0	1979
'Eua National Park	449.0	1992

A number of other sites have been proposed for formal recognition as protected areas. These include: Volcanic Island Reserves (to protect biodiversity in Kao, Late, Niuafu'ou and Tofua Islands); 'Ata Island; Kanokupolu Historic Park, 'Otu Langi Historic Park (Tongatapu); and Coral Gardens, Mt Talau National (terrestrial) Park, Pouono Historic Park, Swallows' Cave (Vava'u). There is also a small area of rainforest at Taloa, the last remnant of this forest type on Tongatapu, which merits formal recognition as a protected reserve.

Giant clams have in the past been overfished. The Giant Clam Sanctuary was established to protect remaining specimens such as this and to promote natural recovery of the clam population. (photo: SPREP)





Many different kinds of fish on coral reefs, such as this sweetlip, are caught for food. The coastal reefs close to population centres are heavily fished. (photo: SPREP)

Fishing a shallow lagoon inside the barrier reef.



3.6 Resource management

3.6.1 Marine

Compared with other areas of Polynesia, Tongan life is strongly land orientated rather than marine based, with most people being farmers. In some villages, though, almost everyone fishes on a casual basis. The catch is distributed to the individual fisherman's family, given to meet social obligations, and sold for cash. The bulk of fishing effort thus is for subsistence and for the local market.

Traditional fishing methods were fairly benign environmentally, using hand-throw nets, spears, fish traps, but also poison to catch reef fish; such traditional fishing practices are still predominant in Tonga today, but the introduction of some types of modern equipment with more intensive fishing practices has proved highly destructive to the reef ecosystems.

The coastal reef area is subjected to considerable fishing pressure with, it is estimated, some 65 per cent of all fish landings, including shellfish and crustaceans, being caught in the shallow-water fisheries zone of reefs and lagoons and the inshore pelagic zone to a maximum depth of 75 m.

Many of the resources in shallow reef areas adjacent to villages and towns have been overfished and current landings are considered close to maximum sustainable yields. A 1983 survey in Vava'u concluded, on the basis of interviews with villagers and town officers, that there was a decrease in variety and quantity of harvest, with shellfish smaller in size.

Commercial bottom fishing on seamounts and reef slopes is being encouraged by the government. The reef-slope zone has a potential harvest of about 321 tons per year (Langi & Langi 1988), sufficient to support a maximum of 33 boats to fish the resource. However, at least 45 boats were fishing with the 1987 harvest at 716 tons. Legislation has recently been enacted to regulate this fishery to stop the over-exploitation. On the other hand, the offshore pelagic zone remains largely untapped and offers future earnings potential.

3.6.2 Agriculture

Laboratory facilities in both the Public Health Section of the Department of Health and the Soil Chemistry Section of the MAF are quite inadequate to provide the essential monitoring service for toxicity and persistence of agricultural chemicals, hormones and veterinary drugs. Some monitoring activity is undertaken using New Zealand laboratories. However, such exter-

nal analysis is restricted to those residues or contaminants not affected by extended storage.

The Public Health Section of the Department of Health needs to be strengthened to control, monitor and test for drugs, hormones and chemical residues to protect consumers from toxins in food. The Soil Chemistry Section of the MAF needs to be strengthened to carry out tests for levels of residual agricultural chemicals in soils and plants to safeguard people from indiscriminate use of farm chemicals.

Further public awareness/educational programmes should also be instituted on the safe use and handling of agricultural chemicals.



There are both direct and indirect controls to protect designated fauna and flora of the Kingdom. The Tongan flying fox is traditionally protected, being sacred to the Royal Family.

3.6.3 National Park & Reserve development

The nation's natural flora and fauna have been degraded over a very long time period with the result that few areas contain remnants of what are thought to be original ecosystems. Tonga has a number of marine parks and reserves but its system of terrestrial protected areas is relatively poorly developed, although the recent gazettement of the 449-ha 'Eua National Park is a major step in rectifying that situation.

Of that remnant vegetation, there appears to be little risk of exploitation of the 300 ha of accessible forest on Tofua. Nevertheless, consideration should be given to its protection as a second national terrestrial park. Concurrently, other areas should be formally identified, surveyed and considered for declaration as protected areas. The Global Environment Facility's regional biodiversity programme being implemented through SPREP will be the main vehicle for such protected area development.

3.6.4 Coastal swamp & mangrove areas

It is of considerable concern that mangrove areas in Tongatapu and Vava'u have been subdivided and some already cleared and filled-in for house sites. Where mangrove is landfilled, the EMP (ESCAP 1990) reports the land is rarely raised to a sufficient height to escape the danger of flooding during storms or even from unusually high king tides. As a result, in addition to property loss, sewerage is inadequate and severe health hazards can arise due to flooding of pit latrines and septic tanks. As such, it seems a risky policy to permit such landfilling; this risk may well be compounded should the predicted rise in sea level occur over the next fifty years, due to global warming.

Traditional, environmental and biological functions of mangrove ecosystems are often ignored and this can have an adverse impact on living conditions and the quality of the environment.

3.6.5 Drinking water

Small coral islands less than 400 m across have no fresh groundwater. On larger coralline islands, there are no streams and water is drawn from a fresh-water lens "floating" on top of the salt water. The shape and size of the lens are governed by rainfall volume and periodicity, tides, seepage, hydraulic conductivity, and rate of abstraction. A bore or well tapping the fresh-water lens should be located in the thickest part of the lens and pumping should be continuous and at a rate such that the thickness of the lens is not reduced to less than half the original thickness. Thus the pumping water level must be closely monitored. When the cone of pumping depression intersects sea-level datum, sea water will upwell into the bore. Once contaminated with sea water, the well may take years before the delicate fresh water: salt water balance is re-established (Dale & Waterhouse 1985). Apart from vulnerability to salt water contamination, the groundwater lens is vulnerable to contamination from surface pollutants which percolate down to the lens.

The Department of Health estimates that 85 per cent of the population uses groundwater while the remaining 15 per cent relies on rain-water catchments. In most of the outer island areas, and in many urban areas in Nuku'alofa, brackish groundwater is used for washing, cleaning and flushing toilets, while rain-water is used for drinking. In the Ha'apai Group, most of the population relies on rain-water systems for drinking water. In some outer islands, only rain-water is available, and during extended periods of drought, as occurred in 1987, coconuts provide the only liquid refreshment.

Demand for water has risen because of the higher standard of living and on Tongatapu it is estimated that potable water consumption increased nearly tenfold over the 1970s and 1980s, with the average daily consumption in Nuku'alofa now about 80 litres per person. In rural areas where a reticulated water supply is available, the average daily consumption is 30-50 litres per person.

In Ha'apai, investigations have located supplies of fresh water close to the main reticulated area in Pangai. Studies to determine the safe number and location of fresh-water wells which can replace the existing salty water supply have been carried out on 'Uiha, Foa and Ha'ano. The results are being used to develop a model for village water supply in similar villages.

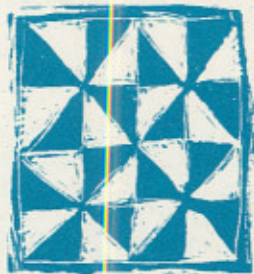
3.6.6 Local construction materials

Quarrying for rock and aggregate is carried out by digging, blasting and ripping fossil coral from hill-sides. No attempt has been made in Tonga to cut limestone for building blocks although that prospect should be examined. The Holonga quarry which was used to supply the Lupepau'u airport (Vava'u) with building material contains very hard reef structures which may prove useful for the production of sawn stone blocks for building construction. The Pangaimotu quarry also has hard, well-cemented segments of reef.

Sand is used primarily for concrete and with the increasing pace of infrastructure development the demand for sand has increased rapidly. Large quantities are also used for the traditional covering of graves in the public cemeteries. In Tongatapu and Vava'u, most of the sand is mined by the MLSNR and sold to the public. Heavy equipment is used for beach mining and a number of beaches have been stripped to the rock substrate, including Monotapu Beach on Tongatapu, once a popular tourist area. Large volumes of sand are also taken by individuals, despite a law forbidding sand removal without the Ministry's approval.

Surveys have been conducted for the past decade to locate marine or terrestrial beds of sand for construction purposes. Many deposits have been considered but the sand either proves to have too much silt or is fragile. There is a need to renew that search to protect the beach and foreshore resources which are important tourist assets.

Action strategies



Eleven strategies are presented below, together with proposed programmes for strategy implementation. For those programmes for which technical assistance from donor agencies would be a necessary precursor to implementation, programme profiles have been prepared in order to facilitate the external funding process. The programmes for which a profile has been prepared are indicated by an asterisk (*) in the Table of Contents and within the body of the Action Strategy. The programme profiles are contained in the Appendix.

No donor agency is suggested as a source of technical assistance for any programme. This is a matter for the Government of Tonga. The programme profiles could be used in approaching potential donors to gauge their interest in specific strategy and programme areas.



4.1 Strategy I Improve environmental awareness & education

Background

Tongans have within their culture a large body of traditional knowledge and practices. However, such traditional knowledge is largely no longer practised and does little to help with contemporary environmental problems such as those associated with imported Western life-styles, modern development programmes and population growth. In order to address such "modern" environmental problems, a much greater and wider education effort is required to raise the level of environmental awareness of these problems and how they can be overcome. Such educa-

tional programmes need to be directed both formally within the education system and informally to the public at large. A well-informed public is in a much better position to assist in environmental management for the benefit of the whole community.

Environmental awareness and education programmes are equally important at the decision-making level in order to ensure greater adherence to the principles of sound environmental management and sustainable development.

Goals

- 1) Increase public awareness of environmental issues, both regional and global, throughout the whole Kingdom of Tonga (including outer islands).
- 2) Increase public support for environmental management efforts.
- 3) Design, produce and distribute environmental awareness and educational materials, such as posters, pamphlets, slides etc., and provide technical support through training, public lectures, individual and group extension programmes and the like.
- 4) Assist in developing appropriate curricula in environmental education.
- 5) Assemble environmental education programmes which will facilitate the Environmental Planning Section, teacher trainers and teachers in disseminating effective environmental information.

Programmes

*4.1.1 National environmental awareness outreach programme

see Appendix, page 57

The overall goal of this programme is to help preserve vital tropical ecosystems within the Kingdom of Tonga through the promotion of environmentally sound developmental activities and the active support of a well-informed public. The outreach programme would:

- 1) develop national education awareness programmes and materials for schools and for the general public;

- 2) increase general knowledge about the ecosystems and environment of Tonga;
- 3) raise public awareness through increased community-based environmental awareness activities and mini-workshops; and
- 4) establish an environmental information network linked through the present educational system and adult formal and informal education.

***4.1.2** Surveys of environmental attitudes & resource-use practices

see Appendix, page 60

The type of environmental education approach adopted for specific issues will vary with the attitudes and current resource-use practices of the community. Thus it is important to determine just exactly what are the predominant views of the community, and the divergence of views within the community. The degree to which each village or island community is aware of a specific environmental issue will vary, their views on the environmental issue will also vary, as will the steps considered necessary to correct an environmental problem. One way to determine environmental views is through the conduct of mini-surveys which supplement the national census. The next census is due in 1996 and it is timely now for the EPS together with the Government Statistician to start developing and testing environmental questions which could be included in the census form.



4.2 Strategy 2 Improve disposal of solid wastes & sewage

Background

Solid waste disposal

Solid waste disposal is recognised as a serious problem in Tonga, particularly so in Nuku'alofa where the main garbage dump for household waste and other non-hazardous wastes, including septic sludge, was for years a mangrove area immediately adjacent to the city at Popua. This refuse tip area became a squatter settlement for landless immigrants from the outer islands, and the squalid surroundings, rats and disease risk have been an embarrassment to the country. In addition to the main refuse site, there are a number of official and unofficial sites, some so constructed that tip-trucks can deposit their loads directly into the sea.

A new dump site has been selected in another mangrove area to the immediate west of the city, although there is now a conflicting claim on the site for part of a golf course. Neither prospective use of the mangrove area was subject to an Environmental Impact Assessment procedure.

The dumping of rubbish directly into the sea is prohibited but there is no capacity and little will to police the many rural dump sites; this problem is compounded by a history of poor co-operation in controlling the dumping of rubbish by government departments themselves.

Many small islands do not have many choices of sites for garbage disposal and may be forced to use a mangrove area as a tip, however undesirable. In Tongatapu's case, other landfill choices are possible although some hard decisions would have to be made by the government on the resumption of private land for the purpose.

No matter the site however, fewer landfills will serve the people longer if it is possible to reduce the volume of rubbish taken to the tip.

Solid waste recycling

The volume of rubbish dumped in landfills could be reduced if non-biodegradable refuse was recycled to

the maximum extent. Imported aluminium and glass beverage containers contribute significantly to the volume of rubbish, as do discarded plastic bags and bottles, and biodegradable newspapers and rags.

Newspapers and rags can be recycled or converted into garden compost. High grade paper (e.g. copy machine and computer) can be recycled into lower grade paper, stationery, or cardboard, while cardboard can be made into new cardboard. Newsprint is recyclable four times back into newsprint. Rags can be made into batting for mattresses and pillows.

Non-biodegradable, high density plastics such as ice cream containers can be remoulded while some plastics can be used in the manufacture of paints. Polythene bags can be remade. Aluminium cans may be smelted and re-formed into new items. Glass bottles can be resanitised and refilled, or ground and remade into new glass products.

However, everything comes down to the cost of recycling compared to buying a new product; where waste has to be sent overseas for recycling, freight is often prohibitively costly without some form of financial subsidy. For some commodities, however, there may be sufficient volume to establish economically viable local recycling industries. This aspect requires study.

Liquid wastes

There is no reticulated sewerage system in Tonga. In urban areas septic systems are mostly used and, because of the highly porous substrate, they can cause water pollution and health problems when incorrectly located and poorly maintained. There are a number of low-lying urban areas in Nuku'alofa which are inundated for lengthy periods during the wet season, with resultant flooding of the septic tanks. As a general practice, overflowing septic tanks are pumped out and the sludge deposited in the open containments near the Popua refuse dump, allowed to break down, and subsequently made available to the community as garden fertiliser.

Goals

- 1) Promote recycling of solid waste to the greatest, economically feasible extent.
 - 2) Encourage greater use of composting techniques to reduce the dumping of organic household refuse.
 - 3) Improve garbage collection, disposal and management systems of the major urban areas.
 - 4) Complement existing efforts to reduce the problem of disposal of human waste in low-lying, heavily populated areas by testing of new designs of closed bio-toilet systems.
-

Programmes

***4.2.1 National recycling programme**

see Appendix, page 62

This programme would investigate the feasibility of establishing economically and financially viable recycling enterprises, or the level of possible government subsidy needed to support recycling as a public service. This feasibility study would proceed over a two-year period and would entail the separation of wastes into recyclable organics and inorganics and non-recyclable wastes. The volume of waste of the various categories would be determined and the practicalities of recycling activities tested with the more economically attractive "recyclables". Bins would be supplied to Nuku'alofa households and businesses for the separation of wastes at the point of collection. This would be accompanied by a public education campaign on the separation of wastes and the promotion of greater attention to composting of organic wastes for garden use. Further basic equipment for the recycling feasibility study would be procured, including collection vehicles, crushing and baling plant, plastics pelletiser, and a storage facility.

***4.2.2 Waste disposal management programme**

see Appendix, page 65

This programme would maintain the focus on the urgent problem in Nuku'alofa, and to a lesser degree in other population centres, of the disposal of solid wastes. It would entail the provision of additional compressor garbage dump trucks, and training of garbage dump operators on modern dump management practices. The privatisation of the garbage dump operation would be examined and severe penalties introduced and enforced for the indiscriminate dumping of rubbish in non-designated sites. This programme would complement the existing programme for the relocation of the garbage dump landfill to the Mulifonua area.

***4.2.3** Urban biological sewage treatment pilot trial for low-lying areas

see Appendix, page 67

This would be a trial and demonstration programme to be conducted in a selected low-lying suburban area of Nuku'alofa. The pilot trial would study new models of bio-toilets and biofilter sewage treatment plants which are completely sealed systems, ensuring odourless operations with no fly nuisance.



4.3 Strategy 3 Strengthen the national capability for environmental management

Background

The National Report to UNCED (GOT 1991b) stated to the world the clear intention of the Government of Tonga to protect the fragile environment of the Kingdom. The Sixth National Development Plan, 1991–1995 (DPVI) (GOT 1991a, p. 75) states the government's natural resource and environmental objectives as:

- *to improve the pattern of land allocation among competing uses or activities such as settlement, agriculture, mineral resources, exploitation, industry and tourism;*
- *to safeguard the natural resources and heritage of the Kingdom, preserve the social and cultural functions that relate to the environment, and enhance the contribution of natural resources to economic and social progress;*
- *to improve the management of natural resources in order to attain optimum levels of exploitation and allow sustainable development.*

However, the government has a severely limited capability for achieving those environmental objectives. This limited capability is manifested in a jumble of outmoded legislation containing confusing environmental provisions; the lack of concise, comprehensive environmental legislation; the understaffed Environmental Planning Section of the MLSNR; and the minuscule allocation of funding to the EPS to implement the tasks expected of it, relative to budgetary provisions made to other sectors.

Land

The issue of land allocation, while central to many environmental concerns, can be discussed only briefly. The issue is a constitutional matter which has to be resolved by the King, government and people of Tonga. It is a highly sensitive issue, of which all Tongans are acutely aware, going to the very core of

the Tongan social structure and culture. It is not a matter which can be usefully addressed by this Action Strategy. Nevertheless, it is acknowledged that the rapidly growing population makes the land allocation problem ever more acute, with the environmental consequences of inappropriate land use ever more apparent. The problem is indeed thorny, but one which can no longer be deferred by His Majesty's Government as being in the "too-hard basket".

Legislation

The many pieces of legislation containing environmental provisions were referred to in Chapter 3 (Section 3.1). A detailed review of environmental law in the Kingdom was undertaken as part of the RETA (Pulea 1992) and a number of recommendations made for revision of those laws to ensure consistency. A Land Use, Natural Resource and Environment Planning Bill was drafted some years ago with the intent of establishing a legal framework for land-use planning and preventing arbitrary decision-making in the absence of overall national land-use planning and environmental guidelines. The Bill has been revised more than once and is currently under further review. Part VI of the Bill provides for an EIA information process for development applications. The Bill also makes provision for the preservation of amenities, historic buildings, sites and landscapes as part of the national heritage. The Bill is limited, however, in the sense that it is confined essentially to those areas for which the MLSNR is functionally responsible; it does not codify within a single Act all land, natural resource, cultural and environmental provisions found scattered amongst a wide body of narrow sectoral legislation. Such codification of environmental law in Tonga into one, single, comprehensive statute is urged, and in this regard the recent New Zealand legislation could serve as a useful model.

Institutional issues

There are four main institutional issues, of which the first three relate directly to the Environmental Planning Section, while the fourth relates to the Civil Service as a whole:

- 1) insufficient trained EPS personnel for the EPS to carry out its prescribed functions;
- 2) inadequate infrastructure with insufficient physical resources for the task expected of the EPS;
- 3) lack of necessary funds for the EPS to perform its
- 4) the low level of environmental awareness of many Civil Service personnel generally and, specifically, the current lack of identification by each sectoral (line) ministry of at least one officer within each department who has specific environmental protection responsibilities, that is, an officer who acts as a watchdog to ensure that the activities of other ministries do not adversely affect the resource for which that officer's own ministry has prime responsibility.

Goals

- 1) Strengthen the legislative framework for environmental management and administration.
- 2) Strengthen the institutional base for environmental management in the Kingdom of Tonga.

Programmes

***4.3.1** Enact comprehensive natural resource legislation

see Appendix, page 69

Under this proposed programme, technical assistance would be provided for two years to the Crown Law Department in order to:

- 1) examine legislation of the Kingdom relevant to natural resources and environmental management—including land use and land planning, water, energy, minerals, fisheries, agriculture (including noxious weeds, animal diseases, plant diseases, quarantine etc.), forestry (including timber cutting, forest produce etc.), national parks and reserves, environmental planning (including Environmental Impact Assessment), and waste management—from the viewpoint of their consolidation into a single, comprehensive Act;
- 2) appraise recommendations of the recent Review of Environmental Law (Pulea 1992) and prepare a plan of implementation for those recommendations adopted by the government;
- 3) draft a comprehensive Natural Resources Bill, together with Regulations for each resource sector contained in the Bill;
- 4) prepare all documentation necessary for the consideration of the Natural Resources Bill by government.

***4.3.2** Strengthen the institutional capability of the Environmental Planning Section

see Appendix, page 71

This programme would:

- 1) support additional high calibre staff for the EPS and support training of current staff;
- 2) foster environmental training as a career path for the future workforce;
- 3) provide environmental training opportunities for existing EPS staff, both professional and technical; and
- 4) provide both the necessary office infrastructure and transportation to support the expanded activities of the EPS inherent in this Action Strategy.

***4.3.3** Raise the level of environmental skills of professional, resource-based staff of the Civil Service

see Appendix, page 74

This programme is directed to existing professional or technical staff within the main ministries of the Tongan Civil Service with specific responsibilities for aspects of resource-use planning and management. Such areas include water, land use (agriculture/forestry), energy, town planning, environmental health and education.

The programme would cover:

- 1) the training overseas of six professional officers for postgraduate diplomas (one year) within areas of environmental science and management; and
- 2) short environmental courses for both professional and technical staff.



4.4 Strategy 4 Assess implications of climate change & sea-level rise

Background

The issues of global warming and sea-level rise are of major concern to Pacific countries and, should anticipated sea-level rises eventuate, the Pacific way of life will be disrupted in a major way. While not of Tonga's making, this global issue could make uninhabitable low-lying coastal areas of the Kingdom and the low atolls. Even where the land is not permanently inundated, the cultural, social and economic well-being of the Kingdom will be threatened.

Such concerns are reflected in the development of a Global Convention on Climate Change, which has been signed by a number of Pacific countries. The Kingdom of Tonga is currently examining the implications of signing this Convention. The South Pacific region has pledged to contribute to international efforts to limit the adverse effects of climate change by limiting emissions of greenhouse gases and by managing natural resources in an ecologically sustainable way. A regional Climate Change Programme has been developed at SPREP to assist with the monitoring of

sea-level rise in a number of Pacific countries and to develop effective response programmes to sea-level rise.

While the Government of the Kingdom of Tonga is rightly concerned about the possibility of sea-level rise, it is difficult to assess the magnitude of risk without further study. There is a need to define the extent of the threat and then to develop appropriate response strategies. It is obviously important that any such studies be undertaken in close consultation with existing regional sea-level rise programmes, including those being executed through SPREP. There is also a need to link planning for sea-level rise with broader coastal zone management planning. Participants at the Second Meeting on Climate Change on Sea-level Rise, held in Noumea in April 1992, emphasised this point and called for the development of specific sea-level case studies in Pacific countries which are linked to the Integrated Coastal Zone Management Programme (ICZM).

Goals

- 1) Increased understanding of the implications of sea-level rise for the Kingdom of Tonga.
- 2) Development of appropriate response strategies to possible sea-level rise.

Programme

*4.4.1 Environmental study of climate-sensitive ecosystems

see Appendix, page 76

This programme would survey and monitor climate-sensitive ecosystems in the Kingdom of Tonga to assess the implications of sea-level rise and identify appropriate responses.



4.5 Strategy 5 Counter the misuse of hazardous chemicals

Background

There are many chemicals which pose a hazard to the terrestrial and marine environment and, when present in sufficient concentration, are a direct threat to human health. However, in the Tongan context, the main chemicals which constitute an environmental hazard when misused are agrochemicals, especially the biocides (pesticides, acaricides, nematocides, herbicides etc.).

Under Tonga's Pesticides Act, 1976, as amended in 1981, restrictions are imposed on the importation or manufacture of pesticides, and provision is made for a Registrar of Pesticides. However, the Act has proved incapable of being implemented as presently framed. A Pesticides Registration Committee was reactivated in 1989, but many problems remain in overcoming the barriers to effective implementation of a practical pesticide control scheme. The Committee needs assistance to overcome the problems.

The routine monitoring of water, plant and soil samples for residues of hazardous agrochemicals is widely accepted as an important role of government in order to protect the health of its own citizens and also to safeguard vital export markets. Of particular concern is the residue level of pesticides in fruit, vegetables, and also meat. Where some sample residues are found to exceed safe international maximum residue limits, then corrective action can be taken with the producers concerned; where the residue levels are repeatedly excessive, agronomic systems and post-harvest handling practices must be adjusted to ensure the

food produced is safe for human consumption when it reaches the market. Such monitoring, at least of plant and soil, is usually undertaken by Departments of Agriculture. Departments of Health often undertake the chemical monitoring of water as well as monitoring for bacteriological content.

Most developed countries monitor imported food for agrochemical residue levels, as well as for pathogens, virus, insect pests etc. Where some samples taken from a consignment are found to exceed the accepted maximum residue level, then the entire shipment could be rejected. Such a risk cannot be taken where the export market is fragile or where the producing country is a minor supplier with perhaps only three or four shipments in a season.

While acknowledging that the use of hazardous chemicals, including pesticides, fertilisers and veterinary preparations, should be continually monitored, no laboratory in Tonga currently has the capability to undertake such sophisticated chemical analyses. It is considered that Tonga should be capable of handling at least basic analyses, perhaps with more complex analyses performed at overseas commercial laboratories. The degree to which monitoring can sensibly be undertaken in-country (or by a government laboratory) needs to be determined. While there are many commercial, non-government laboratories in neighbouring metropolitan countries, and many government departments in those countries also provide a commercial service, their services are quite costly.

Goals

- 1) Improve the control system for the importation, storage, sale, use and disposal of pesticides.
- 2) Institute proper, regular monitoring of both locally produced and imported food to protect the people against harmful high residues of hazardous chemicals in fruit, vegetables and meat, and to protect Tonga's vital export markets for its produce.
- 3) Raise the level of public awareness of the risks associated with the improper use of agrochemicals and other hazardous chemicals, to human beings, livestock, and to the terrestrial and marine environment.

Programmes***4.5.1 Pesticide control measures**

see Appendix, page 77

This programme would provide assistance to the Pesticides Registration Committee in reviewing the Pesticides Act and in the formulation and implementation of a scheme to control the registration, importation, distribution and sale of pesticides in Tonga.

***4.5.2 Monitoring for hazardous agrochemical residues**

see Appendix, page 80

This programme would take the form of a feasibility study to determine the most efficient and cost-effective mode for routine monitoring of hazardous agrochemicals. The study would entail a review of all available laboratory facilities and staffing in Tonga and also existing arrangements for the performance of complex analyses at overseas laboratories. The prospect of real benefits from an amalgamation of all analytical chemical laboratories in Tonga into a single national laboratory would be specifically examined. The feasibility study would necessarily also examine the current capability for routine sampling in the field of agricultural produce, meat and other foodstuff by agriculture and health staff, and devise appropriate staff training programmes.

***4.5.3** Chemical waste workshop

see Appendix, page 82

Over recent years, there has been a greatly increased use of agrochemicals in the Kingdom, associated with large-scale, intensive forms of horticultural production. This is particularly the case with squash (Japanese pumpkin) and taro production. There is concern about the usage of pesticides and fertilisers, but the extent to which agrochemical residues may have infiltrated into the environmental web is unknown. If a residue problem exists, then the nature of the problem and its extent must be determined.

This programme would have two components:

- 1) the conduct of basic research to assess the extent of infiltration of agrochemicals into the environment; and
- 2) the conduct of a workshop in Tonga where the results of the research would be presented, the environmental risks to the human food chain of improper use of agrochemicals would be discussed, and policy recommendations made which will assist legislators and administrators.



4.6 Strategy 6 Foster the use of renewable energy sources

Background

Tonga is heavily dependent on imported oil and petroleum products for energy, particularly for electricity generation. His Majesty's Government is most conscious of the high proportion of export earnings which is spent on imported energy sources and consequently has stimulated a number of initiatives to reduce costs, particularly through the adoption of sources of renewable energy. Steam generation from firewood and agricultural residues is not considered a practical proposition in the Tongan context and studies of renewable energy sources have concentrated on facets of solar, wind and wave energy.

Tongan effort has been directed in particular to the utilisation of solar energy for various applications in the remote outer islands where the freight costs on drums of diesel make electricity generation prohibi-

tively costly by conventional means. These applications include refrigeration, water pumping and, most notably, lighting. The Kingdom allocated part of its Lomé III funds for the supply of photovoltaic systems to all the islands in the Vava'u Group and approaches have been made to other aid donors to provide the islands of the Ha'apai Group with similar systems. Funding has already been secured for a system on Niuafu'ou.

A pilot project implemented on the islands of Taunga in the Vava'u Group and Mango in the Ha'apai Group showed that more emphasis in the introduction of such systems is required for training islanders to understand photovoltaic technology to ensure the system is used correctly and properly maintained.

Goals

- 1) Ensure that Tongans, particularly on the outer islands, understand the need for energy conservation and gain the necessary knowledge to operate and maintain photovoltaic systems for village and household lighting.
- 2) Promote greater use of local renewable energy sources to reduce the rate of usage of imported fuels.

Programmes

*4.6.1 Promote photovoltaic technology

see Appendix, page 84

This programme will institute training in the planning, implementation and maintenance of photovoltaic projects. The training would be directed to villagers of the outer islands in order to provide them with a better understanding of the interrelationships of the components of a photovoltaic system, and to offer them firsthand experience in the implementation and maintenance of a household photovoltaic system.

4.6.2 Promote the replanting of fuel-wood trees

This programme aims to promote the replanting of fast-growing trees for erosion control, for use as windbreaks and shelters, and for fruit and firewood. This is an internal matter and no programme profile has been prepared.



4.7 Strategy 7 Improve & update basic data on natural resources

Background

Accurate information on the status of natural resources is an essential prerequisite to any sensible management planning. Acquiring and analysing such data is quite costly in itself, although it is usually only a minuscule fraction of the value of the resources or the development planned for their proper use. Tonga is fortunate in having some information of use on its natural resources and on past history; nevertheless, the information is patchy, often quite dated, and variable in quality. Much of the resource information was collected in the context of area-specific and often *ad hoc* activity, rather than in a systematic manner for the Kingdom as a whole. Even where such systematic studies have been undertaken, for example of forest resources (Larsen & Upcott 1982; Thompson 1976), the data are difficult of access and use, being available only in reports and publications, not having been placed into relational computer databases.

Databases on their own are useful but maximum use is obtained when they are seen as part of a resource information system, preferably a geographically based information system (GIS). Tonga does not have an

operational GIS and this is considered a deficiency in the government's capability for rational land-use planning and environmental management. The collection of all resource information has not been centralised and the intending user must search the reference literature to glean information sought—if the resource planner is aware of the existence of the reference in the first place and is able to obtain access to it.

Thus an early task of the MLSNR, together with the Central Planning Department and other resource-based or resource-dependent departments, should be to collect existing data (published maps, scientific reports, census population information, climatic summaries, ongoing assessment programmes etc.) at a central location (the Central Planning Department library is suggested) to form a National Resources Library. This task should be accompanied by a critical evaluation of the scientific worth of resource information and an evaluation of gaps. The logical corollary is to institute programmes to acquire data to plug those knowledge gaps.

Goals

- 1) Develop a geographically based resource information system for the Kingdom of Tonga.
- 2) Ensure the compatibility of new resource databases with major regional computer database systems.
- 3) Develop a systematic approach to plugging the gaps in knowledge about the Kingdom's resources and update old resource information, concentrating initially on the major recognised knowledge gaps on marine resources and on insects.

Programmes***4.7.1** Develop a national resource information system (TONGRIS)

see Appendix, page 85

This programme would fund the engagement of a specialist to develop a national resource information system (TONGRIS) which would facilitate the networked updating, analysis and retrieval of resource data, and in a manner compatible with existing regional, computerised environmental information systems and resource databases.

In the development of the system, the programme would entail:

- 1) the collation of existing natural resource information into a central national resource data library;
- 2) identification of data gaps or inadequate data; and
- 3) the review and redesign as necessary of existing resource databases.

Following development and testing, the specialist would train Tongan staff in manipulation of the databases and in the effective use of TONGRIS for land-use planning and environmental management.

***4.7.2** Natural resources & ecosystems survey

see Appendix, page 87

This programme would survey, identify and study endemic marine and terrestrial species and their ecosystems, with particular emphasis on study of the outer islands and current marine parks. Such data are fundamental to any rational decisions on biodiversity conservation in the Kingdom.

***4.7.3** Strengthen the knowledge of insect pests & beneficial insects of the Kingdom

see Appendix, page 90

The programme would seek to:

- 1) update the Vaini Research Station's current insect collection with new specimens;
- 2) expand the collection of beneficial insects and insect pests endemic to Tonga;
- 3) establish a reference collection of important exotic insect pests for quarantine support;
- 4) improve the existing curation facilities for the insect collection; and
- 5) improve the taxonomic support for the Entomological Section at Vaini.



4.8 Strategy 8 Protect the Kingdom's biological diversity

Background

Protection of biodiversity has a high priority on international and regional environmental programmes. For example, a major regional programme (the South Pacific Biodiversity Conservation Programme—SPBCP) has commenced at SPREP in 1993 with the aim of protecting biodiversity in the Pacific region. The most recent initiative at the international level has been the development of the Biodiversity Convention, which aims to protect biodiversity at the global, regional and national levels. A number of Pacific countries have become signatories to this Convention.

Protection of the biodiversity of the Kingdom of Tonga will require the development of a suitable system of protected areas and the development of programmes aimed at the protection of species. The development of such systems will require adequate resources and clear and effective programmes.

There have been a number of initiatives in the Kingdom of Tonga to establish protected areas. Legislation such as the Parks and Reserves Act and various Birds and Fish Preservation Acts have been developed to protect biodiversity in the Kingdom. There are five marine parks established in the Kingdom, and a number of proposals for other marine and terrestrial protected areas have been put forward. The most recent initiative has been the establishment of the 'Eua National Park, which was gazetted in 1992. This National Park represents a significant initiative which will protect the important forest resources of 'Eua.

There are a number of species with some form of protection status in the Kingdom. Some species may be in danger of over-exploitation; however, there is no system of monitoring these species to enable a clearer picture of their status to be developed.

Constraints to the protection of biodiversity in the Kingdom of Tonga include the limited financial and staff resources available for management of protected areas and species. Protection of biodiversity is primarily a responsibility of the Environmental Planning Section within the Ministry of Lands, Survey and Natural Resources; however, this agency currently lacks the resources to address biodiversity conservation in a systematic manner.

Effective biodiversity conservation in the Kingdom is also hampered by a lack of basic information on ecosystems and species. Such information is fundamental to the identification of priorities for the development of protected areas and the protection of species, and also for the development of effective programmes in these areas. In the absence of such information the systematic establishment of protected areas will be difficult to achieve.

There is high potential for linking biodiversity conservation with eco-tourism development. A Tourism Master Plan is currently under development for the Kingdom of Tonga and it is anticipated that a major thrust of this Strategy will be for tourist promotion and development which are based around the outstanding natural and cultural resources of the Kingdom of Tonga. The protection of the natural and cultural environment is given strong emphasis in the tourism planning process. The goals of biodiversity conservation and tourism development in the Kingdom are thus complementary; it is important that programmes be closely co-ordinated between the Tourism and Environment Sectors in the Kingdom.

Goals

- 1) Institutional strengthening of the Environmental Planning Section in the area of wildlife management, to enable effective implementation of biodiversity programmes.
 - 2) Improved planning and management of natural and cultural sites in the Kingdom of Tonga.
-

Programmes

***4.8.1** Strengthen wildlife management capability in the Kingdom

see Appendix, page 93

This programme would establish a wildlife officer position in the Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources to design and implement effective wildlife management programmes in the Kingdom.

The programme would seek to secure the services of a wildlife officer in order to:

- 1) develop wildlife rehabilitation programmes;
 - 2) work with the Science Teachers Association to provide technical input for the incorporation of wildlife ecology and related conservation into school curricula;
 - 3) develop adult educational material and tourist information; and
 - 4) liaise with the Brehm Fund South Seas Expedition's bird conservation programme.
-

4.8.2 Replanting of traditional, medicinal & culturally important plants

It has become evident that plants and trees used for traditional medicines as well as culturally important plants species are disappearing, or are on the verge of extinction, from Tonga. The aim of this project is to identify these plants and trees, establish a nursery for their propagation, and disseminate general information on the distribution and growing of these species. This is an internal matter and no programme profile has been prepared.

***4.8.3** Management planning for protection of 'Eua National Park

see Appendix, page 95

This programme would prepare a five-year management plan for the newly gazetted National Park on the island of 'Eua and institute initial basic measures to safeguard its forest and scenic values. With proper management, the 'Eua National Park is bound to have an increased attraction for tourists, and the money earned from eco-tourism can help offset maintenance costs.

***4.8.4** Preservation of key natural
& cultural sites in Vava'u

see Appendix, page 97

A range of developments have been identified for Pouono Historic Site and Mt Talau National Park in Vava'u. This programme would fund the implementation of these developments over a three-year period, according to a set of detailed plans to be prepared for each site.

***4.8.5** Royal Memorial Botanic
Gardens

see Appendix, page 99

This programme would prepare a detailed costed design for His Majesty's consideration for the conversion of the area surrounding the Royal Tombs in the centre of Nuku'alofa into a Royal Memorial Botanic Gardens where plant species endemic to the Kingdom would be preserved, and other attractive trees, palms, shrubs and flower gardens established to beautify the site.

***4.8.6** Pilot programme for the
control of rats & feral cats on
selected outer islands

see Appendix, page 102

Surveys of bird populations on outer islands by the Brehm Fund have shown an alarming level of predation of eggs and birds on some islands due to high numbers of rats and feral cats. If these predators are not controlled, it is quite possible some bird species will become extinct. Because the islands are small, it may be feasible to completely eradicate these pests. A pilot programme will test the feasibility of eradicating rats and cats on two selected islands in the Ha'apai Group where baseline data on bird populations have already been obtained. The pilot programme will require periodic monitoring of bird populations to determine their response to the eradication campaign.



4.9 Strategy 9 Foster sustainable use of marine resources & the coastal zone

Background

The coastal zone is fundamental to sustainable development in Pacific countries, particularly for the continued viability of subsistence fisheries. The coastal zone is particularly significant in Tonga as it is there that the bulk of the population lives and most fishing occurs. Gleaning of intertidal reef flats for marine resources provides an important dietary supplement. The zone is sensitive and is easily affected by both land- and sea-based activities. Issues that are particularly relevant to the coastal zone in Tonga include:

- 1) *Pollution from sewerage and urban run-off.* Inadequate systems for the treatment of waste have contributed to significant lagoon pollution.
- 2) *Destructive fishing practices.* Traditional fishing practices had a low impact on the fisheries resource and the coastal zone. Methods of fishing are changing and some practices, such as the use of dynamite to catch fish, have a significant long-term effect.
- 3) *Removal of sand.* Sand is used for a number of purposes, particularly for use as an aggregate for cement and for the traditional covering of graves in public cemeteries. The foreshore area has been the

main source of sand for construction and this mining has caused severe damage, in some cases resulting in beaches being stripped to the bare rock substrate.

- 4) *Clearing of mangrove areas.* Due to a limited availability of land a number of mangrove areas have been cleared and in-filled for housing, mangrove areas have been allocated for town 'api, and most of the garbage of Nuku'alofa is dumped in a coastal mangrove area.

There is a need for broad coastal zone management planning and urban development planning to address these and other issues in a comprehensive manner. There is also a need for increased awareness of the values of the coastal zone and marine resources. This lack of awareness stems in part from poor information on the current resources of reef and lagoon, despite increased monitoring of reef conditions and catches by the Department of Fisheries. However, the Department has inadequate numbers of personnel and other resources to undertake such a large monitoring task on a regular basis. There is a particular lack of information on marine invertebrates and on the biological condition of reefs.

Goals

- 1) Systematically develop and implement coastal zone management plans.
- 2) Increase awareness by decision-makers and the general community of the values of the coastal zone and of inshore marine resources.

Programmes

*4.9.1 Develop coastal zone management plans for the Kingdom of Tonga

see Appendix, page 103

This programme would involve the designation of a Tongan team of environmental and town planners, together with a coastal engineer, to develop plans over a five-year period for the management of the coastal zones of the main islands of the Kingdom, commencing with Tongatapu. An integral part would be the preparation of an Urban Development Plan

for Greater Nuku'alofa. This Tongan team would be supported by external specialist advice as required. Plans would be discussed continually with the communities concerned and a public forum held on each draft plan as it is produced.

***4.9.2** Tropical marine ecology
training

see Appendix, page 105

This programme would increase awareness of coastal and marine issues through the implementation of two training workshops on coral reef ecology and the coastal zone. The first workshop would provide an intensive familiarisation course on coral reef ecology for environment planning staff and science educators, with practical study of coral reefs, lagoons, tidal flats, seagrass meadows, mangrove swamps, and the complex of the ecosystems. The second workshop would be targeted specifically at those involved in marine survey and ecological studies of coral reef. Different methods of marine monitoring would be applied and compared to select those techniques most suited to various types of marine habitat found in Tonga.

***4.9.3** Renew the search for
alternative sources of sand for
construction purposes

see Appendix, page 107

The search for alternatives to beach mining to provide sand needed for construction purposes would be renewed by this programme. It would fund an economic and environmental feasibility study for recapturing sand and aggregate deposits from the ocean outfalls of reef passages.



4.10 Strategy 10 Ensure sustainable use of the land resource

Background

Land use and land-use planning in Tonga have to be considered within the context of the socio-political-economic system, which is unique in the Pacific islands. This system has been described in many texts and reports and will not be repeated here. It has many strengths and also some weaknesses which affect agricultural production, particularly those more intensive forms of agriculture such as the export production of pumpkin (squash) to Japan. Among those factors affecting agricultural production are: individual landownership (the 'api); a group concept of labour; involvement of the whole family; the immediacy of social obligations and their strong and cohesive traditions; the protective role of government in farmer subsidies; and individual competitive entrepreneurship.

The land tenure system has problems today for Tonga as it is no longer always possible to allocate land (both the town 'api and the garden or tax 'api for farming) to each Tongan male over the age of sixteen as required by the Constitution. However, land availability for farming is not yet considered a problem, despite the large number of absentee landowners overseas. Informal access to land through the extended family is important. Land for leasing may be available, with

the government permitting leases for up to fifty years (but more commonly a maximum of ten years). The time must come, however, and shortly, when land availability will assume much greater importance. On Tongatapu especially, land suitable for agricultural production will be at a premium in the near future. The land of absentee landlords should not be left idle; while much is leased, there are also many under-utilised 'api. The need for increased food production may be such that idle agricultural land can no longer be tolerated. Furthermore, in rural Tonga, house construction and other development continue on prime agricultural land. This takes it out of production, without any overall plan for land use for the Kingdom which zones or classifies the land according to its potential productivity, or lays out a blueprint for urban and rural land development.

The problems inherent in the land tenure system enshrined in the Constitution are due to the rapidly increasing population; while ultra sensitive, they have to be confronted squarely by the government. This issue has been the subject of a Review by a Royal Commission on the Land Act and it would appear timely for the implementation of that Review to be again considered.

Goals

- 1) Protect the best soil for agricultural production by carefully planning future land use and developments and to promote sustainable agricultural development practices.
- 2) Protect that vital agricultural soil against permanent alienation to other forms of land use and against decline in fertility, erosion, and other deterioration, such as weed invasion through neglect.

Programmes***4.10.1** Prepare comprehensive land-use plans for the Kingdom of Tonga

see Appendix, page 109

With the aid of recent low-level aerial photography, this programme would study current land use and reclassify land types according to optimal use. It would prepare land-use/development plans for Tonga, with first emphasis on Tongatapu, in order to help resolve competing urban and rural demands on land and optimise agricultural production.

The development of this plan would need, as input, information on the land form, slope, soil type, prior and current land use, vegetation, population and climate, and other resource database information which would have been developed as part of the TONGRIS system (see Programme profile 4.7.1). Its development should also be closely co-ordinated with the development of coastal zone management plans (see Programme profile 4.9.1).

4.10.2 Develop & promote sustainable agricultural development & practices

The Ministry of Agriculture and Forestry is to conduct research on present and proposed agricultural practices and develop a work programme which will promote sustainable agricultural development and practices suitable to the physical properties of the land and the cultural systems of Tonga. This is an internal matter and no programme profile has been prepared.

4.10.3 Strengthen land management for rural development & agriculture

This programme would:

- 1) ensure improved participation by landowners and the general public in land-use planning processes;
- 2) enforce and review existing penalties of the Land Act for unused or misused land;
- 3) reappraise the land tenure system enshrined in the Constitution.

This is an internal matter and no programme profile has been prepared.



4.11 Strategy II Improve the supply of drinking water

Background

Outside the metropolitan areas, village drinking water is obtained from a combination of shallow groundwater wells, and household and community rain-water storages, mostly concrete tanks. Tonga has experienced severe, extended droughts in the past where the supply of drinking water on some islands became critical. Many shallow wells are heavily polluted with faecal coliforms or contaminated with salt water as a result of sea-water intrusion into the groundwater aquifer which can arise from excessive drawdown rates or drought.

Despite the regular droughts which are experienced, there is still an unacceptably high level of water wastage, both through leaking pipes and taps, and through plain carelessness in leaving taps running or slow repair of burst pipes. Wells are located too close to latrines or pig pens and become polluted, with a high resultant occurrence of gastro-intestinal health problems. Some wells are over-pumped or otherwise improperly used, often becoming brackish as a result from the intrusion of sea-water. Attempts to raise the level of public consciousness on the need for conservation of water resources and on the consequences of leaving taps running and not repairing leaking pipes have been made in the past. There is a need for regular repetition of such water conservation campaigns.

To help reinforce the message of avoiding water

wastage, the government should again consider the application of a water pricing policy which would seek to recover the real cost of water supply to householders, and also bill each government department for its water usage.

Many homes in the outer islands have small water storages, and some communities collect water from churches and halls, and/or have constructed artificial water catchments. However, tank storage capacity is usually very small, and they often leak or are otherwise poorly maintained. Tonga regularly faces quite severe, extended droughts and all households in the outer islands should have adequate-sized and well-designed, constructed and maintained water storages.

It would also seem desirable for the government to encourage the installation of guttering and rain-water tanks in urban areas to supplement reticulated groundwater supplies. Consideration could also be given to an adjustment of the building code to require each new building to incorporate appropriate water storage in its design.

Many government buildings and churches do not have rain-water storage, and perhaps this should be rectified first before requiring it of private citizens. In the urban centres, each government building could be self-sufficient for water without drawing on public water supplies.

Goals

- 1) Ensure that each household in the Kingdom is equipped with a permanent rain-water storage of sufficient capacity to support the family for six months.
- 2) Ensure that all existing public and community buildings such as churches and halls are equipped with rain-water storages.
- 3) Reduce the level of water wastage by households and government agencies.

Programmes***4.11.1 Roof water catchment & rain-water storage programme**

see Appendix, page 111

This programme would have two main components:

- 1) the provision of rain-water storages on the outer islands of sufficient capacity to supply the average-sized household with six months' water to cope with extended drought;
- 2) to ensure that all major government buildings and churches have large rain-water storages to support community needs during extended drought periods.

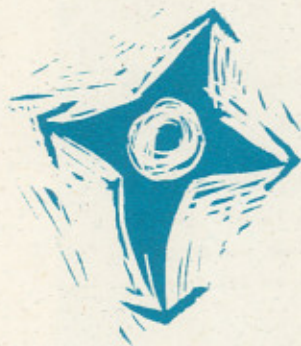
For both components, the process would entail a systematic assessment of the capacity and quality of existing rain-water storage systems throughout the Kingdom, and the preparation of a detailed proposal to a regional lending organisation for loan funds for installation of rain-water storage systems. These loans would be partly for on-lending to householders through the Tonga Development Bank, for home storage, and partly to the government to pay for water storage construction on all major government buildings.

***4.11.2 Public education on conservation of water**

see Appendix, page 112

This programme would fund a new water conservation campaign which would involve a co-ordinated attack on public awareness through brochures and radio and television spots on the use and conservation of water within the Kingdom. Supplementing this media campaign would be the promotion of automatic cut-off taps and other technology designed to conserve water.

Principles for implementation



There are a number of important principles which will guide the implementation of this Action Strategy.

5.1 Ownership

The development and implementation of this Action Strategy must at all stages be guided conjointly by the government and people of the Kingdom of Tonga. There must be ownership of both the process and the product. The Interdepartmental Environment Committee (IDEC) played an important role in the development of the Environmental Management Plan and ensured that a range of government agencies were actively involved in the process. There is a clear, continuing role for the IDEC in the development and implementation of this Action Strategy, and specifically in the oversight of programme implementation; however, for the IDEC to function in this capacity, its mandate would need to be broadened and its status made that of a high level, official body, with private sector representation, meeting regularly and playing a pro-active role in striving to strike a balance between the vital need for effective environmental protection of the Kingdom's resources and the imperatives of economic development.

5.2 Cross-sectoral involvement

The nature of the environmental issues facing the Kingdom necessitates a cross-sectoral approach, involving the range of governmental and non-government agencies engaged in environmental and natural resource management. One lead agency has the prime mandate and overall responsibility for environmental protection—the Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources. However, the responsibility for environmental management does not rest with the EPS alone; there are a number of other agencies which have important environmental responsibilities and must be closely involved in the implementation of this Action Strategy.

A number of the specific programme profiles identified in this Strategy affect a number of government agencies, reflecting the fact that the management of the environment is not the domain of one particular government ministry. Relevant agencies, particularly the sector line departments, should be encouraged to identify an officer who would have responsibility for environmental management activities that concern the agency. Effective environmental action also requires close liaison and co-operation between relevant agencies involved in this area. This should occur at both Permanent Secretary level, as was the case for the IDEC, and at officer level. There is great scope for the involvement of small inter-departmental working groups or committees, each tasked to deal with specific sustainable development issues.

5.3 A focus on regional participation

A number of agencies are involved in environmental management in the region. The major regional organisation is the South Pacific Regional Environment Programme (SPREP) which offers considerable environmental management expertise. This represents an important resource to assist the Kingdom of Tonga in the implementation of environmental programmes. Another advantage of involving regional organisations such as SPREP is that they can provide a regional perspective on many of the issues affecting the Kingdom. In many instances the problems faced in Tonga are not unique; they are often faced by other countries in the Pacific. In many cases, approaches tried elsewhere may be applicable to the Kingdom of Tonga, with appropriate adaptation. A number of major programmes will be implemented through SPREP in the next five years, including the South Pacific Biodiversity Conservation Programme (SPBCP) and the Climate Change Programme. These are important initiatives with which the Kingdom should be closely involved, as they are directly relevant to environmental protection. Several other donor agencies also have a history of assistance in the implementation of

environmental programmes in the Pacific, such as the ADB, EC, AIDAB, NZODA, GTZ and JICA. These agencies should be closely involved in the development and implementation of environmental programmes in Tonga, wherever possible.

5.4 Environmental Impact Assessment

There is an increasing awareness throughout the Pacific of the important role of Environmental Impact Assessment (EIA) in the implementation of environment and development projects. EIA offers an opportunity for the environmental impacts of development proposals to be considered at an early stage of project development and for environmental factors to be incorporated into project implementation. As such, EIA has been recognised as a significant element in ensuring sustainable development in the Pacific countries. Moreover, the requirement for EIA of major project proposals is mandatory for a number of donor agencies such as the Asian Development Bank.

There is thus a strong argument in favour of developing workable EIA procedures in the Kingdom of Tonga. An EIA procedure exists which involves the Central Planning Department referring development proposals to the Ministry of Lands, Survey and Natural Resources, which would then assess whether a proposal will require EIA or not. Such EIAs could be carried out either in-house through the Environment Unit or with external assistance, such as is available through SPREP's EIA programme. In practice, there has been limited application of EIA in the Kingdom, partly through the lack of specific legislation that backs up policy directives in this area. There is, however, a need to develop simple, workable procedures for the application of EIA in the Kingdom of Tonga. The development of procedures must be backed up by appropriate, practical training to develop the skills required for the application of EIA. The EIA workshop due to be held in Tonga in 1993 should assist in this regard, both in the development of procedures and in the acquisition of skills to implement EIA.

5.5 The role of the Environmental Planning Section

The Environmental Planning Section is the key environmental agency in the Kingdom of Tonga. It has a key role in the co-ordination and implementation of environmental programmes in the Kingdom. It also has an important advocacy role for the Kingdom of Tonga in various regional and international forums in relation to the environment. As such, it has a pivotal role and must be equipped with the appropriate skills and infrastructure to enable it to adequately fulfil its functions. It is also important that the Environmental Planning Section be represented on key government committees which deal with environmental and sustainable development issues.

In addition to the important function of the Section it is important that other line ministries and divisions acknowledge their role in environmental management and allocate resources to this area.

5.6 Packaging & prioritisation of programmes

This Action Strategy contains 31 programmes. Programme profiles have been prepared for 27 of these programmes and together they represent a significant sum of money. These are, however, only a few of the many programmes which could have been included in the Strategy; there still remain many needed activities, for which some might claim higher priority than for those presented here.

Most of the 27 programmes for which profiles have been prepared call for implementation over the next two to three years. But it is most unlikely that all of these can be funded by external agencies; the aid programmes of many agencies are already heavily committed for the next five years. Further attention will be required by the government to alternative packaging of the programmes to meet various development assistance agencies' requirements, and to the

tighter prioritisation of programmes. This would seem to be a task best undertaken by the IDEC.

5.7 Review

This Action Strategy reflects the perceived environmental constraints and issues, and the programmes most needed to address them at this time. Inevitably, these perceptions will change, often quite rapidly, as regional circumstances change, the importance attached to environmental issues changes, and new issues arise. Consequently, it is well to plan now for a major revision of this Action Strategy in not more than three years' time, which will be five years after the 1990 EMP Symposium. Ideally, the process of revision would include a national symposium on sustainable development, open to the public and with wide representation from across the Kingdom from both government and non-governmental organisations and agencies, from business houses, banks, and other private industry sectors, and from the churches.

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Detailed programme profiles outlined in the Action Strategy

Contents list of programme profiles

- 4.1.1 National environmental awareness outreach programme 57
- 4.1.2 Surveys of environmental attitudes & resource-use practices 60
- 4.2.1 National recycling programme 62
- 4.2.2 Waste disposal management programme 65
- 4.2.3 Urban biological sewage treatment pilot trial for low-lying areas 67
- 4.3.1 Enact comprehensive natural resource legislation 69
- 4.3.2 Strengthen the institutional capability of the Environmental Planning Section 71
- 4.3.3 Raise the level of environmental skills of professional, resource-based staff of the Civil Service 74
- 4.4.1 Environmental study of climate-sensitive ecosystems 76
- 4.5.1 Pesticide control measures 77
- 4.5.2 Monitoring for hazardous agrochemical residues 80
- 4.5.3 Chemical waste workshop 82
- 4.6.1 Promote photovoltaic technology 84
- 4.7.1 Develop a national resource information system (TONGRIS) 85
- 4.7.2 Natural resources & ecosystems survey 87
- 4.7.3 Strengthen the knowledge of insect pests & beneficial insects of the Kingdom 90
- 4.8.1 Strengthen wildlife management capability in the Kingdom 93
- 4.8.3 Management planning for protection of 'Eua National Park 95
- 4.8.4 Preservation of key natural & cultural sites in Vava'u 97
- 4.8.5 Royal Memorial Botanic Gardens 99
- 4.8.6 Pilot programme for the control of rats & feral cats on selected outer islands 102
- 4.9.1 Develop coastal zone management plans for the Kingdom of Tonga 103
- 4.9.2 Tropical marine ecology training 105
- 4.9.3 Renew the search for alternative sources of sand for construction purposes 107
- 4.10.1 Prepare comprehensive land-use plans for the Kingdom of Tonga 109
- 4.11.1 Roof water catchment & rain-water storage programme 111
- 4.11.2 Public education on conservation of water 112

Programme profile 4.1.1

National environmental awareness outreach programme**Aim and scope**

It is well recognised that improved public awareness of environmental issues and attitudes towards environmental protection and conservation is fundamental to any real national improvement in environmental management. The Environmental Planning Section (EPS) of the Ministry of Lands, Survey and Natural Resources (MLSNR) has for some years sponsored or conducted a number of environmental awareness campaigns, but these have been greatly hampered firstly in their scope, in that they have been directed primarily to people living on Tongatapu, and secondly in their impact, through a very limited production of posters, pamphlets and publications in both the English and Tongan languages. There has been no production of high impact, audio-visual material (particularly videos in the Tongan language), presenting the important environmental issues of immediate concern to the people.

The ultimate goal of this programme is the preservation of vital tropical ecosystems within the Kingdom of Tonga through the promotion of environmentally sound developmental activities and the active support of a well-informed public. The outreach programme would:

- a) develop national education awareness programmes and materials for schools and for the general public;
- b) increase general knowledge about the ecosystems and environment of Tonga;
- c) raise public awareness through increased community-based environmental awareness activities; and
- d) establish an environmental information network linked through the present educational system and adult formal and informal education.

Description

A short-term media consultant would be engaged to develop a detailed environmental awareness outreach strategy with timed and costed activities over a two-year period. The implementation of the strategy would require the services of a video specialist, preferably with Tongan language skills, for two years, the engagement as required of a graphic artist and of a person with desktop publishing skills, and the recruitment of a full-time research assistant with word processing skills. The media specialist would prepare scripts for the environmental education videos together with EPS environmental scientists, shoot the video footage and edit the material to produce an acceptable product for public viewing.

A broad range of environmental materials prepared in both Tongan and

English would be developed locally drawing on existing education staff and resources through special curriculum material workshops; these workshops can be undertaken immediately given minor financial assistance for supplies and printing materials.

The outreach programme would include the production and airing of two 15-minute radio programmes a month beamed to all islands in Tonga, and a monthly half-hour television programme with brief environmental spot "commercials" directed at those living on Tongatapu.

Video recording, editing and reproduction equipment and accessories would be procured, together with a larger capacity colour photocopier. An underwater camera for shooting stills of marine life would be required. Ancillary equipment would include air-conditioners for the media room, together with adequate recurrent budget for its continuous operation. The media facility would be established under the direction of the EPS but in close co-operation with the Department of Education.

Cost estimates

	Year 1	Year 2	Total
Outreach programme staffing	(\$T)	(\$T)	(\$T)
- Media consultant, for detailed outreach strategy	15,000	—	15,000
- Video specialist	12,000	12,000	24,000
- Graphic artist	5,000	5,000	10,000
- Desktop publishing operator	5,000	6,000	11,000
- Research assistant/word processor operator	4,000	4,000	8,000
Curriculum development workshops			
Supplies, and publication of environmental education materials produced	12,000	—	12,000
Radio and television spot programmes			
Miscellaneous costs for production and broadcasting of radio and TV environmental spot programmes	13,500	13,500	27,000

		Year 1	Year 2	Total
	Equipment & materials			
	- Video equipment & accessories	40,000	5,000	45,000
	- Underwater camera & lenses	4,000	—	4,000
	- Colour photocopier	20,000	2,000	22,000
	- Air-conditioners	6,000	—	6,000
	- Miscellaneous (film, copy paper, toner, video cartridges etc.)	8,000	8,000	16,000
	Total costs	\$T 144,500	\$T 55,500	\$T 200,000
Executing agency	Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources, in co-operation with the Department of Education.			
Potential benefits	Tonga-specific materials produced in the Tongan language would have most impact on both urban and rural communities for promoting a heightened environmental awareness in both school children and the general public. Existing material prepared by SPREP and other agencies would be readily translatable into Tongan for wider distribution among the community. Videos are a major media form in Tonga and environmental information presented in video form would be more readily accepted and understood than written media.			
Potential issues	The current office occupied by the EPS is already overcrowded and could not accommodate the additional staff required for this programme. Nor would it be suitable in its present state for the editing of videos. Consequently, additional or alternative accommodation would be required for the EPS.			
Processing/timing	Donor funding: FY 1993. Development of the environmental media consultant's detailed outreach strategy and programme: FY 1993. Implementation of main outreach programme: FY 1994 – FY 1995.			

Programme profile 4.1.2

Surveys of environmental attitudes & resource-use practices

The Kingdom of Tonga conducts a national census every ten years. The next census is due to be conducted in 1996. A census can be undertaken of a wide range of information apart from that of a purely demographic nature. It is proposed that the next census include questions which will probe the views of Tongans about major environmental issues.

Aim and scope

- a) To assist the national policy and planning process through a comprehensive data acquisition exercise on community attitudes towards environmental issues, resource-use practices and conservation needs as part of the 1996 national census;
- b) to assess the differences in opinion from village to village and island to island;
- c) to canvass communally acceptable approaches to environmental protection.

Description

The programme would entail three components:

- a) develop a set of environmentally related questions to be put to householders within the context of the 1996 national census. The National Report to UNCED (GOT 1991b) would be used as a base document indicating national environmental problems, constraints and opportunities for corrective action;
- b) repeatedly test and refine these environmentally related questions in mini-surveys in selected urban and rural communities;
- c) undertake the national environmental attitude survey in conjunction with the census.

Cost estimates

This programme would be mostly an internal government exercise, requiring no more funds for its implementation than would be required for the conduct of the national census. Some funding need is anticipated for inputs from environmental specialists and census experts for testing of questions in mini-surveys prior to census implementation.

Three person months for drafting, testing and review of environmental questions

Includes external and internal travel and miscellaneous costs

\$T 30,000

Executing agency	Government Statistician together with the Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources.
Potential benefits	Views expressed on environmental issues and control measures are often those of individuals or of minority groups, rather than those of the people as a whole. Policy decisions made on such a basis can prove to be wide of the mark. Environmental policy and programmes should respond to the perceived needs of the people; where views are contrary to scientific knowledge, then the prime targets and issues for environmental education and public awareness raising are clearly identified, permitting a focused effort and more efficient use of available funds.
Potential issues	The environmental information required could be sought using a demographic sample for a separate national survey of the people. This would be a major undertaking and a costly process. It is also more intrusive as it requires a further door-knock campaign. It would seem more appropriate to acquire this environmental information at the same time as the conduct of the national census. However, in doing so, the number of questions asked must be kept to a minimum to reduce both the complexity of the census document and the analytical process. The questions therefore must be very carefully selected.
Processing/timing	Commence FY 1993. Field testing during FY 1994 – 1995. Conduct with the census in FY 1996.

 Programme profile 4.2.1

National recycling programme

Aim and scope

There has been a major increase over the past decade in Tonga, as elsewhere, in the use of disposable packaging with a resultant increased disposal problem and pollution. Currently wastes are not being separated and open dumping is the normal practice. Much of the packaging material such as glass, paper, aluminium cans and plastic containers are recyclable.

A small recycling programme has commenced in Nuku'alofa with aluminium cans as a "cottage industry" with cans purchased at one seniti per can. Cans are crushed into bricks, packed in a container and shipped to Australia for reprocessing. Shipping costs are high and profitability is marginal at best. The local brewery encourages recycling of their beer bottles for sanitising and reuse through placing a 20 seniti deposit on each bottle.

To improve the management of solid waste disposal in order to:

- a) protect the physical environment;
- b) reduce the need for landfill where land is a scarce commodity;
- c) promote a minor recycling industry; and
- d) possibly reduce the rate of importation of non-biodegradable or non-recyclable packaging.

Description

The programme would fund a two-year feasibility study which would assess in a practical way the prospect for a commercially viable recycling industry in Tonga, beyond that of the current aluminium can recycling activity. A waste disposal engineer would firstly conduct a pre-feasibility study of the proposed programme and prepare a detailed feasibility study design. Field staff would be hired to assist with garbage handling. The feasibility study would be directed by a waste recycling expert.

The feasibility study would entail:

- a) the separation of wastes, both at the point of collection and at the refuse dump, into recyclable organics and inorganics and non-recyclable wastes;
- b) determination of the volume of waste of the various categories; and
- c) testing the practicalities of recycling the more economically attractive "recyclables".

The feasibility study would fund the procurement of bins for Nuku'alofa households and businesses for the separation of wastes at the point of collection. This procurement would be accompanied by a public education

campaign on the separation of wastes and the promotion of greater attention to composting of organic wastes for garden use. Further equipment which would be procured includes collection vehicles, crushing and baling plant, plastics pelletiser, and a storage facility.

A detailed report of the feasibility study's economic and financial appraisal of the industry prospects would be presented to the government at the end of the two-year period.

Cost estimates

	<i>Year 1</i>	<i>Year 2</i>	<i>Total</i>
	(\$T)	(\$T)	(\$T)
<i>Pre-feasibility study (1 month)</i>			
Waste disposal engineer and hire of field staff	45,000	—	45,000
<i>Feasibility study (2 years)</i>			
Waste recycling expert	60,000	60,000	120,000
Equipment			
- Collection vehicles (2)	50,000	—	50,000
- Crushing and baling plant	50,000	—	50,000
- Pelletiser	50,000	—	50,000
- Garbage bins for waste separation	100,000	20,000	120,000
Storage facility	20,000	—	20,000
Operational costs			
- Truck drivers, garbage collectors, machinery operators	100,000	100,000	200,000
- Vehicle depreciation and operating costs, per year	25,000	25,000	50,000
- Overheads for export of initial crushed and packaged or baled product	20,000	20,000	40,000
Public education			
- Waste separation and recycling public campaign	10,000	—	10,000
- Household compost campaign	2,500	2,500	5,000

	Year 1	Year 2	Total
Miscellaneous costs, materials electricity, water, equipment repairs etc.	50,000	50,000	100,000
Total costs	\$T 582,500	\$T 277,500	\$T 860,000
Financing			\$T
Foreign			740,000
Local			120,000
Total			\$T 860,000

Executing agency	Ministry of Lands, Survey and Natural Resources and the Ministry of Health.
Potential benefits	<ul style="list-style-type: none"> a) Less littering, reduced landfill needs, reduced pollution. b) A possible commercial industry with spin-offs for employment and the recurrent budget. c) Public funds currently spent on collecting recyclable rubbish might be saved.
Potential issues	<p>In other Pacific countries the history of continued viability of recycling programmes without continued government subsidy is not an encouraging one. However, even where full commercial viability is not achievable, the return from the venture helps reduce the funds otherwise required for waste disposal, as well as reducing the public cost of street cleaning and pollution control. The public costs of a government subsidy to support a recycling industry are offset partly by the reduction in the environmental cost of waste disposal to the community.</p> <p>A number of regulatory actions could be considered to complement this programme, including imposition of limitations on the importation of glass, aluminium and plastic packaging and the extension of the 20 senti beer bottle deposit to all glass soft-drink bottles and aluminium cans.</p>
Processing/timing	<p>Pre-feasibility study: late FY 1993.</p> <p>Feasibility study: FY 1994 – FY 1995.</p>

Programme profile 4.2.2

Waste disposal management programme

This programme supplements Programme 4.2.1.

Aim and scope

- a) To improve systems for the collection and disposal of household organic and solid waste.
- b) To improve the management of waste disposal sites.

Description

This programme entails short-term technical assistance on appropriate waste collection and compaction systems, provision of additional equipment for the management of solid waste, and training of managers of dump sites and landfill operators. The brief for the waste disposal specialist would include a review of the current collection and management systems, a review of dump design and management factors, and the development and implementation of a system tailored to the needs of Tonga's urban centres, with emphasis on the needs of the capital, Nuku'alofa. An important aspect of the specialist's brief would be the selection of a further range of sites to provide for landfill needs for Tonga through to the year 2020, the conduct of Environmental Impact Assessment on these sites, and the selection of those sites least damaging to the natural and social environment.

Cost estimates

Technical assistance for 3 months for developing improved waste disposal and management strategies. A Tongan senior engineer would head this activity, supported by a Tongan assistant engineer (who will be trained to lead the municipal waste management programme), and in consultation with recognised waste disposal expertise in nearby metropolitan countries

- Fees and salaries	20,000
- Travel, overseas and local	12,000
- Miscellaneous training costs	8,000

Provision for supply of capital equipment for garbage disposal

May include mini compactor-trucks, small bulldozers with rakes and blades, and other equipment

400,000

Vehicle, 4 x 4, for managerial inspection of
dump sites

*Purchase and running costs for
2 years*

30,000

Total cost

\$T 470,000

Financing

\$T

Foreign

400,000

Local

70,000

Total

\$T 470,000

Executing agency

A co-operative programme between the Ministries of Health, Works, and Lands, Survey and Natural Resources, with the latter Ministry taking overall responsibility.

Potential benefits

The management of waste is an increasing problem. The development of a longer term waste disposal strategy, implementation of improved disposal and management systems, and provision of essential capital items will greatly assist relevant authorities involved in waste management.

Potential issues

Nil.

Processing/timing

Development of waste management strategy: FY 1993.

Purchase of equipment and implementation of improved management system: FY 1994 – FY 1995.

Programme profile 4.2.3

Urban biological sewage treatment pilot trial for low-lying areas

The Kingdom of Tonga has benefited from a number of projects directed to improving the disposal of human wastes, with particular attention to the low-lying areas of Nuku'alofa. Perhaps the most notable is the National Sanitation Programme which has aimed to provide sewage disposal for residents of low-lying areas, with the residents paying 20 per cent of the cost as well as providing labour.

However, where the groundwater table is shallow, the septic systems in common use are a serious source of pollution and a health hazard; low-lying areas are inundated during the wet season. Even if costly piped sewerage systems were installed, without constant maintenance groundwater pollution would still occur from leaking joints, cracks etc. There is a need to re-examine alternative systems of disposal of human wastes in a way less threatening to the environment. Newer designs in biological sewage treatment (e.g. the Enviroflow system) offer householders the opportunity at reasonable cost to overcome the problem of low-lying areas. These systems are completely sealed, ensuring odourless operations with no fly nuisance. The residual sludge is bacteriologically safe and can be used as a fertiliser and soil conditioner for gardens. The liquid effluent can be used for watering lawns or gardens or, with treatment to remove residual chlorines, safely discharged into the lagoons.

Aim and scope

- a) To assess the suitability of new biological sewage treatment systems for Tonga, especially for low-lying areas; and
- b) to examine the economic viability of establishing a local industry to manufacture the treatment systems for sale in the Pacific.

Description

Different-sized biological sewage treatment plants would be purchased and installed in low-lying areas of Tongatapu to test their efficiency and suitability under Tongan conditions. [The modular systems can operate for a single household of 10 people to a plant treating the sewage of 5,000 people.] Given the successful performance of the biological sewage treatment systems, a joint-venture proposal with the manufacturers would be developed for their local manufacture at the Small Industries Centre in Nuku'alofa for sale both within Tonga and throughout the Pacific. Donor funding or loan funds would be sought for the Tongan Government's equity in the joint venture, with the provision for the subsequent purchase of the government's equity by Tongan business people in a fully privatised venture.

Cost estimates

Phase 1 *Pilot trial*

Purchase and installation of biological sewage treatment systems, chemicals and maintenance. (The cost of supply of a system for 10 persons is about \$A 4,500) 100,000

Phase 2 *Local manufacture phase*

Purchase of technology with manufacturing rights or joint venture with system inventors and manufacturers: joint-venture estimate (on basis of Asian operations) of \$T 3.5 million with local equity of \$T 1.5–2 million. Soft loans could be sought to finance the Tongan equity in the venture; the manufacturer's equity would comprise cash, equipment and know-how. Such a venture would seem to qualify for the special conditions pertaining to sunrise industries which are established in the Small Industries Centre.

Estimated cost for preparation of detailed joint-venture proposal by a consultant 50,000
Includes travel

Total cost \$T 150,000

Loan for joint-venture equity \$T 1.5 million

Executing agency Ministry of Health for pilot trials, together with the Ministry of Works.

Potential benefits

- Reduced pollution and improved health status, particularly of residents living in low-lying areas.
- Through the joint venture, there would be local subcontracting opportunities (e.g. of fibreglass tanks) and increased labour opportunities.
- A new export industry for Tonga.

Potential issues None anticipated. No cultural aversion to the use of composted sludge as garden fertiliser is envisaged; human wastes are already used for crop fertiliser.

Processing/timing Phase 1: FY 1993 – FY 1994.
Phase 2: FY 1995.

Programme profile 4.3.1

Enact comprehensive natural resource legislation

Aim and scope	To rationalise and consolidate the existing body of legislation containing environmental provisions.
Description	<p>Under this proposed programme, technical assistance would be provided for two years to the Crown Law Department in order to:</p> <ol style="list-style-type: none"> examine legislation of the Kingdom relevant to natural resources and environmental management—including land use and land planning, water, energy, minerals, fisheries, agriculture (including noxious weeds, animal diseases, plant diseases, quarantine etc.), forestry (including timber cutting, forest produce etc.), national parks and reserves, environmental planning (including Environmental Impact Assessment), and waste management—from the viewpoint of their consolidation into a single, comprehensive Act; appraise recommendations of the recent Review of Environmental Law (Pulea 1992) and prepare a plan of implementation for those recommendations adopted by the government; draft a comprehensive Natural Resources Bill, together with Regulations for each resource sector contained in the Bill; and prepare all documentation necessary for the consideration of the Natural Resources Bill by government.
Cost estimates	<p>Technical assistance of an experienced specialist in environmental law at the Senior Crown Counsel level within the Crown Law Department—2 years</p> <p><i>Includes recruitment expenses, external and internal travel, housing subsidy, education allowances for children</i></p> <p style="text-align: right;">\$200,000 package</p>
Total cost	\$T 200,000
Executing agency	Crown Law Department. The specialist would work in-line to the Solicitor-General, in close consultation with the Ministry of Lands, Survey and Natural Resources.
Potential benefits	<ol style="list-style-type: none"> Updated, consistent and consolidated natural resource legislation. Simplified legal reference.
Potential issues	There are a number of models of comprehensive natural resource legislation on which the Kingdom could draw, as seen fit.

Processing/timing

The IUCN funded the Review of Environmental Law (Pulea 1992) which was carried out under the RETA. The Australian Centre for Environmental Law (ACEL) has been closely involved in a number of such reviews in the Pacific region as well as in Asia. It would seem appropriate therefore for both IUCN and ACEL to be approached for support for this exercise, together with a major donor agency in a tripartite arrangement.

Funding: mid FY 1993.

Recruitment action to proceed: late FY 1993.

Implementation: over FY 1994 – FY 1995.

Programme profile 4.3.2

Strengthen the institutional capability of the Environmental Planning Section

The Environmental Planning Section (EPS) of the Ministry of Lands, Survey and Natural Resources (MLSNR) is charged with the prime responsibility by government for environmental administration. Its location in the MLSNR requires the Section to administer the environmental programme conjointly with the other Civil Service departments which have legal carriage for sectoral environmental responsibilities. The programme requires a co-operative relationship as there is no legal obligation at present for the various line departments to consult the EPS on environmental matters, even where there are areas of overlapping responsibility. The co-ordination of environmental action is therefore not always close, despite the existence of the Interdepartmental Environment Committee (IDEC) which includes representation from most areas of government involved in resource planning or management. In part, the limited interaction at the technical level between the EPS and the divisions/sections of other departments stems from the limited capability of the EPS to respond to requests for assistance with environmental matters. This is due to both institutional and infrastructural shortages. Indeed, the EPS does not currently have the capability to handle even those areas for which it is regarded as having prime carriage.

Aim and scope

To strengthen the professional and technical capability of the Environmental Planning Service and improve its infrastructure and support services.

Description

The proposed programme would have the following seven components:

- a) technical assistance through attachment of an experienced environmental management specialist/administrator to aid implementation of this Action Strategy;
- b) funding of a Tongan environmental management counterpart;
- c) establishment of a fund for environmental scholarships for cadets to complete secondary school to matriculation standard, followed by undergraduate training in environmental science, management or law at an approved university;
- d) short-term attachments overseas (e.g. two months) for EPS technical staff for practical training on aspects of administration of parks and reserves and other areas of environmental management;
- e) budgetary provision for specialist short-term training, including middle- and senior-management courses in civil service administration;

- f) design and construction of a new office building for the Environmental Planning Section (with professional and clerical offices to accommodate the expanded EPS, air-conditioned computer room, library, and conference room, general staff room, showers, toilets, and mess-room for EPS labourers);
- g) funding for provision and operation of twin-cab vehicle and motorcycles.

Cost estimates

Advisory technical assistance—2 years <i>Includes administrative on-costs</i>	225,000
Senior Tongan environmental administrative counterpart funding—3 years	33,000
Environmental scholarships (one new award per year for 3 successive years) (see Table)	
- Annual award of \$1,000 per year for 2 years' secondary school in matriculation science stream (which can lead to environmental science undergraduate training), at \$2,000 per student x 3 students	6,000
- Scholarship award, over 3 successive years, of 3 university undergraduate scholarships in environmental science (3-year course) to an approved overseas university, at \$10,000 per year	90,000

Scholarship holders	Cost per year \$T '000							Total
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	
Student 1	1	1	10	10	10			32
Student 2		1	1	10	10	10		32
Student 3			1	1	10	10	10	32
Total costs	1	2	12	21	30	20	10	96

Environmental training attachments 2 per year x 2 months each: cost per year, including travel and living allowances, of \$8,000 for 3 years	24,000
Short courses, technical and managerial over 3-year period, at \$9,000 per year	27,000
EPS office design	40,000
EPS office construction	150,000
Vehicles Twin-cab utility and 2 motorcycles, and maintenance for 3-year period	50,000

Total cost **\$T 645,000**

Executing agency	Ministry of Lands, Survey and Natural Resources together with the Chief Establishment Officer of the Prime Minister's Office.
Potential benefits	Improved environmental planning and management.
Potential issues	The scholarship component of the programme requires continuity of funding for seven years (see Table), at the end of which the EPS should have on its staff three additional professional environmental scientists. A five-year service bond to the Tongan Civil Service should be one condition of the scholarship, in order to ensure trainees return to the Kingdom following graduation from university. The bond should be made with the student's parents, not the student, and legally require full repayment of the scholarship by the parents should the bond be broken.
Processing/timing	Apart from the scholarship component of the programme, funding would be sought initially for a three-year period, FY 1994 – FY 1996. Funding should be sought in 1993 for programme commencement in FY 1994. Funding for the first environmental scholarship should be given priority to permit a call for applications by October 1993 from senior secondary school students. Funding for the environmental scholarships would be sought for the period 1994–2000.

Programme profile 4.3.3**Raise the level of environmental skills of professional, resource-based staff of the Civil Service**

A number of government departments have legal sectoral environmental responsibilities. However, specific staff are not always charged with the prime carriage for those responsibilities. This may stem in part from the fact that few professional staff have had environmentally specific training, other than as an adjunct to their main course of graduate study. The management of the environment is complex and requires a holistic view, not one concentrated on a specific sector to the exclusion of others. Were postgraduate training in environmental science, management, or law made more readily available to professional staff throughout the Civil Service, the discharge of sectoral environmental responsibilities would be more effectively undertaken and there would be an increased level of awareness at senior departmental levels of environmental planning and management issues.

Aim and scope

To broaden the professional skills of resource-based Civil Service staff through specific specialist environmental training and improve the overall capability of the Civil Service to discharge its environmental responsibilities.

Description

This programme is directed to existing professional or technical staff within the main ministries of the Tongan Civil Service with specific responsibilities for aspects of resource-use planning and management. Such areas include water, land use (agriculture/forestry), energy, town planning, environmental health and education.

The programme would be spread over a three-year period and cover:

- a) the training overseas of six professional officers for postgraduate diplomas (one year) within areas of environmental science and management; and
- b) short environmental courses for both professional and technical staff.

Cost estimates	Over a 3-year period.		
	Environmental academic training, 2 Civil Service officers per year		
	<i>Includes travel, living allowances and other support for 1-year postgraduate diploma courses, at \$9,500 each</i>	57,000	
	Practical training through short courses/ attachments		
	- Local courses, at \$10,000 per year	30,000	
	- Overseas short courses or attachments, at \$15,000 per year	45,000	
	Total cost	\$T 132,000	
	Executing agency	Office of the Chief Establishment Officer in the Prime Minister's Office.	
	Potential benefits	Increased environmental awareness by professional staff in the government's sector departments and more effective overall environmental management.	
	Potential issues	Nil.	
Processing/timing	FY 1994 – FY 1996.		

Programme profile 4.4.1

Environmental study of climate-sensitive ecosystems

Aim and scope

- a) To survey and monitor climate-sensitive ecosystems to identify vulnerable areas;
- b) to assess the present state of climatic impact (sea-level rise, storm surge, intense rain etc.) on those vulnerable areas; and
- c) to identify appropriate response strategies.

Description

This programme would support the collection of relevant information over a three-year period to develop an accurate assessment of sea-level rise and its implications for the Kingdom, specifically in relation to impacts on human health, social conditions, agricultural production and the national economy. The immediate focus would be on the identification of areas most vulnerable to the impacts of sea-level rise. Appropriate response strategies would be identified which would enable prompt and efficient action in the event of significant sea-level rise.

Cost estimates

Staffing

- Tongan specialist/consultant
(who would direct the study over the 3-year period) 40,000
- Data collection assistants 30,000

Travel and transportation 10,000

Operational costs

- Boat and equipment hire 15,000
- Purchase of recording equipment
and accessories 20,000
- Miscellaneous supplies 5,000

Total cost \$T 120,000

Executing agency

Ministry of Lands, Survey and Natural Resources.

Potential benefits

The information obtained under this programme will greatly assist planners and decision-makers in developing responses to a rise in sea level.

Potential issues

It is important to ensure that this programme is complementary to studies undertaken elsewhere, particularly those conducted through the SPREP sea-level rise programme. It is also important that Tonga make every endeavour to obtain the results of other studies carried out in the Pacific and make the results of its own studies widely available.

Processing/timing

FY 1993 – FY 1995.

Programme profile 4.5.1

Pesticide control measures

Aim and scope

The Pesticides Act, 1976, provides for the registration of pesticides for their importation, distribution/sale and use in Tonga. Implementation of the Act has proved very difficult due to registration requirements, including mandatory labelling. A Pesticides Registration Committee was established in 1981 to review the Act and it was subsequently amended (1981). However, while the review process did improve public awareness of pesticide controls, the Committee was not able to improve implementation of the amended Act and the Committee subsequently went into recess.

The Pesticides Registration Committee was reactivated in 1989 to determine how best the pesticide control scheme could be implemented under existing legislation, and to develop procedures for registration. Under this Committee, regulations have been drafted to control or license pesticide importers and retailers. The Pesticides Registration Committee assists the Registrar of Pesticides, appointed under the Act.

- a) To implement registration of at least the major pesticides currently used in Tonga as a step towards the establishment of a permanent pesticide control scheme.
- b) To re-examine the Pesticides Act to determine what further significant amendments may be required to overcome current difficulties in the implementation of the pesticide control scheme.

Description

The programme would fund advisory technical assistance for two years to assist the Pesticides Registration Committee with formulation and implementation of a workable control scheme and assist with further review of the Pesticides Act. Subsequently, extensive training in the application of the devised pesticide control measures will be undertaken with appropriate staff of the Ministry of Agriculture and Forestry (MAF) and other ministries. A consultant would be engaged who would operate with a Tongan counterpart, the Head of the Vaini Research Station who is by profession an entomologist. Office space for the consultant is available at the Vaini Research Station but office furniture, and equipment, including computer, printer and accessories for pesticide registration and control, would be required. Considerable travel is necessary, both externally and internally, for consultation with importers, retailers and pesticide specialists in the region. A vehicle would be needed for use by the consultant on Tongatapu. Operational

funding for the consultant and his counterpart would include training costs and costs of printing and distribution of pesticide information to suppliers and consumers.

Cost estimates	Year 1	Year 2	Total
	(\$T)	(\$T)	(\$T)
Consultant	80,000	80,000	160,000
Tongan counterpart	14,000	14,000	28,000
Travel	8,000	8,000	16,000
Training	5,000	5,000	10,000
Printing costs	8,000	8,000	16,000
Office equipment, including			
- computer, accessories	15,000	—	15,000
- air-conditioner	4,000	—	4,000
- furniture	2,000	—	2,000
Vehicle purchase and operation	30,000	5,000	35,000
Miscellaneous stores	3,000	3,000	6,000
Contingency	5,000	5,000	10,000
Total costs	\$T 174,000	\$T 128,000	\$T 302,000

Financing	\$T
Foreign	272,000
Local	30,000

(Note: In addition to the above local costs, Tonga could provide accommodation and support services for the programme.)

Total **\$T 302,000**

Executing agency Research Division of the Ministry of Agriculture and Forestry, in close collaboration with the Pesticides Registration Committee.

Potential benefits Proper use of pesticides will minimise their adverse effect on the environment.

Potential issues

Pesticide manufacturers would not be prepared to market their product to Tonga with special labelling, due to the small volume of pesticide sales in the Kingdom. Consequently, specifications on storage, use, disposal etc. for Tongan conditions would need to be prepared in both the Tongan and English languages for mandatory issue by retailers to consumers at point of sale. After the initial two years of the programme, it is anticipated that the local MAF counterpart will continue the pesticide control programme with local funding.

Processing/timing

Programme funding to be secured for FY 1993.

Implementation over the two years FY 1993 – FY 1994.

Programme profile 4.5.2

Monitoring for hazardous agrochemical residues

Aim and scope

Tonga has two laboratories which both have some basic equipment necessary for chemical analysis. These laboratories are operated by the Department of Health and by the Department of Agriculture. Neither has the technical equipment or currently the trained staff to undertake pesticide residue analysis, for example. If monitoring of hazardous chemicals is to be undertaken within the Kingdom (rather than fly samples to overseas laboratories), then the question is by which laboratory, or indeed can Tonga afford to continue to operate two such separate laboratories when it might be more efficient to combine them into a single national laboratory. Such questions and their financial implications need to be reviewed and subsequently the recommendations developed in a detailed project proposal for funding action.

To determine the most efficient and cost-effective mode for routine monitoring of hazardous agrochemicals in the environment in the Kingdom of Tonga.

Description

This activity calls for a review of existing agrochemical monitoring, the additional need, and the capability required to service that need. Detailed costed options would be prepared together with a recommended course of action. The proposed programme steps are:

- a) review all available laboratory services in the Kingdom of Tonga and examine possible cost savings or efficiencies in their amalgamation into a single national laboratory;
- b) establish the extent of the need for analysis of hazardous chemical residues, the degree of analytical capability required locally to meet that need, and the complementary degree of complex analysis still required to be undertaken at overseas laboratories;
- c) prepare a detailed set of costed, realistic options for consideration by government for the monitoring of hazardous chemical residues.

The programme would fund a pre-feasibility study by a team of specialists comprising: an agricultural chemist or biochemist with extensive laboratory administrative experience at a senior level (team leader); an economist to conduct economic and financial appraisals and cost options; and an agricultural scientist with detailed knowledge of the use of agrochemicals in Tonga. The Team Leader would need to visit major analytical laboratories in Australia and New Zealand, with particular attention to the functioning of government laboratories and their relationship with private industry.

Cost estimates

Team of 3 experts to conduct the feasibility study—team leader for 1 month with the other 2 team members for 2 weeks.

Fees and per diems 26,000

Travel 9,000

Communications and transport 2,000

Miscellaneous

Includes report preparation 3,000

Total cost \$T 40,000

Executing agency

Ministry of Agriculture and Forestry, in consultation with the Ministry of Health.

Potential benefits

Environmental protection, consumer protection, and protection of export markets.

Potential issues

There are many hazardous chemicals, other than agrochemicals, which would require some degree of monitoring or would entail special analysis. One example would be the detection of poisons in dead animals and as part of autopsies. It is likely that the feasibility study will lead to further programme proposals for funding local improved laboratory analytical capability.

Processing/timing

FY 1993.

Programme profile 4.5.3

Chemical waste workshop

Over recent years, there has been a greatly increased use of agrochemicals in the Kingdom, associated with large-scale, intensive forms of horticultural production. This is particularly the case with squash (Japanese pumpkin) and taro production. There is concern about the usage of pesticides and fertilisers, but the extent to which agrochemical residues may have infiltrated into the environmental web is unknown. If a residue problem exists, then the nature of the problem and its extent must be determined.

A recent two-day Pesticides Workshop, conducted by the Ministry of Agriculture and Forestry, clearly indicated that a follow-up workshop was required for Civil Service departmental and section heads, and particularly for those involved in the drafting of pesticide legislation. This need is strengthened by the concern about human poisoning from previously safe sources, including fish, tank water etc.

Aim and scope To assess the degree of infiltration of hazardous chemicals into the Tongan environment and raise the level of awareness in the government and among the public of such environmental infiltration.

Description This programme would have two components:

- a) the conduct of basic research to assess the extent of infiltration of agrochemicals into the environment;
- b) the conduct of a two-day workshop in Nuku'alofa where the results of the research would be presented and discussed within a public forum. The environmental risks of improper use of chemicals, particularly on the human food chain, would be debated and policy recommendations made which will assist legislators and administrators.

Cost estimates *Research*

Overseas analysis of soil, plant and water samples for chemical residues	20,000
Travel for field survey team	3,000
Miscellaneous equipment costs <i>Includes sample bottles and sample preparation</i>	2,000
Sub-cost	25,000

<i>Workshop</i>	
Printing/duplication	2,000
Workshop costs	
<i>Includes hire of venue</i>	5,000
Travel support for participants from Vava'u and Ha'apai	10,000
Sub-cost	17,000
<hr/>	
Total cost	\$T 42,000

Executing agency	The research would be undertaken by a team comprising scientists from the Ministry of Lands, Survey and Natural Resources, the Ministry of Health, and the Ministry of Agriculture and Forestry. The workshop would be organised by the Environmental Planning Section of the MLSNR.
Potential benefits	Baseline research on chemical residues in the environment and the influence such facts can have on legislation designed to control improper chemical usage.
Potential issues	In this Strategy this programme has some overlap with other programmes for countering the misuse of hazardous chemicals. However, the level of funding necessary for execution of the other programmes means that some delay in their implementation is likely. The problem of low public awareness of hazardous chemical residues is an immediate one, and this can be addressed partly by the conduct of the proposed chemical waste workshop at the earliest opportunity. Major donor agencies have previously expressed concern about the chemical residue problem, especially pesticides. Because of the low level of funding required for this programme, funding from external donors should be expedited through the Ministry of Finance.
Processing/timing	FY 1993.

Programme profile 4.6.1

Promote photovoltaic technology

Aim and scope	The government is continuing with a programme to provide photovoltaic lighting systems to all households on the outer islands of the Vava'u and Ha'apai Groups. Pilot projects conducted in those groups demonstrated the need for close attention to the training of islanders in the correct operation and maintenance of photovoltaic systems. Without this, there is a risk that system failure will be blamed by villagers on the technology itself, rather than on improper use or lack of maintenance.														
Description	To raise the level of expertise on outer islands in the use and maintenance of photovoltaic energy systems. This programme will institute training in the planning, implementation and maintenance of photovoltaic projects in the form of a one-week workshop, conducted in Tongan, and with an emphasis on practical training (40 per cent theoretical: 60 per cent practical). The training would be directed to 50 selected villagers of the outer islands in order to provide them with a better understanding of the interrelationships of the components of a photovoltaic system, and to offer them firsthand experience in the implementation and maintenance of a household photovoltaic system. The training will be on the "train the trainers" principle to spread the knowledge of photovoltaic systems as widely and quickly as possible.														
Cost estimates	<table border="0" style="width: 100%;"> <tr> <td style="padding-right: 20px;">Resource personnel to support workshop</td> <td style="text-align: right;">3,000</td> </tr> <tr> <td>Course materials</td> <td style="text-align: right;">2,000</td> </tr> <tr> <td>Travel and transportation</td> <td style="text-align: right;">5,000</td> </tr> <tr> <td>Living subsistence allowance</td> <td style="text-align: right;">10,500</td> </tr> <tr> <td>Miscellaneous costs</td> <td style="text-align: right;">2,500</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black; padding-top: 5px;">Total cost</td> </tr> <tr> <td></td> <td style="text-align: right;">\$T 23,000</td> </tr> </table>	Resource personnel to support workshop	3,000	Course materials	2,000	Travel and transportation	5,000	Living subsistence allowance	10,500	Miscellaneous costs	2,500	Total cost			\$T 23,000
Resource personnel to support workshop	3,000														
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Travel and transportation	5,000														
Living subsistence allowance	10,500														
Miscellaneous costs	2,500														
Total cost															
	\$T 23,000														
Executing agency	Energy Planning Section of the Ministry of Lands, Survey and Natural Resources. Staff of the Energy Planning Section will conduct the workshop training with the assistance of technicians from islands where photovoltaic systems have been installed.														
Potential benefits	Islanders with experience in the use of photovoltaic systems will share their knowledge and learn from each other, as well as receive instruction from photo-voltaic specialists. Improved understanding of the systems and their maintenance will lead to improved success with their wider introduction and adoption in the outer islands. As a result, a reduced use of petroleum products is expected.														
Processing/timing	FY 1993.														

Programme profile 4.7.1

Develop a national resource information system (TONGRIS)

Aim and scope	<p>Much of the accumulated resource data of Tonga is locked away in reports and publications and is thus not readily accessible or usable for land and marine resource conservation or broadly scoped environmental planning. The databases in use are not necessarily compatible with each other or with standard regional and global databases and information systems.</p> <p>The development of a nationally appropriate and regionally compatible natural resource information system, called here TONGRIS.</p>										
Description	<p>A specialist would be engaged for one year to develop a computer-based, national resource information system, which:</p> <ol style="list-style-type: none"> a) is appropriate to the needs of Tonga; b) can accommodate existing computer databases; c) is flexible in design to handle future natural resource, land use, population and climatic information databases; and d) is simple to access and use. <p>Coupled with this development would be the procurement of additional computer hardware and software for operation by the user departments.</p> <p>The specialist would train Tongan staff in the manipulation of the databases and in the effective use of TONGRIS for land-use planning and environmental management.</p>										
Cost estimates	<table border="0"> <tr> <td>Specialist technical assistance for design and implementation of system</td> <td style="text-align: right;">60,000</td> </tr> <tr> <td>Equipment and supplies</td> <td></td> </tr> <tr> <td style="padding-left: 20px;"><i>Computer hardware and software (for TONGRIS operation in the resource-based departments)</i></td> <td style="text-align: right;">45,000</td> </tr> <tr> <td>Training in TONGRIS use</td> <td style="text-align: right;">50,000</td> </tr> <tr> <td>Total cost</td> <td style="text-align: right;">\$T 155,000</td> </tr> </table>	Specialist technical assistance for design and implementation of system	60,000	Equipment and supplies		<i>Computer hardware and software (for TONGRIS operation in the resource-based departments)</i>	45,000	Training in TONGRIS use	50,000	Total cost	\$T 155,000
Specialist technical assistance for design and implementation of system	60,000										
Equipment and supplies											
<i>Computer hardware and software (for TONGRIS operation in the resource-based departments)</i>	45,000										
Training in TONGRIS use	50,000										
Total cost	\$T 155,000										
Executing agency	<p>Central Planning Department, in close collaboration with all the resource-based departments, and particularly with the Ministry of Lands, Survey and Natural Resources.</p>										

Potential benefits	The utility of resource information systems has been amply illustrated in the Pacific for effective land-use planning and environmental management. Their use automatically encourages close co-operation of all resource-based departments.
Potential issues	The programme should be implemented in parallel with, or precede, the proposed natural resources and ecosystems survey (Programme profile 4.7.2).
Processing/timing	FY 1993.

Programme profile 4.7.2

Natural resources and ecosystems survey

Data on terrestrial and marine resources and ecosystems are incomplete, patchy in quality and in some cases grossly out of date. In the closer settled areas of the main islands, such as Tongatapu, little remains of the original vegetation and a number of endemic wildlife species have either been wiped out or are under severe threat of extinction from development activities and the growing population.

The current knowledge of marine resources is poor, particularly that of the biological condition of reefs and of marine invertebrates. Nearshore subsistence resources on islands such as Tongatapu and Vava'u are considered to be overfished or excessively gleaned of shellfish. Fish numbers are said to be down and species sizes smaller. However, such views are largely conjectural in the absence of baseline data and regular monitoring.

On outer islands, especially those with low resident populations, the diversity of endemic flora and fauna is richer, although limited by distance from nearby large land masses in the range of genera and species. However, even on some of these islands the predation of introduced animals, particularly cats and rats, is a major threat to bird populations. The urgent need to collect information on the Kingdom's natural resources is evident, and this is exacerbated by the potential threats to some flora and fauna through climate change and sea-level rise.

Aim and scope

This programme would:

- a) support inventory and study of the biological diversity of the Kingdom of Tonga, with particular emphasis on the current marine parks and outer island bird populations;
- b) develop a database on biological diversity.

Description

The programme would be implemented over two years and have the following components:

- a) advisory technical assistance to design, test, and implement databases compatible with TONGRIS (see Programme profile 4.7.1);
- b) conduct of field surveys by plant, animal and marine ecologists;
- c) on-the-job training of local personnel, with specialised training for staff who demonstrate particular aptitude and competence;
- d) procurement of equipment and materials.

The engagement of external consultants will be unavoidable because of limited availability of qualified, experienced Tongan professional personnel.

Cost estimates

Phase 1	Preparation of detailed resource survey plans	35,000
Phase 2	Over a 2-year period.	
	Terrestrial and marine ecologists/consultants	125,000
	Local divers/survey assistants	40,000
	Field survey operations	
	- terrestrial	30,000
	- marine	50,000
	Equipment	
	- Field survey equipment	5,000
	- Hire of SCUBA and other diving gear	15,000
	- Miscellaneous supplies	2,000
	Outer Island transport	3,000
	Support vessel	
	<i>Includes hire and operating costs</i>	20,000
	Training costs, on-the-job and overseas	25,000

Total cost **\$T 350,000**

Financing **\$T**

Foreign 310,000

Local 40,000

Total **\$T 350,000**

Executing agency

Ministry of Lands, Survey and Natural Resources, in collaboration with other resource-based or dependent ministries, particularly the Ministry of Agriculture and Forestry and the Ministry of Fisheries, and the Central Planning Department.

Potential benefits

The resource information will have a number of important uses including:

- a) assisting site-specific planning for existing protected areas;
- b) assisting the determination of priorities for the future identification of protected areas;

Potential issues

- c) assisting with the determination of priorities for the protection of endemic species; and
- d) providing information for use in educational programmes.

This programme should be implemented in parallel with, or immediately follow, Programme profile 4.7.1, the development of a national resource information system (TONGRIS). The resource databases should be developed in close consultation with the Central Planning Department, which is seen as the executing agency for TONGRIS, and with SPREP to ensure consistency with other database development in the Pacific region.

Processing/timing

Detailed project preparation: early FY 1993.

Implementation: FY 1994 – FY 1995.

Programme profile 4.7.3

Strengthen the knowledge of insect pests & beneficial insects of the Kingdom

A comprehensive collection of insects, both beneficial and pests, is fundamental to the rapid identification of insect problems and the planning of control measures. The only insect collection in Tonga is held at the Vaini Research Station. It is an old collection, poorly curated and hence of limited value as a reference tool; it includes only a small number of the insects endemic to Tonga. The Entomological Section also requires a comprehensive reference collection of the major known insect pests of the region, particularly of agricultural and horticultural crops, but not yet established in Tonga. A continued vigilant quarantine service will help prevent the entry of pests, but it is vital that insects intercepted by the quarantine service on imported goods are identified immediately. A collection retains value only if it is well curated, and the Entomological Section has the specialist taxonomic expertise required for identifications, or has rapid and assured access to experienced taxonomists.

Aim and scope

The programme would seek to:

- a) update the Vaini Research Station's current insect collection with new specimens;
- b) expand the collection of beneficial insects and insect pests endemic to Tonga;
- c) establish a reference collection of important exotic insect pests for quarantine support;
- d) improve the existing curation facilities for the insect collection; and
- e) improve the taxonomic support for the Entomological Section at Vaini.

Description

Annual visits, each of about one week's duration, would be made to each of the island groups of the Kingdom to collect insects. This would entail a group of 2 or 3 entomologists and technicians. The collected insects would be cross-checked with the existing collection and, if necessary, sent to taxonomic specialists for identification. A person would also be trained in the proper curation of an insect collection (including field collection methods, setting, storing, identification and recording) through attachment to a scientific research organisation in the region; this person would then become the full-time curator of the collection.

Cost estimates

The project would operate over a 3-year period, at a total estimated cost of \$T 80,000, after which full operational costs for maintaining the insect collection would become the responsibility of the Ministry of Agriculture and Forestry (MAF).

Improvement of facilities for the insect collection	
- Insect cabinets (4)	2,000
- Collecting equipment (nets, collecting-jars, cool boxes etc.)	1,500
- Air-conditioner/dehumidifier for insect storage room	2,500
Field collections	
- Travel costs, including fares, accommodation, fuel and miscellaneous expenses	
- 'Eua, \$600 per year; Ha'apai \$860 per year; Vava'u \$1,170 per year (3 persons)	
Total per year of \$2,630	7,900
- Niuafo'ou \$1,400 per year; Niuaotupapu \$1,300 per year (2 persons). Total per year of \$2,700	8,100
Specialist taxonomic services at \$4,000 per year	12,000
Taxonomic training attachment—6 months	10,000
Taxonomic advisory support—3 person months	28,000
Contingency	8,000
Total cost	\$T 80,000
Financing	\$T
Foreign	73,000
Local	7,000
Total	\$T 80,000

Executing agency

Ministry of Agriculture and Forestry.

Potential benefits

The main value of this programme will be in monitoring the introduction of new pests in order to protect the agricultural base of the nation. The regular field visits will enable the MAF to monitor agricultural pest activity in the Kingdom and assess insect diversity among the various island groups. The insect collection would be used as a reference for agriculturalists, foresters, environmentalists, quarantine officers, and others, and for education purposes.

Potential issues

Taxonomic identification is a highly specialised scientific area and it will be necessary, even with a trained full-time curator, to send some insects to external specialist organisations for positive identification. In the absence of such a taxonomic service within the South Pacific Commission, foreign research services would have to be used and the costs of those services are high.

Processing/timing

Project funding: FY 1993.

Implementation of funding over period FY 1994 – FY 1996.

Programme profile 4.8.1

Strengthen wildlife management capability in the Kingdom

Aim and scope	There is limited local wildlife management expertise in the Kingdom of Tonga, with the only significant scientific input currently coming from the German-funded Brehm Fund South Seas Expedition, which has established a native bird research station and sanctuary on Tongatapu. There are also plans to develop a second bird sanctuary and wildlife centre. While that study of birds is proceeding successfully, Tonga needs to have its own permanent Wildlife Officer.
Description	<p>To establish a wildlife officer position in the Ministry of Lands, Survey and Natural Resources to design and implement effective wildlife management programmes in the Kingdom of Tonga.</p> <p>This programme would seek to secure the services of a wildlife officer in order to:</p> <ol style="list-style-type: none"> develop wildlife rehabilitation programmes; work with the Science Teachers Association to provide technical input for the incorporation of wildlife ecology and related conservation into school curricula; develop adult educational material and tourist information; liaise with the Brehm Fund South Seas Expedition's bird conservation programme; and liaise with the tourism agency and media outlets on wildlife activities. <p>A vehicle is essential for the successful implementation of this programme, given the scattered locations of the Brehm Fund Bird Park and Tongatapu schools.</p>

Cost estimates

	Year 1	Year 2	Total
	(\$T)	(\$T)	(\$T)
Wildlife Officer	10,000	10,000	20,000
Training	5,000	—	5,000
Counterpart	10,000	—	10,000
Vehicle	20,000	—	20,000
Materials (audio-visual)	5,000	—	5,000
Total costs	\$T 50,000	\$T 10,000	\$T 60,000

	<table border="0"> <tr> <td>Financing</td> <td style="text-align: right;">\$T</td> </tr> <tr> <td>Foreign</td> <td style="text-align: right;">55,000</td> </tr> <tr> <td>Local</td> <td style="text-align: right;">5,000</td> </tr> <tr> <td>Total</td> <td style="text-align: right;">\$T 60,000</td> </tr> </table>	Financing	\$T	Foreign	55,000	Local	5,000	Total	\$T 60,000
Financing	\$T								
Foreign	55,000								
Local	5,000								
Total	\$T 60,000								
Executing agency	Ministry of Lands, Survey and Natural Resources.								
Potential benefits	This additional staff member would provide the Environmental Planning Section with much-needed expertise in wildlife management, as well as providing a service to the education system and the development of eco-tourism in Tonga. This would result in an increased awareness and appreciation of the Tongan environment and wildlife.								
Potential issues	The appointment to the wildlife officer position of a Tongan citizen familiar with local culture is essential. This will enable the officer to understand the questions and voiced concerns of Tongan citizens and students and develop Tonga-specific materials which would be more readily accepted and understood locally. A long-term objective would be for the appointment of two wildlife officers, to enable the expansion of the programme to permit regular school visits throughout the Kingdom and facilitate the production of educational material. Candidates for the posts would preferably have qualifications and practical experience in the area of wildlife management and/or ecology.								
Processing/timing	Recruitment of Wildlife Officer: late FY 1993 – FY 1994.								

Programme profile 4.8.3

Management planning for protection of 'Eua National Park

In 1982, 3,779 ha of forest reserve existed on 'Eua located along the eastern ridge of the island. The Environmental Management Plan (ESCAP 1990, p. 158) comments that subdivision into tax 'api, leases for agriculture, and deforestation by government and private logging have reduced the indigenous forests of the reserve. The establishment of a national forest park (of 380 ha) had been proposed for many years (since 1976). The Forestry Division of MAF continued to push for the establishment of this Park, with recent support of the Ministry of Lands, Survey and Natural Resources. An area of 449 ha was officially gazetted in April 1992 as the 'Eua National Park to protect the important area of remnant forest. The Forestry Division has been given the task of managing the National Park in addition to the management of 900 ha of adjacent forest. The forest area has watershed protection, conservation and timber production roles. The National Park has important conservation and protection roles, and will inevitably be a major drawcard for those tourists seeking "adventure tourism". The Forestry Division is concerned to develop a detailed management plan for the Park and has undertaken preliminary work. It seeks the services of a specialist consultant to prepare a detailed draft five-year management plan.

Aim and scope

To ensure that the 'Eua National Park is subject to effective management planning, and is appropriately developed and well maintained. A five-year management plan would be developed and basic protection measures initiated to safeguard the Park until funds can be secured for implementation of the management plan.

Description

An environmental consultant with extensive experience in the establishment and management of national parks would be engaged to prepare the draft plan. This plan would be made freely available in Tonga for written public comment. All public comment would then be discussed at an open workshop to be held on-site on 'Eua. The plan would be revised, again made available for comment, and subsequently a final plan prepared and published. The public consultation process is considered vital, but it will inevitably be somewhat protracted. In the meantime, a list of immediate, basic initiatives has been drawn up. These initiatives are needed to safeguard the Park until plan implementation can be put into effect; they include some boundary fencing; removal of livestock; and the commencement of regular patrols of the Park to minimise further destruction of flora and fauna.

Cost estimates*Management Plan development*

Consultant

- 1 month, for plan preparation, including travel costs and administrative on-costs 18,000
- 2 weeks for plan finalisation, including travel 8,500

Local transportation/vehicle hire 1,500

Workshop costs, miscellaneous 2,000

Printing

- Draft plan and dissemination 1,000
- Management Plan publication 2,000

Sub-cost 33,000*Interim management measures*

Park Assistant Ranger—1 year 6,000

Labourers (2)—1 year 4,000

Fencing materials 10,000

4 x 4 vehicle for 'Eua 35,000

Sub-cost 55,000**Total cost \$T 88,000****Executing agency**

Forestry Division of the Ministry of Agriculture and Forestry, in consultation with the Environmental Planning Section of the Ministry of Lands, Survey and Natural Resources.

Potential benefits

A well-prepared plan with which both the government and public agree.

Potential issues

Nil.

Processing/timing

FY 1993.

Programme profile 4.8.4

Preservation of key natural & cultural sites in Vava'u

Aim and scope

Description

There are two key sites in the Kingdom (in addition to 'Eua National Park) for which special planning and management action is sought: Pouono Historic Site (Vava'u) and Mt Talau National Park (Vava'u). Key features of these areas are:

- a) Pouono is the most historic site in Vava'u and thus the Kingdom of Tonga. It was at Pouono that the first law of Tonga was promulgated on 29 November 1839. The Code of Vava'u, as it was called, was the first step towards the end of serfdom. Pouono has major cultural significance and it is thus crucial to preserve it for future generations.
- b) The Mt Talau National Park is a peakless mountain which abounds with legend and historical tradition in the Kingdom. It also qualifies as one of the most distinctive miniature mountains in the region, although it is only 131 m high.

To preserve two additional important natural and cultural sites in the Kingdom of Tonga, at the same time making them more accessible as tourist destinations.

It is considered the protection of the Pouono and Mt Talau sites can be made self-funding through eco-tourism, once initial infrastructure developments are made. These developments include:

- a) Pouono Historic Site
 - fencing of the site;
 - landscaping;
 - preparation and placement of informational and instructional signs;
 - erection of an appropriate monument.
- b) Mt Talau National Park
 - construction of an all-weather access road to the base of the mountain;
 - development of a small sealed carpark;
 - improvement of walking track to the mountain top;
 - construction of nature trails, with rest stops, with access to two nearby beach sites for swimming and picnicking;
 - temporary fencing of a badly eroded area to restrict public access;
 - construction of sites for picnicking, camping and barbecues;

	<ul style="list-style-type: none">- preparation and placement of informational and instructional signs;- planting of native trees and plants, to rehabilitate badly eroded areas. <p>Detailed site plans would be prepared for these proposed developments and implementation staged in accordance with those plans over a three-year period.</p>
Cost estimates	A total cost of \$T 150,000 over a 3-year period is estimated for instituting the developments in the 2 areas, including costs of supervisory staff. Site management and maintenance after the development has been completed will be the financial responsibility of the Government of Tonga.
Executing agency	Ministry of Lands, Survey and Natural Resources, and Tonga Visitors Bureau.
Potential benefits	Most tourists seek interesting activities as part of their Tongan experience. This programme will help develop eco-tourism and at the same time help protect important cultural and natural resources in the Kingdom.
Potential issues	The collection of revenue from each site through entrance fees could be investigated. Such funds would greatly assist in funding long-term maintenance at each site.
Processing/timing	FY 1994 – FY 1996.

Programme profile 4.8.5

Royal Memorial Botanic Gardens

A small 1.6 ha botanic gardens once existed at Fa'onelua in Nuku'alofa, adjacent to the Tonga Visitors Bureau. This was a very small area in which examples of the endemic vegetation of the Kingdom were preserved, including trees, shrubs, and herbs important in traditional medicine. This area has been converted into the Free Market and its value as a botanic gardens has been lost entirely.

Tonga does need a botanic gardens where not only endemic species are preserved but other attractive exotic trees, palms, shrubs, herbs and flower gardens are established for the enjoyment of Tongans and visitors. Anyone who has visited Singapore knows that botanic gardens of exceptional beauty as well as scientific value can be established on a small island. An opportunity exists in Tonga for such a botanic gardens to be established in the centre of Nuku'alofa where it would honour the Royal Family and help beautify the city. The site is the grassed fields surrounding the Royal Tombs. With proper care in both design and management, these Royal Memorial Botanic Gardens would indeed honour His Majesty's forbears; the design, for example, could include a buffer area around the Tombs from which visitors would be excluded, and an avenue of Royal Palms or other status tree leading up to the Tombs.

The grassed area around the Royal Tombs has seen many forms of use in the past, including for golf, and for cattle and sheep raising. Currently, no use is made of the large area and it has little attraction.

Aim and scope

To establish in Nuku'alofa a Royal Memorial Botanic Gardens of world repute.

Description

The programme would have three phases:

Phase 1: Specialist consultant advice on the design, establishment and upkeep of a Botanic Gardens.

Phase 2: Establishment of the Gardens and associated infrastructure.

Phase 3: Ongoing upkeep.

This programme would fund only the provision of the initial consultant services.

Cost estimates

- Phase 1 Design
- Consultant services for the preparation of a set of landscape designs for the Botanic Gardens, together with a recommended design and plan of management, with detailed costings for the establishment and annual upkeep of the Gardens.
- Total cost** **\$T 80,000**
- Phase 2 Establishment. Provisional estimate of **\$T 750,000** for:
- Fencing: circumference fencing and ornamental fencing around the Central Royal Tomb area
 - Infrastructure development (in corner of the Gardens)
 - Small office and curation building with national herbarium
 - Nursery, with soil bins, potting area, shade stand out area, mist irrigation, etc.
 - Equipment, including trickle/spray irrigation system, tools, agrochemicals, sprayers, mowers, netting, shade cloth
 - Materials procurement, including soil, humus, rocks, sand, aggregate, cement, bark mulch, paving
 - Vehicles, including tractor with rake and blade, trailers, truck, twin-cab utility
 - Garden equipment, including park benches etc.
- Phase 3 Upkeep. Provisional estimate of **\$T 160,000** per year for:
- Government Botanist (who would be curator of the Gardens)
 - 6 x labour gang
 - Plant and equipment, materials
 - Utilities (water, power)
 - Vehicle maintenance and running expenses

Funding would be sought initially only for Phase 1, that is \$T 80,000. When detailed design costings have been prepared, His Majesty would give his consideration to the proposal. Should he approve of the plan, the capacity for the local funding contribution towards Phase 2 for establishment of the Royal Memorial Botanic Gardens would be determined, external funding sought for the remainder, and tender

	documents drawn up. Phase 3, upkeep of the Gardens, would be funded by the government.
Executing agency	Initially the Ministry of Lands, Survey and Natural Resources. Later, the government might consider supporting the formation of a special small unit in the Nuku'alofa Town Council.
Potential benefits	a) Beautification of the centre of Nuku'alofa. b) A major public amenity and tourist attraction. c) High scientific value through preservation of vegetation endemic to Tonga.
Potential issues	His Majesty's approval of the concept is assumed prior to proceeding to Phase I.
Processing/timing	FY 1993.

Programme profile 4.8.6

Pilot programme for the control of rats & feral cats on selected outer islands

Surveys of bird populations on outer islands by the Brehm Fund have shown an alarming level of predation of eggs and birds on some islands due to high numbers of rats and feral cats. If these predators are not controlled, it is quite possible some bird species will become extinct. Because the islands are small, it may be feasible to completely eradicate these pests. A pilot programme will test the feasibility of eradicating rats and cats on two selected islands in the Ha'apai Group where baseline data on bird populations have already been obtained. The pilot programme will require periodic monitoring of bird populations to determine their response to the eradication campaign.

Aim and scope

To assess the validity of a proposal to completely eradicate feral cats and rats from a small island.

Description

It is proposed that the Royal Tongan Army carry out the extermination programme of the feral cats as part of a military training exercise and rifle practice. Advisers would be engaged to instruct government employees on eradication approaches for rats, and on necessary equipment and baits.

Cost estimates

Advisers for eradication campaign	30,000
Material and baits	20,000
Army personnel, ammunition and logistics	50,000

Total cost **\$T 100,000**

Executing agency

The Royal Tongan Army, in consultation with the Ministry of Lands, Survey and Natural Resources, the Brehm Fund and SPREP.

Potential benefits

Protection for endemic bird populations.

Potential issues

Feral cats are dangerous animals and their eradication will not be a simple exercise. The possible use of attractant baits, trapping and poisons must be carefully assessed for their environmental impact on other than the target population.

Processing/timing

FY 1993.

Programme profile 4.9.1**Develop coastal zone management plans for the Kingdom of Tonga****Aim and scope****Description**

The coastal zone is the most sensitive environmental zone of the Kingdom of Tonga. Coastal degradation and erosion are of considerable concern. While some erosion is attributed mainly to natural causes, particularly as a result of the recent cyclones, much erosion is attributable either directly or indirectly to the action of people. A particular case is where areas of mangroves are felled and in-filled for house sites or destroyed by being used as garbage dumping grounds. Pollution of lagoons, poor construction of sea-walls, and other infrastructural development have all contributed. There is a need for clear, effective coastal planning, identifying areas at risk, and developing appropriate response strategies including land-use zoning. Some of the worst examples of coastal degradation are seen near the urban centres, and the preparation of urban development plans should be an integral part of coastal planning in Tonga, with special attention to low-lying areas in Nuku'alofa being used as house sites.

To prepare formal plans for the management of the coastal zone, in close consultation with the people.

Coastal zone management planning would be instituted systematically for the Kingdom, commencing with Tongatapu. An integral part of the Tongatapu coastal management plan would be an Urban Development Plan for Nuku'alofa and its immediate environs. Qualified Tongan town and environmental planners would work as a team, together with an experienced coastal engineer, to develop draft management plans, in consultation with the communities concerned. Public debate would be invited on the draft plan. Funding would be sought to support the activities of the planning team, particularly for travel within the region to study how other countries have approached their coastal management problems and the development of plans. The final report would be published and serve as a model to other SPREP members.

Cost estimates	Over a 5-year period.	
	Specialist advisory support, hired as required \$40,000 x 5 years	200,000
	Salaries of Tongan planning team members \$14,000 x 3 persons x 5 years	210,000
	Travel \$12,000 x 5 years	60,000
	Public consultative meetings	10,000
	Preparation and publication of plans, with colour maps	30,000
	Contingencies	20,000

Total cost	\$T 530,000
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Financing	\$T
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Foreign	450,000
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Local	80,000
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Total	\$T 530,000
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Executing agency	Ministry of Lands, Survey and Natural Resources to co-ordinate planning team activity.
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Potential benefits	<p>a) Publicly agreed plans which will guide development in the coastal zone for many years to come.</p> <p>b) Reduced people-induced rate of coastal degradation; preservation of coastal mangrove vegetation to protect against natural erosion from storm surge etc.</p>
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Potential issues	The development of an urban plan for the Greater Nuku'alofa area has been proposed previously as a priority project within Budget Estimates.
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Processing/timing	FY 1995 – FY 1999.
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Programme profile 4.9.2

Tropical marine ecology training

Aim and scope

To provide intensive, practical familiarisation training in coral reef ecology in the Kingdom of Tonga.

Description

This programme will involve two workshops. The first will be an intensive three-week hands-on tropical marine ecology course for selected participants directly involved with various aspects of planning, management or use of the coastal zone. The course will study the coral reefs, coral reef lagoons, tidal flats, seagrass meadows and mangrove swamps in various locations throughout the Kingdom. The workshop will be in two parts:

- a) A series of lectures and demonstrations devoted to learning organisms, their ecology and some detail on the complex ecosystems which exist in the Kingdom. Reef walking, snorkelling and underwater photography will be the major activities of this part.
- b) Making observations and preparing field activities for school students, community groups and educators etc. Survey methods and locations requiring further study for conservation programmes will be discussed and prepared through site inspection and practical reports/case studies.

The second workshop will be a follow-up on the first workshop to reinforce that training but will be targeted only at those who will be directly involved in marine survey and ecological studies of coral reef. The workshop activity will revolve around a practical assessment of different marine monitoring and survey methods to select those best suited to the various types of marine habitat found in Tonga. Those will become the standard methods for Tongan marine research.

Cost estimates*Workshop 1*

Consultants	10,000
Transporting participants	6,000
Allowances and per diems	1,500
Snorkelling equipment	5,000
SCUBA rental	5,000
Operating costs and support vehicle	5,000
Stationary supplies and materials	2,500
Sub-cost	35,000

Workshop 2

Consultant	6,000
Transporting participants	3,000
Allowances and per diems	1,000
Snorkelling equipment and SCUBA rental	5,000
Marine research vessel ⁶	25,000
Sub-cost	40,000

Total cost **\$7 75,000**

⁶The operation and maintenance of this vessel will be a MLSNR responsibility. The vessel will be used for marine studies and surveys.

Executing agency

Ministry of Lands, Survey and Natural Resources.

Potential benefits

These training courses will significantly increase the level of awareness of marine and coastal issues in the Kingdom of Tonga. Staff involved in management of the coastal zone will acquire necessary field skills; basic equipment will be provided so that implementation of these skills may be continued.

Potential issues

Nil.

Processing/timing

FY 1993.

Programme profile 4.9.3

Renew the search for alternative sources of sand for construction purposes

While the foreshore zone is a convenient source of material for construction purposes, the Government of Tonga has been concerned about environmental damage caused by this mining activity and has searched for alternative sand sources for a number of years. That intermittent search was unsuccessful and study ceased. However, with the rising pace of development, the need for alternative sources has become even more urgent. Much infrastructure development for which construction grade sand is needed is directed to the promotion of tourism; the beaches from which the sand is taken are major tourist assets. It would of course be nonsensical for such a tourist drawcard to be damaged by infrastructure constructed to support tourism.

However, Tongatapu has few alternatives to quarrying sand from beaches and inland deposits. One possible alternative is the ocean outfall of passages in the fringing reef.

Aim and scope

- a) To assess the economic and financial feasibility, and the environmental acceptability, of recapturing sand and gravel deposits on Tongatapu from reef passage outfalls; and if assessed positively,
- b) to conduct a trial recovery operation to prove technical feasibility and verify predicted environmental consequences.

Description

The programme would require a team of coastal engineering, economic and environmental specialists to advise on the technical, economic, financial and environmental viability of recapturing sand and gravel of suitable construction grade from selected reef passages. Overall feasibility would be reported and the steps to implement a pilot trial outlined, with detailed costings.

Cost estimates

Consultants	40,000
Travel	6,000
Equipment hire	10,000
Materials	14,000

Total cost**\$T 70,000****Executing agency**

Ministry of Lands, Survey and Natural Resources together with the Ministry of Works.

Potential benefits	Reduced pressure for removal of sand and aggregate from the coastal zone, with reduced beach erosion and marine sedimentation from this source.
Potential issues	Need for public education on indiscriminate (and illegal) mining of sand from beaches.
Processing/timing	FY 1994.

Programme profile 4.10.1

Prepare comprehensive land-use plans for the Kingdom of Tonga

Competing demands for land in the more heavily populated areas of the Kingdom will increase as the population grows. The sprawl of housing development in towns and villages, and other infrastructure development, continues to remove agriculturally valuable land from production, rather than being confined to less productive sites. On Tongatapu, even though it is blessed with naturally fertile soils, the expected population growth is such that every scrap of arable soil must be jealously guarded for future food production.

Aim and scope To prepare land-use plans for the future development of Tonga to ensure that optimal use is made of the limited land resource.

Description Advisory technical assistance would be provided to the Ministry of Agriculture and Forestry (MAF) over a three-year period for the analysis of current land use in the Kingdom, the classification of land types according to optimal use, and the subsequent preparation of plans to help shape future land-use patterns and development activity in order to preserve the best land for agricultural production. Public participation would be actively sought in the plan preparation, with a workshop on the draft plan; the final plan would be published and widely disseminated in the Kingdom. This technical assistance should be seen as a corollary to the development of a geographic resource information system, TONGRIS (see Programme profile 4.7.1).

Cost estimates	Tongan technical adviser—3 years	45,000
	Technical assistants <i>Computer operator, draughtsman, agricultural assistant— \$35,000 per year x 3 years</i>	105,000
	Technical equipment and materials <i>(e.g. additional drafting equipment, aerial photographs, computer accessories etc.)</i>	30,000
	Travel and field expenses	10,000
	Workshop costs for public review of plan	5,000
	Printing and dissemination of plan	5,000
	Total cost	\$T 200,000

	Financing	\$T
	Foreign	165,000
	Local	35,000
	Total	\$T 200,000
Executing agency	Agriculture Division of the Ministry of Agriculture and Forestry, in close consultation with the Lands Division of the Ministry of Lands, Survey and Natural Resources.	
Potential benefits	Better planned land development and preservation of the agricultural production base of the nation.	
Potential issues	This programme should follow the development of TONGRIS (see Programme profile 4.7.1) and be closely co-ordinated with the development of coastal zone management plans (see Programme profile 4.9.1). The proper development of land-use plans will require resolution of issues of land tenure referred to in Section 4.10.	
Processing/timing	FY 1995 – FY 1997.	

Programme profile 4.11.1

Roof water catchment & rain-water storage programme

Aim and scope

- a) To foster on the outer islands the systematic provision of rain-water storages of sufficient capacity to supply the average-sized household with six months' water to help cope with drought.
- b) To ensure that all major government buildings and churches have large rain-water storages to satisfy their own needs and support community needs during extended drought periods.

Description

A hydrologist/water supply engineer would be engaged to undertake a systematic assessment of the capacity and quality of existing rain-water storage systems throughout the Kingdom and appraise current programmes for installation of rain-water systems by donor agencies and NGOs. Based on those findings, a detailed proposal would then be prepared for loan funds to install rain-water storage systems according to an overall plan. These loans would be applied partly for on-lending to householders through the Tonga Development Bank, for home storage development, and partly for government construction of water storages on all its major buildings.

Cost estimates

Immediate provision of **\$T 35,000** for a 6-week review of rain-water storage within the Kingdom by a water supply specialist in rain-water systems.

Water supply engineer/hydrologist—6 weeks	18,000
Travel and accommodation	10,000
Miscellaneous costs	7,000

Total cost **\$T 35,000**

Executing agency

Hydrology Division of the Ministry of Lands, Survey and Natural Resources.

Potential benefits

- a) Reduced demand on limited groundwater resources.
- b) Reduced risk of pollution and health-related problems in the outer islands.
- c) Greater preparedness and self-reliance for droughts.

Potential issues

Nil.

Processing/timing

FY 1993.

Programme profile 4.11.2

Public education on conservation of water

Aim and scope

To reinforce to the public the message of water conservation in all its forms.

Description

Radio and television spots are already available for a water conservation campaign. This programme would fund the production of 20,000 brochures in both English and Tongan, and additional material in the form of wall charts and posters for presentation in schools. A consultant would be engaged to research and collate material from the agencies involved in public water supply and subsequently prepare the brochure to camera-ready stage. Brochure preparation will involve the production of maps, diagrams, photographs, cartoons and a narrative.

Cost estimates

Consultant's fees

*(for graphic art, layout, design,
photography and preparation of brochure
to camera-ready stage)*

30,000

Brochure production, at \$1 per brochure

20,000

Total cost**\$T 50,000****Executing agency**

Ministry of Lands, Survey and Natural Resources, in co-operation with the Ministry of Health and the Tonga Water Board. The brochure will be printed by the Government Printing Office.

Potential benefits

- a) Increased public awareness of water as a resource and the need for its conservation and protection against pollution.
- b) Reduced water costs are possible through a reduction in wastage of the public reticulated water supplies.

Potential issues

The rain-water storage programme (see Programme profile 4.11.1) would complement this programme. The brochure will support implementation of the Tonga Water Supply Master Plan which will upgrade water supply facilities.

Processing/timing

FY 1993.